

# Measuring inflation

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## Abstract

This note focusses on key issues-both conceptual and practical- with regard to the measurement of inflation such as the tradeoff between different measures and the incorporation of prices not fully determined by market forces of supply and demand. It also draws on a recent survey of emerging market economy central banks conducted by the BIS to highlight specific issues faced by these economies and how the resulting inflation indices differ across countries.

Keywords: Price index, Inflation measurement

JEL classifications: E31, P24, P44

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## Introduction

Broadly considered, there are two main rationales for measuring inflation. First, inflation reduces welfare. Second, inflation provides an indication of the degree of slack or short-term developments in the economy.<sup>2</sup> The weight given to these respective elements will determine the definition of inflation used.

How to measure inflation is a highly technical issue and involves many choices that could have significant consequences for the level and dynamics of the series one would like to construct. At the same time, it is important to measure inflation in a transparent and credible way, one that is understood by different constituencies of society. That said, if the measurement of inflation relies on cost of living estimates across different groups of the population, such a measurement could vary across groups; targeting the cost of living index relevant to one specific group might not be appropriate for another group.

This note reviews different aspects of inflation measurement. Section 1 discusses what is to be measured. Section 2 reports on alternative prices indices and their possible biases. Section 3 deals with the challenges faced by emerging market economy (EME) central banks in appropriately defining and measuring inflation, focusing in particular on the treatment of administered prices and owner-occupied housing across a surveyed sample of EME central banks.

### 1. What are we trying to measure?

Inflation acts as a tax on money: high and volatile inflation rates affect negatively the demand for money. To the extent that money provides services valued by consumers and producers, inflation imposes a welfare cost. Moreover, inflation can result in relative price changes in the presence of nominal price and wage rigidities (Vedrin (2015)), which can create significant welfare costs. How large these welfare costs are depends, *inter alia*, on the competitive structure of the economy, government interference, market imperfections and financial factors. As a consequence, central banks care about the level and variability of inflation.

The theoretical basis of inflation measurement is the concept of a “composite good” whose price is measured by a cost-of-goods index. A special case of a cost-of-goods index is the cost-of-living index (Wynne (2008)), which derives the choice of goods to be included in the index and their weights from the theory of consumer behaviour. The relative importance of different goods and services changes in response to changes in prices and preferences. A fixed bundle of goods is therefore likely to become less representative as time elapses. Popular cost-of-living indices are the CPI and retail price index (RPI), both of which measure the rate of change in the prices of goods and services consumed by households.<sup>3</sup>

<sup>2</sup> Of course, the degree of slack in an economy and other short-term developments are also affected by other factors not reflected in current inflation rates.

<sup>3</sup> The difference between these two indices is more historical than conceptual. The RPI originated as a measure of the cost-of-living needed to maintain healthy living conditions in a working class household in the United Kingdom. However, over time its scope expanded to include all major categories of household expenditure. The CPI, which was originated in the United States, initially valued the expenditure of a clerical urban wage-earner. Later on, coverage was extended to all urban

While changes in a cost-of-living index come very close to what most people intuitively understand by the term “inflation” (Lebow and Rudd (2008)), it is not clear that this is what central banks want to target since monetary policy affects only a subset of prices in the economy. For this reason, central banks usually do not react to the first round effects of changes in prices resulting from changes in indirect taxes or administered or regulated prices, even if they are included in the index targeted. One possibility would be to exclude such prices from the index altogether. We will return to this issue later.

A related problem is that the cost of living may fluctuate because of transitory shocks that cannot be addressed by monetary policy. Many central banks therefore use different measures of “core” inflation that eliminate some of the most volatile price components or those most affected by transitory shocks (for instance, highly seasonal food prices). We will discuss core inflation in the next section, when we look at the actual indices used by EME central banks.<sup>4</sup>

The downside of dropping specific price categories is that the resulting narrow index may become less representative of the actual cost of living. This compounds the problem that different parts of the population have different consumption patterns and thus face price changes which can differ significantly even from the broadest price index. This problem tends to be especially acute in EMEs, where a larger fraction of income is spent on items with volatile prices (such as food).

Producer price indices (PPI) or the GDP deflator provide an alternative to the CPI or similar cost-of-living indices. For economies vulnerable to terms-of-trade shocks, targeting the PPI or the GDP deflator might help preserve price stability, as fluctuations in the nominal exchange rate can counter movements in the terms of trade. Central banks would then react to any changes in producer prices that are not absorbed by exchange rate movements (Agénor and Pereira da Silva (2013)).

