

How have world shocks affected the UK economy?

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- The UK economy is closely integrated into the wider global economy. These ties mean that global developments affect the economic fortunes of the United Kingdom.
- This article presents model-based estimates which suggest that world shocks have driven around two thirds of the weakness in UK output since 2007.
- Trade linkages are an important channel for the transmission of world shocks to the UK economy. But financial linkages and spillovers through uncertainty are significant, too — and together are likely to account for the majority of the impact of world shocks on the United Kingdom since 2007.

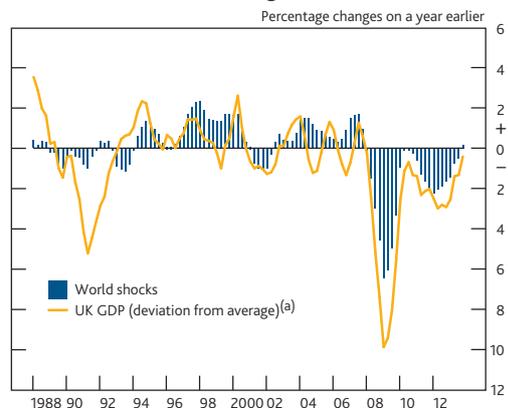
Overview

The UK economy is closely integrated with the rest of the world through the trade of goods and services, and the exchange of financial assets. This interconnectedness means that the UK economic environment is shaped, in part, by events in the wider global economy. These events can be external to the United Kingdom, or common to many economies, including the United Kingdom.

Based on analysis described in this article, the **summary chart** presents estimates of the impact that world shocks have had on UK GDP growth. Integration into the global economy benefited the United Kingdom for much of the two decades prior to the crisis. But global influences drove the bulk of the decline in UK output during the 2008/09 recession, and they held back growth over 2011–12. Overall, world shocks account for around two thirds of the weakness in the level of UK output since 2007.

As well as assessing the *impact* of world shocks, this article considers the *channels* through which they have affected the UK economy. Three channels are likely to have been particularly important since 2007. First, some of the impact of world shocks has come through the **trade channel**, as demand for UK exports weakened and UK import prices increased. Second, world shocks have led to a tighter supply of credit and more volatile asset prices in the United Kingdom — the key mechanisms of the **financial channel**. And third, the close comovement of measures of UK economic uncertainty with those of other countries suggests that the **uncertainty channel** has also played a role in the transmission of world shocks.

Summary chart Estimates of the historical impact of world shocks on UK GDP growth



Sources: Bloomberg, Bureau for Economic Policy Analysis, IMF, OECD, ONS, Thomson Reuters Datastream and Bank calculations.

(a) Line shows UK GDP growth relative to the average over the period 1988–2007, which is 3.1%. The contributions of world shocks are relative to model-consistent trend growth rates.

The Bank's main forecasting model suggests that around one fifth of the total impact of world shocks experienced by the United Kingdom since 2007 was transmitted through the trade channel. The remaining four fifths, therefore, appear to have affected the UK economy through other channels.

This analysis highlights the importance of policymakers understanding the international environment so that domestic monetary and financial policy can be set in a way which takes into account the impact that world shocks are expected to have.

[Click here for a short video that discusses some of the key topics from this article.](#)

(1) The authors would like to thank Tsvetelina Nenova for her help in producing this article.

As an open economy, activity in the United Kingdom is not only affected by domestic economic developments, but also by events taking place in the rest of the world. This article assesses the role that global developments have played in driving the UK business cycle, with a particular focus on the post-2007 period.

There are two ways in which the world will affect the UK economy. First, *events outside of the United Kingdom* can be transmitted to the domestic economy through cross-border linkages. And, second, the UK economy can be affected by *global economic events*, common to large parts of the world. These two concepts can be understood as ‘spillovers’ and ‘common shocks’, respectively. This distinction is conceptually helpful but, in practice, it is hard to distinguish between the two. For that reason, the focus of this article is to investigate the combined role of both these global influences on the United Kingdom, and they are referred to collectively as ‘world shocks’. In that context, this article focuses on two questions. First, what has the total impact of world shocks on the UK economy been? And, second, what are the channels through which those shocks have had an impact on the United Kingdom?

Understanding world shocks is important for the Monetary Policy Committee (MPC) for the setting of monetary policy and the Financial Policy Committee (FPC) for the setting of macroprudential policy.⁽¹⁾ Gauging their impact on the United Kingdom allows the MPC and FPC to set policy in a manner which takes into account the effect that world shocks are expected to have on the UK economy and financial system over coming years. And identifying transmission channels can allow policymakers to put in place policies that help either to limit or to offset the impact of shocks. A strong understanding of how the rest of the world affects the United Kingdom can also assist the Bank in its aim to support the setting of policy in international fora, such as the G20.⁽²⁾

