

How has globalisation affected inflation dynamics in the United Kingdom?

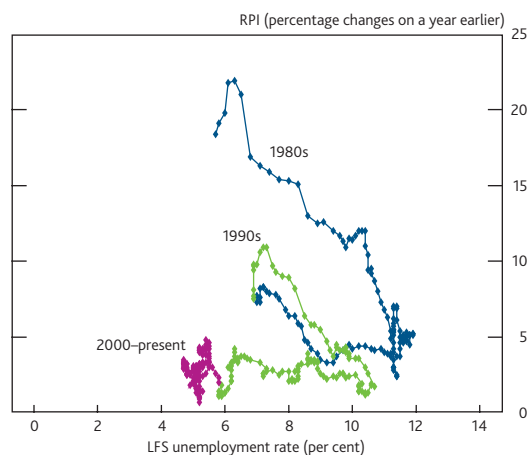
By Jennifer Greenslade and Stephen Millard of the Bank's Structural Economic Analysis Division and Chris Peacock of the Bank's International Finance Division.

This article discusses how globalisation may influence the way inflation moves over the business cycle in the United Kingdom. Globalisation may do this by affecting how costs respond to changes in economic activity in the United Kingdom or by affecting how inflation responds to changes in costs. Some evidence is presented that suggests globalisation may have led to an increase in the importance of import prices relative to domestic economic activity in explaining changes in firms' costs. But, once this has been taken into account, the response of inflation to movements in costs does not appear to have changed over recent years. This suggests it is increasingly important to understand what drives movements in import prices, particularly given the rapid rise in global food and energy prices over the past year.

Introduction

Although inflation in the long run is ultimately determined by domestic monetary policy, globalisation — the progressive integration of more countries into international trade and financial markets — may affect how inflation moves over the business cycle: in particular, the response of inflation to changes in demand relative to supply. Since the effect of such changes on inflation is an important part of the monetary transmission mechanism, it is important for central banks to understand how globalisation affects this. A simple way to look at the short-run relationship between demand and inflation is to plot inflation and unemployment data, since unemployment will be high when demand is low and *vice versa*. In the 1980s and early 1990s, there was a stable negative relationship between inflation and unemployment, in other words, lower unemployment was associated with higher inflation. **Chart 1** shows that there has been an apparent flattening in this relationship in the United Kingdom since the mid-1990s so that lower unemployment has not generally been associated with higher inflation. However, such a picture can be misleading as it does not allow for changes in monetary policy regimes, changes in the natural rate of unemployment or exchange rate and import price developments. It also conflates two distinct, structural, aspects: the link from fluctuations in economic activity to firms' costs of production and the link from costs to inflation. Globalisation may affect either or both of these links.

Chart 1 Retail prices index (RPI) inflation and LFS unemployment, 1980–2008



This article examines how globalisation might have affected each of these links. The analysis uses a structural framework, since this better identifies which underlying economic mechanisms are driving the relationship between economic activity and inflation. The first section explains how globalisation can have different effects on the response of costs to changes in activity and on the response of inflation to changes in costs. The second section looks at some empirical work on the response of inflation to changes in costs. It investigates whether import prices, by affecting firms' costs of production, help to explain short-run movements in inflation. The results suggest that accounting properly for import prices

in firms' costs leads to a model that can better explain UK inflation and that failing to do so leads to misleading inferences about the effect of movements in costs on inflation. Given this, the article also investigates whether the contribution of import prices has increased as the pace of globalisation has intensified, in which case it becomes even more important to account properly for the role of import prices in costs when examining the links between demand, costs and inflation. The article concludes with a brief discussion of the implications of these results for monetary policy.

