

2.1 Labour Market Conditions

Strong Job Creation amid Labour Supply Constraints

Total employment continued to expand at a robust pace in H1 2013, notwithstanding the tighter foreign labour policy and more modest increase in resident population. The domestic-oriented services and construction sectors led overall job growth, even as a recovery in the external-facing sectors added to labour demand. Despite the increase in resident labour force participation, labour market conditions remained tight and wage growth rose.

Domestic-oriented sectors continued to account for the bulk of job creation.

In line with stronger economic growth, 62,600 workers were added to the workforce in H1 2013 compared to 58,900 in H1 2012. (Chart 2.1) The faster job creation came on the back of sustained demand for workers in the domestic-oriented sectors, which accounted for almost nine in ten of the net job gains in H1 2013, the highest since H1 2009. (Chart 2.2)

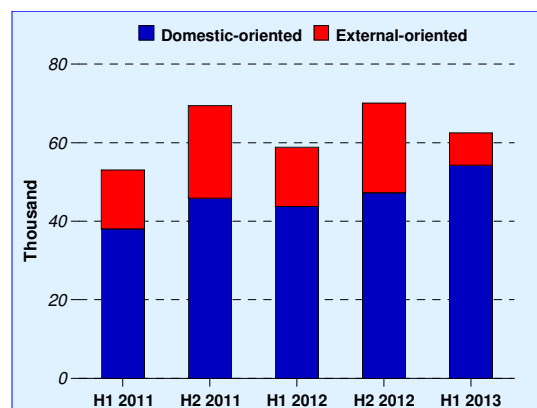
Construction employment gains remained high in H1 2013 due to the pickup in private residential building activity and ongoing public infrastructure development. Hiring also continued to be robust in administrative & support and community, social & personal services. The latter was likely spurred by the ongoing expansion of childcare centres and tertiary education institutes, as well as healthcare and social support facilities.

Meanwhile, ancillary services such as the information & communications and professional services benefited from the broadening of economic growth to the external-oriented industries.

Hiring in some external-oriented sectors also turned around.

In the manufacturing sector, hiring in the electronics industry rose slightly in Q2 2013 after nine consecutive quarters of job cuts. (Chart 2.3) The related upstream machinery & equipment segment followed by adding modestly to headcount after job losses in the preceding two quarters. The transport equipment industry meanwhile posted strong employment gains, likely

Chart 2.1
Share of Employment Changes by Sector



Note: The external-oriented sectors comprise manufacturing, wholesale & retail trade, transportation & storage, financial & insurance services and accommodation.

Chart 2.2
Employment Changes by Sector

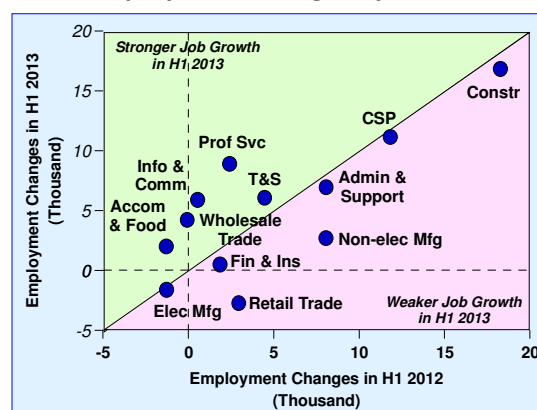
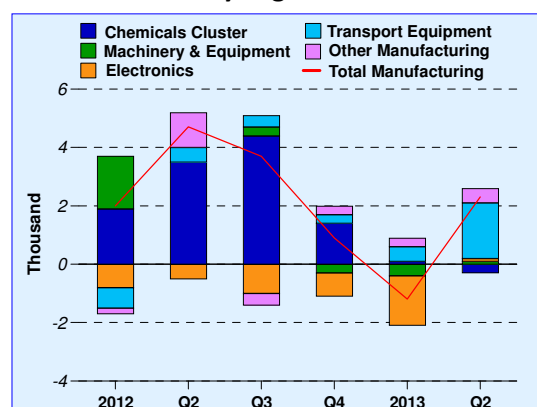


Chart 2.3
Manufacturing Employment Changes by Segment



accounted for by the opening of a new shipyard.

The stronger hiring in these segments more than offset the shedding of workers in the chemicals cluster following the completion of expansion works at a major petrochemical plant. On the whole, headcount in the manufacturing sector expanded by 2,300 in Q2 2013, after falling by 1,200 in Q1. The pickup in manufacturing activity in turn had a positive spillover effect on job growth in the trade-related transportation & storage and wholesale trade segments.

In comparison, headcount expansion continued to slow in financial & insurance services in tandem with some restructuring in the sector. Despite the surge in financial services activity in H1, the segment registered one of the highest number of redundancies across the economy in Q2 2013, owing to manpower re-organisation within firms.

Tighter foreign worker policy led to a shift from non-resident to resident workers ...

The contribution of foreign workers to total employment growth slowed in H1 2013, as foreign labour policies became more binding. (Chart 2.4) Notably, the number of Work Permit Holders (WPH) rose by only 18,500 in H1 2013 compared to 43,500 for the whole of 2012, while the inflow of S Pass Holders (SPH) moderated to 11,700 in H1 from 28,500 in 2012. At the same time, the number of Employment Pass Holders (EPH) fell by 1,700 in the first six months of the year, extending the decline of 1,600 in 2012.

The slower inflow of WPHs and SPHs reflected the further restrictions placed on their hiring in H2 2012 and 2013, while the fall in EPHs can be attributed to the raising of the minimum qualifying salary from January 2012. In the construction industry, for example, contracts awarded after June 2012 had to meet new rules where Man-Year Entitlements were significantly reduced, while levies for WPHs—on whom the sector is heavily reliant—were hiked again in January 2013.

