Wages, productivity and "structural" inflation in emerging market economies

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1.   Introduction

Wage and price setting in advanced economies is well documented in the literature, but little work has been done on this topic for the emerging market economies. The aim of this paper is to start filling this gap by discussing how central banks in emerging market economies (EMEs) take account of wage inflation, productivity and some structural characteristics of their economies in analysing inflation.

Keeping the growth of real wages in line with labour productivity is widely viewed as a necessary condition for long-term macroeconomic stability – it helps preserve country competitiveness while limiting inflationary pressures and risk of a wage-price spiral. Yet increases in real wages in EMEs often exceed productivity gains. In recent years, many observers have highlighted skilled labour shortages, spillovers from terms-of-trade shocks and loose public sector wage policy as factors driving real wage growth above labour productivity. Other possible explanations are rapid urbanisation; gradual transformation of the "grey" economy into official economic activity; and rapid productivity growth of the tradable goods sector, in which the resulting fast growth of wages spreads to the rest of the economy, where prices are insulated from international competition and productivity grows more slowly.

We proceed by providing a simple analytical framework for integrating wages, productivity and certain structural features of EMEs in the analysis of inflation (Section 2). We then discuss various data issues that central banks confront in empirical applications of such frameworks (Section 3). Finally, we illustrate some key developments in wages, productivity and consumer price inflation for a sample of EMEs participating in this meeting (Section 4). The appendix provides central bank responses to a questionnaire on the measurement of wage and productivity data and on the significance of various institutional and structural characteristics of labour and product markets in central bank assessments of inflation.

2.   Analytical framework

Consider a simple aggregate model of the economy with a Cobb-Douglas constant-returns-to-scale production function,

$$Y = AL^{\gamma}K^{1-\gamma} \tag{1}$$

where Y is output, A is total factor productivity, L and K are labour and capital inputs, and γ is the labour elasticity of output (labour intensity). The profit function for this economy is given by:

$$\Pi = PY - RK - WL \tag{2}$$

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where Π, P, R and W are, respectively, the profit, the price of output, the interest rate (or the capital rental price) and the wage. If product and factor markets operate under conditions of perfect competition, profit maximisation implies that the marginal product of labour and capital are equal to the wage and the interest rate

$$W = P \cdot A \cdot \gamma \cdot \left(\frac{K}{L}\right)^{1-\gamma} \tag{3}$$

$$R = P \cdot A \cdot (1-\gamma) \cdot \left(\frac{L}{K}\right)^{\gamma} \tag{4}$$

Solving equation (1) for (K/L) and substituting into (3) and (4) yields:

$$W = P \cdot \gamma \cdot \left(\frac{Y}{L}\right) \tag{3'}$$

$$R = P \cdot (1-\gamma) \cdot \left(\frac{Y}{K}\right) \tag{4'}$$

A useful property of the Cobb-Douglas constant-returns-to-scale production function is that the labour share of output, or the real unit labour cost, is equivalent to the labour elasticity of output, γ – thus, from (3'), unit labour costs can be expressed as:

$$\frac{W \cdot L}{P \cdot Y} = \gamma \tag{3''}$$

Taking the logs, totally differentiating (3''), and assuming that γ is constant gives the familiar condition that the growth of real wages should not exceed the growth of average labour productivity:

$$\hat{w} = \hat{p} + \left(\frac{\hat{Y}}{L}\right) \quad \text{or} \quad \hat{w} - \hat{p} = \left(\frac{\hat{Y}}{L}\right) \tag{5}$$

where the lower-case letters stand for variables expressed in logarithms and the hat symbol (^) denotes the growth rates of variables, dx/x. The simplest way to monitor the emergence of wage pressures is therefore to compare real wage growth with labour productivity growth.

One simple extension of this model is to assume that the output price is fixed in the world market, so that domestic inflation is given by the sum of changes in the world price measured in foreign currency $(\hat{p}^*)$ and changes in the exchange rate $(\hat{e})$, $\hat{p} = \hat{p}^* + \hat{e}$:

$$\hat{w} = (\hat{p}^* + \hat{e}) + \left(\frac{\hat{Y}}{L}\right) \tag{6}$$

Different versions of (6) were widely used in the 1970s and the 1980s in OECD countries. At that time, the coincidence of oil shocks and a sharp fall in the growth of labour productivity led to a search for the so-called "warranted" rate of wage growth – a measure of nominal wage change that, given productivity changes and terms-of-trade developments, would be associated with stability in the share of wages in national income.

Analysis based on economy-wide measures of wage and productivity growth is often usefully supplemented by more disaggregated measures derived from two-sector models. One of the most widely used two-sector models is that of differential productivity growth in tradable and non-tradable industries.[2] Historically, productivity growth in the tradable goods sector has

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[2] Appendix Box A1 discusses other two-sector models potentially relevant for the analysis of inflation in EMEs.

been faster than in the non-tradable goods sector. By the law of one price, the prices of tradables tend to get equalised across countries. Higher productivity in the tradable goods sector will bid up wages in that sector and, with labour being mobile, wages in the entire economy will rise. In general, to pay the higher wages, producers of non-tradables will raise the relative price of their goods, which will lead to an increase in the overall price level in the economy.

Starting from the definition of consumer price inflation ($\hat{p}$) as a weighted average of tradable ($\hat{p}^T$) and non-tradable ($\hat{p}^{NT}$) goods price inflation:

$$\hat{p} = \alpha\hat{p}^T + (1-\alpha)\hat{p}^{NT} \tag{7}$$

where α is the share of tradable goods in the CPI basket, and using Cobb-Douglas production functions for tradables and non-tradables, the difference between inflation rates of non-tradables and tradables can be expressed as the difference between the growth rates of average labour productivity in tradable ($\hat{a}^T$) and non-tradable ($\hat{a}^{NT}$) industries:

$$\hat{p}^{NT} - \hat{p}^T = \left(\frac{\delta}{\gamma}\right)\hat{a}^T - \hat{a}^{NT} \tag{8}$$

where γ and δ are labour intensities (ie factor income shares) in tradable and non-tradable industries.[3] Assuming that $\gamma = \delta$, and using the above decomposition of the growth rate of tradable prices into the growth rate of world prices of tradables, equations (3) and (4) can be combined to give the following expression for inflation in a two-sector open economy model:

$$\hat{p} = (\hat{p}^{T*} + \hat{e}) + (1-\alpha)(\hat{a}^T - \hat{a}^{NT}) \tag{9}$$

Equation (9) implies that the rate of inflation can be decomposed into "imported" inflation ($\hat{p}^{T*} + \hat{e}$) and "structural" inflation $(1-\alpha)(\hat{a}^T - \hat{a}^{NT})$, where the latter is determined by the sectoral productivity trends (assuming that factor income shares are constant). This equation provides several valuable insights for the analysis of inflation in EMEs:

- Changes in world market prices of tradables and exchange rates will be fully transmitted to domestic inflation at given rates of productivity growth and weights of tradables in the consumption basket.

- If world market prices for tradables and the exchange rate are constant (or move at the same rate in the opposite direction), domestic inflation will increase by a fraction $(1-\alpha)$ of the sectoral productivity growth differential.

- Faster productivity growth of non-tradables will *decrease* the rate of inflation, while faster productivity growth of tradables will *increase* inflation. The intuition behind this conclusion is that faster productivity growth for tradables results in a faster rate of wage increase for both sectors, which speeds up the rate of price increase for non-tradables without affecting the price trend for tradables, the latter being determined by the path of world market prices and the exchange rate.

- Countries with particularly large differences in productivity growth between the tradable and non-tradable sectors will, ceteris paribus, have higher inflation relative to countries with small differences in sectoral productivity growth.

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[3] Versions of this model of "structural" inflation were developed independently by Balassa (1964), Samuelson (1964), Baumol and Bowen (1966) and several Scandinavian economists (see eg Aukrust (1977) and Lindbeck (1979)). For a derivation of the above equations, see eg Mihaljek and Klau (2004).