A framework for thinking about the effects of globalisation

Given that firms may only set their prices infrequently, when they do reset them they will do so with regard to what they expect to happen to their competitors' prices until they reset their prices again, as well as their costs. This idea is captured for the economy as a whole in the structural 'New Keynesian Phillips Curve' (NKPC) in which inflation today depends on expected future inflation and real marginal cost (the cost of producing an extra unit of output divided by its price):

$$\pi_t = \beta E_t \pi_{t+1} + \lambda \hat{\mu}_t \quad (1)$$

where π is the inflation rate, $E_t \pi_{t+1}$ denotes the expectation formed at time t of inflation at time $t+1$, $\hat{\mu}$ denotes the deviation of real marginal cost from trend, λ denotes the slope of the NKPC (in other words, the response of inflation to changes in costs) and β is the rate at which people discount the future (a number close to one). The derivation of this relationship is described in more detail in the annex. In the NKPC, globalisation can affect inflation dynamics by affecting the response of real marginal cost, $\hat{\mu}$, to economic activity, or by affecting the response of inflation to movements in real marginal cost, ie the slope of the NKPC. So, to understand the effects of globalisation on the transmission of movements in demand to movements in inflation — a key part of the monetary transmission mechanism — it is important to consider each of these links in the mechanism. In particular, failing to allow adequately for the effect of current economic activity on real marginal cost, $\hat{\mu}$, could lead to misleading inferences about the slope of the NKPC, λ .

Effects of globalisation on the link between economic activity and real marginal costs

In an open economy such as the United Kingdom, firms import raw materials, energy and intermediate goods to use in the production of output. As discussed in the article by Bowen and Mayhew on pages 283–91, this means that movements in the price of these imported inputs will have an effect on the level of real marginal cost and could have a temporary effect on inflation, though the direction and

magnitude of these effects will depend on, for example, the responses of real income expectations and monetary policy.

In addition, if firms are more able to respond to increases in demand by using foreign inputs to increase output, then their real marginal cost will respond correspondingly less to increases in domestic demand, which are unlikely to have much effect on these foreign input costs. One mechanism is to use more foreign labour. Two important aspects of the recent period of globalisation have been an increase in migration — both actual migration and the potential ability of workers to migrate across borders — and in outsourcing, shifting parts of the production process abroad. These both make it easier for firms to employ foreign labour, either at home or abroad. As a result, they are both likely to reduce the response of real marginal costs in UK firms to increases in domestic demand since the potential ability of firms to employ migrants, or to outsource production to foreign workers, will lessen the increase in wages they would have to pay to attract more labour. In terms of the equation above, this would mean that a given movement in demand would have a smaller effect on $\hat{\mu}$.

Effects of globalisation on the response of inflation to movements in real marginal cost

Given the effects of different shocks on costs, a second question, then, is whether globalisation has any effect on the response of inflation to changes in real marginal cost, ie λ in the above equation. One aspect of the recent increase in globalisation has been its effect in increasing the competition that domestic firms face. Unfortunately, theory is ambiguous on how increased competition affects the response of inflation to movements in real marginal cost. On the one hand, increased competition will make firms more likely to review their prices regularly against their competitors, making the response of inflation to movements in real marginal cost more pronounced. On the other hand, increased competition may reduce the scope for firms to raise their prices in response to increases in their costs, for fear of losing market share. This would act to reduce the response of inflation to movements in real marginal cost.⁽¹⁾ So, whether increased competition raises or lowers the response of inflation to movements in costs is an empirical question. The next section presents some evidence on this.

Empirical evidence

Empirical work based on the structural NKPC approach described above is relatively recent and is still evolving. The literature has focused on the link between movements in real marginal cost and inflation, ie estimating λ , but has also highlighted the importance of correctly measuring marginal costs, in particular, accurately capturing the role of import

(1) For a detailed theoretical description of these arguments, see Khan (2004).