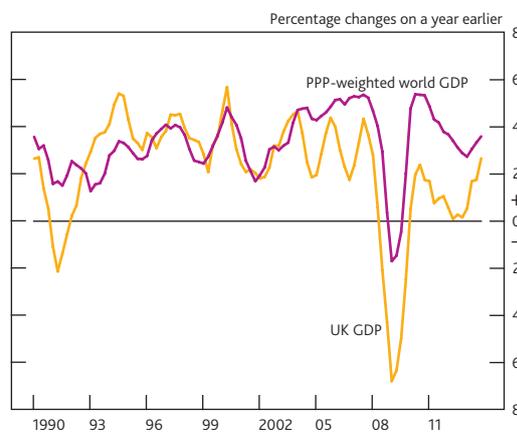
The first section of this article discusses how the events of the 2007–09 financial crisis and subsequent UK recovery have been shaped by global events. The next section uses a modelling approach to analyse *how much* world shocks have affected UK activity. The results presented in that section show that world shocks have played a first-order role in driving the UK business cycle. Given their importance, the final section explores the ways in which world shocks made their impact, documenting that financial linkages and uncertainty appear to have been more important than trade linkages for the transmission of world shocks. A short video explains some of the key topics covered in this article.⁽³⁾

How have global developments affected the United Kingdom since 2007?

Economic developments in other countries matter for the United Kingdom because it is exposed to the rest of the world — that is, it is an ‘open’ economy. This means that the international environment can affect a number of economic variables in the United Kingdom, including output and inflation. There are two key dimensions in which the UK economy is open: first, by how much it trades with the rest of the world, and second, by how financially integrated it is with other countries in terms of capital flows. On these two dimensions, the United Kingdom has a high level of trade and financial openness compared to other advanced economies.⁽⁴⁾

If an economy is open, like the United Kingdom, then domestic activity is likely to display some comovement with global activity because developments abroad transmit to the United Kingdom, or because the United Kingdom is affected by the same shocks that affect other countries. **Chart 1** shows that the correlation coefficient between annual UK and world GDP growth is reasonably high at 0.6, consistent with world shocks having a material influence on the United Kingdom.

Chart 1 UK and world GDP growth^(a)



Sources: IMF, OECD, ONS, Thomson Reuters Datastream and Bank calculations.

(a) World GDP is constructed using data for the real GDP growth rates of 144 countries weighted according to their shares in world GDP using the IMF's purchasing power parity (PPP) weights. For more information, see Callen (2012). Data are shown up to the end of 2013. The weight of UK GDP within PPP-weighted world GDP has been around 3.4%, on average, over 1988–2013, such that it is only a minor contributor to the magenta line.

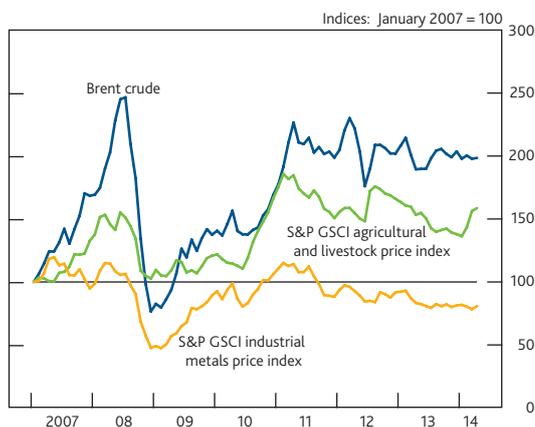
- (1) Tucker, Hall and Pattani (2013) describe the new powers for macroprudential policymaking in the United Kingdom in the wake of the recent financial crisis.
- (2) Carney (2014), for example, notes the Bank's aim to support the G20's programme of financial reform.
- (3) See <http://youtu.be/bPWAWOAvTA4>.
- (4) The United Kingdom's trade openness, measured by adding together the value of its exports and imports as a share of GDP, is greater than 60%. The United Kingdom's financial openness, measured by adding together its stock of assets and liabilities with the rest of the world, is around 1,400% of GDP. These two measures indicate how much the United Kingdom trades in goods and services and financial assets, respectively, relative to its size. They are based on an updated and extended version of the data set constructed by Lane and Milesi-Ferretti (2007), as well as the IMF April 2014 *World Economic Outlook*. Around half of the UK external assets are held by banks, indicating that international banking is integral to the United Kingdom's financial openness.

The importance of world shocks for the UK economy is well illustrated by the period since 2007. Over that time, world events — the stresses in global financial markets over 2007–09, the steep fall and rise in global commodity prices over 2008–11 and, since 2010, the euro-area crisis — have shaped macroeconomic developments in the United Kingdom.⁽¹⁾

Over 2007–09, the United Kingdom, like many countries, was adversely affected by the sudden deterioration in risk appetite and increased uncertainty associated with the global financial crisis. The downturn in the US sub-prime market triggered stress in international banking systems and money markets. As the crisis escalated, credit conditions tightened and households and firms became more uncertain about the outlook for activity across many advanced economies. The crisis was associated with a severe downturn in the United Kingdom, as demand for UK exports collapsed and borrowing costs in the UK private sector increased severely.⁽²⁾ The peak-to-trough fall in UK output was 7.2%, the largest recession in the post-war period.⁽³⁾