The inflation differential between two countries can be expressed as the sum of changes in the exchange rate and (weighted) productivity growth differentials between the two sectors at home and abroad (foreign country variables are denoted by the symbol *):

$$\hat{p} - \hat{p}^* = \hat{e} + (1-\alpha)[\hat{a}^T - \hat{a}^{NT}] - (1-\alpha^*)[\hat{a}^{T^*} - \hat{a}^{NT^*}] \tag{10}$$

When used as a positive theory of inflation, the basic insight of this model is that the rate of wage increase tends to adjust for the "room" for wage increase in the tradable sector, as defined by the sum of the (exogenous) increase in world market prices for tradables and the (exogenous) rate of productivity increase in that sector.

A broader insight is that not all inflation in the catching-up economies is "pathological" – faster productivity growth in industries producing tradable goods and services is part of the "physiology" of economic development (Padoa-Schioppa (2003)). If labour and capital markets are unencumbered, there is not much that monetary policy could or should do to control this source of inflation. This insight seems particularly relevant for the economies moving rapidly towards higher living standards – for instance, as a result of economic and financial integration with a neighbouring advanced economy.

Over the years, such aggregate models have been extended by providing a much richer description of the micro foundations of labour and product markets. One widely used characterisation of the joint behaviour of wage and price inflation is a model including a "price equation" and a "wage equation" such as:

$$p = \left(w - \frac{Y}{L} \right) + \mu \tag{11}$$

$$w = -\beta u + \frac{Y}{L} + \theta(p^* + e) + z \tag{12}$$

where μ is the mark-up resulting from imperfect competition in the goods market; β measures the responsiveness of wages to unemployment, u; θ measures the pass-through from import prices to wages; and z includes a range of institutional factors such as unemployment benefits, minimum wages, restrictions on firing or hiring, the degree of unionisation, the tax wedge (in terms of earnings and payroll taxes), skills mismatches and information problems.[4] Equation (11), which describes labour demand, states that firms set prices at a markup, μ, over unit labour costs. Equation (12), which describes labour supply, states that the workers' desired wage level depends on the unemployment rate, labour productivity, the pass-through from terms-of-trade shocks to wages, and various institutional characteristics of the labour market, which may lead to nominal wage rigidities.

These models have been used to test a wide variety of hypotheses about wage and price formation, including whether wage-price dynamics are consistent with the view that prices are set after wages are known (the so-called "cost push" view of inflation – see eg Angeloni et al (2006)); the spillover effects of nominal adjustments across labour and product markets (the "wage spiral" – see eg Kandil (2003)); the extent to which changes in the degree of price flexibility modify the ranking of alternative monetary policy regimes in an open economy framework (see eg Devereux and Engel (2003)). To support the implementation of monetary policy, several central banks, including a few in EMEs, have developed more fully specified dynamic stochastic general equilibrium (DSGE) models founded on the new open economy macroeconomics paradigm advanced by Obstfeld and Rogoff (1996).[5]

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[4] For a more complete specification of this model, see eg Blanchard and Katz (1997) or Layard, Nickell and Jackman (2005). For an empirical application to the emerging European economies, see Goretti (2008).

[5] For an overview of the use of DSGE models in central banks, see Tovar (2008).

3.   Data issues

The advanced economies have a long tradition of analysing the wage-price mechanism in assessing inflation coming from the labour market and in forecasts of inflation. For example, the OECD has published its annual *Employment Outlook* for several decades now.[6] The European Commission started a similar annual exercise in the early 2000s.[7]

Countries in the euro area, for instance, focus on three main measures of the growth in nominal labour costs: negotiated wages, the labour cost index and compensation per employee.[8] The assessment of inflationary pressures stemming from the labour market focuses on nominal unit labour costs by quantifying their contribution to the increase in the final demand deflator. In addition, to separate the influence of external and domestic cost components, the final demand deflator is decomposed into import deflator and income components of the GDP deflator, ie nominal unit labour costs, gross operating surplus and net indirect taxes. The requirement that wage developments contribute to price stability translates into the condition that nominal increases in compensation per employee should not exceed the sum of productivity and the ECB inflation target of close to, but below, 2%. The application of this rule distinguishes between actual and long-term productivity and between the cyclical and long-term situations of the labour market.

The lack of good labour market data has until recently limited this type of analysis in most EMEs. For instance, many EMEs use payroll statistics or narrower estimates of employment instead of the more comprehensive labour survey data. That choice can lead to underestimation of the number of employees in the economy; the resulting overestimation of productivity can lead policymakers to conclude that a higher-than-warranted growth rate of wages is acceptable at a given rate of inflation.

Another frequent data problem in EMEs is the lack of adequate price deflators, which makes it difficult to identify the sources of external and domestic cost pressures. However, widespread adoption of inflation targeting frameworks by central banks has provided an incentive to compile better labour market data and has enabled central banks to use productivity and unit labour costs more widely in their inflation forecasts.

In the survey conducted among emerging market central banks participating at this meeting, central banks noted that they use a variety of ***measures of wage inflation*** for the gross wages whole economy (Hungary, Korea and Poland) and for individual sectors (eg industry for Argentina, public and private sectors for the Czech Republic) (see Appendix Table A1). Central banks also monitor hourly compensation (Israel, Mexico and Thailand), compensation per employee (Hong Kong SAR, Israel, South Africa and Turkey) and unit labour costs (Colombia, Hong Kong SAR, Hungary, South Africa and Thailand). They view an increase in any of these costs as a potential source of wage pressure that could spill over to higher prices. To gauge demand-side inflationary pressures, some central banks also track real wages (Colombia, the Czech Republic, Poland and Turkey).

The majority of inflation targeting central banks in the sample (Chile, the Czech Republic, Hungary, Korea, Poland, Thailand and Turkey) follow ***labour productivity and unit labour***

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[6]   The reports for the past 20 years are available at
www.oecd.org/document/0/0,3343,en_2649_33927_40774656_1_1_1_37457,00.html.

[7]   See the annual series *Labour market and wage developments* at
http://ec.europa.eu/economy_finance/publications/specpub_list9266.htm.

[8]   Compensation per employee includes gross wages and salaries (ie wages plus employees' social security contributions) and employers' social security contributions. When disaggregated, compensation per employee, together with negotiated wages, gives an indication of labour cost pressures coming from a particular sector (public/private, industry/services). The labour cost index (which does not cover government activities) captures the evolution of hourly labour costs, correcting for the changes in overtime hours and part-time employment.

cost measures very closely, using them in both short-term and medium-term forecasts of inflation (Appendix Table A2).[9] Other inflation targeters (Colombia, Israel, Mexico, Peru and South Africa) use unit labour cost indicators mainly in the assessment of inflation trends rather than as an input for inflation forecasts. The central bank of Argentina (which is not an explicit inflation targeter) follows a similar approach. Inflation reports produced by central banks in all these countries analyse the labour market and wage developments.

Although many emerging market economies today face the combination of increased labour productivity (allowing higher nominal wages) and substantial terms-of-trade shocks, only a few EME central banks consider *measures of "warranted" wage growth* such as equation (6): in Colombia and Poland, warranted wage growth is considered in minimum wage negotiations; in Korea, it is calculated by the Korea Labour Institute; and in Israel, a measure of warranted wage growth is used to assess changes in business sector costs and competitiveness.[10]

Measures of price inflation for *tradables and non-tradables* are widely used by central banks (Appendix Table A3), and they are monitored on a systematic basis except in Hong Kong SAR, Israel, Saudi Arabia, South Africa and Thailand. CPI aggregates of goods price inflation are often used to assess the extent of "imported" inflation and the pass-through of exchange rate changes into inflation; while the CPI aggregates of service price inflation are generally considered a good proxy for the domestic sources of inflation.