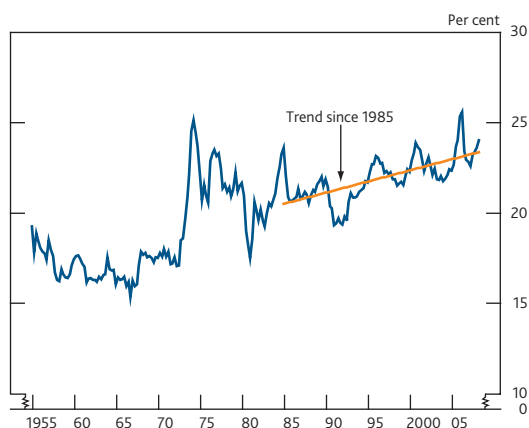
prices. This section provides an overview of the current state of knowledge. In particular, it focuses on models where firms substitute between imported inputs and labour when producing output. Recent research at the Bank using this framework has concentrated on two key questions: first, whether accounting for movements in import prices when measuring marginal cost has become more important as the pace of globalisation has quickened; and second, once marginal costs have been measured correctly, whether the slope of the NKPC, λ , has been affected by the recent quickening in the pace of globalisation.

Have movements in import prices become more important for explaining movements in marginal cost?

Given the framework described above, import prices will play an important role in explaining short-run movements in inflation if they have a significant effect on firms' marginal costs. In practice, marginal costs are hard to measure and any particular measure of firms' marginal costs depends crucially on the assumptions made about the way firms combine inputs, such as labour and imported goods.

As shown in Peacock and Baumann (2008), the weight of import prices in firms' marginal costs is broadly related to the share of the value of imports in gross output, where the latter is equal to gross domestic product plus the value of imported goods and services. That share has steadily risen in the United Kingdom, by around 2 percentage points since 1985 (Chart 2).

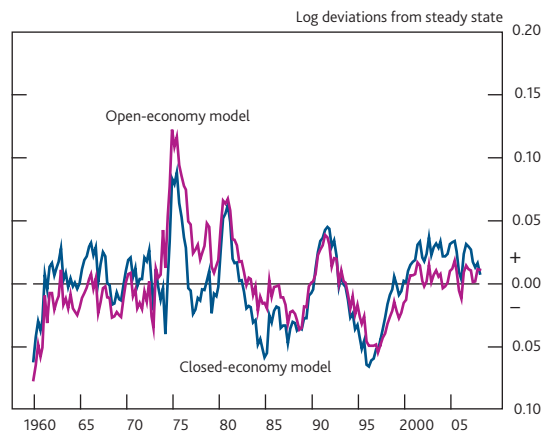
Chart 2 Import share of gross output



Sources: ONS and Bank calculations.

This suggests that movements in import prices may have become more important in explaining movements in marginal cost. Chart 3 presents some further evidence on this. It plots two common measures of real marginal cost: in one ('closed-economy'), real marginal costs are given by real unit labour costs; while in the other ('open-economy'), real marginal costs are a weighted combination of real unit labour costs and real import prices.⁽¹⁾ While both measures tend to move closely together, it is clear that there are a number of

Chart 3 Closed-economy and open-economy measures of UK real marginal cost



Sources: ONS and Bank calculations.

instances of divergence, particularly in the 1970s and 1980s. More importantly for the discussion here, real unit labour costs have been higher relative to their average than the open-economy measure over the past decade or so. In other words, accounting for movements in import prices gives a different picture of recent movements in marginal cost.

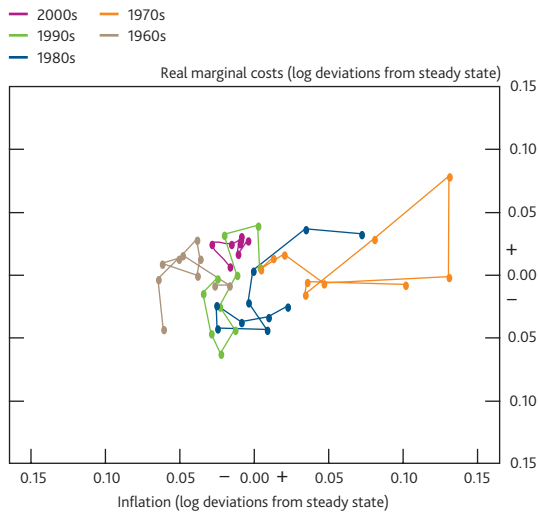
A number of studies estimate the structural NKPC described above. They find that the open-economy measure of real marginal costs (that is, including import prices) provides a significantly better fit for UK inflation than the closed-economy measure (eg Balakrishnan and López-Salido (2002); Batini *et al* (2005)). More recent work has built upon this strand of the empirical literature by employing more robust estimation techniques and lengthening the sample period (eg Kurmann (2007) and Peacock and Baumann (2008)).