Similarly, the services sector saw higher foreign worker levies for WPHs and SPHs, as well as cuts in the Dependency Ratio Ceilings that began in July 2013.

Chart 2.4
Local and Foreign Share of Employment Changes

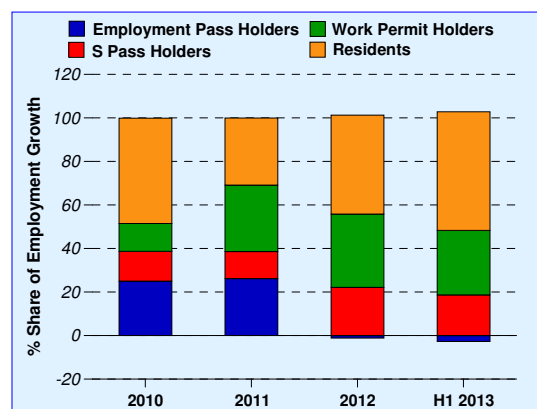


Chart 2.5
Resident Labour Force Participation Rate and Resident Population Change

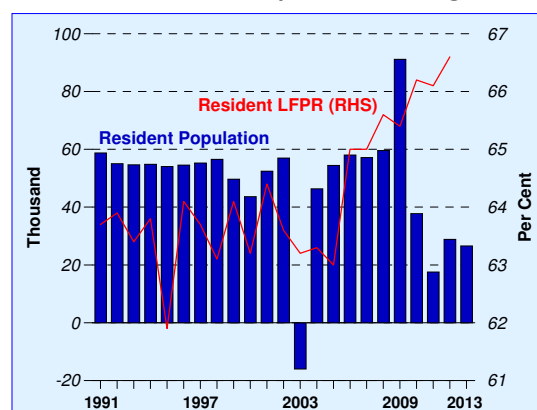
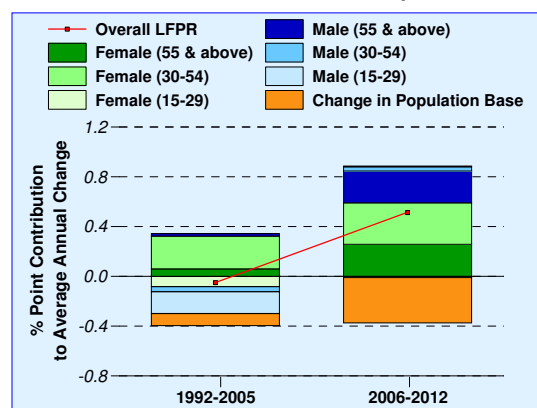


Chart 2.6
Decomposition of Average Annual Change in Resident Labour Force Participation Rate



Source: EPG, MAS estimates

... increasing the resident labour force participation rate ...

Labour demand was thus increasingly met by resident workers who accounted for approximately 55% of overall job gains in H1 2013, compared to 45% in 2012 and 31% in 2011. (Chart 2.4) Taking into account the slower pace of resident population growth and strong gains in resident employment, the resident labour force participation rate (LFPR) is estimated to have risen to a new high of over 67% in 2013. (Chart 2.5) As in recent years, most of the increase in the resident LFPR likely came from women and older residents. As these groups of workers tend to prefer flexible working arrangements and shorter working hours, they were unlikely to have fully offset the constraints in foreign labour supply. (Chart 2.6)

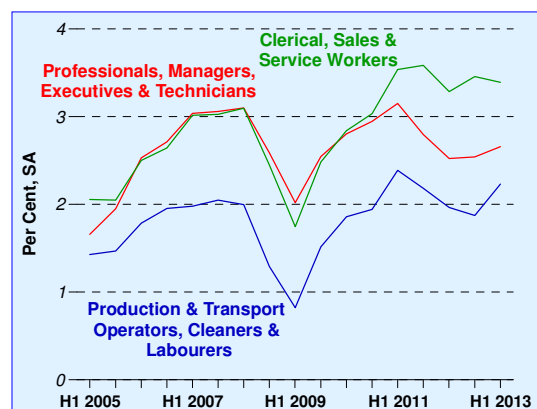
... and supporting the rise in vacancy rates.

Consequently, the seasonally adjusted overall job vacancy rate rose to 2.7% in H1 2013 compared to 2.5% in H2 2012. In particular, the vacancy rates of PMETs, production & transport operators and cleaners & labourers ticked up slightly in H1 2013 on the back of the recovery in the external-oriented and ancillary services industries. (Chart 2.7) Vacancy rates had generally been weak for these groups of workers over the last two years relative to that of clerical, sales & service workers as robust hiring in the domestic-oriented sectors had mainly benefited the latter.

The labour market remained tight and resident wages grew firmly.

Reflecting the broadening of labour demand, resident wage growth on a year-ago basis picked up across most sectors of the economy in H1 2013 compared to the preceding six months. (Chart 2.8) Overall, resident wage growth accelerated to 4.5% y-o-y in H1 2013 from 2.3% in 2012. This was largely consistent with the resident unemployment rate which remained low at around 3.0% in H1 2013. (Chart 2.9)

Chart 2.7
Vacancy Rates by Occupation



Source: EPG, MAS estimates

Chart 2.8
Resident Wage Growth by Sector

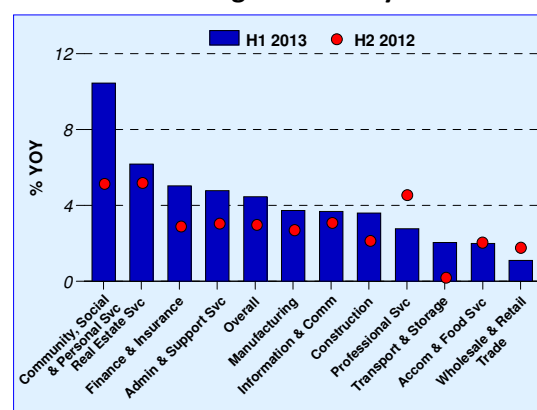
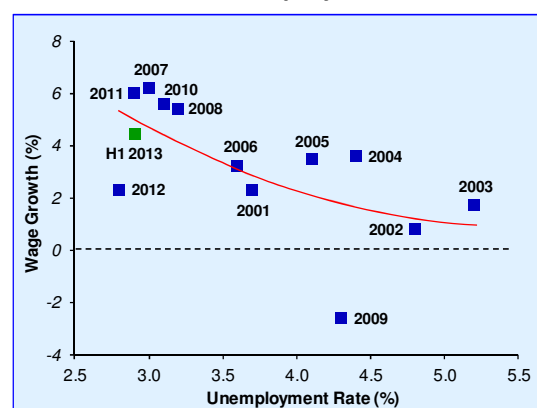


