Sterling depreciation

1.1 USD/GBP
1.2 EUR/GBP
1.3 Referendum

Breinlich, Leromain, Novy & Sampson
Brexit Vote & Inflation
October 2018
Inflation and real wages
This paper

- Study impact of Brexit vote on UK living standards
- Estimate effect on inflation and real wage growth
- Referendum was unanticipated shock to the UK economy. Use as natural experiment
Is the Brexit vote responsible for the rise in UK inflation after June 2016?

Other possible factors: oil price movements, global inflationary pressures

Isolate referendum effect by comparing changes in inflation for product groups with differential exposure to import costs

Goal is to understand consequences of Brexit vote not a generic exchange rate depreciation . . . source of exchange rate shock matters
Following the referendum, UK inflation rose sharply. Annual CPI inflation increased from 0.4% in June 2016 to 3.0% in September 2017. Other major economies also experienced an increase in inflation over this period, but the rise was much smaller. In the euro area, inflation increased from 0.1% in June 2016 to 1.5% in September 2017, while US inflation rose from 0.2% to 1.9%.

Figure 2 shows the evolution of price levels in the UK, the euro area and the United States before and after the referendum. Prior to the referendum, there are no obvious differences in the inflation rates in the three areas, but after June 2016, a gap emerges as prices in the UK increase more quickly than those in the euro area and the United States.

A lower exchange rate raises the cost of importing both consumption goods and intermediate inputs. Consequently, it is natural to hypothesise that the Brexit vote and subsequent exchange rate depreciation caused the rise in inflation in the UK. But higher inflation may also be driven by other trends in the UK economy or by global economic events that are unrelated to Brexit, such as changes in the price of oil and inflationary pressures resulting from faster growth in the euro area and the United States.

To isolate the effect of the Brexit vote on inflation, we study whether products that are more exposed to changes in the value of sterling experienced higher inflation following the referendum.
Motivating theory

- Suppose households consume $G$ product groups indexed by $g = 1, \ldots, G$
- Consumption $C_g$ of product group $g$ is composite of imported good $M_g$ and domestic good $D_g$
  \[ C_g = M_g^{\gamma_g} D_g^{1-\gamma_g} \]
Motivating theory

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- Consumption $C_g$ of product group $g$ is composite of imported good $M_g$ and domestic good $D_g$

\[ C_g = M_g^{\gamma_g} D_g^{1-\gamma_g} \]

- Price growth can be expressed in terms of price indices $P$ as

\[
\ln \left( \frac{P_{g,t}}{P_{g,t-1}} \right) = \gamma_g \ln \left( \frac{P_{gM,t}}{P_{gM,t-1}} \right) + (1 - \gamma_g) \ln \left( \frac{P_{gD,t}}{P_{gD,t-1}} \right)
\]
Motivating theory

- Suppose households consume $G$ product groups indexed by $g = 1, \ldots, G$.
- Consumption $C_g$ of product group $g$ is composite of imported good $M_g$ and domestic good $D_g$

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- Price growth can be expressed in terms of price indices $P$ as

$$\ln\left( \frac{P_{g,t}}{P_{g,t-1}} \right) = \gamma_g \ln\left( \frac{P_{gM,t}}{P_{gM,t-1}} \right) + (1 - \gamma_g) \ln\left( \frac{P_{gD,t}}{P_{gD,t-1}} \right)$$

- Direct import share $\gamma_g$ measures share of consumer expenditure on imports.
- Indirect import share defined as share of consumer expenditure on imported intermediate inputs used in domestic production.
Suppose domestic good $g$ produced using labour $l$, domestic input $i_{Dg}$ and imported input $i_{Mg}$ according to

$$y_g = \phi_g l^{1-\alpha_g} \left( i_{Dg}^{1-\xi_g} i_{Mg}^{\xi_g} \right)^{\alpha_g}$$
Suppose domestic good $g$ produced using labour $l$, domestic input $i_{Dg}$ and imported input $i_{Mg}$ according to

$$y_g = \phi_g l^{1-\alpha_g} \left(i_{Dg}^{1-\varepsilon_g} i_{Mg}^{\varepsilon_g}\right)^{\alpha_g}$$