Has the slope of the NKPC changed during the recent period of increasing globalisation?

Peacock and Baumann (2008) specifically examine the question of whether the increasing pace of globalisation in recent years has led to a change in the slope of the NKPC, λ . To answer this question they demonstrate the importance of correctly measuring the effect of import prices on marginal cost by estimating the slope of the NKPC using the closed and open-economy measures of marginal cost shown in Chart 3. Chart 4 shows no relationship between real marginal cost and inflation when the closed-economy measure is used: the points appear to be scattered around a horizontal line. By contrast, Chart 5 shows that measures of marginal costs that appropriately include the impact from import prices reveal the expected positive link between costs and inflation: the points

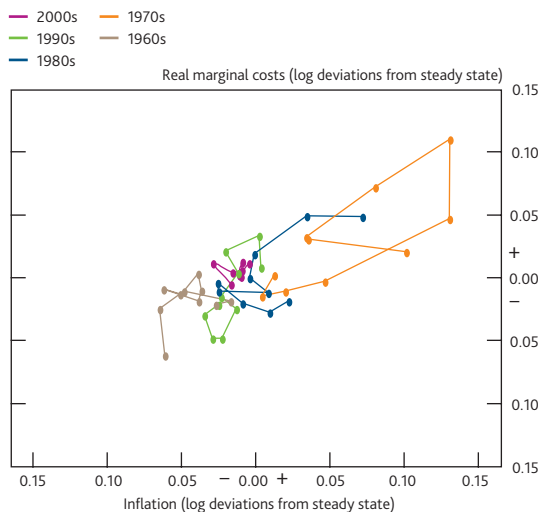
(1) Under certain assumptions, spelt out in the annex, real unit labour costs will be equal to real marginal cost. Under alternative assumptions, the 'open-economy' measure used here will be equal to real marginal cost. This measure is based upon a calibration of the model in Peacock and Baumann (2008), which is also the benchmark calibration used in Balakrishnan and López-Salido (2002). Both measures are plotted as the log deviation from steady state, which are set to their sample averages.

Chart 4 Inflation and real marginal costs: closed-economy model



Sources: ONS and Bank calculations.

Chart 5 Inflation and real marginal costs: open-economy model



Sources: ONS and Bank calculations.

lie around an upward-sloping line, giving a positive value for λ . So, failure to measure real marginal costs correctly could give a misleading view of whether the relationship between inflation and firms' costs had changed over time. The change in the response of real marginal cost to shocks, because imported inputs have become more important, would be incorrectly attributed to a change in the slope of the NKPC. These issues are particularly relevant currently given the rapid rises in global food and energy prices over the past year. Using real unit labour costs to proxy real marginal cost would suggest a more benign near-term outlook for inflation than that implied by a measure of real marginal cost that appropriately takes import price developments into consideration.

Peacock and Baumann (2008) suggest that once import prices are included in the measure of marginal cost, there has been no significant change in λ , the slope of the NKPC, since the mid-1980s. So the recent quickening in the pace of globalisation does not seem to have affected the relationship between marginal cost and inflation. As discussed on page 293, theory is ambiguous about whether globalisation might affect the relationship between costs and inflation so this result is not that surprising. In addition, it is in line with the results of Groen and Mumtaz (2008) who use a different methodology to estimate how the structural NKPC has varied over time, finding that the slope has not changed over the period they consider.

In summary therefore, with the cost of imports now forming a larger part of total costs, it would seem likely that movements in import prices now play a more important role in explaining short-term movements in UK inflation than in the past. And once these movements are accounted for, this article finds little evidence that the slope of the structural NKPC has changed since the mid-1980s.

