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EXCHANGE RATE PASS-THROUGH – SUMMARY NOTE

Key Message

In the August Report, the expected pass-through of changes in sterling into import prices was reduced from 85% to 60%, pending further investigation. The evidence presented in this note is supportive of maintaining the new assumption. The prevalence of dollar pricing of UK imports might also help to explain the relatively small response of import prices to the recent appreciation of sterling.

Main points

- There is a consistent finding of incomplete pass-through to import prices in the academic literature across a wide range of countries, and empirical estimates for the UK are broadly consistent with the 60% assumption used in the August Report. A variety of reasons for incomplete pass-through have been put forward in the literature such as pricing to market behaviour, which can imply that exporters vary their margins in the face of exchange rate movements to protect their market share.
- There are significant issues with the UK import price data further back in time, particularly prior to 1998, making longer-run empirical work potentially misleading. Using a relatively short backrun, a reduced form error-correction model would suggest pass-through of 60% in the long-run, with most of that effect coming through in the first year.
- The degree of pass-through is likely to vary according to the circumstances prevailing at the time, but it is hard to find evidence of asymmetries or nonlinearities in the aggregate data given the short sample available. A structural VAR approach finds that the source of the shock to exchange rates can affect the degree of pass-through.
- The dollar is much more important as a currency for pricing UK imports than its simple trade weight would imply. That could reduce the recent 'effective' appreciation of sterling by around a quarter, helping to explain the puzzling strength of import prices in the face of the appreciation.
- Identifying the pass-through from import prices to CPI inflation is more difficult empirically, but the evidence presented in this note is supportive of our current assumption that it is full but very gradual. There is considerable uncertainty around both the speed and the extent of pass-through, and that is particularly important as these judgements affect the outlook for inflation at policy-relevant horizons.
- We have also tried to use microdata on CPI price quotes to analyse exchange rate pass-through, but struggled to find robust results. Excluding the components with unrealistic responses, we do see quick pass-through to food, and much slower pass-through to core goods as we would expect.

I. Introduction

1. Movements in exchange rates have played an important role in the dynamics of CPI inflation in recent years, given the open nature of the UK economy. Exchange rate pass-through can be thought of in two stages: from exchange rates to import prices; and from import prices to CPI inflation. Both stages are difficult to identify, and are likely to vary over time. This note summarises our latest work on pass-through.

2. Prior to the August 2015 Report, our assumption had been that a 1% appreciation of sterling would pull down on the level of the CPI by around 0.2% after four years through its direct effect on non-energy prices.¹ That reflected an assumed pass-through of 85% into non-energy import prices, most of which comes through within a year, and full-pass-through from import prices into the (non-energy) imported component of the CPI, which is estimated to be a little under 30% (total pass-through is equal to $1 \times 0.85 \times 0.27 = 0.23$). The second stage pass-through is assumed to be protracted such that inflation is lower for four years, with the peak impact in year 1, but only around two-fifths of the overall price level effect comes through over that period (Chart 1). Energy prices are treated separately in the forecast, and represent another channel through which movements in exchange rates will affect CPI inflation.²

3. The work for this round has focused on the first stage of pass-through, although there is also some evidence to draw on for the second stage. That reflects the fact that the movement of import prices in particular has been surprising following the recent appreciation of sterling. As discussed during the August round, import prices have fallen by less than we would have expected given our previous assumptions.³ Sterling appreciated by 13% between 2013Q1 and 2015Q2 but (non-fuel) import prices only fell by 6% over that period (Chart 2). Alongside that, we reduced the first-stage pass through for the most recent exchange rate news to 60%, pending further analysis. The evidence in this note is supportive of maintaining that change. That reduces the overall impact of a 1% appreciation on the level of the CPI from 0.23% to 0.16%.

Chart 1
Direct impact of a 1% appreciation on CPI inflation (excluding energy impact)