## 2. What indices do EME central banks use?

Responses to our survey questionnaire reveal that EME central banks use a relatively narrow set of measures of inflation in their monetary policy assessment, with the changes in the CPI playing a central role (Table 1). Most central banks target inflation measures based on the CPI – 16 out of the 22 responses received. A small number of central banks replied that they did not target inflation directly as measured by a price index. This group of central banks base their monetary policy strategy on the targeting of the external value of the currency although the CPI still plays a central role as a measure of inflation.<sup>5</sup>

None of the EME central banks that participated in the survey targets a measure of inflation based on an index other than the CPI (for instance, producer prices or the GDP deflator). This overwhelming preference for targeting the CPI suggests that central banks do not see the shortcomings of the CPI, such as the high share of

consumers. In both cases, the prices used in the index are obtained by regular nationwide sampling while the weights pertaining to each price category are derived from household budget surveys.

<sup>4</sup> From a statistical point of view, more volatile price categories tend to reduce the precision of the price index estimates. In some cases, price categories with a comparably small relative weight may make a big contribution to variation in the overall index.

<sup>5</sup> Central banks targeting the exchange rate appear to have considerable leeway in keeping inflation low and stable. However, they still need to wrestle with considerable challenges in securing price stability. The note submitted for this meeting by the Hong Kong Monetary Authority describes some of those challenges.

regulated or administered prices in EMEs, as insurmountable obstacles in the achievement of their monetary policy objectives. In particular, by choosing the CPI over other measures of inflation, EME central banks appear to place greater weight on the welfare cost rationale for measuring inflation than on measures of slack or short-term developments.

The widespread use of the CPI as the preferred price index in inflation targeting and other monetary policy strategies in EMEs seems to reflect a number of perceived advantages. First, the CPI is relatively easy to understand and is the best available measure of the cost of living faced by consumers. Second, it is familiar to large segments of the population, regularly reported in the news media, used as a reference for the provision of government benefits or contracts and is widely followed as an indicator of macroeconomic stability. Finally, it is available at a relatively high frequency and is not subject to many revisions, enhancing its transparency and use in monetary policy (Moreno (2010)).

## What measure of inflation and for what?

Summary of questionnaire responses

Table 1

	Target <sup>1</sup>	Other uses <sup>2</sup>		
		Set policy	Forecasting	Assessment of policy stance
CPI	16 (22)	13 (15)	16 (18)	15 (18)
CPI (core)	...	10 (12)	13 (14)	13 (15)
Import prices <sup>3</sup>	...	1	7	2
GDP deflator	...	1	2	2
Producer price index	...	2	8	7

<sup>1</sup> Total number of countries that provided information in parenthesis. <sup>2</sup> Number of countries using the CPI (headline) for inflation targeting and for other uses. <sup>3</sup> Chile uses external prices instead of import prices for forecasting purposes.

Source: BIS survey.

Central banks that target inflation as measured by the CPI also make use of the inflation index for other aspects of their monetary strategy. Of the 16 central banks that target consumer price inflation, 13 replied that they also make use of CPI inflation to set their policy (Table 1). This reveals consistency between the measured target and the use of this measure in setting the policy rate. The three central banks that do not set policy on the basis of the CPI tend to use a narrower measure. A few central banks do not target consumer price inflation in their monetary policy but instead forecast it (three central banks) and use the forecasts to assess the policy stance (three others) or set policy (two others).

Many central banks also rely on measures of "core inflation" to forecast inflation, assess the policy stance and set policy. There is a large overlap in the central banks that make use of a "core inflation" measure as part of their monetary policy strategy with those that target a measure of consumer price inflation. But "core" can mean different things to different countries. It may exclude highly volatile prices (eg those of foodstuffs and fuel), non-monetary expenditures (eg imputed housing costs for owner-occupied property or rents) or the effects of changes in taxes, subsidised prices or rents, and administered prices.

## Biases in the measurement of inflation

While the CPI has a central role to play in the monetary policy framework of many EMEs, there are reasons to believe that it may be biased. The most common arguments suggest that it typically overestimates inflation. This bias reflects substitution effects, household heterogeneity, and quality improvement and product replacement effects. Unless the weights are revised frequently, the index will become less representative as goods with larger price increases tend to be demanded less and those with lower prices increases or price decreases tend to be demanded more. The obvious solution lies in a more frequent updating of the index. However, this comes at the cost of more frequent expenditure surveys and possibly also perceptions of index manipulation.