In Chile, Colombia, the Czech Republic, Hungary, Poland and Turkey, the split of inflation into tradable and non-tradable components is considered particularly important and is used in macro forecasting models, either directly or via the real exchange rate (as in Poland). Several central banks have also produced estimates of the Balassa-Samuelson effect (Chile, Colombia, the Czech Republic, Hungary, Israel). In Hungary, the definition of price stability incorporates the Balassa-Samuelson effect.

Only a few central banks seem to closely monitor the evolution of wage differences between *formal and informal* or *urban and rural* sectors (Appendix Table A4). One reason is the lack of data (eg in Chile, Hong Kong SAR, Israel, Korea, Peru, Saudi Arabia and Thailand); another is that these differences are not considered important (eg in the Czech Republic). In Hungary, wages in the informal sector are estimated by statistical methods and used to forecast wage dynamics in the entire economy (see Eppich and Lörincz (2007)). In Colombia, wage data for the informal and rural sectors are not timely, but employment trends for these two sectors are followed closely throughout the cycle (see Leibovich, Nigrinis and Ramos (2006)). In Poland, wage data for the rural sector are fragmentary and unreliable, but differences between urban and rural wages are considered to be important for overall wage dynamics because of the large number of self-employed farmers. In South Africa, minimum wages for farm workers and urban/rural CPI data provide some indication of the urban/rural wage gap and its impact on overall wages.

The relevance of institutional characteristics of the labour market for the assessment of inflation is generally smaller in the emerging markets than in advanced economies, and it is smaller today than it was a couple of decades ago. *Wage indexation* was quite common before the 1990s, when many emerging market countries experienced episodes of high inflation (see Box A2 in the Appendix for the experiences of Chile and Brazil). However, as a

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[9] Measures of labour productivity in manufacturing are available monthly and are widely used. For other sectors as well as the whole economy, real output measures are generally available only quarterly and are used by inflation targeters for medium-term forecasts. Central banks also look closely at various time series for wages and employment (eg average wage vs compensation per employee, total employment vs hours worked). Information on the price deflators used to obtain estimates of real wages was not readily available.

[10] See Barnea and Djivre (2004) and Lavi and Sussman (2001).

result of low and falling inflation in most EMEs, automatic wage indexation schemes are no longer significant (Appendix Table A5).

Certain exceptions nonetheless exist. Pensions (Argentina, Thailand) and public sector wages (Columbia, South Africa, Turkey) are still indexed to inflation. In Columbia, minimum wages are indexed because of the high percentage of workers earning the minimum wage and its use in the setting of other wages; in Thailand, minimum wages are generally adjusted once a year according to the previous year's inflation rate. In Chile, 70% of labour contracts are adjusted every six months according to past CPI inflation. Israel abolished the cost of living adjustment for senior officials in the public sector in 1996, but it established a mechanism that links the allowances of other employees – and, since 2008, unfunded pension payments – to the CPI. In Hungary, past and expected inflation are taken into account in the wage setting process. In Poland, inflation is taken into account in public sector wage negotiations. In Thailand, most firms in the private sector also use backward indexation. Some firms even use year-ahead forecasts of inflation for wage indexation. Inflation also affects wage agreements made through collective bargaining in Korea and South Africa, although no explicit indexation schemes are used there.

With the exception of Argentina, the Czech Republic, Mexico and South Africa, most central banks have concluded that **collective bargaining and negotiated wages** were no longer important for the dynamics of inflation (Appendix Table A6).[11] In South Africa, the number of bargaining councils was in decline, and only 25% of the active labour force was covered by bargaining council agreements. Even where labour unions are more active, their bargaining powers have diminished. In Hungary, for instance, the tripartite National Interest Reconciliation Council only provides recommendations for wage increases and sets the legally guaranteed minimum wage. In Thailand, the presence of migrant labour, weak labour unions and government regulations considerably limit the impact of collective bargaining on economy-wide wages.

4.   Empirical illustrations

Consumer price inflation and nominal wage inflation in EMEs have generally moved close together over the past decade (Appendix Graph A1), which warrants a look at wage dynamics in the analysis of inflation in emerging markets. Countries with high average annual inflation tended to have higher annual wage growth during 2000–08 (Graph 1, left-hand panel). The sensitivity of that relationship has changed over time: given a 1 percentage point increase in inflation, wage growth increased 1 percentage point during 2000–03 (Graph 2, left-hand panel), but 1.2 percentage points during 2004–08 (right-hand panel). Between the 2000–03 period and the 2004–08 period, the correlation between inflation and wage growth increased significantly for China, Chile, the Czech Republic, Hong Kong SAR, Korea, the Philippines and Thailand (Table 1). Positive correlations suggest that wages do adjust for inflation, even if automatic indexation is no longer as prevalent as in the past.

Higher wage growth also has a (weak) positive association with a higher unemployment rate (Graph 1, right-hand panel). That relationship contrasts with most estimates of the Phillips curve for advanced economies and might reflect the greater importance of supply shocks in EMEs than in advanced economies.

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[11]   For recent central bank studies of wage bargaining and labour market flexibility in EMEs more generally, see Du Caju et al (2008), which also covers advanced EU economies; Godfrey, Theron and Visser et al (2007); Horváth and Szalai (2008); Pauwels and Zhang (2008); and Waiquamdee, Sutthasri and Tanboon (2009).

Graph 1

Wages, inflation and unemployment, 2000–08

In per cent
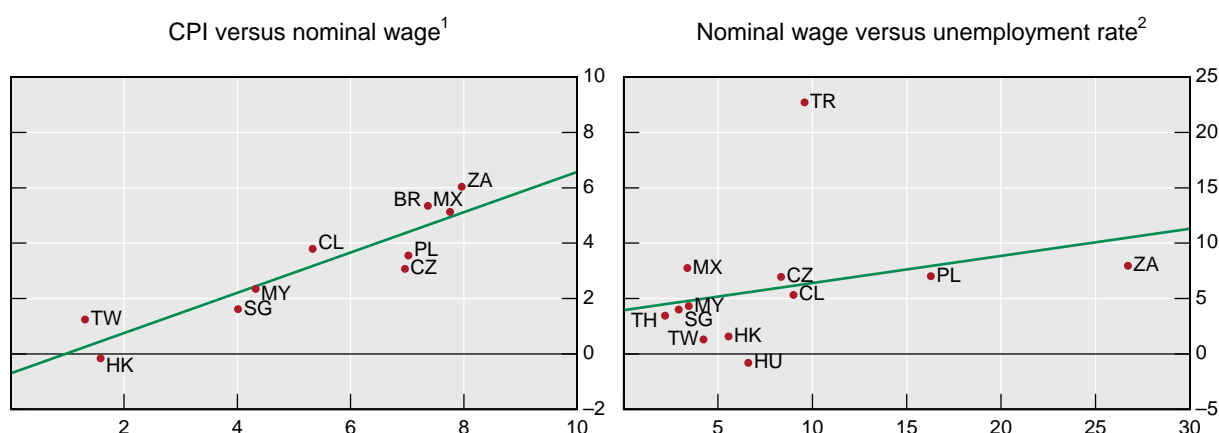
CPI versus nominal wage[1]   Nominal wage versus unemployment rate[2]

BR = Brazil; CL = Chile; CZ = Czech Republic; HK = Hong Kong SAR; HU = Hungary; MX = Mexico; MY = Malaysia; PL = Poland; SG = Singapore; TH = Thailand; TR = Turkey; TW = Chinese Taipei; ZA = South Africa.

[1] Vertical axis: average annual CPI inflation, average for 2000–08. Horizontal axis: average annual growth of nominal wages for the same period.   [2] Vertical axis: average annual growth of nominal wages for 2000–08. Horizontal axis: average annual unemployment rate for the same period.

Sources: Datastream; national data.