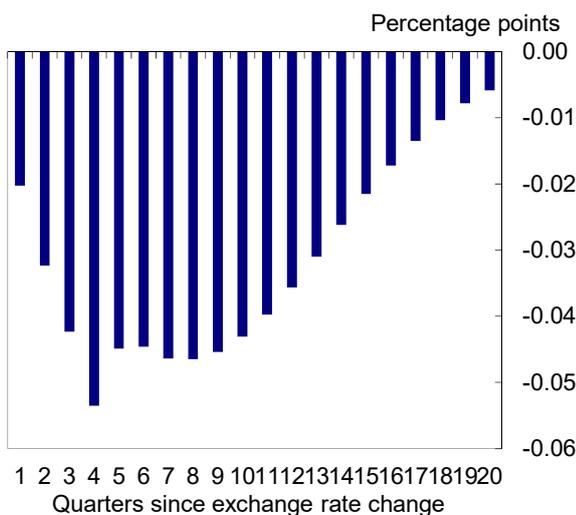
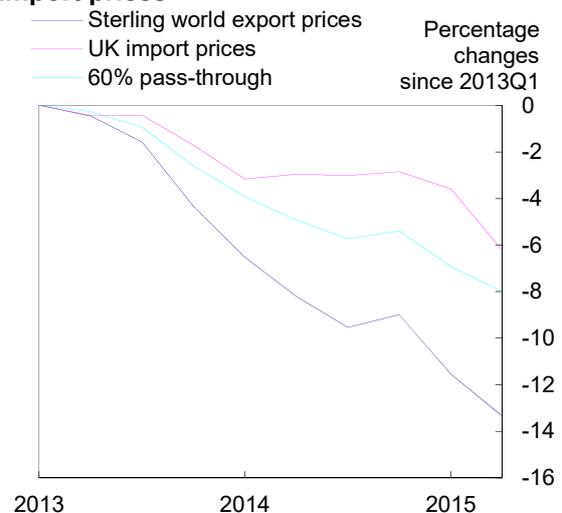


Chart 2
Sterling world export prices and UK non-fuel import prices



¹ The dampening effect on aggregate demand from the appreciation reduces the price level by a further 0.1pp after 4 years.

² The impact on energy prices is variable depending on the starting level of oil prices (given the importance of duties).

³ [\[Link\]](#) for more details.

II. Theoretical considerations.

For more details, see the note by [REDACTED]

4. There is a rich academic literature on the pass-through of exchange rates movements into import prices. There is a consistent finding of less than complete pass-through across a wide range of countries. Estimates for the UK in cross-country studies are broadly consistent with the 60% we assumed in August (Table A). This robust empirical finding of partial pass-through has led to consideration of the theoretical reasons why it might occur. There are a variety of reasons put forward. Some revolve around the decision by exporters to 'price to market', differentiating their prices across different export markets, a concept dating back to Dornbusch and Krugman in the late 1980s. Mishkin (2008) highlights that monopolistically competitive firms set their markups as a function of the elasticity of demand, and changes in exchange

Table A
Estimates of long-run exchange rate pass-through to UK import prices (%)

Source	Estimate
Campa and Goldberg (2005)	46
Mumtaz et al (2011)	43-66
Bussiere, Chiaie and Peltonen (2014)	47
IMF WEO (2015)	48
Gopinath (2015)	69

rates can lead them to vary their markups in order to avoid a loss of market share. In a world of variable markups, the degree of pass-through is also likely to depend on the relative market power of the exporter and importer. The UK is an important export destination, accounting for 5-10% of the exports of a wide range of countries, which might be consistent with lower pass-through for example.

5. A potentially less persistent mechanism is the choice by some exporters to set their prices in the currency of the importer (known as local currency pricing in the literature). This can provide at least some temporary stickiness in import prices if exporters take time to adjust their prices in local currency terms. Other potential explanations include the role of distribution costs which may be less affected by exchange rate movements, and the presence of long supply chains which can lead to exporters facing offsetting changes in their costs when exchange rates move that limit their ability to change their own prices.

6. Another important consideration is that the degree of pass-through is likely to vary, both over time and according to the circumstances accompanying a change in exchange rates. For example, pass-through may vary depending on which bilateral exchange rates move. In addition, there may be asymmetries between depreciations and appreciations if exporters are under more pressure to increase their prices in the face of a depreciation of the importers currency (as they would otherwise take a hit to their margins). There may also be nonlinearities. If exporters are reluctant to change their local currency prices, pass-through may be less for small changes in exchange rates than larger ones. In addition, the degree of pass-through is likely to depend on why the exchange rate moved in the first place (the source of the shock is likely to matter). We try to explore some of these aspects in the empirical work below.

7. One final source of variation in the observed pass-through can come from measurement issues. For example, pass-through is often estimated using effective exchange rate indices that weight together bilateral exchange rates. If the weights do not accurately capture the relative importance of different bilateral rates for import prices, pass-through may appear different to what it really is. There is an equivalent issue for movements in world prices given that we typically use measures of aggregate export prices to all countries and not just to the UK. Differences in the composition of exports to the UK relative to other countries, for

example, could affect the pass-through we observe. Evidence presented later in the note highlights some potential issues with the composition of both the sterling ERI and world export prices.