Prices of oil and other commodities have also been volatile since 2007. Having reached historically high levels in mid-2008, the dramatic weakening in prospects for world activity led to a sharp fall in commodity prices. This increased the amount of income available to UK households to spend on goods other than energy and food, thereby providing some offset to the downward pressure on demand associated with the financial crisis. But commodity prices recovered strongly from 2009 onwards, driven in part by strong demand associated with the robust recovery in emerging economies. And subsequent supply shocks in several markets led to further increases in these prices, even as the recovery in global activity moderated from mid-2011 (Chart 2). Hackworth, Radia and Roberts (2013) argue that the consequent price pressures contributed to UK inflation exceeding the MPC's target of 2% after 2010. And, by squeezing real incomes, they were also a

Chart 2 Commodity prices^(a)



Sources: Thomson Reuters Datastream and Bank calculations.

(a) Monthly data. All indices are priced in US dollars.

factor in the sluggishness of the recovery in UK demand between 2010 and 2012.

The euro-area crisis, which began in 2010, was also a significant world shock for the United Kingdom. As concerns mounted in financial markets from mid-2010 about the solvency of several euro-area governments and banking systems, borrowing costs in a number of countries increased. Alongside fiscal consolidation to reduce government deficits, a tightening in credit conditions reduced demand across much of the euro area. The United Kingdom was negatively affected by this as demand for UK exports from major trading partners diminished. Moreover, concerns about the UK banking system's exposure to the euro area also led to higher funding costs for banks with a presence in the United Kingdom. This in turn raised the price and reduced the availability of credit to UK households and firms, weighing on domestic activity.⁽⁴⁾

In response to world shocks, as well as some more UK-specific factors, UK monetary policy was loosened significantly, with Bank Rate reduced from 5.75% in late 2007 to 0.5% in early 2009 in order to support UK output and inflation during the global financial crisis. Having reached the effective lower bound for interest rates, the MPC then began a series of asset purchases, often referred to as quantitative easing, in a further attempt to stimulate UK economic activity.⁽⁵⁾ And as the euro-area crisis intensified from late 2011, measures were also taken to alleviate the increase in UK banks' funding costs and the associated tightening of credit conditions. The Funding for Lending Scheme, introduced in mid-2012, provided a source of cheap funding to banks and building societies, with more (and cheaper) funding made available to banks that extended loans to the UK real economy.⁽⁶⁾ All of these policies can be viewed — at least in part — as responses to world shocks, rather than exogenous actions in themselves. And without them, UK GDP growth would have been substantially weaker.

Which world shocks have been most important for the United Kingdom since 2007?

To analyse world shocks in a more systematic way, it is useful to distinguish between the *source* of the underlying economic

- (1) Another important economic development for the United Kingdom since 2007 was the 25% nominal depreciation of the sterling effective exchange rate index between mid-2007 and early 2009. Kamath and Paul (2011) note that this depreciation induced 'expenditure switching' such that UK net trade improved, supporting domestic output.
- (2) Astley *et al* (2009) provide a similar account of the financial crisis, but focus on the role of global imbalances as a cause in the years preceding 2007.
- (3) Hills, Thomas and Dimsdale (2010) discuss the features of the 2008/09 UK recession in a historical perspective.
- (4) Similarly, Hackworth, Radia and Roberts (2013) argue that the intensification of the euro-area crisis can explain part of the unexpected weakness of UK GDP from mid-2010 to mid-2013. Note that the analysis presented in that article focused on explaining the news in economic developments relative to the MPC's projections, whereas this article analyses the total impact of world shocks.
- (5) Joyce, Tong and Woods (2011) discuss the United Kingdom's quantitative easing programme in detail.
- (6) Churm *et al* (2012) discuss the Funding for Lending Scheme in detail.

disturbance and the *transmission channels* through which these shocks operate. The next section of this article considers these transmission channels in more detail. This section focuses on the source (or nature) of world shocks, and presents some quantitative estimates of the impact of those shocks, operating through all channels, on UK GDP.

In the real world, each event will be associated with unique circumstances, so that each 'shock' that causes economic agents to adjust their behaviour is slightly different to any other. Nonetheless, it is useful to classify world shocks into three broad types, according to their source.

- (i) **World demand shocks.** These are associated with a rise or a decline in spending and confidence abroad. This group of shocks includes changes to fiscal plans of foreign governments, as well as changes to foreign firms' and households' confidence and thus their appetite to spend, hire and invest.
- (ii) **World supply/price shocks.** These shocks originate in the production sector of the global economy and affect the global supply and prices of goods and services. For example, an unexpected fall in the supply of a commodity that is traded globally would likely trigger a rise in its price.
- (iii) **World financial shocks.** These occur in the global financial system, such as increased stress in the international banking system or financial markets. They might relate, among other things, to changes in the price of risk, driven by investors reassessing their perceptions of the riskiness of an asset class.