Table 1
Correlation between wages and CPI inflation[1]

	2000–03	2004–08	2000–08
China	−0.79	0.78	0.43
Indonesia	0.98	0.09	0.13
Hong Kong SAR	0.48	0.86	0.78
Korea	−0.31	0.31	0.01
Malaysia	0.09	0.10	−0.13
Philippines	0.33	0.83	0.70
Singapore	0.89	0.81	0.57
Thailand	0.29	0.87	0.91
Argentina	…	0.36	0.36
Brazil	…	−0.45	−0.45
Chile	0.43	0.89	0.86
Mexico	0.82	0.22	0.86
Peru	…	0.20	0.20
Venezuela	…	0.40	0.40
Czech Republic	0.39	0.77	0.46
Hungary	−0.10	−0.11	−0.04
Poland	0.89	0.32	0.84
Russia	0.79	0.13	0.87
Turkey	0.55	−0.18	0.85
South Africa	−0.21	−0.17	−0.18

[1] Correlation between annualized changes in quarterly average nominal wages, and year-on-year changes in quarterly average CPI inflation.

Sources: Datastream; national data.

Graph 2

Changes in CPI inflation and nominal wages[1]

In per cent
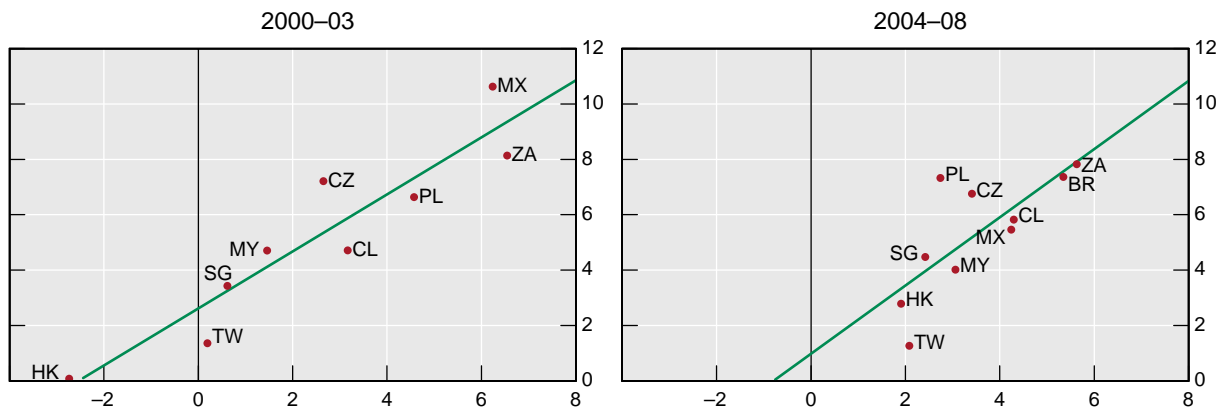
2000–03	2004–08

BR = Brazil; CL = Chile; CZ = Czech Republic; HK = Hong Kong SAR; HU = Hungary; MX = Mexico; MY = Malaysia; PL = Poland; SG = Singapore; TH = Thailand; TR = Turkey; TW = Chinese Taipei; ZA = South Africa.

[1] Vertical axis: average annual growth of nominal wages; horizontal axis: average annual CPI inflation for the same period.

Sources: Datastream; national data.

Many EMEs experienced very strong *real wage growth* during 2005–07, reaching in some cases 5–10% per year on average (eg in China, the Czech Republic, Korea and South Africa; Graph 3, top left-hand panel). For the most part, however, real wage growth was offset by fairly high *productivity growth* (Graph 3, top right-hand panel), so that real unit labour costs – measuring the difference between real wages and labour productivity – were stable or falling in about half of EMEs in the sample, with Chile, Indonesia, Malaysia and Poland experiencing a more pronounced decline (Graph 3, bottom right-hand panel).

As indicated in the third panel of Graph 3, observations on average growth rates of labour productivity and real wages were closely aligned for most EMEs in the sample. The exceptions were Brazil, China, Korea and South Africa. In these countries, real wages grew faster than average labour productivity during 2005–07, implying rising real unit labour costs and, hence, rising inflation pressures coming from the labour market.
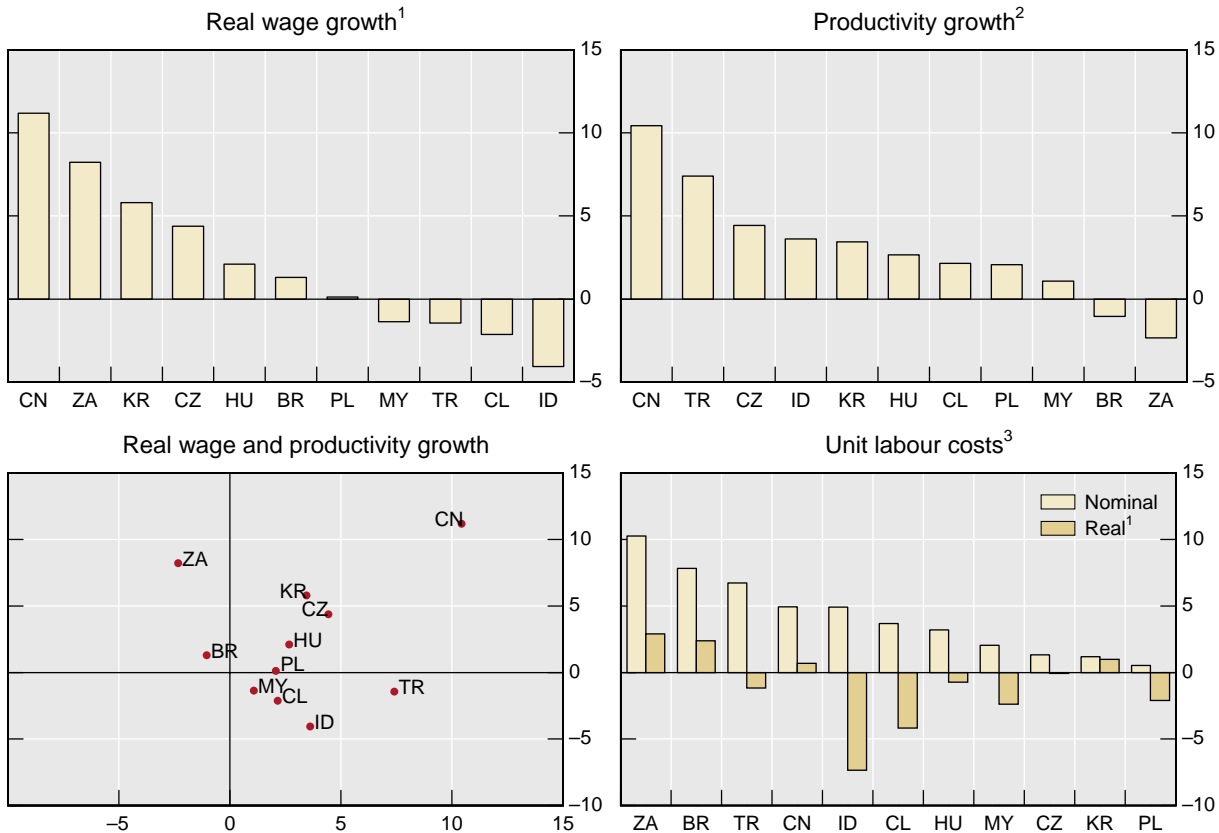
The "structural" sources of inflation in EMEs discussed in Section 2 have not received much empirical attention. One exception is the pass-through of exchange rate changes into domestic inflation.[12]

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[12] For a recent overview, see eg Ca' Zorci, Hahn and Sánchez (2007).

Graph 3

Productivity, wages and unit labour costs

Average annual changes, in per cent, 2005–07

Real wage growth[1] — CN ZA KR CZ HU BR PL MY TR CL ID

Productivity growth[2] — CN TR CZ ID KR HU CL PL MY BR ZA

Real wage and productivity growth — CN, ZA, KR, CZ, HU, BR, PL, MY, CL, TR, ID

Unit labour costs[3] — Nominal, Real[1] — ZA BR TR CN ID CL HU MY CZ KR PL

BR = Brazil; CL = Chile; CN = China; CZ = Czech Republic; HU = Hungary; ID = Indonesia; KR = Korea; MY = Malaysia; PL = Poland; TR = Turkey; ZA = South Africa.