Complete pass-through from costs to output prices implies

$$\frac{p_{gD,t}}{p_{gD,t-1}} = \left(\frac{\phi_{g,t}}{\phi_{g,t-1}}\right)^{-1} \left(\frac{w_t}{w_{t-1}}\right)^{1-\alpha_g} \left(\left(\frac{p_{gID,t}}{p_{gID,t-1}}\right)^{1-\varepsilon_g} \left(\frac{p_{gIM,t}}{p_{gIM,t-1}}\right)^{\varepsilon_g}\right)^{\alpha_g}$$

Assume TFP and factor prices do not change over time
Input-output linkages

- Intermediates produced using output of all other sectors

\[ \frac{P_{gD,t}}{P_{gD,t-1}} = \prod_{j=1}^{G} \left( \frac{P_{jD,t}}{P_{jD,t-1}} \right)^{\psi_{jg}}, \quad \frac{P_{gM,t}}{P_{gM,t-1}} = \prod_{j=1}^{G} \left( \frac{P_{jM,t}}{P_{jM,t-1}} \right)^{\mu_{jg}} \]

- \( \psi_{jg} \) equals share of domestic good \( j \) in cost of producing domestic intermediate \( g \)

- \( \mu_{jg} \) denotes share of imported good \( j \) in cost of producing imported intermediate \( g \)

- Solving this system of equations gives \( \ln \left( \frac{P_{gD,t}}{P_{gD,t-1}} \right) \) in terms of change in import prices
Indirect import share

- We defined indirect import share as fraction of consumer expenditure spent on imported intermediate inputs used in domestic production.

- Model implies indirect import share equals \((1 - \gamma_g)\) times elasticity of domestic good price \(P_{gD,t}\) to import costs.

- Suppose exchange rate depreciation increases import costs by \(\beta\) log points.

\[
\ln \left( \frac{P_{gM,t}}{P_{gM,t-1}} \right) = \beta, \quad \forall g = 1, \ldots, G
\]

Consumer price growth is

\[
\ln \left( \frac{P_{g,t}}{P_{g,t-1}} \right) = \beta \times (\text{Direct import share} + \text{Indirect import share})
\]

Use this expression as basis for our estimation equation.
Data

- Import shares calculated from 2013 UK input-output tables
  - Direct import share equals share of household expenditure on imports
  - Indirect import share equals share of household expenditure on intermediate inputs embedded in domestic production (using all input-output linkages)
  - Total import share equals sum of direct and indirect measures

- Price data for 84 product groups corresponding to COICOP classes

- Euro area inflation by product group from Eurostat

- Oil price exposure by product group calculated using input-output tables as indirect consumer expenditure share on imported oil used in domestic production
Import shares

For the 84 product groups that compose the CPI, we calculate the share of consumer expenditure that is spent on imports. We expect that products with a higher import expenditure share will experience larger price rises when the cost of imported goods increases. Our calculations take into account both direct consumer expenditure on imported final goods and indirect expenditure on imports used as intermediate inputs in domestic production.

Table 1 summarises our import exposure measures. We divide the 84 product groups into the 12 divisions that make up the CPI. Column (1) shows direct exposure defined as the share of consumer expenditure on imported final goods. Column (2) shows indirect exposure to imports of intermediate inputs. Column (3) gives the total import expenditure share, which is the sum of columns (1) and (2).

Table 1: Import shares in consumer expenditure by COICOP division

<table>
<thead>
<tr>
<th>COICOP division</th>
<th>Import share in consumer expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1) Direct</td>
</tr>
<tr>
<td>Food and non-alcoholic beverages</td>
<td>50%</td>
</tr>
<tr>
<td>Alcoholic beverages and tobacco</td>
<td>50%</td>
</tr>
<tr>
<td>Clothing and footwear</td>
<td>88%</td>
</tr>
<tr>
<td>Housing, water, electricity, gas and other fuels</td>
<td>1%</td>
</tr>
<tr>
<td>Furniture, household equipment and maintenance</td>
<td>66%</td>
</tr>
<tr>
<td>Health</td>
<td>42%</td>
</tr>
<tr>
<td>Transport</td>
<td>31%</td>
</tr>
<tr>
<td>Communication</td>
<td>43%</td>
</tr>
<tr>
<td>Recreation and culture</td>
<td>34%</td>
</tr>
<tr>
<td>Education</td>
<td>1%</td>
</tr>
<tr>
<td>Restaurants and hotels</td>
<td>0%</td>
</tr>
<tr>
<td>Miscellaneous goods and services</td>
<td>36%</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>39%</strong></td>
</tr>
<tr>
<td><strong>Standard deviation</strong></td>
<td><strong>0.35</strong></td>
</tr>
</tbody>
</table>

Source: CEP calculations.