This categorisation, which explicitly allows for financial shocks, is supported by much of the theoretical literature: several studies have highlighted the importance of financial frictions in driving business cycle fluctuations,⁽¹⁾ while others emphasise that financial crises have particularly large effects on output. Reinhart and Rogoff (2009), for example, find that financial crises are associated with larger output losses and slower recoveries than more 'conventional' recessions (such as those driven by central banks actively raising interest rates to dampen demand). Indeed, Hills, Thomas and Dimsdale (2010) argue that the recent UK recession had a defining characteristic that 'the financial sector was both the source and propagator of the crisis'. Given this, it is logical to capture the role of financial shocks separately to more traditional demand and supply shocks.

For countries with a flexible exchange rate, like the United Kingdom, standard macroeconomic theory suggests that the exchange rate can act as a stabiliser against shocks. In the event of an adverse domestic demand shock, for example, depreciation of the UK real exchange rate should induce domestic consumers to import less from the rest of the world,

and foreign consumers to import more from the United Kingdom, supporting UK net trade and output. In practice, however, movements in the exchange rate do not appear to fully insulate economies from the effect of shocks. For that reason, the analysis in this article is based on the premise that sterling may not adjust sufficiently to prevent world shocks from affecting the United Kingdom.⁽²⁾

Modelling world shocks: a VAR approach

The common difficulty in quantitatively assessing the impact of different forces on the macroeconomy is distinguishing between the original shocks and the endogenous responses by economic agents — such as households, companies, employees and policymakers — to those shocks. This is because patterns observed in the data could be consistent with several different underlying causes. Higher inflation in an open economy, for example, could be consistent with a positive domestic or foreign demand shock, as well as a negative domestic or foreign supply shock.

A frequently used approach in macroeconomics to deal with this issue of identification of shocks is a vector autoregression (VAR).⁽³⁾ This approach allows a high degree of interconnectedness — or endogeneity — meaning that all the variables can, in principle, be affected by each other. This is desirable when modelling, as it captures the interconnectedness of economic variables in the real world. The VAR models presented here allow for the classification of the shocks as described above. And, by imposing a simple economic structure on the data, it also makes it possible to trace their impact on the UK economy.⁽⁴⁾

There are several ways in which such a structure could be imposed. Most techniques focus on the response of each variable 'on impact': the structure imposes restrictions on how each variable responds to the shock as it happens. The models used here rely on two different techniques. The first focuses on *which* variables respond to each shock. For example, asset prices are assumed to respond to activity shocks immediately, but not *vice versa*. This corresponds to the intuition that asset price movements take some time to feed through to households' and businesses' decisions and thus to activity. The second technique restricts the *sign* of the response of variables on impact. For example, positive demand shocks boost output and prices, while negative supply shocks put upward pressure on prices and depress activity.

(1) Kiyotaki and Moore (1997) and Bernanke, Gertler and Gilchrist (1998), for instance, are two seminal contributions that introduce credit and financial frictions to the analysis of the business cycle.

(2) Farrant and Peersman (2006), for example, argue that the exchange rate is a source of shocks, rather than a stabiliser.

(3) Sims (1980), for instance, proposes the use of VAR models to capture the endogeneity of macroeconomic variables.

(4) Of course, this is only one potential technique that can be applied in this context. Alternative estimates could be obtained from general equilibrium models, for example. These are not considered in this article.

As with every modelling exercise, there is uncertainty about how well any given technique fits the data and how accurately it represents the real world. For that reason, this article presents results from four models that use different techniques. This demonstrates how robust the conclusions are to any particular approach. The set-up of the models rests on the assumption that the rest of the world can have a large impact on the UK macroeconomy, while home-grown UK-specific shocks have no impact on the rest of the world. Of course, in practice, this assumption only holds approximately: several smaller countries most tightly linked with the United Kingdom may be affected by shocks that originate here. And the relatively large UK financial system could in principle be a source of shocks for other countries. But those effects are likely to be limited in a global context.

This means that the models contain two sets of variables — or ‘blocks’. The UK block is relatively simple, as it contains only real GDP, consumer prices index (CPI) inflation and Bank Rate. This simplicity is intentional, and reflects the objective of the modelling exercise, which is to identify world, rather than domestic, shocks (this is explored in more detail below). Correspondingly, the world block is more complex, and consists of a measure of world activity (world GDP, or a broader set of indicators), a measure of world prices, an indicator of financial market stress (the spread between the three-month dollar interbank lending rate and the three-month Treasury bill rate) and a financial market-based measure of uncertainty (the VIX index). All variants of the model are estimated on quarterly data spanning the period from 1987 Q1 to 2013 Q4. A more detailed description of the individual models is contained in the annex.