Chart 2.9
Resident Wage Growth & Resident Unemployment Rate



Nonetheless, effective wage pressures are possibly slightly stronger than that implied by the headline wage growth, given the rising prevalence of part-time employment and hence the trend decline in the number of hours worked by residents. (Chart 2.10) Indeed, based on the latest available data¹, the 0.7% fall in average hours worked by residents in 2012 meant that resident wage growth, on a per hour basis, was somewhat higher at 3.0% last year.

**Weak labour productivity kept
unit labour costs high.**

Overall labour productivity remained weak in H1 2013 even as wage growth accelerated. (Chart 2.11) After taking into account the slight decline in total hours worked, labour productivity, as measured by output per hour worked, fell further in Q1 this year before improving in Q2 largely on account of the surge in GDP. Nonetheless, productivity growth was relatively lacklustre across most sectors, although services productivity appeared to be on a mild uptrend.

Coupled with the strong wage growth and foreign worker levy increases, unit labour costs (ULC) rose further by 3.9% y-o-y in Q2 2013, following the 8.5% increase in Q1.

Chart 2.10
**Average Usual Hours Worked
by Employed Residents**

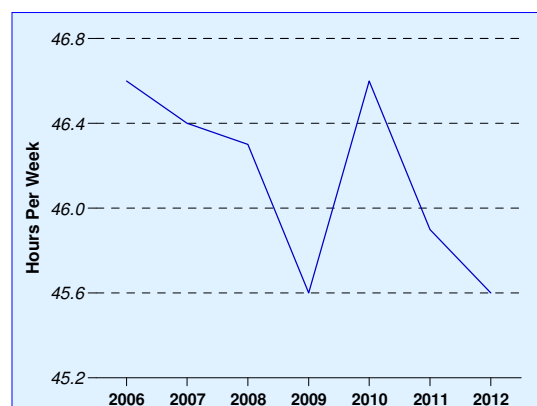
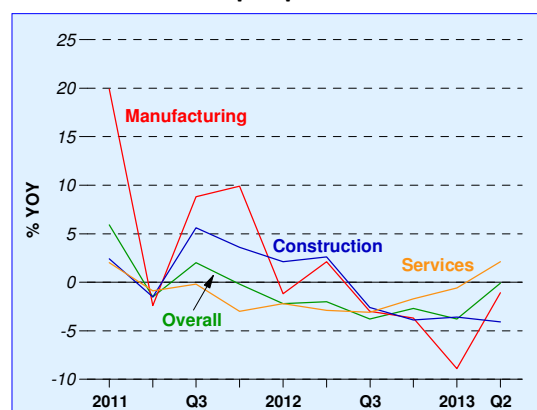


Chart 2.11
Growth in Output per Hour Worked



Source: EPG, MAS estimates

¹ Data on hours worked by residents are required to adjust resident wage growth and they are available only on an annual basis since 2006. Total hours worked by all workers are available on a quarterly basis and are used to compute value added per worker in the next section.

2.2 Consumer Price Developments

Core Inflation Picked Up in Q3 after Moderating for More than a Year

Core inflation moderated for five consecutive quarters ...

Core inflation was modest in recent quarters on account of benign cyclical factors. Except for the recent rise in oil prices, external price pressures were muted. Domestic cost pass-through to consumer prices was also generally contained, owing to subdued economic sentiment.

MAS Core Inflation, which excludes the costs of accommodation and private road transport, moderated for five straight quarters, from a multi-year peak of 3.1% y-o-y in Q1 2012 to 1.6% in Q2 2013. (Chart 2.12)

CPI-All Items inflation fell to 1.6% y-o-y in Q2 2013 from 4.0% in the preceding two quarters, largely reflecting the sharp correction in car prices following the tightening of the motor vehicle financing policy² as well as the easing of underlying price pressures in the economy. (Charts 2.12 and 2.13)

On a sequential basis, core inflation was modest from Q2 2012 to Q2 2013, staying below its ten-year historical average. (Chart 2.14) CPI-All Items inflation was volatile, hitting -1.2% q-o-q in Q2 after averaging 1% over the past four quarters.

... but picked up slightly in Q3 2013.

However, MAS Core Inflation inched up to 1.7% y-o-y in Q3, as businesses passed on more of their cumulative cost increases to consumers alongside an improvement in economic conditions. Likewise, CPI-All Items inflation rose to 1.8% in Q3 due to a smaller drag from car prices. (Charts 2.12 and 2.13)

Sequentially, MAS Core Inflation reverted to its historical average in Q3, while the overall CPI surged. (Chart 2.14)

Box B at the end of this chapter examines the inflation dynamics in Singapore using the open economy New Keynesian Phillips Curve.