Notes: Average and standard deviation are unweighted and computed at the product group level. Column (3) is the sum of columns (1) and (2), but the numbers may not match the exact total due to rounding.

The average total import share across all product groups is 51%, but there is substantial variation both across and within divisions. At the division level, total import shares range from 5% in Education to 90% in Clothing and footwear. Unsurprisingly, tradable goods, such as food and drinks, have higher import exposure than services, such as restaurants and hotels.

We calculate import exposure using the UK Input-Output Analytical Tables for 2013 from the Office for National Statistics. Our measure of indirect expenditure on imported intermediate inputs embodied in domestic production takes into account the input-output linkages across sectors in the UK economy. Our 84 product groups are chosen to match the level of disaggregation available in the Input-Output tables and correspond to COICOP classes. Full details of all the calculations and estimation results reported in this briefing are in our technical paper, Breinlich et al (2017). Levell et al (2017) discuss the direct and indirect components of UK households’ food expenditure.
Import shares and inflation

Do changes in inflation after June 2016 differ depending on the product’s import expenditure share? We divide our 84 product groups into a high import exposure set containing the top half of product groups ranked by total import share and a low import exposure set including product groups in the bottom half by total import share. Figure 3 shows the average inflation rates for these two sets, where inflation is expressed as the difference from the average inflation rate in the set in January 2015. We see that following the referendum there is a rapid increase in inflation for the high exposure set, while the rise in inflation is slower and much more muted for the low exposure set. This suggests that the Brexit vote led to higher inflation by increasing the cost of imports.

Figure 3: Import exposure and inflation, 2015-

Source: CEP calculations.

Notes: High import exposure set includes product groups with import shares above the sample median. Low import exposure set includes product groups with import shares below the sample median. Figure shows the unweighted average inflation rate for each set expressed as the difference from the set average for January 2015. Statistical analysis confirms the pattern shown in Figure 3. Accounting for differences in product-specific inflation rates that are unrelated to Brexit, oil price movements and global inflationary pressures that led to changes in euro area inflation, we find that product groups with higher import shares experienced significantly higher inflation following the referendum. We interpret this finding as evidence that the referendum outcome caused an increase in inflation.
Empirical specification

\[
\ln \left( \frac{P_{g,t}}{P_{g,t-1}} \right) = \beta Post_t \times ImportShare_g + \alpha X_{gt} + \delta_t + \delta_g + \epsilon_{gt}
\]

- \text{Post}_t\text{ is a dummy for periods after June 2016}
- \text{ImportShare}_g\text{ is the total import share of product group } g
- X_{gt}\text{ includes controls for oil price movements and Euro area inflation}
- \delta_t\text{ and } \delta_g\text{ are period and product group fixed effects}
- Estimate on both annual (year ending in June) and quarterly data
- Annual sample June 2015-17. Quarterly sample ends September 2017
- Standard errors clustered by product group
### Annual specification: Import share