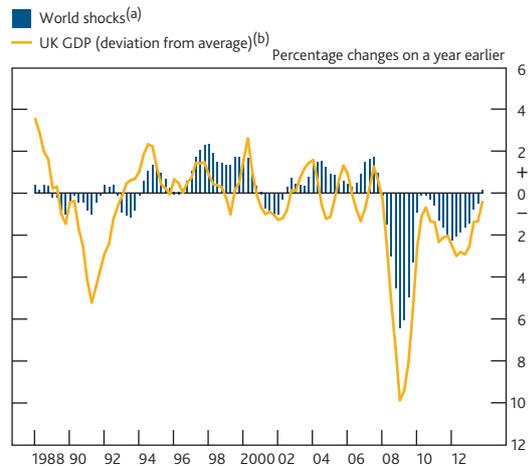
This approach means that UK monetary policy is endogenous to the models, with movements in Bank Rate largely being interpreted as responses to other shocks. Reductions in Bank Rate after 2007 can therefore be understood as a response to the global financial crisis, rather than as shocks in themselves. ‘Unconventional’ monetary policy, such as quantitative easing and the Funding for Lending Scheme, is not explicitly included in the model. But insofar as these policies affect UK GDP, their effects will be captured implicitly as positive UK-specific shocks.

Results of the VAR

To present the key results, it is useful to average across the four different model specifications. Averaging across the models yields a central estimate for the impact of world shocks on UK GDP growth over the past 25 years (**Chart 3**). The blue bars show the total impact of all world shocks (world demand, world supply/price and world financial) on annual GDP growth in the United Kingdom.⁽¹⁾

This analysis suggests that the early 1990s UK downturn was mostly driven by domestic, rather than external factors.

Chart 3 Estimates of the historical impact of world shocks on UK activity



Sources: Bloomberg, Bureau for Economic Policy Analysis, IMF, OECD, ONS, Thomson Reuters Datastream and Bank calculations.

- (a) Average estimates across the four variants of the structural vector autoregression model.
 (b) Line shows UK GDP growth relative to the average over the period 1988–2007, which is 3.1%.
 The contributions of world shocks are relative to model-consistent trend growth rates.

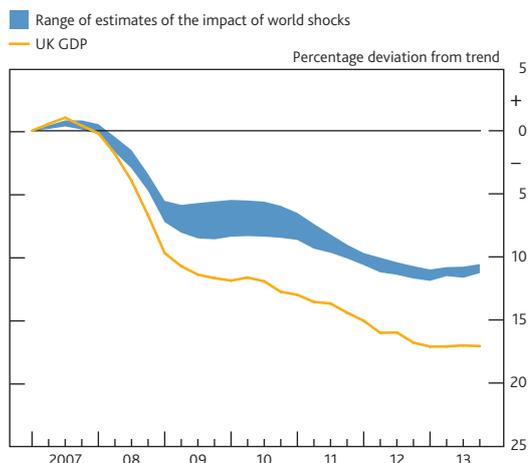
During the so-called ‘Great Moderation’ — the period of stable growth and inflation between the mid-1990s and 2007 — world shocks generally exerted a positive impact on the United Kingdom, possibly reflecting loose global credit conditions and a low perception of risk, as well as healthy growth in overseas demand.

Consistent with the narrative in the previous section, these results indicate that UK GDP growth since 2007 has largely been shaped by global developments. It is particularly striking that world shocks deducted over 6 percentage points from annual UK GDP growth at the height of the recession. The recovery was subsequently held back by world shocks too. This result is consistent with Hackworth, Radia and Roberts (2013), who find that disappointing global growth and high commodity prices accounted for a significant part of the unexpected weakness in UK GDP after mid-2010. Interestingly, a large part of the pickup in UK growth since 2012 appears to have been driven by a waning of the drag from world shocks.

The identified world shocks can account for the level of UK GDP at end-2013 being around 11% lower than a simple counterfactual of a continuation of the pre-crisis trend would have predicted (**Chart 4**). These results therefore suggest that around two thirds of the current shortfall in output in the United Kingdom relative to pre-crisis trend came about as a result of global developments.⁽²⁾

- (1) The lines for UK GDP in **Charts 3–5** represent useful reference points to put estimates for the impact of world shocks into context.
 (2) The difference in trends between the model-based estimates and UK GDP in **Charts 4 and 5** mean that the models provide a conservative estimate for the impact of world shocks on UK GDP. This is because the 1988–2013 average of UK GDP growth is lower than the 1988–2007 average, such that the deviation of UK GDP since 2007 from the longer 1988–2013 trend period would be lower than that shown here.

Chart 4 Estimates of the impact of world shocks on the level of UK GDP since 2007, relative to trend^(a)



Sources: Bloomberg, Bureau for Economic Policy Analysis, IMF, OECD, ONS, Thomson Reuters Datastream and Bank calculations.

(a) The line shows the level of UK GDP relative to a continuation of the average four-quarter growth rate of 3.1% over the 1988–2007 period. Estimates in the blue swathe are relative to model-consistent trend rates.