Chart 2.12
CPI-All Items and MAS Core Inflation

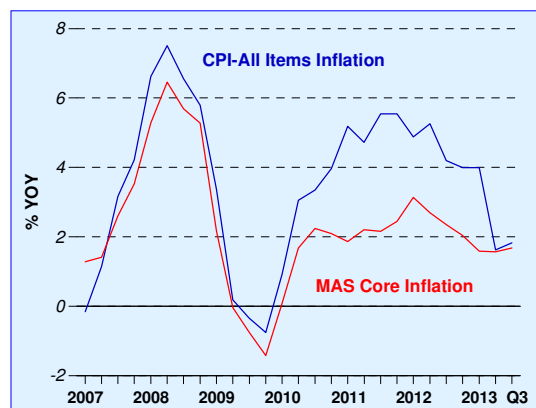


Chart 2.13
Contribution to CPI-All Items Inflation

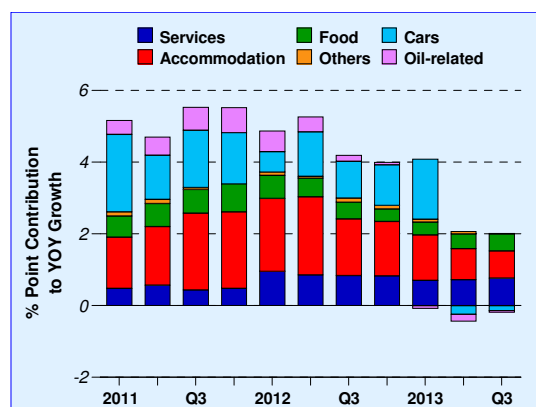
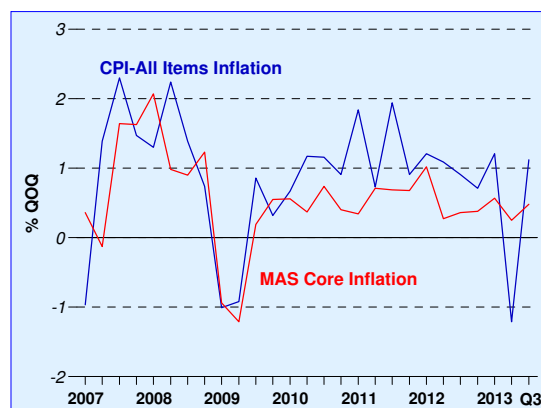


Chart 2.14
Sequential CPI-All Items
and MAS Core Inflation



² In February 2013, MAS put in place restrictions to limit car loans to no more than 60% of the vehicle's purchase price and the repayment period to no more than five years.

The proportion of CPI items with stronger inflation increased recently after moderating since 2012.

Apart from CPI-All Items and MAS Core Inflation, disaggregated CPI data also provide useful information about price changes in the economy. Specifically, EPG examined the distribution of the change in y-o-y inflation rates across the 184 categories of goods and services in the CPI. For each of these categories, we compared the inflation rate with a year ago and computed the difference, taking into account the category's weight in the CPI basket. The results are shown in Chart 2.15. Goods and services that experienced higher (lower) inflation in a particular quarter compared to a year ago are depicted above (below) the zero line for that quarter.

The 10th, 25th, 75th and 90th percentiles, as well as the median changes in inflation rates for each quarter, are plotted. The results show that inflationary forces in the economy have become less widespread since early 2012, given that a larger proportion of the shaded areas—represented by the different percentiles—fall below the zero line. However, consistent with the pickup in CPI-All Items and MAS Core Inflation, the disaggregated data show that inflationary pressures have started to build in the more recent period. Indeed, the proportion of the CPI basket that experienced a rise in inflation compared to a year ago increased from 25% in H1 2013 to 36% in Q3 2013.

External inflationary pressures remained broadly subdued.

External price developments have been benign since the previous *Review*. Wholesale prices in Singapore's major trading partners were largely flat as the moderation in GDP growth kept prices stable in Asia, while the slack in the labour market constrained price increases in the developed economies.

At the same time, prices of industrial materials were depressed by weaker demand from China and other emerging economies. (Chart 2.16) Global food prices also fell in recent months on account of growing optimism over this year's crop harvests in the US. Energy prices were the main exception, having increased by around 10% since end-May 2013, amid geopolitical tensions in the Middle East

Chart 2.15
Distribution of Changes in CPI Inflation Rates Compared to a Year Ago

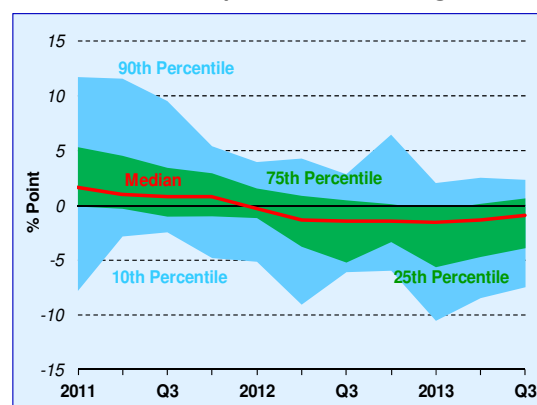
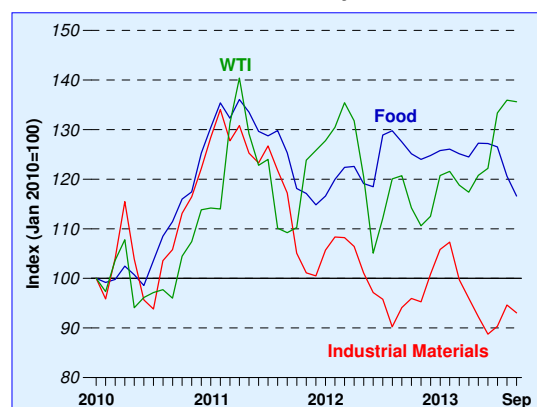


Chart 2.16
Global Commodity Prices



Source: EIA, IMF

and a spate of production outages.³

Domestic fuel costs rose in line with global oil prices, while food inflation was driven up by higher business costs.