III. Empirical estimates

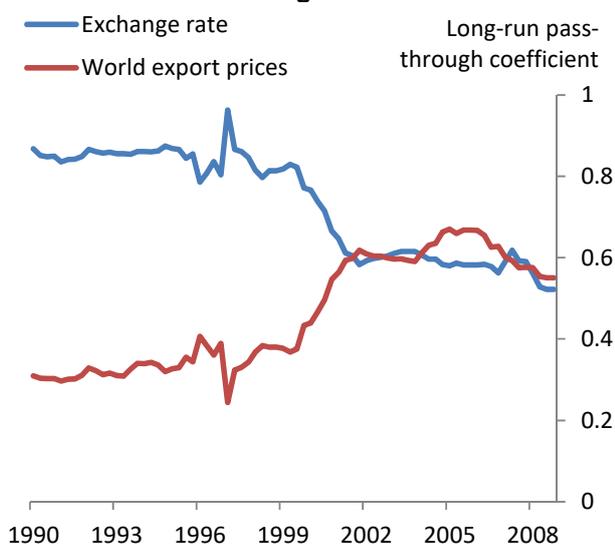
For more details, see the note by [redacted]

8. Our baseline model for forecasting import prices is a reduced-form error-correction model that regresses non-fuel import prices against world export prices, the sterling ERI and a measure of capacity utilisation (to pick up the influence of demand conditions on the speed of pass-through). The ECM term provides an estimate of the long-run pass-through from exchange rates to import prices.

9. Changes to the measurement of import prices over time, mean that earlier data are unlikely to provide a reliable estimate of pass-through. Where direct estimates of import prices are not available, indirect estimates based on domestic or foreign prices used, sometimes assuming full pass-through from changes in exchange rates. That is limited mainly to imports of services in the recent data, but further back, particularly before 1998, this approach was used for a larger proportion of the import basket, which is likely to bias up estimates of pass-through that are derived from earlier data.

10. Consistent with that, over a long sample of 1989-2015, the estimated pass-through from our equation is high at around 90%. That is likely to be by construction given the way the early data are calculated. Chart 3 shows the evolution of the long-run coefficient from recursive regressions that gradually increase the sample further back in time. The step down in the coefficient is clear as the measurement of import prices improves. The recent data point to a long-run coefficient of 0.6 (60% pass-through). The long-run coefficient on world export prices is of a similar magnitude in the recent data. These results are not that surprising – the limited extent of pass-through is evident by looking at the behaviour of (non-fuel) import prices and sterling world export prices in Chart 4. The equation also suggests that most of the response from import prices comes through within a year.

Chart 3
Estimates of long-run pass-through to import prices from recursive regressions^(a)



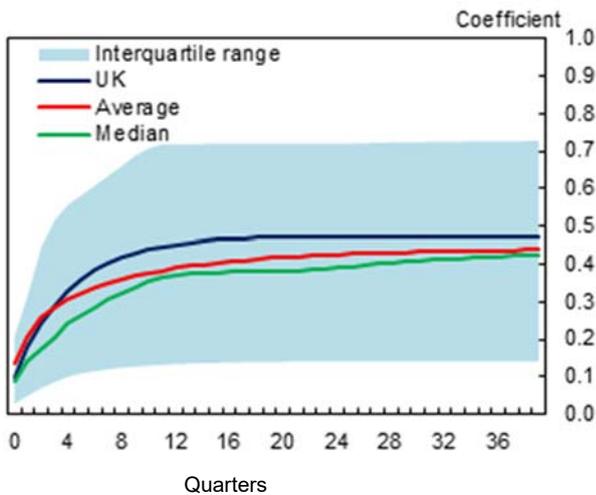
(a) The recursive regressions gradually expand the window further back in history, so the coefficient shown for 2002, for example, comes from a regression starting in 2002 and running up to 2015.

Chart 4
Sterling world export prices and UK non-fuel import prices



11. The extent of pass-through suggested by the recent UK data is broadly consistent with estimates for other countries as well. The seminal paper by Campa and Goldberg (2005) finds an average long-run pass-through coefficient of 0.64 for 23 different advanced economies (though lower for the UK), and more recent studies find similar results. Recent work by ID estimating similar ECM style equations to those used for the UK across 34 different countries finds a slightly lower average long-run response of 0.44 (Chart 5, for more details [redacted]). The US is typically found to be towards the lower end of the range of cross-country estimates of exchange rate pass-through to import prices. This is often attributed to the importance of the US as an export destination and the prevalence of dollar pricing.

Chart 5
Estimates of long-run pass-through across countries^(a)



(a) Estimates based on a similar reduced form import price equation to the baseline model for the UK and applied to 34 different countries.