[1] Deflated by the GDP deflator.   [2] Change in real GDP divided by change in employment. Coverage of employment differs across countries. For the Czech Republic, Hungary, Poland and Turkey, change in real GDP per occupied person. For Korea, OECD data.
[3] Change in total labour cost, divided by the change in real output. For the Czech Republic, Hungary, Poland and Turkey, European Commission data. For Korea and South Africa, OECD data.   [4] Unit labour costs in the manufacturing sector.

Sources: European Commission; IMF; OECD; CEIC; national data; BIS calculations.

Another is the difference in productivity growth between tradable and non-tradable goods industries and the related ***Balassa-Samuelson effect***. The issue is of particular importance for the new EU member states from CEE because of their obligation to join the euro area in the foreseeable future. If the productivity growth differential between the tradable and non-tradable goods sectors is larger in an EMU candidate country than in the euro area, overall inflation will be higher in the candidate country. Under a fixed exchange rate regime, that will result in real appreciation of the candidate country's currency. Under a flexible exchange rate regime, it will result in some combination of nominal appreciation and CPI inflation. If the Balassa-Samuelson effect is particularly strong, the candidate country might violate the inflation criterion for membership in the euro area.[13]

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[13] According to the Maastricht inflation criterion, EMU candidate countries must demonstrate sustainable price stability and an average rate of inflation (observed over a period of one year before the examination) that does not exceed by more than 1½ percentage points the average rate of inflation of, at most, the three EU member states with the best price stability performance.

This is not likely to be the case according to most studies – the Balassa-Samuelson effect is usually estimated to add around 0.2–2.0 percentage points to the CPI inflation (see eg Mihaljek and Klau (2008), Égert (2005), and Égert, Halpern and MacDonald (2006)), but for some countries with a fixed exchange rate regime the effect could be much larger. The authorities in such countries might therefore feel compelled to maintain, at least temporarily, relatively restrictive monetary and fiscal policies in order to meet the inflation criteria, which might dampen economic growth and job creation.

The literature has also identified some puzzles related to the operation of the Balassa-Samuelson effect. On the one hand, the evidence suggests that this effect is not the main driving force of the observed relatively high inflation rates of 3–6% per year in most CEE countries. On the other hand, although productivity growth in the tradable sectors has indeed been high, it has not led to correspondingly high inflation rates. Explanations of these puzzles include a trend increase in tradable prices due to quality improvements (Cincibuch and Podpiera (2006)); the role of regulated price adjustments in overall inflation; a disconnect between productivity growth and real wages in the manufacturing sector (Égert (2007)); incomplete wage equalisation and substantial productivity gains in market non-tradables; and the low share of market non-tradables in consumer price indices of CEE countries (Égert, Halpern and MacDonald (2006)).[14]

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[14] Several central banks participating in the meeting conducted studies of the Balassa-Samuelson effect or, more generally, appreciation of the "equilibrium" real exchange value of the currency in the past few years. See Caputo, Nuñez and Valdes (2007), Kiss and Krekó (2004), Kovács (2002), Oliveros and Huertas (2002), Romanov (2003) and Vilagi (2004).

Appendix

Box A1

Informal economy, public sector and urban vs rural sector in EMEs

Besides differential productivity growth, inflation in EMEs can be affected by other structural features, such as the relative size of the informal sector; wage formation in the public vs. private sectors; and differences between urban and rural wages. Better statistical coverage of the ***informal economy*** will boost the official figures for output, employment and wages without necessarily boosting inflation. Conversely, when the informal economy expands (eg in a recession), inflation could remain sticky despite the fall in the official employment and wage figures.

Shifts in ***public sector*** labour demand and a loose wage policy may have a demonstration effect on the private sector. In some countries, collective bargaining at the national level may set by law the minimum conditions for all of the economy, thereby generating a wage-push effect.

Another consideration is the difference between ***urban and rural wages***. Higher urban wages, the typical case in EMEs, will attract rural workers to cities in search of jobs. The prediction of a standard model is that such rural-urban migration would apply downward pressure on wages and hence on inflation.[1] However, congestion effects created by the growing number of city dwellers can be so large as to lead to higher prices of non-tradables such as transportation, utilities and rents, especially in those market segments that are not subject to price controls, and eventually result in higher overall inflation.

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[1] In the model of Harris and Todaro (1970), the expected income of an urban dweller is equal to that of a rural dweller: the rural worker earns a low wage without being laid off, while urban employees earn a high wage for some of the time and are laid-off on zero income for the rest of the time. This model has been used to explain the coincidence of high unemployment and high wages on the basis of macro data. However, on the basis of micro data, Blanchflower and Oswald (1994) discovered for a number of advanced economies a robust empirical relationship (the "wage curve") between higher unemployment in a region or industry and lower wages.

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Box A2

Experience with indexation in Chile and Brazil

High inflation in the 1960s provided a rationale for indexing all contracts in **Chile**, including wages, house rentals, tuition and health insurance; financial instruments (consumer loans, mortgages, corporate bonds, all fixed income securities with a maturity of one quarter or longer); and policy instruments (exchange rates, interest rates on public debt, income tax brackets and public sector wages) (see Lefort and Schmidt-Hebbel (2002)). The indexed unit of account, called *Unidad de Fomento* (UF) and introduced in January 1967, related the currency to the Chilean CPI. The UF was originally calculated three times a year; then, between 1975 and 1977, monthly; and after 1977 daily. In the financial sector, the UF was widely adopted in the early 1980s. By 1983, more than 60% of total bank loans in Chile were tied to the UF. The UF was a lagged daily interpolation of the monthly CPI. The formula for computing the UF on day t was given by:

$$UF_t = UF_{t-1}x(1+\pi)^{1/d}$$

where π was either the inflation rate for the $t-1$st calendar month (for t between the 10th and the last day of the month), or the inflation rate for the $t-2$nd calendar month (for t between the 1st and the 9th day of the month); d was the number of days in the $t-1$st calendar month. For instance, the UFs for 1–9 April depended on the CPI for January and February; and the UFs for 10–30 April depended on the CPI for February and March. The UFs for a given month thus depended on the CPI for each of the preceding three months.

To reduce the prevalence of indexation, the Central Bank of Chile in September 1990 adopted a monetary framework based on public announcement of an explicit, forward looking annual inflation target. This helped reduce the annual rate of inflation from 27% in 1990 to 3% in 2001. Although the prevalence of indexed contracts has declined in recent years, the Chilean economy remains heavily indexed: about 70% of all labour contracts are adjusted every six months for past inflation.

Indexation in **Brazil** was institutionalised in 1964, when the government introduced *correçãomonetária*, a sophisticated indexation mechanism that adjusted taxes, tariffs and some financial contracts (see Goldfajn (2002)). The exchange rate, wages and bank deposits were initially not indexed, but over time they too became indexed in various ways. Indexation came to an end only with the *Real* Plan of 1994 (see Goldfajn and Valdes (1999)).

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Table A1

Measures of wage inflation used in inflation analysis

Measure	Country	Comment
Gross wages	Argentina	Industrial wage index for industrial sector
	Czech Republic	For public and private sectors
	Hungary	For economy-wide analysis, inflation analysis and forecasting
	Korea	Gross nominal wages
	Mexico	36% of employees; gross wage increments negotiated for next 12 months for contractual employees
	Peru	Gross nominal wages estimated semiannually by labour ministry
	Turkey	Per hour in manufacturing
	Poland	
Net wages	Argentina	Wage index for all workers
Hourly net wages	Mexico	Hourly compensation per employee
	Thailand	Hourly compensation
Compensation per employee	Hong Kong SAR	Nominal payroll per person
	Turkey	Nominal and real earnings per employee
	Israel, South Africa	
Unit labour costs	Colombia	For manufacturing and retail sectors
	Hungary	For inflation analysis and forecasting
	Israel	Hourly nominal wages adjusted for labour productivity
	South Africa	Total salaries and wages as a ratio to real GDP in the formal non-agricultural sector
	Chile, Hong Kong SAR, Thailand	
Nominal wages	Colombia	For manufacturing, retail and construction sectors
	Czech Republic	For public and private sectors
	Thailand	Including minimum wage
	Turkey	Per hour in manufacturing
	Chile, Korea, Poland	
Real wages	Colombia	For manufacturing, retail and construction sectors
	Czech Republic	For public and private sectors
	Turkey	Per hour in manufacturing
	Chile, Poland	
CPI/Non-oil GDP deflator	Saudi Arabia	

Source: BIS survey of central banks.