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1) Inflation</th>
<th>(2) Inflation</th>
<th>(3) Inflation</th>
<th>(4) Inflation Difference</th>
<th>(5) Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post × Import share</td>
<td>0.0760***</td>
<td>0.0709***</td>
<td>0.0709***</td>
<td>0.0706***</td>
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<td></td>
<td>(0.0185)</td>
<td>(0.0148)</td>
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<tr>
<td>2016 × Import share</td>
<td>-0.00295</td>
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<td>-0.000295</td>
<td>-0.00106</td>
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<tr>
<td></td>
<td>(0.0106)</td>
<td></td>
<td></td>
<td>(0.0155)</td>
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<tr>
<td>2017 × Import share</td>
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<td></td>
<td>0.0694***</td>
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<td>(0.0155)</td>
<td>(0.0155)</td>
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<td>Oil</td>
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<td>0.672**</td>
<td>0.232</td>
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<tr>
<td></td>
<td>(0.393)</td>
<td>(0.296)</td>
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<tr>
<td>Euro area inflation</td>
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<td>0.282</td>
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<td></td>
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<td>(0.201)</td>
<td>(0.200)</td>
<td>(0.200)</td>
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<td>(0.00637)</td>
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<td>-0.0146**</td>
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<td>-0.0153**</td>
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<tr>
<td>R-squared</td>
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<td>0.459</td>
<td>0.491</td>
<td>0.256</td>
<td>0.491</td>
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<td>Number of products</td>
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<tr>
<td>Product fixed effects</td>
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<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

Notes: The dependent variable in columns (1)-(3) and (5) is the annual UK inflation rate. In column (4) it is the difference between the UK and Euro area annual inflation rates. Post is a dummy variable for the post-referendum period. Sample covers 2015-17. We define year $t$ as the period from June of year $t-1$ to June of year $t$. See the main text for additional details. Constant not reported. OLS estimation. Standard errors in parentheses clustered by product. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. 
# Direct & indirect import shares

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
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<tbody>
<tr>
<td></td>
<td>Inflation</td>
<td>Inflation</td>
<td>Inflation</td>
<td>Inflation Difference</td>
<td>Inflation</td>
</tr>
<tr>
<td><strong>Post × Direct import share</strong></td>
<td>0.0916***</td>
<td>0.0760***</td>
<td>0.0719***</td>
<td>0.0612***</td>
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<td></td>
<td>(0.0209)</td>
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<td>(0.0126)</td>
<td>(0.0126)</td>
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<tr>
<td><strong>Post × Indirect import share</strong></td>
<td>0.310**</td>
<td>0.138**</td>
<td>0.0850*</td>
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<tr>
<td></td>
<td>(0.125)</td>
<td>(0.0597)</td>
<td>(0.0499)</td>
<td>(0.0669)</td>
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<td><strong>2016 × Direct import share</strong></td>
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<td></td>
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<tr>
<td><strong>2017 × Direct import share</strong></td>
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<td></td>
<td></td>
<td>0.0673***</td>
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<tr>
<td><strong>2016 × Indirect import share</strong></td>
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<tr>
<td><strong>2017 × Indirect import share</strong></td>
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<td></td>
<td></td>
<td>0.0432</td>
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<td></td>
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<td>(0.0778)</td>
<td></td>
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<tr>
<td><strong>Oil</strong></td>
<td>0.729*</td>
<td>0.651*</td>
<td>0.447*</td>
<td>0.741*</td>
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<tr>
<td></td>
<td>(0.391)</td>
<td>(0.328)</td>
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<td>(0.393)</td>
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<tr>
<td><strong>Euro area inflation</strong></td>
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<tr>
<td><strong>Observations</strong></td>
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<tr>
<td><strong>R-squared</strong></td>
<td>0.409</td>
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<td>0.491</td>
<td>0.268</td>
<td>0.492</td>
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<tr>
<td><strong>Number of products</strong></td>
<td>84</td>
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</tr>
<tr>
<td><strong>Product fixed effects</strong></td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
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*** p < 0.01, ** p < 0.05, * p < 0.1.
Quarterly estimates

estimate that the referendum outcome increased prices by 1.7% also implies that real wages in June 2017 were 1.7% lower than they otherwise would have been. This decline is equivalent to a £448 cut in annual pay for the average worker.

Put another way, this means the increase in inflation due to the Brexit vote has cost the average worker almost one week's wages (4.4 working days' wages, to be precise). Unless Brexit increases real wages in future years, this pay cut will be permanent.

To shed further light on inflation dynamics following the referendum, we study the speed of pass-through from the exchange rate depreciation to import prices. For each quarter, we analyse whether there is a relationship between import shares and price increases across product groups. As before, our analysis takes account of other factors that may lead to differences in inflation, but are unrelated to Brexit, such as oil price movements and global inflationary pressures.