Given benign external price developments, Singapore's non-oil imported inflation was generally muted, at 0.1% q-o-q in Q3. The increase in non-oil import prices largely reflects the pass-through of the earlier spike in global food prices in the second half of 2012 and the S\$ depreciation against the US\$ on expectations of an imminent tapering of asset purchases by the Federal Reserve. Overall import prices, however, rose by a more significant 1.5% q-o-q in Q3 due to the surge in global oil prices. (Chart 2.17)

In tandem with import prices, domestic retail prices of oil-related items increased by 1.0% q-o-q in Q3, after falling by 1.3% in the preceding quarter. Retail food price inflation also picked up to 0.7% q-o-q in Q3, from 0.2% in Q2. Apart from costlier raw materials, the rise in food inflation likely reflects the stronger pass-through of domestic business costs. Notably, prepared meals, which have a higher domestic cost component than non-cooked food items, experienced relatively higher inflation. Prices of prepared meals also rose at a faster pace in Q3 2013 compared to their historical trend. (Chart 2.18)

Domestic cost pressures continued to mount, given rising wages ...

Domestic cost pressures persisted, largely as a result of the tight labour market. In particular, in light of the more restrictive foreign worker policy, firms have increasingly turned to resident workers to fill job vacancies. Consequently, the resident unemployment rate remained low, supporting wage growth of 4.5% y-o-y in H1 2013, considerably higher than the historical average of 3.3%. The strong wage increments in turn kept ULC high. Notwithstanding a fall in Q2 this year on account of the strong but one-off cyclical uptick in productivity, ULC has risen sharply over the past few years and added to business cost pressures. (Chart 2.19)

Chart 2.17
Sequential Import Price Inflation and Contribution from Mineral Fuels

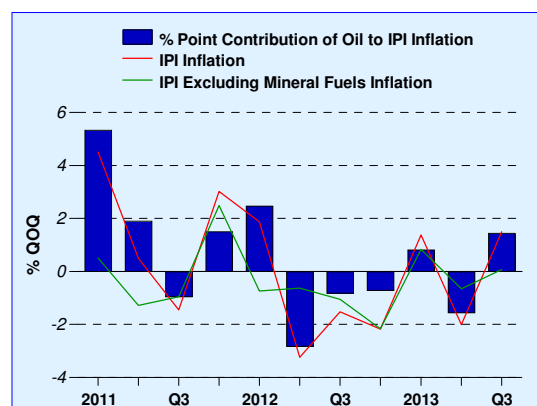


Chart 2.18
Sequential Growth in Consumer Food Prices

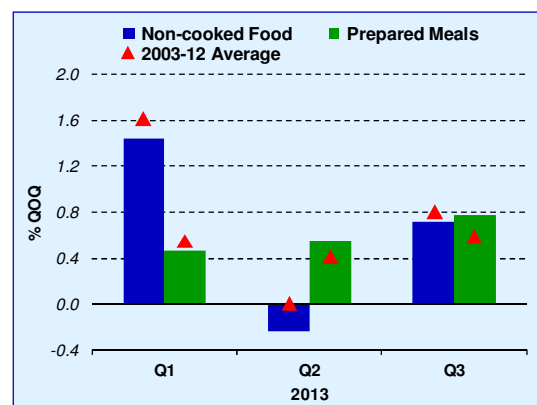


Chart 2.19
Unit Labour Cost Index



³ The US Energy Information Administration estimated that in August, unplanned disruptions reached 2.7 million barrels per day, or 3% of global oil demand, the highest level since January 2011 during the outbreak of the Libyan civil war. The latest disruptions mainly arose from the oil theft in Nigeria, the militia labour strikes in Libya and the disputes between South Sudan and Sudan.

... elevated commercial rentals ...

Meanwhile, despite office and retail space rentals remaining broadly stable as new supply came on-stream, firms that recently renewed their leases likely faced an increase in rental cost compared to what was paid under previous contracts signed three years ago. (Chart 2.20)

... and higher COE premiums for commercial vehicles.

Businesses which had to renew or bid for new commercial vehicle (Category C) COEs also continued to face higher costs. Premiums for Category C COEs have risen sharply from 2011, reaching a record high of \$76,000 in October 2013, despite a 38% increase in quota since the beginning of the year. (Chart 2.21) This was driven by sharply higher demand for commercial vehicles, possibly underpinned by strong construction activity, a mandatory replacement of a large number of vehicles purchased twenty years ago and the rush to acquire less costly models before they are phased out by stricter environmental regulations.

Pass-through of costs to consumer prices increased recently after staying sluggish over the past year.

Until recently, lacklustre GDP growth constrained firms' ability to pass on cost increases, resulting in a decline in firms' cost mark-ups. (Chart 2.22) However, there have been recent signs of a pickup in cost pass-through, though this was not uniform across industries. Reflecting differences in cost pass-through, current price adjustments relative to historical trend were weak for sentiment-sensitive items such as retail goods, but were stronger for consumer services, including education and holiday travel. (Charts 2.23a and 2.23b)