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Table A2

Measures of productivity and unit labour costs used in inflation analysis

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Country	Measure	Data
Argentina	Labour productivity	Industry; based on employment and hours worked
	Unit labour costs	Considered but not included in forecast calculations
Chile	Labour productivity	Four alternative measures, by sector (excluding agriculture and natural resources); monthly and (for projections) quarterly
	Unit labour costs	
Colombia	Labour productivity	Overall economy, considered in assessment of cost pressures, aggregate demand/supply trends
	Total factor productivity	
	Unit labour costs	Manufacturing and retail
Mexico	Labour productivity	Whole economy (quarterly) and manufacturing (monthly and quarterly) considered in forecast calculations
	Unit labour costs	
Peru	Labour productivity	Corporate sector, biannual
	Unit labour costs	Preliminary use as a leading indicator of inflation pressures
Hong Kong SAR	Labour productivity	Used to analyse the effect of labour costs on inflation
	Unit labour costs	
Korea	Labour productivity	Non-farm sectors, quarterly
	Unit labour costs	Calculated using gross nominal wages, quarterly; used in evaluating and forecasting inflation
Thailand	Labour productivity	Whole economy and industries
	Unit labour costs	Whole economy and industries
Czech Republic	Labour productivity	Whole economy
	Unit labour costs	Whole economy and sectors; nominal; used as an explanatory variable in short-term inflation forecasts
Hungary	Labour productivity	Market sector excluding agriculture; as a whole and disaggregated; used in evaluating inflation
	Unit labour costs	Private sector as a whole, plus manufacturing and market services; quarterly; used in inflation forecasts
Poland	Labour productivity	Whole economy and main sectors (excluding agriculture)
	Unit labour costs	Based on average wage, used in inflation forecasts (ex post also look at compensation/employee)
Turkey	Labour productivity	Manufacturing and major sectors; based on employment and hours worked
	Unit labour costs	Manufacturing; nominal and real; used in inflation forecasts
Israel	Labour productivity	Whole economy and export manufacturing; monitored on a regular basis
	Unit labour costs	
Saudi Arabia	Labour productivity	Calculated independently by the government and private sector; not regularly monitored
	Unit labour costs	
South Africa	Labour productivity	Formal non-agricultural economy
	Unit labour costs	Based on gross salaries and wages

Source: BIS survey of central banks.

Table A3

**Measures of tradable/non-tradable goods inflation
used by EM central banks**

Country	Data
Argentina	Goods and services inflation closely followed; used to assess exchange rate pass-through
Chile	Goods and services price inflation closely followed; used in analysis of inflation
Colombia	Very important in analysis of inflation, used in macro forecasting model
Mexico	Monitored on a systemic basis and reported (bi-weekly) to the Board; used to assess domestic/external inflation pressures
Peru	Tradable/non-tradable price data available monthly, not used in analysis of overall inflation
Hong Kong SAR	Tradable/non-tradable inflation not monitored, but non-rental component of CPI is forecast
Korea	Tradable/non-tradable price data regularly monitored
Thailand	Not monitored (labour market data not detailed enough); real exchange rate stable
Czech Republic	Tradable/non-tradable price data closely followed; used as input to policy decisions and to assess the exchange rate pass-through
Hungary	Very important in analysis of inflation; definition of price stability incorporates the BS effect
Poland	Tradable/non-tradable inflation not monitored systematically, but BS effect included in inflation projections via real exchange rate equation
Turkey	Goods and services price inflation closely monitored and analysed in detail
Israel	Tradable/non-tradable inflation not monitored on a systematic basis
Saudi Arabia	Tradable/non-tradable inflation monitored and incorporated in quarterly analysis of inflation
South Africa	Tradable/non-tradable price data yet to be compiled; BS effect not considered relevant for inflation analysis in an inflation targeting framework

Source: BIS survey of central banks.

Table A4

**Central bank assessment of the significance of differences in
wage dynamics in formal/informal and urban/rural sectors**

Importance	Country	Data
Wages in formal vs. informal economy		
Differences important for assessment of inflation dynamics	Argentina	Wage evolution in the informal sector closely related to the cost of the basic food basket
	Colombia	Wage data not timely, but formal vs. informal employment data followed closely throughout the cycle
	Hungary	Wages in the informal sector estimated through statistical methods; used to forecast wage dynamics
	Mexico	Comprehensive data available, followed on a monthly basis
	Poland	Size of the informal economy estimated but wage data not available
Differences not important	Czech Republic	
Data not available	Chile, Hong Kong SAR, Israel, Korea, Peru, Saudi Arabia, South Africa, Thailand, Turkey	
Urban vs. rural wages		
Differences important for assessment of inflation dynamics	Colombia	Wage data not timely, but urban vs. rural employment data followed closely throughout the cycle
	Poland	Wage data fragmentary, unreliable; differences important because of large number of self-employed farmers
	South Africa	Minimum wage for farm workers, urban/rural CPI provide some indication of the urban vs. rural wage dynamics
Differences not important	Czech Republic	
Data not available	Chile, Hong Kong SAR, Israel, Korea, Peru, Saudi Arabia, Thailand, Turkey	

Source: BIS survey of central banks.