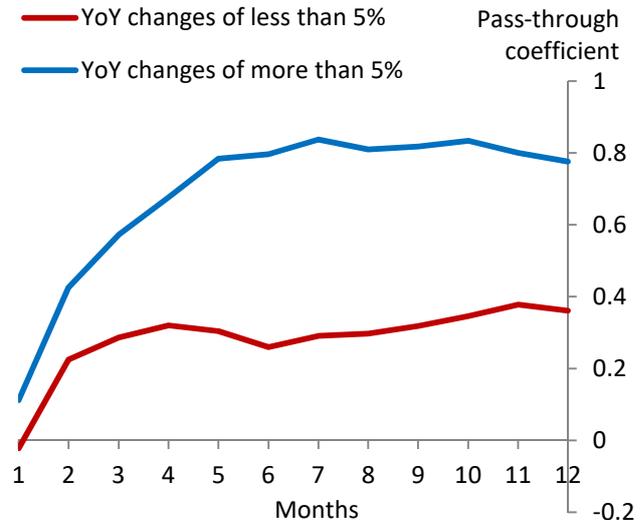
Variation over time

12. The estimated long-run pass-through in the ECM equation from the recursive regressions in Chart 3 is fairly stable from around 2001 onwards, suggesting little evidence of recent changes in the relationship. There is some evidence in the literature of declining pass-through in different countries over a longer horizon. Two potential explanations that are often discussed for that are the shift in the composition of imports away from commodities, which tend to have higher pass-through, and the more stable nominal environment which may have made exporters less keen to vary their prices. Assessing the importance of this in a UK context is difficult given the issues with import price measurement prior to 1998.

Asymmetries and nonlinearities

13. In principle, pass-through could vary according to the direction of the exchange rate move or its scale. Previous microdata work on the import prices of specific goods found some evidence of differences when movements in exchange rates were large. Updated estimates suggest that when bilateral exchange rates move by more than 5% over the course of a year the pass-through is 0.8 (this is slightly lower than earlier estimates due to the inclusion of more controls). For smaller changes, the pass-through is much lower (Chart 6). But in practice, movements in exchange rates meet this threshold most of the time because they

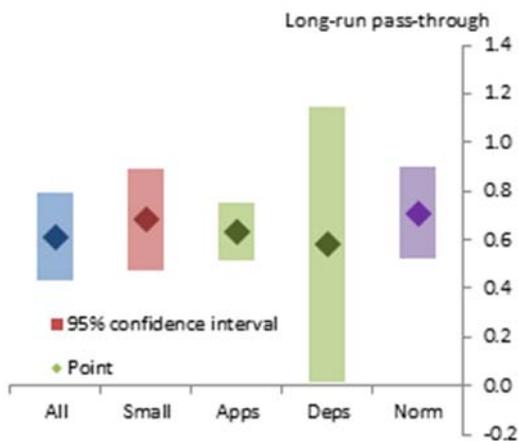
Chart 6
Estimates of pass-through based on microdata for large and small changes in exchange rates



relate to changes in bilateral exchange rates rather than the ERI (and sterling often gets caught in the middle of movements between the dollar and the euro, for example, that leave the ERI more stable). The variability of pass-through from this source, therefore, may be relatively limited.

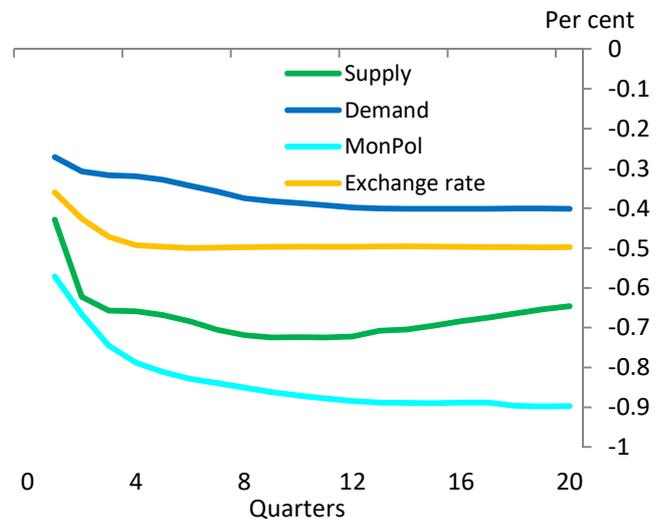
14. We can also look at asymmetries and nonlinearities in the aggregate data, but we have found ourselves constrained by the data issues discussed earlier, which limit the useful sample for empirical analysis – we have only a very limited number of episodes to use. Nevertheless, we can look to split the sample into periods when sterling was appreciating or depreciating, or when the movements are small and look at how the long-run pass-through estimates vary. Based on recent movements, there is little evidence of differences in pass-through based on the size of the movements in exchange rate or their direction (Chart 7), but some of the error bands are very large, so it is difficult to place much weight on this evidence.

Chart 7
Long-run pass-through estimates depending on type of exchange rate move^(a)



Note: Apps=YoY rises in ERI; Deps=YoY falls in ERI; Small=YoY absolute change in ERI<5%; Norm=Dropping 2007/08 depreciation episode.