Chart 2.20
Commercial Property Rentals

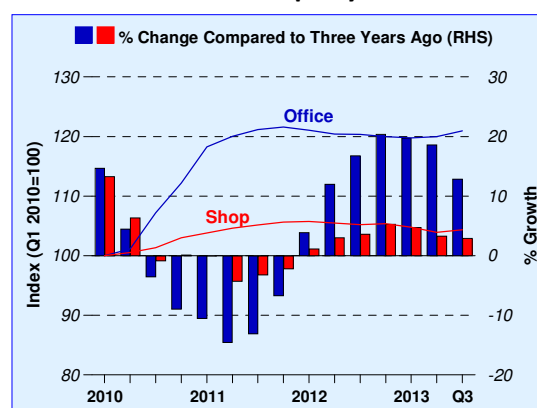


Chart 2.21
Category C COE Premiums and
Monthly COE Supply

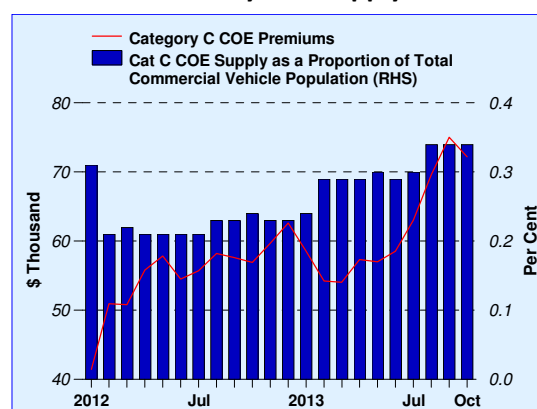
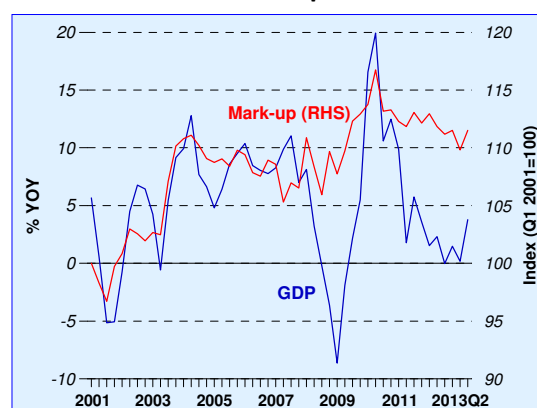


Chart 2.22
GDP Growth and Mark-up Coefficient Index⁴



⁴ The firms' mark-up coefficient is proxied by MAS Core Inflation/Weighted Import & Unit Labour Costs. Weights were derived using the cost structure breakdown of various sectors that cater to final private consumption expenditure in the 2007 Input-Output tables.

For non-core CPI items, imputed rental inflation continued to slow ...

The increase in imputed rentals eased following some stabilisation in the public and private residential rental markets.⁵ HDB flat rentals rose at a slower pace compared to the past three years as leasing demand moderated alongside slower foreign labour inflows and immigration. Market rentals for private residential units were broadly flat in 2013 after rising over the three preceding years, as a significant supply of residential units came on-stream.

Overall, imputed rentals contributed 0.7% point to CPI-All Items inflation in Q3, down from 1.1% points in Q1 this year.

... while COE premiums for cars have been on the rise.

COE premiums for cars have been on the rise in recent months and are now close to 30% higher compared to that during the April Review. (Chart 2.24) As a result, on a year-ago basis, private road transport cost contributed negligibly to overall inflation in Q3 this year, compared to the -0.3% point in Q2. New car demand remained relatively firm in recent months, partly due to policy uncertainties surrounding COEs, as buyers sought to lock in their purchases before any changes are implemented.

Together, accommodation cost and car prices accounted for slightly more than a third of CPI-All Items inflation in the last two quarters, down from more than 60% last year.

Chart 2.23(a)
Price Movements of Retail Goods

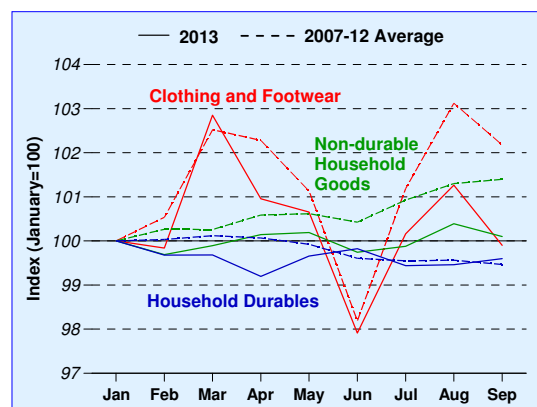


Chart 2.23(b)
Price Movements of Selected CPI Items

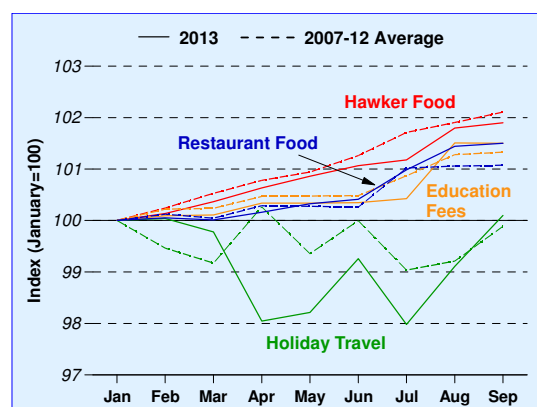
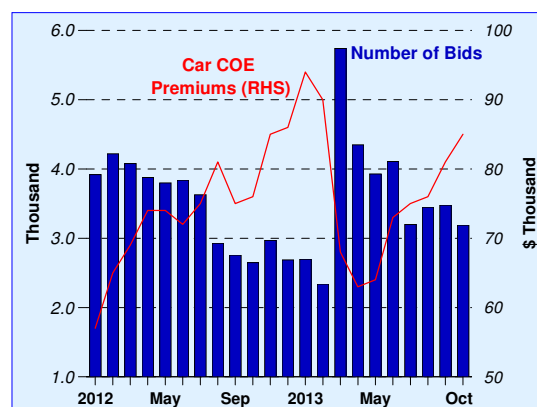


Chart 2.24
Car COE Premiums and
Number of Bids Submitted



⁵ Imputed rentals on owner-occupied accommodation in the CPI are measured using the average rentals of the entire stock of lease properties including new and renewed leases signed during the period and existing leases signed earlier. This is unlike rental indices published by URA and HDB which only track rentals of new and renewed rental contracts that were signed during the reporting period.