Table A5

**Central bank assessment of the significance of wage indexation
for inflation dynamics**

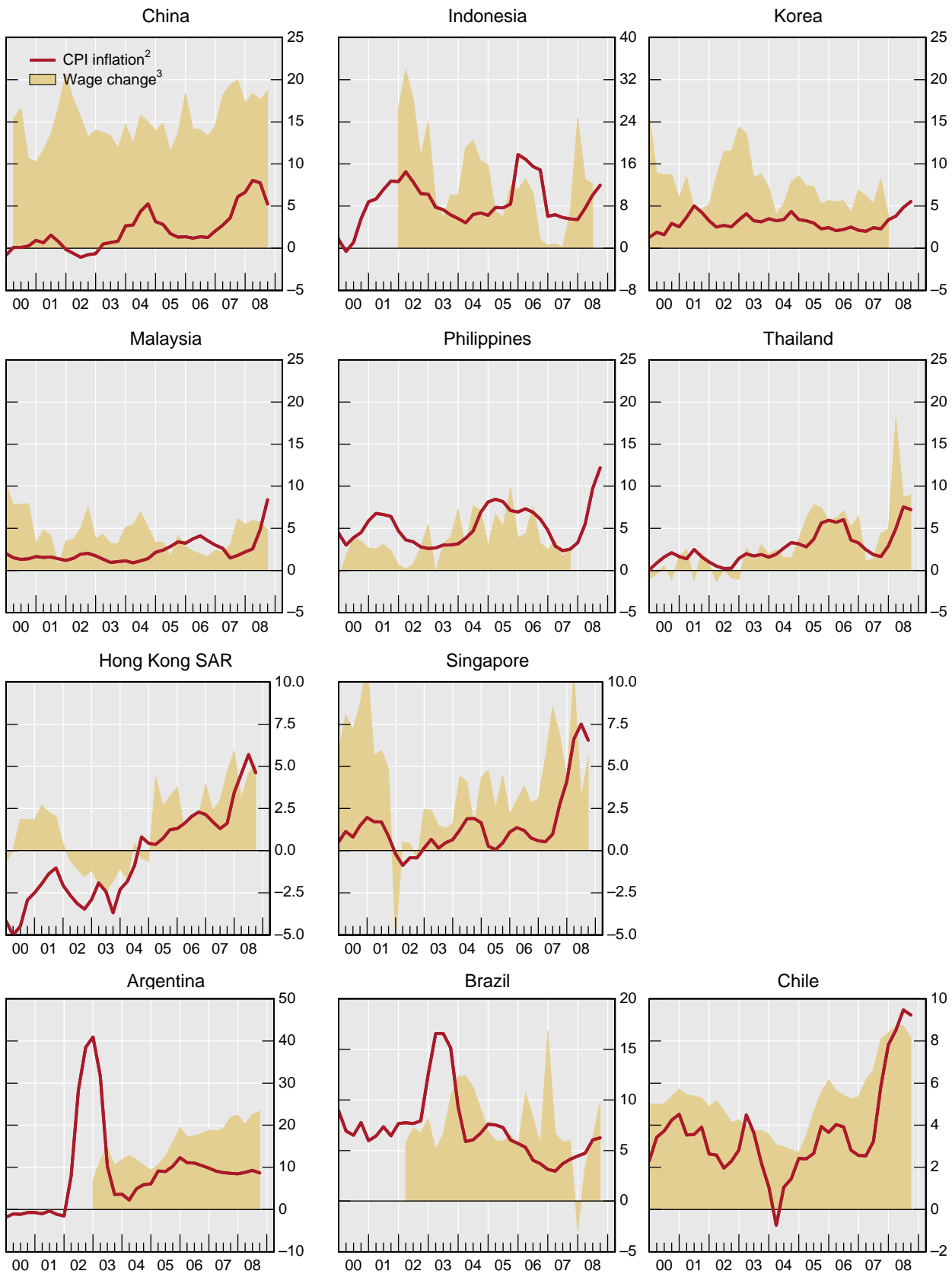|	Countries	Comments
High significance	Chile	About 70% of labour contracts adjusted every six months for past CPI inflation
	Colombia	Important for the public sector and the minimum wage
	South Africa	Applies to multi-year wage agreements, which are fairly common in South Africa, eg multiyear agreement in the public sector during the past three years links CPIX inflation plus a certain percentage point above that
	Turkey	Public sector wages mostly indexed to inflation targets. When inflation targets are missed within a certain margin, employees are protected against inflation
Low/no significance	Argentina	Except for pensions
	Hong Kong SAR	Some companies set wage levels making reference to CPI inflation
	Israel	Has become insignificant in light of low inflation in the past ten years
	Thailand	Public pension benefits indexed to inflation in the previous year (most important form of indexation). Most firms in the private sector also use backward indexation. Few firms use year-ahead forecast inflation. Minimum wage generally adjusted only once a year, indexed to the previous year's inflation rate
	Czech Republic, Hungary, Korea, Mexico, Peru, Poland, Saudi Arabia	

Source: BIS survey of central banks.

Table A6

**Central bank assessment of the significance of collective bargaining
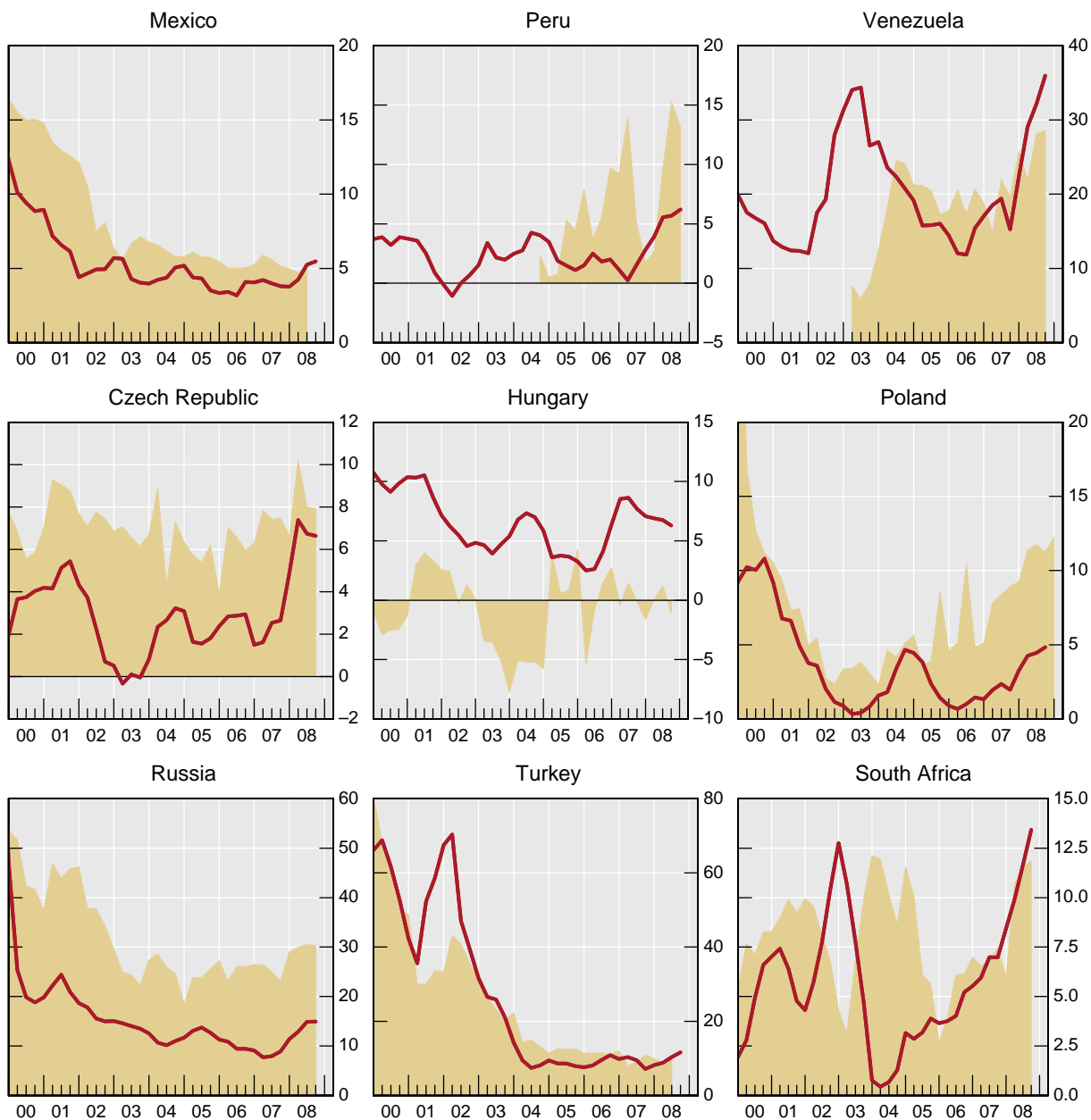for inflation dynamics**

Importance	Country	Comment
High significance	Argentina	Collective bargaining takes place annually since 2005
	Czech Republic	30–40% of wages covered by collective bargaining.
	Mexico	9% of total contractual wages are negotiated (does not include teachers' unions)
	South Africa	25% of labour force covered by bargaining council agreements; 75% by ministerial decrees and legislation (which offer minimum levels of protection). Number of bargaining councils declined from 80 to 57 between 1995 and 2005 (51 councils in the private sector, of which 41 are functional, and 6 in the public sector)
Low/no significance	Colombia	Collective bargaining important only for large firms
	Hong Kong SAR	Labour unions/organisations have limited wage bargaining power
	Hungary	Wage setting process largely conducted at company or plant level
	Poland	Collective bargaining mostly takes place at firm level
	Thailand	Presence of migrant labour, weak labour unions and regulations limit the size of negotiated wage increases
	Peru, Saudi Arabia	
Not applicable	Chile, Korea, Turkey	

Source: BIS survey of central banks.