But which particular world shocks have been important since 2007? **Chart 5** sets out model estimates for the individual contribution of world demand, world supply/price and world financial shocks to the shortfall of UK GDP, relative to the same simple counterfactual of the pre-crisis trend. The models suggest that two shocks were particularly important: world supply/price shocks and world financial shocks. The world demand shocks played a role in the early stages of the financial crisis, but their impact has since diminished. As the width of these swathes illustrates, there is substantial uncertainty about the ‘source’ of the shocks: some models suggest that world financial shocks played a bigger role than world

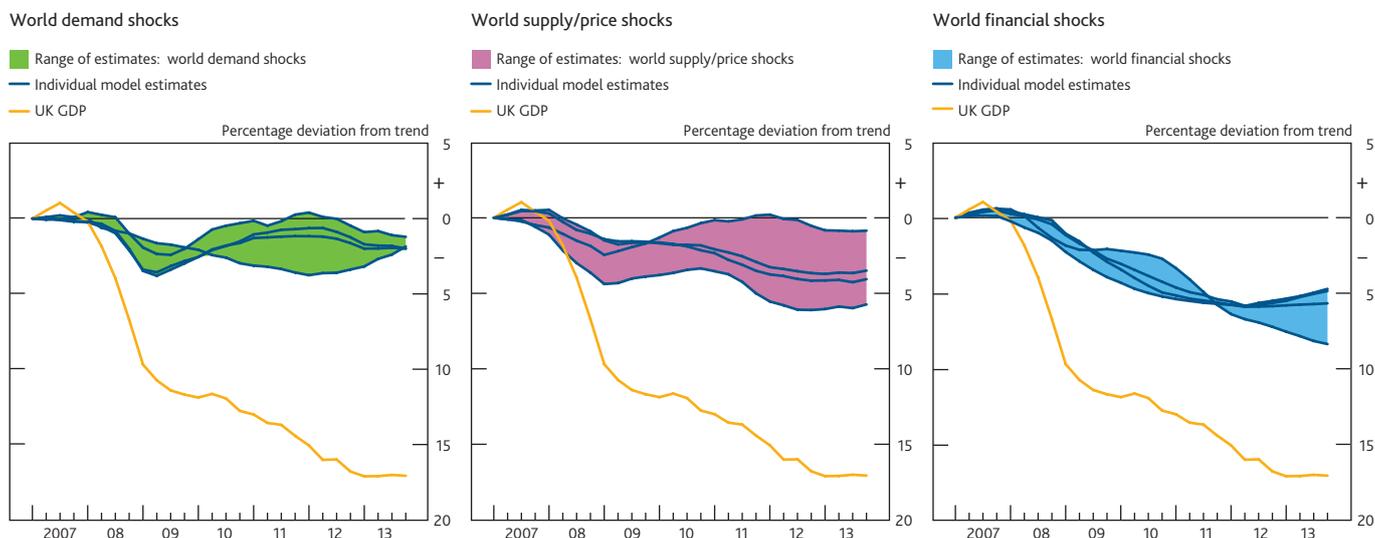
supply/price shocks, while others suggest that the two had a similar impact.

The results show that the key headline result — that world shocks in aggregate account for around two thirds of the weakness in UK output since 2007 — seems robust to several different VAR-modelling strategies. And despite identification of the impact of *specific* shocks being more uncertain, different specifications confirm that world shocks have been important for the United Kingdom.

While world shocks have been the dominant influence on UK activity in recent years, domestic factors have also been important over this period. UK productivity growth, for example, has been extremely weak over this period, both compared with past experience, as well as relative to other countries.⁽¹⁾ It is therefore likely that the UK economy’s supply capacity has been adversely affected since the onset of the crisis.⁽²⁾ That said, the poor recent performance of UK productivity may itself be symptomatic of world shocks. The impairment of the UK banking system associated with the global financial crisis, for instance, may have restricted the reallocation of resources from less to more productive uses. In addition, weak UK credit supply may also have slowed productivity growth. A further domestic shock that has detracted from UK growth since 2010 is fiscal consolidation, as reduced discretionary government spending and higher VAT dampened aggregate demand.⁽³⁾

- (1) Hughes and Saleheen (2012) consider UK labour productivity since the financial crisis in an international and historical perspective.
- (2) See Barnett *et al* (2014), in this edition of the *Bulletin*, for a detailed discussion of candidate explanations for the UK productivity puzzle.
- (3) Hackworth, Radia and Roberts (2013) point out that fiscal consolidation has been broadly in line with the Government plans announced in 2010 and is, therefore, unlikely to explain the *unexpected* weakness of UK GDP from mid-2010 to mid-2013.

Chart 5 Estimates of the impact of three world shocks on the level of UK GDP since 2007, relative to trend^(a)



Sources: Bloomberg, Bureau for Economic Policy Analysis, IMF, OECD, ONS, Thomson Reuters Datastream and Bank calculations.

(a) Charts show the estimated impact of the shock on the level of UK GDP, with separate lines for each of the four estimated models. The swathe illustrates the range of impacts across the models. Pre-crisis trend for four-quarter UK GDP growth calculated over the period 1988–2007 is 3.1%. The model estimates are relative to model-consistent trend rates.

All of the models in this article share the same broad characteristics, and, as is the case with every econometric modelling exercise, there is a degree of uncertainty around the results. Three of these characteristics merit discussion.