Heterogeneity of household income is a significant potential source of bias in EMEs. The weights of the CPI are often based on the average share of expenditure from different groups in society. Because the distribution of expenditure tends to be skewed, the index is likely to overweight the expenditure patterns of the more affluent segments of society. This problem might be more serious in EMEs where the distribution of income is more unequal. The impact on the inflation rate is less clear: it would depend on the relative price changes taking place in the economy. If the prices of goods prominent in the expenditure of households at the higher end of the income distribution scale are growing faster than those of groups at the lower end, the measurement of inflation will be biased upwards.

The implications of overestimation have often been flagged in other areas of public policy such as fiscal policy and the assessment of economic competitiveness. For example, an upward bias may drive up pensions and social spending more rapidly than justified by changes in the cost of living. If it is not anticipated, the systematic overestimation of the inflation rate due to a bias can also have significant consequences for perceived real interest rates and thus for saving and investment as well as monetary policy.

The replies to the survey show that half of the 16 central banks have estimates for the potential bias in CPI inflation, although the type of bias and even sometimes the sign vary across countries. The central banks of Malaysia, Poland, Russia and Thailand estimate an upward bias. In Chile, by contrast, the quality bias in the clothing category imparts a negative bias to inflation as estimated by the CPI. In Malaysia, the heterogeneity of income is a motive for considerable control of surveys carried out at five-year intervals. The substitution bias is also monitored with surveys carried out every six months in order to adjust expenditure shares.

## 3. Some practical issues in measuring inflation

Prices of goods and services that are not freely determined in the market present a challenge to inflation measurement. Conceptually, it is not always clear whether and to what extent these prices should be incorporated in an inflation measure used for conducting monetary policy. Moreover, given the difficulty of estimating and inferring prices in the absence of explicit markets, it is not always feasible to implement an optimal index even if one attempts to base it on firm conceptual grounds.<sup>6</sup> Central banks therefore face the complex task of striking a balance between practice and

<sup>6</sup> For instance, while in theory it may be optimal to fully incorporate the cost of owner-occupied housing (an issue discussed in detail below), in practice this may not be feasible in the absence of good proxies for the cost of owner-occupied housing, given the lack of actual market prices.

theory when deciding how such prices should be treated in their preferred inflation measure. This section covers two prominent prices that fall into this category, namely administered and regulated prices, and the prices of owner-occupied housing services. It also summarises how central banks in our survey deal with them.

### 3.1 Administered and regulated prices

Governments typically regulate the prices of certain goods and services. These obviously include goods and services provided by the government itself, such as public transport, health care and education, but also other goods that are considered essential.<sup>7</sup> It is in the treatment of administered prices that the tension between the welfare cost and slack measurement rationales for measuring inflation come to the fore. On the one hand, if such prices are mainly driven by social and political concerns, they cease to be good indicators of slack in the economy or of short-term developments more generally. On the other hand, these prices represent a significant share of the consumption basket in most EMEs and hence warrant inclusion as a gauge of the cost of living.

According to questionnaire responses, the share of administered and regulated prices varies substantially across countries (Appendix Table 3.1). It is as high as 34.6% in Thailand and less than 5% in India. As expected, food, energy and government services are the most prominent categories.

The survey also highlights how central banks differ in their treatment of administered and regulated prices, and in balancing the trade-offs mentioned above. At one extreme, these prices are incorporated fully in the inflation measure (eg in Peru). At the other extreme, they are dropped from the index altogether (eg in Hungary and Poland).<sup>8</sup> In between, many central banks choose to downplay administered and regulated prices through different means, often retaining scope to exercise discretion and judgment in the presence of large movements.<sup>9</sup>

The Bank of Thailand provides a slightly different and interesting alternative. It uses an inflation measure that attempts to explicitly exclude only government measures (such as an increase in excise taxes) from regulated prices. This has the advantage of retaining goods with administered prices to maximise the coverage of the inflation measure while at the same time preventing government actions (which are presumably not directly linked to the state of the economy) to affect it. Taking this approach further, another option might be to estimate shadow prices for regulated goods and services by using, for instance, estimates of the cost of production. That said, this would make the measure less transparent and timely and no longer indicative of the cost of living.

Regulated prices often give rise to black markets and underground economies. More generally, the informal sector of an economy, which in some cases is fairly sizeable (39–42% of GDP for the Philippines according to the estimates of Schneider

<sup>7</sup> This, for instance, is the case for fuels such as kerosene and liquefied petroleum gas (LPG) in India.

<sup>8</sup> The core inflation measure computed by the National Bank of Poland excludes administered and regulated prices. As discussed above, different countries work with different definitions of core inflation.