Conclusions

It is important for a central bank to understand what globalisation means for inflation and the monetary transmission mechanism. The structural NKPC model outlined in this article shows that to understand the effects of globalisation on the monetary transmission mechanism it is necessary to consider both the impact of globalisation on the response of real marginal cost to movements in demand and the response of inflation to movements in real marginal cost.

Globalisation increases the ability of firms to substitute out of domestic inputs and into foreign inputs, reducing the responsiveness of real marginal cost to movements in domestic economic activity. Although theory is unclear about how globalisation may affect the response of inflation to real marginal cost, the evidence presented in this article suggests that the response has not changed markedly during the recent period of globalisation. But, it is crucially important to measure real marginal cost appropriately — in particular, accounting for imported input prices — as the empirical results presented in this article suggest that failing to do so could lead to the mistaken conclusion that the response of inflation to movements in real marginal cost had changed.

Moreover, there is evidence that import prices have become a more important component of real marginal cost over recent years. This makes it important to understand what drives movements in import prices, particularly given the rapid rises in global food and energy prices over the past year.

Annex The New Keynesian Phillips Curve (NKPC)

This annex shows how to derive the NKPC. The intuition is that when a firm comes to set its price, it will do so with regards to its costs and how it expects the prices of its competitors to evolve over the period until it once again resets its own price.

First, suppose that the economy consists of monopolistically competitive firms. Following Calvo (1983), suppose that each period a proportion $1 - \xi$ of firms set their price. When setting their price, their aim is to maximise their expected profit over the time that they expect to pass until they can reset their prices. Their expected profit will be given by:

$$E_t \sum_{s=0}^{\infty} (\beta \xi)^s \left(\frac{P_{j,t}}{P_{t+s}} - \mu_{t+s} \right) y_{t+s} \left(\frac{P_{j,t}}{P_{t+s}} \right)^{-\eta} \quad (\text{A1})$$

where β is the discount rate, P_j is the price set by firm j (able to change its price), P is the aggregate price level, μ is real marginal cost, y is aggregate demand and η is the elasticity of demand for firm j 's good. The first-order condition for a price-changing firm will be given by:

$$E_t \sum_{s=0}^{\infty} (\beta \xi)^s \left(1 - \eta \left(1 - \mu_{t+s} \frac{P_{t+s}}{P_{j,t}} \right) \right) \frac{y_{t+s}}{P_{t+s}} \left(\frac{P_{j,t}}{P_{t+s}} \right)^{-\eta} = 0 \quad (\text{A2})$$

The aggregate price level will be given by

$$P_t = P_{t-1}^\xi P_{j,t}^{1-\xi} \quad (\text{A3})$$

Combining equations (A2) and (A3) and taking a first-order Taylor series expansion implies the NKPC:

$$\begin{aligned} \pi_t &= \beta E_t \pi_{t+1} + \frac{(1-\xi)(1-\beta\xi)}{\xi} \hat{\mu}_t \\ &= \beta E_t \pi_{t+1} + \lambda \hat{\mu}_t \end{aligned} \quad (\text{A4})$$

where π is the inflation rate, $\hat{\mu}$ denotes the log deviation of real marginal cost from trend and λ denotes the slope of the NKPC. As can be seen, inflation depends on real marginal cost — reflecting the fact that firms want to set their price as a mark-up over cost — and future expected inflation — reflecting the fact that firms are forward looking and realise that their relative price may change during the time that their prices remain fixed. Equation (A4) also makes clear that, at least according to this model, the response of inflation to changes in real marginal cost will depend only on the discount rate and how often firms reset their prices: the more often they reset their prices (lower ξ), the more strongly inflation reacts to a given movement in real marginal cost.⁽¹⁾

The key point of the article is that the response of inflation to shocks will depend on both the response of inflation to real marginal cost *and* the response of real marginal cost to the shocks. To assess the response of real marginal cost to shocks implies the need for a good measure of real marginal cost. It is relatively straightforward to show that if output is produced according to a Cobb-Douglas production function, ie $y = h^\alpha x^{1-\alpha}$ where h is labour input and x is a composite non-labour input, then real marginal cost will be equal to the labour share (real unit labour costs) defined as $\frac{Wh}{Py}$ where W is the nominal wage. This is the 'closed-economy' measure referred to in the main text.