Chart 8
Impact on import prices from a 1% appreciation from a structural VAR model by source of shock



Source of the shock

15. Pricing decisions by exporters are likely to depend on the circumstances prevailing at the time, so the reason for a change in exchange rates could affect the degree of pass-through. A recent speech by Kristin Forbes made use of a structural VAR model to get at the pass-through to import prices based on different types of shock. An updated version of that model shows a reasonable degree of variation in pass-through (for more details [redacted]). For example, demand shocks were associated with smaller pass-through than shocks to supply or monetary policy, or exogenous exchange rate shocks (Chart 8). If an appreciation of sterling has been driven by strong domestic demand, exporters may see less need to reduce their prices, given the buoyant market conditions. Nevertheless, the estimated import price responses to different shocks are, on average, around 0.6, consistent with the estimate from our reduced form equation. The SVAR also has the import price effect largely coming through within a year.

The impact of changes in sterling against the dollar and the euro

16. The degree of pass-through to import prices could also depend on which currencies sterling is moving against. We tried to explore this issue by estimating separate import price ECM equations for the EU and non-EU, using the euro and dollar bilaterals with sterling respectively. The long-run exchange rate pass-through is very similar for both equations, suggesting the responses are similar across currencies, although the coefficient in the non-EU equation is not significant. Even if the pass-through from different currencies is the same, the composition of changes in the sterling ERI can still be important, as discussed below.

IV. Measurement issues around first-stage pass-through

For more details, see the note by

17. As noted earlier, our standard aggregate measures for exchange rates and world export prices are only proxies for the movements that are relevant for UK import prices, so they could be subject to measurement error. For the sterling ERI, the weighting of different currencies could potentially give a misleading steer, which is particularly important when bilateral exchange rates move differently as the euro and dollar have done recently for example.

18. There are a number of potential issues with the sterling ERI weights. First, the ERI should ideally be based on import weights when thinking about import price pass-through, but it also takes into account export weights and third country competition.⁴ Using import weights alone increases the weight of the euro, and reduces the weight of the dollar, so this does not help us to explain the surprisingly low pass-through to import prices from the recent appreciation. If anything it would point to a larger aggregate exchange rate move, given the larger appreciation of sterling against the euro, making import prices harder to explain.

19. Another potential source of measurement error comes from the 'Rotterdam effect'. Some imports to the UK from non-EU countries are routed via ports such as Rotterdam, boosting the import weights of the Netherlands and Belgium in particular. Although this could work in the right direction, in that more imports are likely to be linked to the dollar than the ERI assumes, its impact is likely to be small.

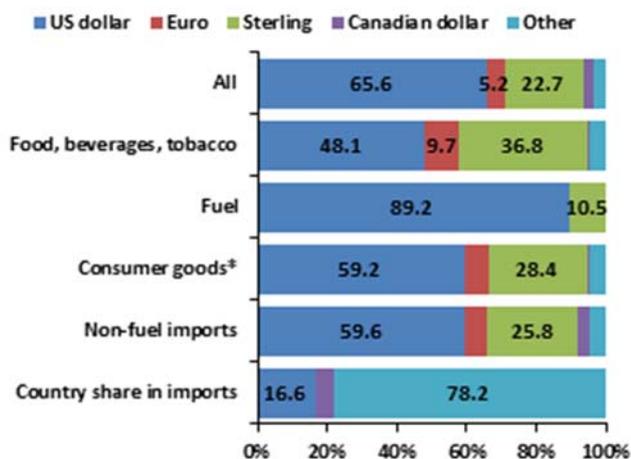
20. The most promising explanation for the surprising strength in import prices following the appreciation of sterling comes from looking at the currency of invoicing. Companies may choose to price their exports in a different currency to their home currency. There is a rich literature around the optimal choice of currency for pricing. In particular, the dollar has advantages in terms of its liquidity, and once a critical mass of exporters decides to price in dollars, it is in the interests of other exporters to follow suit. HMRC data suggest that around three-fifths of goods imports from non-EU countries (excluding fuel) are priced in dollars, much larger than the US share of non-EU goods imports to the UK (17%) (Chart 9). If exporters pricing in dollars are less likely to respond to movements in their own currencies, then the sterling ERI underweights the dollar significantly. Applying currency of invoicing weights could reduce the scale of the appreciation by around a quarter, making the path of import prices we have seen broadly in line with 60% pass-through. However, such a large impact from this adjustment is rare, so can probably be considered on a case-by-case basis in the forecast. The significant use of sterling pricing is also consistent with a reasonable degree of 'local

⁴ For example, the third country competition weight for the dollar will depend on the extent to which the US exports to the same countries as the UK. Changes in the dollar-sterling rate will affect the competitiveness of UK exports in those countries.

currency pricing' that may help to explain the incomplete pass-through we observe in our empirical estimates.