Graph A1

CPI and nominal wage inflation[1]

In per cent

China

CPI inflation[2]
Wage change[3]

Indonesia

Korea

Malaysia

Philippines

Thailand

Hong Kong SAR

Singapore

Argentina

Brazil

Chile

CPI and nominal wage inflation

In per cent

Mexico · Peru · Venezuela · Czech Republic · Hungary · Poland · Russia · Turkey · South Africa

[1] Argentina, average monthly wage; Brazil, average monthly earnings; Chile, hourly wage index; China, cumulative salary of employed persons divided by employed persons; Czech Republic, average monthly wages; Hong Kong SAR, nominal payroll per person; Hungary, employee gross wages; Indonesia, monthly average wage (manufacturing); Korea, monthly earnings; Malaysia, earnings in manufacturing sector; Mexico, average monthly wage; Peru, average monthly income; Philippines, manufacturing industry wage index; Poland, average monthly wage; Russia, average monthly wages; Singapore, average monthly earnings; South Africa, average monthly earnings in manufacturing; Thailand, average wage rate; Turkey, hourly wages (manufacturing); Venezuela, wage index.   [2] Annual change of CPI inflation.   [3] Annual change of nominal wage.

Sources: Datastream; national data.

References

Angeloni, I, L Aucremanne, M Emrmann, J Gali, A Lewin and F Smets (2006): "New evidence on inflation persistence and price stickiness in the euro area: implications for macro modelling", *Journal of the European Economic Association*, vol 4, pp 562–74.

Aukrust, O (1977): "Inflation in the open economy: a Norwegian model", in L Krause and W Salant (eds), *Worldwide inflation*, Brookings Institution.

Balassa, B (1964): "The purchasing power parity doctrine: a reappraisal", *Journal of Political Economy*, vol 72, pp 584–96.

Barnea, E and J Djivre (2004): "Changes in monetary and exchange rate policies and the transmission mechanism in Israel, 1989.IV– 2002.I", *Bank of Israel Discussion Paper*, no 13.

Baumol, W and W Bowen (1966): *Performing arts: the economic dilemma*, 20th Century Fund.

Blanchard, O and L Katz (1997): "What we know and do not know about the natural rate of unemployment", *Journal of Economic Perspectives*, vol 11, pp 51–72.

Blanchflower, D and A Oswald (1994): *The wage curve*, MIT Press.

Caputo, R, M Nuñez and R Valdes (2007): *Análisis del tipo de cambio en la práctica,* Central Bank of Chile, *Documento de Trabajo*, no 434, November.

Ca' Zorzi, M, E Hahn and M Sánchez (2007): *Exchange rate pass-through in emerging markets*, *ECB Working Paper*, no 739.

Cincibuch, M and J Podpiera (2006): "Beyond Balassa-Samuelson: real appreciation in tradables and transition countries", *Economics of Transition*, vol 14, no 3, 547–73.

Devereux, M and C Engel, (2003): "Monetary policy in open economy revisited: price setting and exchange rate flexibility", *Review of Economic Studies*, vol 70, 765–83.

Du Caju P, E Gautier, D Momferatou and M Ward-Warmedinger (2008): "Institutional features of wage bargaining in 22 EU countries, the US and Japan", Paper presented on the Wage Dynamic Network Conference, www.ecb.europa.eu/events/conferences/html/wage _dynamics_network.en.html

Égert, B (2005): "Balassa-Samuelson meets south-eastern Europe, the CIS and Turkey: a close encounter of the third kind?", *European Journal of Comparative Economics*, vol 2, December, pp 221–43.

——— (2007): "Real convergence, price convergence and inflation differentials in Europe", *CESifo Working Paper*, no 2127, October.

Égert, B, L Halpern and R MacDonald (2006): "Equilibrium exchange rates in transition economies: taking stock of the issues", *Journal of Economic Surveys*, vol 20, no 2, pp 257-324.

Eppich, G and S Lörincz (2007): "Three methods to estimate the whitening-related distortion of the wage statistics", *Hungarian National Bank Occasional Papers*, no 66.

Goldfajn, I (2002): "Indexation of public debt: analytical considerations and an application to the case of Brazil," in F Lefort and K Schmidt-Hebbel (eds), *Indexation, inflation and monetary policy*, Central Bank of Chile.

Goldfajn, I and R Valdes (1999): "The aftermath of appreciations," *Quarterly Journal of Economics*, vol 110, pp 127–59.

Godfrey, S, J Theron, and M Visser (2007): "The state of collective bargaining in South Africa", *DPRU Working Paper*, no 07-130, November.

Goretti, M (2008): "Wage-price setting in new EU members", *IMF Working Paper*, no 08/243.

Harris, J and M Todaro (1970): "Migration, unemployment and constant: a two-sector analysis", *American Economic Review*, vol 60, pp 126–42.

Horváth, H and Z Szalai (2008): "Labour market institutions in Hungary with a focus on wage and employment flexibility", Hungarian National Bank, *Occasional Paper*.

Kandil, M (2003): "The wage-price spiral: industrial country evidence and implications", *IMF Working Paper*, no 03/164.

Kovács, M (ed) (2002): "On the estimated size of the Balassa-Samuelson effect in CEC5 countries", *MNB Working Paper*, no 2002/5.

Kiss, G and Judit Krekó (2004): "Optimal rate of inflation in Hungary", *MNB Background Study*, no 2004/1.

Lavi, Y and N Sussman (2001): "The determination of real wages in the long run and its changes in the short run: evidence from Israel, 1968-1998", *Bank of Israel Discussion Paper*, no 2001.04.

Layard, R, S Nickell and R Jackman (2005): *Unemployment: macroeconomic performance and the labour market*, Oxford University Press.

Lefort, F and K Schmidt-Hebbel (2002): "Indexation, inflation and monetary policy: an overview," in F Lefort and K Schmidt-Hebbel (eds), *Indexation, inflation and monetary policy*, Central Bank of Chile.

Leibovich, J Nigrinis and M Ramos (2006): "Caracterización del mercado laboral rural en Colombia", *Banco de la República Working Paper*, no 408, October.

Lindbeck, A (1979): "Imported and structural inflation and aggregate demand: the Scandinavian model reconstructed", in A Lindbeck (ed), *Inflation and employment in open economies*, North Holland, pp 13–40.

Mihaljek, D and M Klau (2004): "The Balassa-Samuelson effect in central Europe: a disaggregated analysis", *Comparative Economic Studies*, vol 46, March, pp 63–94.

——— (2008): "Catching-up and inflation in transition economies: the Balassa-Samuelson effect revisited", *BIS Working Papers*, no 270.

Obstfeld, M and K Rogoff (1996): *Foundations of international macroeconomics*, MIT Press.

Oliveros, H and C Huertas (2002): "Desequilibrios nominales y reales del tipo de cambio en Colombia", *Banco de la República Working Paper*, no 220, September.

Padoa-Schioppa, T (2003): "Trajectories towards the euro and the role of ERM II", in Gertrude Tumpel-Gugerell and Peter Mooslechner (eds), *Structural Challenges for Europe*, Edward Elgar, pp 405–12.

Pauwels, L and Z Zhang (2008): "How flexible is the labour market in Hong Kong? Some statistical observations", *HKMA Research Note*, no 04/2008, September.

Romanov, D (2003): "The real exchange rate and the Balassa-Samuelson hypothesis: an appraisal of Israel's case since 1986", *Bank of Israel Discussion Paper*, no 2003.09.

Samuelson, P (1964): "Theoretical notes on trade problems", *Review of Economics and Statistics*, vol 46.

Tovar, C (2008): "DSGE models and central banks", *BIS Working Papers*, no 258.

Világi, B (2004): "Dual inflation and real exchange rate in new open economy macroeconomics", *MNB Working Paper*, no 2004/5.

Waiquamdee, A, P Sutthasri and S Tanboon (2009): "Monetary policy and underlying inflation pressures: the essence of monetary policy design", *Bank of Thailand Discussion Paper*, no 01/2009, February.