<sup>9</sup> For example, while regulated and administered prices are incorporated in the inflation measure used by Korea, steps are taken to exclude transitory changes due to institutional shifts unrelated to economic forces.

et al (2010)), presents a challenge for inflation measurement since these prices are excluded from the computation of economic indices.

### 3.2 Measuring the price of housing services

Housing services, whether explicitly accounted for by rental payments or implicitly incorporated in owner-occupied housing estimates, account for a large proportion of total household expenditure. But houses tend to be big-ticket items that are purchased infrequently, so the cost of the implicit services provided must be estimated.<sup>10</sup> This could be done by including house prices directly in the measure of inflation, for instance through the net acquisition approach that measures the average change in the price paid by a household to acquire a home, or by estimating implicit rents. Yet another option is to follow the user cost approach, which covers various costs of home ownership such as interest payments on mortgages, taxes, insurance, repairs and maintenance costs (see McCarthy and Peach (2010) and Cecchetti (2007) for discussions of how those issues are being addressed in advanced economies).<sup>11</sup>

Our survey responses show that EME central banks address these issues in very different ways. As a result, the share of housing in the inflation measures varies widely, ranging from 1.2% in Hungary to 31.7% in Hong Kong SAR (Appendix Table 3.2).

While rental prices are relatively easy to obtain and are incorporated by all the surveyed countries, with the exception of Peru, Saudi Arabia and the United Arab Emirates, the extent to which owner-occupied housing is covered differs widely. Some central banks choose to exclude owner-occupied housing completely (Chile, Hungary, Korea, Malaysia, the Philippines, Poland, Russia and Turkey).<sup>12</sup> This could be either because they prefer to work with an inflation measure that is representative only of market prices or because it is not feasible to obtain satisfactory measures. Among the central banks that do incorporate owner-occupied housing in their inflation measure, the rental equivalence approach is nearly the unanimous choice (Appendix Table 3.2).<sup>13</sup> This is consistent with Gillingham (1983), who argues that this is preferable on both theoretical and empirical grounds.

Even in the case of rents, central banks in our survey highlight potential sources of bias. Typically, the longitudinal nature of most surveys implies that newly constructed houses are often underrepresented, leading to a downward bias in measured inflation. Central banks address this issue in several ways. For instance, some countries report using rotating samples and replace a certain fraction of the sample at a specific frequency.<sup>14</sup> Recognising the problem posed by lags between construction of new housing units and their full incorporation in the rental

<sup>10</sup> From the point of view of national income accounting, homeowners living in their own houses are assumed to pay themselves a market rent, which appears as consumption expenditure in GDP. The rationale is that if some or all homeowners become renters or vice versa, GDP should not be affected.

<sup>11</sup> See Poole et al (2005) for a detailed description and comparison of these methods.

<sup>12</sup> This is also the approach taken in computing the Harmonised Index of Consumer Prices (HIPC), the primary inflation measure used by the ECB to set monetary policy for the euro area.

<sup>13</sup> The only exceptions are Israel, which in addition to the rental equivalence approach gives a small weight to the cost of insurance and legal services; Chile, which reports using repairs and maintenance services; and the Czech Republic, which reported using the user cost approach in the past, but switched to the rental equivalence approach in 2007.

<sup>14</sup> One thirty-sixth of the sample is replaced in Korea every month, while one third is replaced by Turkey every year.

computation programme, the Czech Republic makes annual adjustments based on finalised construction works and liquidated housing.

Survey attrition, small sample coverage and changes in neighbourhood quality are some of the other sources of bias that affect the measurement of housing services for both tenant and owner-occupied units. Israel, for instance, identifies the small sample of rental housing units as a major potential source of bias and uses a hedonic estimation routine to address it.

Sometimes the biases are not easy to minimise, and central banks may be left with little choice but to use an inflation index that excludes housing inflation to reflect inflationary pressure, as is done by Thailand.