The results are shown in Figure 5. The squares (joined by the solid line) show the estimated effect of the total import share measure on inflation in each quarter. The upper and lower dashed lines show the 95% confidence interval for our estimates. This means that we estimate that there is a 95% chance that the true effect in each quarter lies between the two dashed lines. We see that prior to the referendum, the estimates are close to zero and there is no evidence of a relationship between import shares and inflation.

Figure 5: Estimated effect of the import share on quarterly inflation, 2015-17

Source: CEP calculations.

Notes: For each quarter the solid line shows the estimated effect of a product group's total import share on its quarterly inflation rate. The dashed lines bound the 95% confidence interval for the import share effect. See Breinlich et al (2017) for technical details. Estimates are from Table 5, column 1.

Average earnings in June 2017 were £506 per week (Source: EARN01 October 2017, series KAB9, Office for National Statistics) or £26,366 per year. 1.7% of this is £448.

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Results summary

- For each 10 percentage point increase in total import share, product group inflation estimated to be 0.71 percentage points higher in year after referendum.

- Both direct and indirect import exposure led to higher inflation. Cannot reject hypothesis of equal effects.

- Pass-through to import prices peaked in Q1 2017, but still ongoing in Q3 2017.
Did the referendum affect inflation through channels other than import prices?

Estimated period fixed effect is negative and significant in year after the referendum

To obtain a conservative estimate of the Brexit vote effect, we attribute this negative general equilibrium estimate to the referendum

Aggregating across product groups using CPI weights find that Brexit vote increased inflation by 1.7 percentage points in year to June 2017

Equivalent to 404 pounds per year higher expenditure for average UK household
Wage growth

- Nominal wages grew at around 2%-2.5% throughout 2016 and 2017.
- Real wage growth fell from 1.7% in June 2016 to -0.3% in December 2017.
- Assuming nominal wage growth unaffected by referendum, our estimates imply Brexit vote reduced real wages in June 2017 by 1.7%.
- Equivalent to loss of 4.4 working days’ wages for average worker.
Wage growth

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Robustness checks

- Findings robust to alternative estimation specifications
  
  1. Inclusion of distribution costs in calculation of import shares
  
  2. Interact import shares with observed exchange rate changes
Distributional effects

- Share of expenditure allocated to different product groups varies by household
- Use this variation to calculate effect of referendum on inflation for different household types
- Distributional consequences are independent of general equilibrium effects
Income deciles

Inflation costs of Brexit vote evenly shared across the income distribution

**Figure 6:** Inflation differences across income deciles due to the Brexit vote

Source: CEP calculations.

Notes: For each decile we show the estimated inflation increase due to the Brexit vote minus the increase for the average UK household. Deciles are based on disposable household income. Decile 1 is the poorest households, decile 10 the richest. See Breinlich et al (2017) for technical details.

Although the inflation effect differs little across income deciles, there are stark differences across regions. We perform the same exercise described for income deciles above, but using data on household expenditure patterns by region. Figure 7 shows the difference between the inflation rate for each region and the UK average. We find that all regions experience a rise in inflation because of the referendum (remember our baseline estimate for the UK as a whole is a 1.7 percentage point increase), but some regions lose more than others.

London is the least affected region with a rise in inflation 0.35 percentage points below the UK average. The increase is smaller for London primarily because Londoners spend relatively more on rent than the average household and rent has a very low import share.

In general, the north of England is harder hit than the south. Scotland, Wales, and Northern Ireland are the worst affected areas. Our estimates imply that inflation in Northern Ireland increased by 0.47 percentage points more than the UK average because of the Brexit vote.

The average London household spends 12.9% of its budget on rent, compared to a UK average of 7.1%. Housing rental has a direct import share of 0% and an indirect import share of 8%.
 Regions  

Scotland, Wales and Northern Ireland hit hardest – higher expenditure on food, drink, and fuel, lower expenditure on rent.
Conclusions

- Brexit vote was an unanticipated negative shock to the UK economy
- Product groups with larger import shares have experienced higher inflation since the vote
- Estimates imply referendum increased inflation by 1.7 percentage points in the year to June 2017
- UK households are already paying a price for voting to leave the EU
Baseline estimates use import shares calculated at basic prices excluding
distribution costs and taxes on products
But consumer price index computed using purchasers’ prices
Suppose good $g$ produced using distribution sector $R$ in addition to
imported and domestic goods

$$C_g = \left( M_g^{\gamma_g} D_g^{1-\gamma_g} \right)^{1-\lambda_g} R^{\lambda_g}$$

$\lambda_g$ is share of distribution sector in consumer expenditure at purchasers’
prices net of product taxes
Baseline estimates use import shares calculated at basic prices excluding distribution costs and taxes on products.