Box B

A New Keynesian Phillips Curve for Singapore^{1/}

The relationship between inflation and measures of economic activity has been at the core of monetary analysis and policy since Phillips' seminal contribution in 1958. Phillips (1958) examined the relationship between wage inflation and unemployment in the UK over the period 1861–1957 and found a significantly negative relation between the two variables. Similar results were also obtained in other countries even when alternative measures of inflation were used. Since then, various versions of the Phillips Curve have appeared as theoretical and empirical challenges to the original formulation, but continue to uphold the fundamental relationship between economic activity and inflation. In this box, the evolution of the Phillips Curve to its now widely used form as the New Keynesian Phillips Curve (NKPC) is outlined, following which a reduced-form version for Singapore is estimated. The results unequivocally show that inflation dynamics are forward-looking in Singapore and broadly similar to other open economies.

From Phillips Curve to New Keynesian Phillips Curve

Phillips' work was initially interpreted as presenting policymakers with a permanent choice between price (or wage) inflation and the level of economic activity. However, this conflicted with the notion of long-run monetary neutrality, which Edmund Phelps (1968) and Milton Friedman (1968) later argued was due to the absence of expectations in the Phillips Curve. They stressed that anticipated changes in inflation would have no impact on economic activity, and that only unanticipated changes in inflation would be able to generate a trade-off between inflation and economic activity. This subsequently led to the formulation of the expectations-augmented Phillips Curve, with the inflation-unemployment trade-off being confined to the short-run.

Despite its reformulation, the Phillips Curve fell from grace in the late 1970s, particularly among the academic community. This period of stagflation was interpreted as evidence against the Phillips Curve trade-off, and the onslaught of the rational expectations revolution led by Lucas (1972) and Sargent and Wallace (1975) provided further theoretical reasoning against it. If the expectations of economic agents were rational, in the sense that their forecasts of the economy were derived from a robust understanding of the economy and economic policy, and that they do not make systematic forecasting errors, policymakers would be unable to create unanticipated inflation systematically, thereby leaving little room for monetary policy to steer the economy. However, the rapid adjustment of the price level predicted under rational expectations stood in contrast to the observed smooth evolution of the price level. It was the early contributions of Calvo (1983), Rotemberg (1982), and Taylor (1980) to overcome this tension that ultimately led to the revival of the Phillips Curve. By the late 1990s, the New Keynesian paradigm had emerged as the predominant monetary framework. This approach was derived from microeconomic principles and incorporated the lessons from rational expectations theory, but also allowed for a trade-off between inflation and economic activity (typically measured by the output gap) in the short run.

The (Hybrid) New Keynesian Phillips Curve

In its simplest form, the NKPC states that inflation in time t , π_t , depends positively on the output gap, x_t , and expected inflation, $E_t\pi_{t+1}$. While the traditional Phillips Curve assumed that inflation expectations are entirely backward-looking, in even the simplest formulation of the NKPC, inflation expectations are purely forward-looking. This makes empirical validation of the NKPC challenging, since this specification solves out inflation as a function of the current and all expected future output gaps, posing difficulties for estimation.^{2/}

^{1/} This box was prepared in collaboration with Martin Bodenstein, Associate Professor at the NUS Department of Economics.

^{2/} With inflation lags absent from this specification, persistence in inflation is solely determined by the persistence in the output gap. The model also implies that inflation leads the output gap over the business cycle. Data, however, contradicts these features, causing empirical estimation of the purely forward-looking NKPC to be difficult.

To overcome these difficulties, Fuhrer and Moore (1995) and Galí and Gertler (1999) advocate augmenting the NKPC with features that would reintroduce lags of inflation. Assuming that some economic agents follow “rules of thumb” rather than exhibiting full rationality, Galí and Gertler (1999) proposed a hybrid NKPC. They found, however, that the hybrid NKPC was sensitive to the output gap measures used. Accordingly, they reformulated their model, substituting out the output gap with real marginal costs, and augmenting it further with measures of marginal costs to yield the following specification:

$$\pi_t = \lambda_f E_t \pi_{t+1} + \lambda_b \pi_{t-1} + \lambda_{mc} \widehat{mc}_t \quad (1)$$

where $\widehat{mc}_t$ measures the deviation of marginal costs from its long-run trend. In models of this nature, the labour income share in GDP is often used to proxy marginal costs, and inflation is usually defined in terms of the GDP deflator.

Estimating the Hybrid NKPC for Singapore

Studies by Balakrishnan and Lopez-Salido (2002), and Batini *et al.* (2005), however, show that the hybrid models of Galí and Gertler (1999) tend to produce parameter estimates that were inconsistent with New Keynesian theory when aspects of the open economy are ignored. They argue that the labour share of income, used to proxy marginal cost in a closed economy, was not tenable in an open economy context, since it does not account for the potentially large impact of imported intermediate goods on domestic inflation dynamics. To address these issues, Leith and Malley (2007) developed a framework in which marginal cost is allowed to respond to the relative wage (domestic wage relative to import price) and the terms of trade (domestic price relative to import price), in addition to labour share and aggregate output in the closed economy case. The relative wage and terms of trade variables encapsulate a model of price setting behaviour that allows firms to substitute imported intermediate goods for domestic labour in production and to sell their products in both home and foreign markets. As in the closed economy case, the labour share is modelled as a measure of marginal cost, together with aggregate output. Altogether, the four terms constitute a more appropriate proxy for marginal cost in an open economy setting.

The hybrid NKPC specification that is estimated for Singapore is modelled in the spirit of the Leith and Malley (2007) study. Notably, equation (2) below specifies the form of the NKPC for Singapore, with y-o-y CPI-All Items inflation, π_t , regressed against its expected value in the next period, its lagged value, and the separate components of real marginal costs, which include the labour income share in GDP, $\hat{s}_t$, the ratio of the CPI to the import price index, $\widehat{tot}_t$, aggregate output, $\hat{y}_t$, and the domestic wage relative to the import price index, $\hat{w}_t$.^{3/}

$$\pi_t = \lambda_f E_t \pi_{t+1} + \lambda_b \pi_{t-1} + \lambda_1 \hat{s}_t + \lambda_2 \widehat{tot}_t + \lambda_3 \hat{y}_t + \lambda_4 \hat{w}_t \quad (2)$$

Estimation Results

Table B1 presents the estimation results for three different regression models. The first model M1 reports the results when marginal cost comprises only the labour share of income in nominal GDP, which is closest in form to the Galí and Gertler (1999) specification. The remaining model specifications (M2 and M3) add the other components of marginal costs sequentially. Generalised Method of Moments (GMM) is used to estimate the equations for Singapore over the sample period from Q1 1994 to Q1 2013, using four lags of aggregate output and global commodity inflation as instruments.