- (1) **The models implicitly assume that there was no structural change in the UK or world economies over the past 25 years.** In practice, the structure of both the UK and global economies has of course changed. Financial openness, for example, has tended to increase over time. But the headline results are robust to varying the estimation period: for example, estimation only over the post-2000 period yields very similar results to those presented here.
- (2) **The models do not distinguish between shocks which are genuinely external to the UK economy, and those which are common to most or all individual economies, including the United Kingdom.** This distinction may be straightforward at times. A fiscal expansion abroad, for example, is clearly external to the United Kingdom. An increase in oil prices, by contrast, is a common shock in the sense that all countries would experience the higher global oil price. But the distinction between external and common shocks is more blurred in other cases. Some shocks may have a specific geographical origin, but still transmit instantaneously to the wider global economy. Stresses in the US sub-prime sector in 2007, for instance, quickly increased households' and firms' uncertainty levels in many advanced economies. Given this conceptual difficulty, and as discussed in the introduction, the aim of this section is to assess the *total* impact of world shocks on the United Kingdom, rather than analyse the relative importance of external versus common shocks.
- (3) **The modelling approach assumes that the United Kingdom is a small open economy, meaning that UK-specific developments have little to no impact on the world economy.** In particular, if truly domestic UK shocks happen to coincide with world shocks, the models could misinterpret those as world shocks. And given the relatively large size of the UK financial system, it is of course possible that the United Kingdom could be a source of financial shocks for the rest of the world. But over the long sample period considered it is sensible to assume that UK-specific shocks had little impact on the global economy at large.

Through which channels do world shocks affect the United Kingdom?

The previous section discussed estimates of the *impact* of world shocks on the UK macroeconomy. But those models did not identify the *channels* through which those shocks affected the United Kingdom.⁽¹⁾ Understanding channels of

transmission is important because doing so can allow policymakers to attempt either to limit or to offset the impact of shocks. In practice, it is the United Kingdom's trade and financial linkages with the rest of the world that allow for the transmission of world shocks. This section provides a stylised explanation of the trade and financial channels of transmission, as well as a third channel that transmits world shocks via agents' economic uncertainty. It outlines how specific mechanisms operate, and also provides an indicative assessment of the importance of trade relative to other channels for the United Kingdom. While the focus is on the period since the onset of the financial crisis — when global events are estimated to have had a negative impact on UK GDP — it is important to bear in mind the fact that the UK economy benefitted from world shocks for much of the two decades prior to the financial crisis (**Chart 3**).

The trade channel

The trade channel captures changes to the cross-border flow of goods and services that result from world shocks. The impact of developments abroad will be felt in the United Kingdom through changes in the quantities and prices of UK exports and imports.

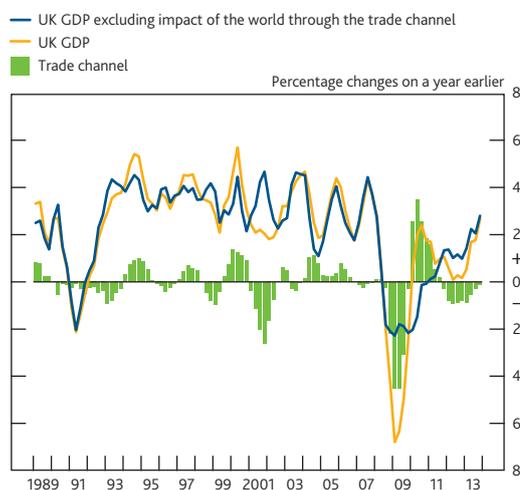
All the world shocks discussed in the previous section can propagate through the trade channel. A negative demand shock abroad will reduce demand for UK exports, lowering the price and quantity of UK goods and services exported. And insofar as it leads to a greater shortfall in UK output than the United Kingdom's trading partners, the negative demand shock may also cause sterling to depreciate in order to eliminate spare capacity in the UK economy. A foreign financial shock, such as a failure of a financial institution abroad, could also reduce demand for UK exports. Meanwhile, a world supply/price shock, for instance a natural disaster that leads to a fall in the production of oil and an increase in oil prices, would primarily transmit through increased UK import prices, which in turn would put upward pressure on firms' costs and squeeze households' incomes available for other purchases. Regardless of the source of the shock, lower demand for UK exports or higher import prices are likely to depress domestic output.

Indirect trade effects also matter because a shock in a country *without* sizable direct trade linkages with the United Kingdom could still affect UK GDP by transmitting through other countries which are close trading partners of the United Kingdom. This is particularly the case given the presence of long and complex global supply chains: for example, the floods in Thailand in 2011 resulted in disruption to the global supply chain of hard drives.

(1) 'Channels' here refers to both the mechanisms by which shocks originating in a foreign country transmit to the UK economy, but also the linkages that allow 'global' shocks common to a number of economies (including the United Kingdom) to have a direct impact on the UK economy.