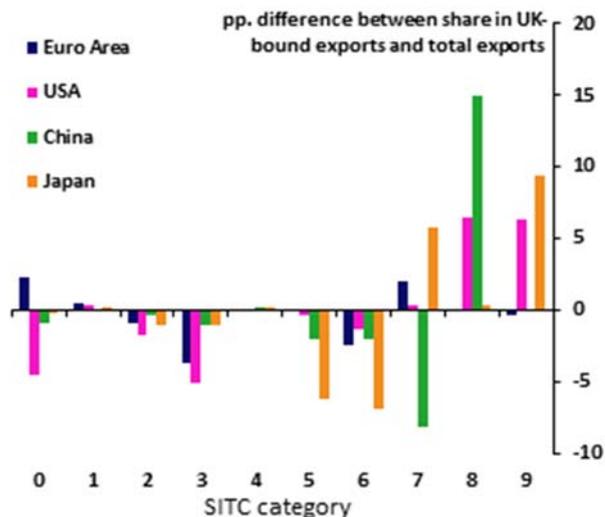
21. There is also likely to be measurement error in our world export price series. It captures export prices to all countries, rather than the UK specifically, and differences in the composition of exports to the UK and other countries could mean that the aggregate price series is misleading. Disaggregated trade data point to some differences in composition particularly for Japan and China (Chart 10), but in practice it will be difficult to project forward detailed component-level measures of export prices across countries.

Chart 9
Currency of invoicing for goods imports from non-EU countries



*Data are for machinery and transport equipment, and miscellaneous and manufactured articles. While many consumer goods reside in these categories, some capital goods are also included.

Chart 10
Difference in composition of selected exporters' UK-bound exports and total exports by SITC



V. Pass-through from import prices to CPI

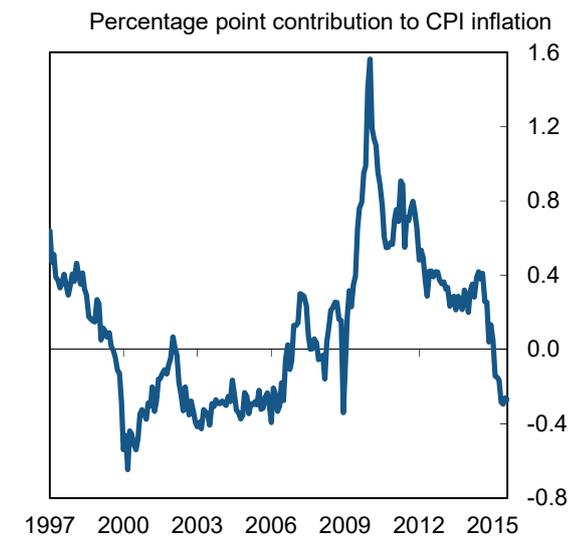
22. Our work this round has focussed on the pass-through from exchange rates to import prices, following the assumptions made during the August round. The academic literature has also tended to focus more on the first stage of exchange rate pass-through than the second. One reason for that may be that monetary policy responses are likely to play a more important role in the second stage, making it harder to identify the underlying pass-through. The source of the shock is also likely to have more significant effects on the overall impact on inflation. For example, in the structural VAR discussed earlier, CPI inflation is higher when an appreciation in sterling is driven by domestic demand shocks, whereas it is lower for monetary policy and exogenous exchange rate shocks. In the forecast we typically take these different channels into account separately when thinking about the inflation narrative, for example by attributing the impact of stronger demand on inflation via domestic costs to a reduction in slack. More generally, it is difficult to get precise estimates of the different factors affecting inflation. Identifying the role of slack via the (price) Phillips curve is also problematic, for example.⁵ There is considerable uncertainty, therefore, about this aspect of pass-through.

⁵

23. Our current treatment of exchange rate news assumes full pass-through from import prices to CPI (equivalent to 60% pass-through from exchange rates given our assumptions on import prices). That means that for a 1% fall in import prices, the level of the CPI would fall by the share of imported content within the basket, which we current assume is around 27% for the non-energy component of CPI. We were surprised by the persistent strength of inflation following the depreciation of sterling in 2007/08. In particular, the contribution of core goods (which includes many of the more import-intensive components) remained elevated relative to pre-crisis levels for several years after the depreciation (Chart 11), leading us to the view that pass-through to consumer prices may be protracted and large.