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$\lambda_g$ is share of distribution sector in consumer expenditure at purchasers’ prices net of product taxes.

Price growth now given by

$$\ln \left( \frac{P_{g,t}}{P_{g,t-1}} \right) = (1-\lambda_g)\gamma_g \ln \left( \frac{P_{gM,t}}{P_{gM,t-1}} \right) + (1-\lambda_g)(1-\gamma_g) \ln \left( \frac{P_{gD,t}}{P_{gD,t-1}} \right) + \lambda_g \ln \left( \frac{P_{R,t}}{P_{R,t-1}} \right)$$

Recalculate direct import share as $(1-\lambda_g)\gamma_g$ and indirect import share to include expenditure on imported intermediate inputs used in distribution sector.
## Estimates with distribution costs

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1) Inflation</th>
<th>(2) Inflation including distribution</th>
<th>(3) Inflation</th>
<th>(4) Inflation including distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post x Import share</td>
<td>0.0709*** (0.0140)</td>
<td>0.123*** (0.0277)</td>
<td>0.0719*** (0.0126)</td>
<td>0.123*** (0.0294)</td>
</tr>
<tr>
<td>Post x Direct Import Share</td>
<td></td>
<td></td>
<td>0.0850* (0.0499)</td>
<td>0.101** (0.0493)</td>
</tr>
<tr>
<td>Post x Indirect Import share</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil</td>
<td>0.672** (0.296)</td>
<td>0.530*(0.289)</td>
<td>0.651* (0.328)</td>
<td>0.559* (0.314)</td>
</tr>
<tr>
<td>Euro area inflation</td>
<td>0.282 (0.201)</td>
<td>0.236 (0.183)</td>
<td>0.277 (0.206)</td>
<td>0.241 (0.189)</td>
</tr>
<tr>
<td>2015 dummy</td>
<td>-0.00510 (0.00399)</td>
<td>-0.00611 (0.00394)</td>
<td>-0.00525 (0.00396)</td>
<td>-0.00591 (0.00394)</td>
</tr>
<tr>
<td>2017 dummy</td>
<td>-0.0146** (0.00693)</td>
<td>-0.0175** (0.00868)</td>
<td>-0.0166** (0.00736)</td>
<td>-0.0169** (0.00768)</td>
</tr>
<tr>
<td>Observations</td>
<td>252</td>
<td>252</td>
<td>252</td>
<td>252</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.491</td>
<td>0.467</td>
<td>0.491</td>
<td>0.476</td>
</tr>
<tr>
<td>Number of products</td>
<td>84</td>
<td>84</td>
<td>84</td>
<td>84</td>
</tr>
<tr>
<td>Product fe</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>
Distribution cost results

- For each 10 percentage point increase in total import share, inflation estimated to be 1.2 percentage points higher in year after referendum.

- Sterling depreciated by ≈ 10% following referendum. Estimates consistent with 100% pass-through of exchange rate depreciation to import prices and 100% pass-through of import costs to consumer prices.

- Aggregating across product groups and attributing negative 2017 fixed effect to referendum implies Brexit vote increased inflation by 1.9 percentage points in year to June 2017.
Exchange rate controls

- Alternative specification: interact import share with observed exchange rate changes (import-weighted)
  - Advantage: controls for pre-referendum exchange rate movements
  - Disadvantages: pre-referendum exchange rate changes not exogenous; assumes symmetry between Brexit vote effect and impact of pre-referendum exchange rate movements

- Quarterly estimates show positive effect of Import share-Exchange rate interaction with one and two lags

- Implied increase in aggregate inflation is 1.6-2.3 percentage points