^{3/} All hatted-variables enter into the model as deviations from their respective HP-filtered trends while inflation enters as a deviation from its long-run mean.

Table B1
Main Estimation Results
Dependent Variable: CPI-All Items Inflation

	M1	M2	M3
$E_t\pi_{t+1}$	0.82*** (0.09)	0.84*** (0.10)	0.65*** (0.21)
π_{t-1}	0.27*** (0.10)	0.27** (0.11)	0.33** (0.14)
$\hat{s}_t$	0.08** (0.03)	0.08** (0.04)	0.18*** (0.06)
$\widehat{\tau\hat{o}t}_t$		0.02 (0.06)	0.18 (0.14)
$\hat{y}_t$			0.18** (0.08)
$\hat{w}_t$			-0.18* (0.11)
Adjusted R²	0.917	0.913	0.905

Note: Standard errors in parentheses.

* Statistically significant at the 10% level.

** Statistically significant at the 5% level.

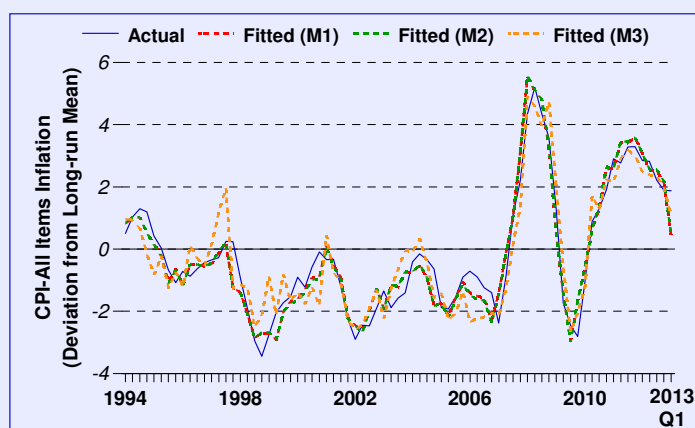
*** Statistically significant at the 1% level.

The results show that both forward- and backward-looking inflation expectations have a significant role in driving inflation dynamics in Singapore. The coefficient on $E_t\pi_{t+1}$ in particular is highly significant in all three regression models, exceeding the coefficient on π_{t-1} by at least two times in all cases. Interestingly, the results also highlight the importance of adopting the appropriate hybrid NKPC model for an open economy like Singapore. In M1, when a closed economy specification is adopted, forward-looking inflation is found to have a much larger role in determining inflation dynamics relative to backward-looking inflation. However, M3 shows that when the hybrid NKPC model controls for aspects of the open economy through $\widehat{\tau\hat{o}t}_t$ and $\hat{w}_t$, the relative importance of forward-looking inflation expectations falls to a level that is more consistent with the experience in other countries. The $\widehat{\tau\hat{o}t}_t$ term in M3 is positive and is economically meaningful relative to the other components of marginal cost, even though it is not statistically significant. Compared to M2, the coefficient on the $\widehat{\tau\hat{o}t}_t$ term is higher in M3, reflecting the importance of accounting not just for trade in final goods, but also in intermediate goods.^{4/} Moreover, the component variables of marginal cost are jointly statistically significant in M3, indicating the consistency of these results with the framework in Leith and Malley (2007).

Chart B1, which plots the fitted values for inflation from the three models together with actual inflation, shows that the NKPC framework captures inflation dynamics in Singapore well. Interestingly, the hybrid NKPC model can be rewritten to express inflation as the sum of discounted expected marginal costs. The strong influence of expectations, therefore, indicates that agents systematically take into account anticipated changes to marginal costs. Notably, if the marginal cost changes are persistent, the sum of discounted expected marginal costs more than outweighs contemporaneous movements in marginal costs. Invariably, this highlights the role of expectations in driving inflation, and thus the need for monetary policy to provide a nominal anchor in managing inflation expectations.

^{4/} The $\widehat{\tau\hat{o}t}_t$ variable captures trade in final goods using the relative prices of domestic goods to foreign goods, while the $\hat{w}_t$ variable measures trade in intermediate goods which can be substituted for labour in production.

Chart B1
Actual and Fitted Inflation



Sum-up: Modelling Inflation at MAS

The above results show that the New Keynesian framework is useful in analysing inflation dynamics in Singapore. Two of MAS' macroeconomic models adopt some form of the NKPC. For instance, the Monetary Model of Singapore (MMS)^{5/} has a wage equation that features an inflation expectations-augmented Phillips curve in which expected inflation is one of the key drivers of nominal wage growth. The Satellite Model of Singapore (SMS)^{6/}, in comparison, incorporates a hybrid NKPC equation directly within its framework. In the SMS, current inflation is driven by expected and lagged inflation, the output gap, and changes in the real exchange rate. Inflation expectations are model-consistent, resulting in an inflation process that is forward-looking, while the lagged inflation term is used to capture inflation inertia. The NKPC formulations in the MMS and SMS are fully integrated within the whole economy model specification, thereby providing a consistent approach to modelling inflation dynamics in the Singapore economy.

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^{5/} For further details on the MMS, see Special Feature A of the October 2007 *Review*.

^{6/} An overview of the SMS can be found in Special Feature A of the October 2011 *Review*.

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