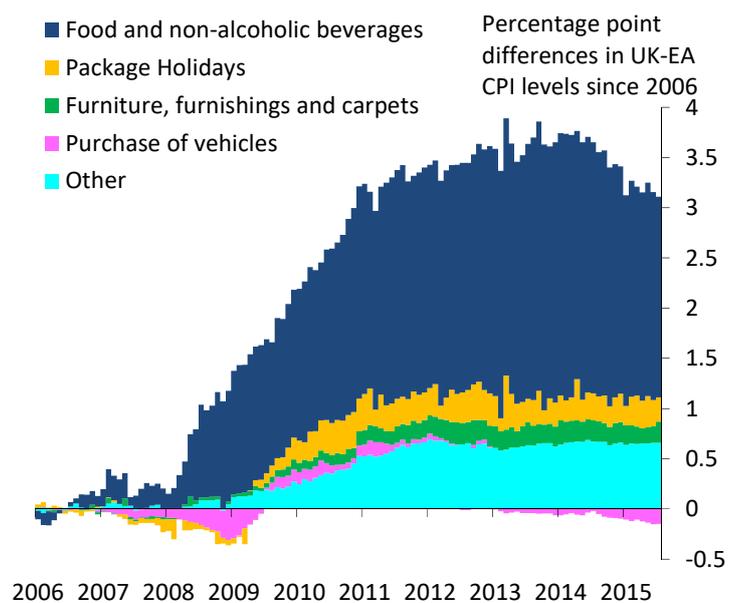
24. Another piece of evidence for gradual pass-through comes from the difference between UK and euro area inflation over that period. The depreciation of sterling was likely to be a key factor driving differences between inflation rates in the two economies and if we focus on some particularly import intensive components, we can see that the differential built up over several years, with food prices reacting most rapidly, and other items taking much longer to feed through (Chart 12).

Chart 11
Contribution of core goods to CPI inflation^(a)



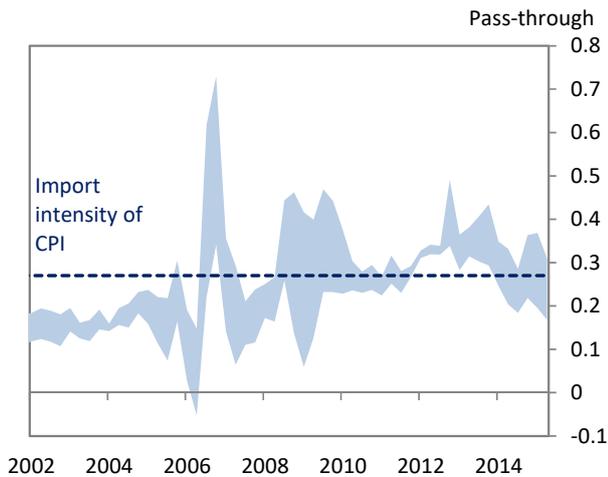
(a) Excludes clothing and footwear due to changes in measurement practices in 2010.

Chart 12
Contributions of import-intensive items to UK – euro area inflation differentials



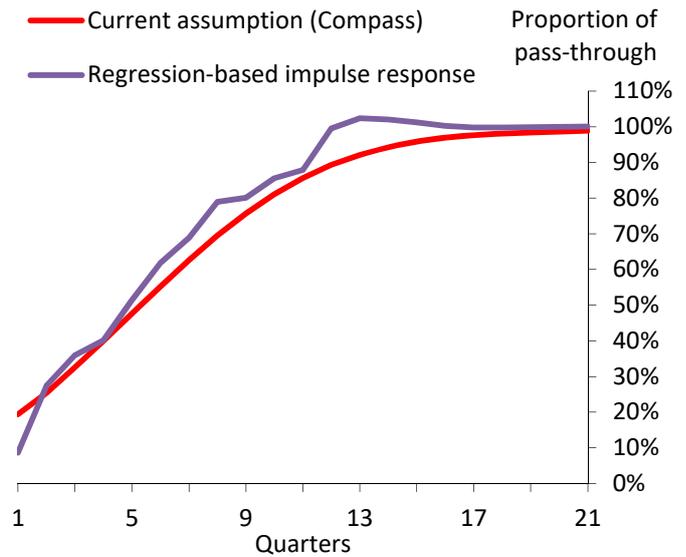
25. Estimates from simple time series regressions, following the approach of Campa and Goldberg (2008), suggest that pass-through in the long-run is full (Chart 13). They also suggest that pass-through is gradual. Only around 40% of the overall impact comes through in the first year, consistent with our assumed speed of pass-through. Impulse responses from Compass also point to gradual pass-through, and are what our current assumption is based upon (Chart 14). There are a number of reasons why pass-through may be gradual. Many companies will hedge their exchange rate risk. A recent survey by the Agents suggested that for those that do hedge, around a third of their exposures were hedged out to a year, and 14% beyond that. Some companies may also wish to wait to see if the move in prices is likely to persist.

Chart 13
Rolling regression estimates of long-run pass-through of import prices to CPI^(a)



(a) The swathe reflects variations in the number of lags.