For a small open economy such as the United Kingdom, a key component of costs will be the cost of imported raw materials, energy and intermediate goods, and it is likely that the production function combining these with labour is not Cobb-Douglas. So, suppose that firms use labour and imported intermediates, M , to produce output according to the constant returns to scale, constant elasticity of substitution, production function:

$$y = \left(\alpha_m M^{1-\frac{1}{\sigma}} + \alpha_h h^{1-\frac{1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$$

In this case, real marginal cost will be given by:

$$\mu = \frac{Wh \left(1 + \left(\frac{\alpha_m}{\alpha_h} \right)^\sigma \left(\frac{P_M}{W} \right)^{1-\sigma} \right)}{Py} \quad (\text{A5})$$

where P_M is the price of imported intermediates in domestic currency and W is the nominal wage. In terms of deviations from steady state:

$$\hat{\mu} = \frac{\mu-s}{\mu} (1-\sigma) (\hat{P}_M - \hat{W}) + \hat{s} \quad (\text{A6})$$

where $\hat{\mu}$ is the percentage deviation of real marginal cost from its steady-state value, μ , \hat{s} is the percentage deviation of real unit labour costs from its steady-state value, s , σ is the elasticity of substitution between labour and imported intermediates, \hat{P}_M is the percentage deviation of the price of imported intermediates from steady state and \hat{W} is the percentage deviation of wages from their steady state. This is the measure referred to as the 'open-economy' measure of real marginal cost in the main text.

According to equation (A6), the effects of a given shock, such as a demand shock, on real marginal cost will depend on the effects of the shock on the price of imported intermediates

(1) As explained in the main text, different models imply that this response could also depend on the degree of competition in the economy.

relative to wages in addition to its effect on real unit labour costs, together with the degree of substitutability between labour and imported intermediates and steady-state real marginal cost. To the extent that globalisation has increased the degree of substitutability between labour and imported intermediates, ie σ , equation (A6) would suggest that the response of real marginal cost to a given shock should have fallen. Similarly, if globalisation has reduced the steady-state mark-up — that is, increased steady-state real marginal cost

(its inverse), μ , — then equation (A6) would again suggest that the response of real marginal cost to a given shock should have fallen (given σ has been estimated to be greater than one in the literature). Note that if real unit labour costs were used to proxy real marginal cost, any change in the response of real marginal cost to shocks, because for example imported inputs have become more important, would be incorrectly attributed to a change in the response of inflation to changes in real marginal cost, the point made in the main text.

References

Balakrishnan, R and López-Salido, D (2002), 'Understanding UK inflation: the role of openness', *Bank of England Working Paper no. 164*.

Batini, N, Jackson, B and Nickell, S (2005), 'An open-economy New Keynesian Phillips Curve for the UK', *Journal of Monetary Economics*, Vol. 52, pages 1,061–71.

Calvo, G A (1983), 'Staggered contracts in a utility-maximising framework', *Journal of Monetary Economics*, Vol. 12, pages 383–98.

Groen, J J J and Mumtaz, H (2008), 'Investigating the structural stability of the Phillips curve relationship', *Bank of England Working Paper no. 350*.

Khan, H (2004), 'Price-setting behaviour, competition, and mark-up shocks in the New Keynesian model', *Bank of England Working Paper no. 240*.

Kurmann, A (2007), 'VAR-based estimation of Euler equations with an application to New Keynesian pricing', *Journal of Economic Dynamics and Control*, Vol. 31, pages 767–96.

Peacock, C and Baumann, U (2008), 'Globalisation, import prices and inflation dynamics', *Bank of England Working Paper*, forthcoming.