## Appendix

### Administered and regulated prices

Summary of survey responses; as a share of preferred inflation measure

Table 3.1

	Overall weight on preferred inflation measure	Sectors	
Chile	9.9	Gasoline	3.5
		Electricity	2.7
		Drinking water	1.9
		Transportation by subway	1.3
China	...	Agricultural goods	3.0–5.0
		Petrol	3.0–5.0
		...	...
		...	...
Colombia	15.2	Urban public transportation	4.8
		Fuel	2.9
		Electricity	2.9
		Water/sewage	2.6
Czech Republic	16.9	Housing, water, electricity, gas and other fuels	11.6
		Health	1.7
		Transport	1.2
		Restaurants and hotels	0.9
Hungary	17.8	Regulated services and medicines	10.5
		Regulated energy	7.3
		...	...
		...	...
India	...	Fuel group – administered kerosene prices and subsidised liquefied petroleum gas prices	1.8
		Food group – prices of food items distributed through the Public Distribution System (PDS)	0.6
		...	...
		...	...
Indonesia	18.0	Transport, communication, and financial services	9.7
		Housing, water, electricity, gas, and fuel	5.1
		Prepared food, beverages, cigarette, and tobacco	3.1
		Health	0.0
Israel	...	Education	4.2
		Energy	3.1
		Food	2.4
		Municipal taxes	2.3
Korea	...	Public services	8.6
		Electricity and water and gas	4.9
		...	...
		...	...
Malaysia	...	Utilities and energy (excluding fuels for personal transport equipment)	4.5

		Alcoholic beverages and tobacco	2.2
		Food (controlled price)	1.1
		Transport services	0.9
Mexico	14.8	Gasoline	3.7
		Electricity	3.6
		Public transportation	2.0
		Liquefied petroleum gas	1.6
Peru	...	Electricity	2.9
		Telephone	2.9
		Water	1.6
		...	...
Poland	...	Energy	9.4
		Services	5.2
		Electricity	4.4
		Gas	2.5
Russia	...	Public utilities	5.7
		Housing services other than apartment rentals	2.6
		Local railway and municipal transportation	1.6
		Vital medicines	0.8
Singapore	...	Electricity	3.2
		Bus fares	1.4
		Train fares	1.2
		Household services and supplies: government levy for foreign domestic worker	0.8
South Africa	18.5	Petrol	5.7
		Electricity	4.1
		Education	3.0
		Communication	76.0
Thailand	34.6	Core	19.9
		Energy	11.4
		Raw foods	3.3
		...	...
Turkey	...	Energy	6.9
		Alcoholic beverages and tobacco	4.8
		...	...
		...	...
United Arab Emirates	...	Gas, electricity and water	5.2
		...	...
		...	...
		...	...

Source: BIS survey responses.

## Housing rental cost in the CPI

Table 3.2

	Market rent	Imputed rent based on:			Other	Share in price index (%)
		Net acquisition approach	Rental equivalent approach	User cost approach		
Chile	YES	...	...	...	...	4.20
China	YES	...	YES	...	...	20.00
Colombia	YES	...	YES	...	...	18.59
Czech Republic	YES	...	YES	...	...	13.82
Hong Kong SAR	YES	...	YES	...	...	31.70
Hungary	YES	...	...	...	...	1.20
India	YES	...	YES	...	...	10.10
Indonesia	YES	...	...	...	...	8.57
Israel	YES	...	YES	...	...	24.80
Korea	YES	...	...	...	...	9.28
Malaysia	YES	...	...	...	...	17.20
Mexico	YES	...	YES	...	...	17.20
Peru	...	...	YES	...	...	2.40
Philippines	YES	...	...	...	YES	13.80
Poland	YES	...	...	...	...	1.20
Russia	YES	...	...	...	...	2.90
Saudi Arabia	...	...	...	...	...	20.50
Singapore	YES	...	YES	...	...	22.90
South Africa	YES	...	YES	...	...	0.00
Thailand	YES	...	YES	...	...	15.40
Turkey	YES	...	...	...	...	5.10
United Arab Emirates	...	...	...	...	...	39.00

Source: BIS survey responses.

## Core inflation measures used by central banks

Summary of survey responses

Table 3.3

Chile	CPI (core): CPI without foods and energy
China	...
Colombia	CPI (core):
Czech Republic	CPI (core): excluding fuels
Hong Kong SAR	...
Hungary	CPI (core): adjusted for the effects of indirect taxes
India	...
Indonesia	CPI (core) CPI (volatile foods) CPI (index-administered prices)
Israel	CPI (core): excluding energy, food, fruits and vegetables
Korea	CPI (core)
Malaysia	CPI (core)
Mexico	CPI (core)
Peru	CPI (core)
Poland	CPI (core): CPI net of food and non-alcoholic beverages and energy Inflation net of administered prices
Philippines	CPI (core)
Russia	CPI (core)
Saudi Arabia	...
Singapore	CPI (core): excludes accommodation and private road transport costs
South Africa	CPI (core) Administered prices
Thailand	CPI (core) Core inflation excluding government measures and rent
Turkey	CPI (core): excludes unprocessed food and alcohol-tobacco
United Arab Emirates	CPI excluding rent

Source: BIS survey responses.

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