Chart 14
Estimates of speed of pass-through



26. The estimates of long-run pass-through from the simple time series regressions have been fairly stable in recent years. There is more evidence of a longer-run decline in pass-through from a version of Compass with time-varying parameters (this is based on work undertaken on the transmission mechanism – [redacted] for more details). An exchange rate risk premium shock has had a progressively smaller impact on inflation (Chart 15). In part, that is likely to reflect the changing monetary policy response.

Chart 15
Pass-through to CPI from an exchange rate risk premium shock in Compass with time-varying parameters

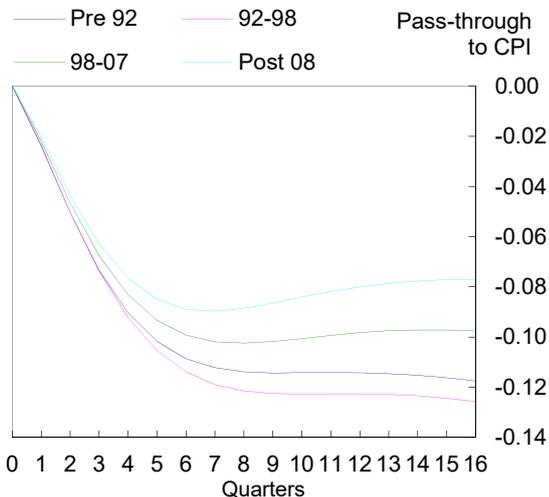
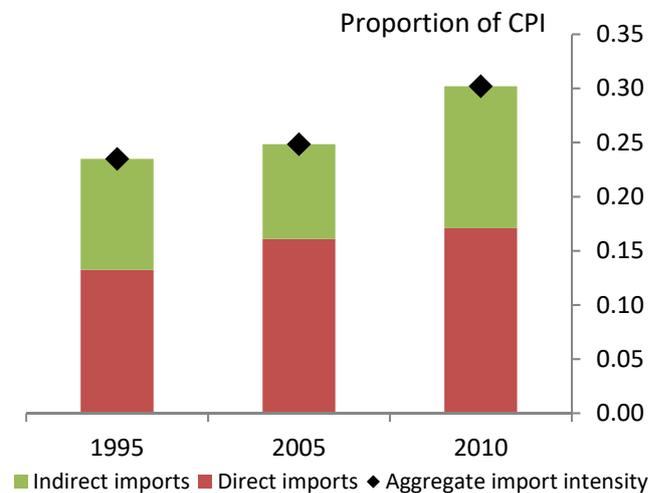


Chart 16
Estimates of import intensity for CPI excluding energy



27. The pass-through of import prices to CPI will depend in part on the import intensity of the CPI basket. Estimates of the intensity can be derived from the input-output tables, although these are published infrequently. These suggest that the import intensity of the CPI basket increased between 1995 and 2010, fairly evenly split between an increase in imported final goods and intermediate inputs (Chart 16). The increase in import intensity over that period appears to have taken place despite a shift in the CPI basket away from import intensive items (ie. the import intensity of specific items must have increased). Since 2010

though, shifts in the composition of the CPI basket have been towards more import intensive items. Other things equal, that could have increased non-energy import intensity by around 0.8pp.

28. Pass-through to CPI inflation will also depend on how the import prices for different components evolve. As highlighted in the August round, the import prices of finished consumer goods have risen over the past year, while other import prices have fallen. That could pose an upside risk to CPI inflation, given that prices of imported finished consumer goods are likely to be more important than, say, imported capital goods (for more details [\[redacted\]](#)).

29. Given the data issues around import prices discussed earlier, another approach is to look at pass-through as a whole, from exchange rates to CPI inflation. As part of the recent work on pass-through we have been exploring the microdata on individual price quotes from the CPI. Unfortunately, we have struggled to pin down robust and plausible relationships for a number of components, which leads to aggregate results that are not particularly revealing. This highlights again the difficulty in identifying the relationships between inflation and its drivers. If we exclude the components with implausible estimated responses, we do find some supportive evidence for our current assumptions. Food prices respond quickly to exchange rate movements, but the impact on core goods prices takes much longer to come through, consistent with gradual pass-through (for more details [\[redacted\]](#)). That said, given the difficulties we have faced in this work, these findings should be considered extremely tentative, and more work will be required to understand the broader patterns in the data. There is also little evidence of a strong link between the import intensity of different components and the estimated pass-through from exchange rate movements, consistent with time series analysis of CPI components discussed in the recent speech by Kristin Forbes.

30. Overall, the evidence presented here is supportive of our current assumption on the second stage of pass-through, from import prices to CPI inflation. But there is considerable uncertainty around both the speed and the extent of pass-through, and that is particularly important as these judgements affect the outlook for inflation at policy-relevant horizons.