The Bank's main forecasting model, COMPASS, can be used to estimate the extent to which world shocks transmitted to the United Kingdom through the trade channel (**Chart 6**).⁽¹⁾ While subject to uncertainty, the estimate from COMPASS suggests that, at its peak, the collapse in world trade detracted significantly from annual UK growth.⁽²⁾ Around 2% of the total shortfall, relative to trend, in the level of UK GDP by end-2013 was due to world shocks being transmitted to the United Kingdom through the trade channel. While clearly significant, this represents only around one fifth of the total weakness in UK GDP allocated to world shocks in the previous section. Four fifths of world shocks since 2007 therefore appear to have affected the UK economy through other, 'non-trade' channels (**Table A**).

Chart 6 Estimated impact of world shocks on UK GDP through the trade channel^(a)



Sources: IMF, OECD, ONS, Thomson Reuters Datastream and Bank calculations.

(a) Green bars are the difference between blue and orange lines and show estimates from COMPASS that capture the trade effects of shocks that originate outside the United Kingdom. And while they do not capture the *direct* effects on UK GDP of any shocks that are common to both the United Kingdom and other economies, they do include the 'second-round' trade spillover effects of those common shocks.

Table A Channels through which world shocks have impacted UK GDP

Total estimated impact of world shocks on the level of UK GDP relative to pre-crisis trend since 2007^(a)	Around -11%
<i>of which is estimated to have transmitted through:</i>	
<i>the trade channel</i>	<i>Around -2%</i>
<i>other (non-trade) channels</i>	<i>Around -9%</i>

(a) Average of structural vector autoregression models discussed in the previous section of this article.

Financial channels

Financial channels operate in parallel to the trade channel described above. While the trade channel involves the exchange of goods and services across countries, the exchange of financial assets underlies financial channels. Financial integration can bring benefits to the world economy, for instance by increasing the flow of funding to globally productive projects. But in times of stress, those same

financial linkages can allow shocks to spread from one country to another.⁽³⁾

Although the financial transmission of shocks is complex, a simple classification distinguishes between three types of channel: credit, funding and non-banking. Both credit and funding channels operate through the banking system and are associated with changes in UK credit conditions, via the availability or price of credit. Non-banking channels, by contrast, operate directly through households, firms and non-bank financial institutions, such as pension funds and hedge funds. These banking and non-banking channels can affect overall UK activity through their impact on household consumption and business investment.

(i) Credit channel

The credit channel works via banks operating in the United Kingdom, and in particular, how lending to UK households and companies may be affected by the crystallisation of risks associated with these banks' exposures abroad. Consider, for example, a weakening of demand conditions in a foreign country that led to an increase in non-performing loans there. If a UK bank suffered losses abroad as a result of this then its capital base would be reduced — as would its capital ratio, that is, capital as a share of total assets.⁽⁴⁾ In response to this, if the bank attempted to rebuild its capital ratio then one way in which it might achieve this is via reducing the size of its balance sheet (that is, total assets) by restricting the amount of new loans it supplies to the UK real economy (which might be achieved by raising the interest rates the bank charges on new loans). Similarly, foreign banks operating in the United Kingdom may face losses on their lending in their home country or elsewhere. This too may result in a tightening of UK credit conditions.

(ii) Funding channel

The funding channel reflects the reliance of UK financial institutions on foreign funding. To illustrate this channel, consider the case of a foreign bank short of liquidity. The cash-strapped foreign bank may withdraw funding that it supplies to UK banks. This might occur directly through international wholesale markets (where UK banks seek funds), or through a reduction of cross-border lending to the foreign bank's affiliates in the United Kingdom (if these affiliates in turn provide funds to UK banks). If UK banks cannot replace

(1) COMPASS includes trade linkages between the United Kingdom and the rest of the world. For more information on COMPASS see Burgess *et al* (2013).

(2) Domit and Shakir (2010) explain the collapse of world trade during the Great Recession in more detail, focusing on the fact that the decline in world demand was skewed toward tradable sectors.

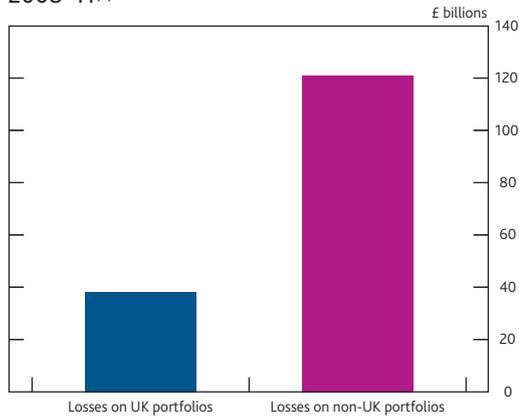
(3) See, for example, Devereux and Yetman (2010) and Enders, Kollmann and Müller (2011). Lane and Milesi-Ferretti (2011) find that the importance of financial channels might have increased in recent years, particularly in the context of the financial crisis.

(4) For an explanation of bank capital, see Farag, Harland and Nixon (2013).

this lost funding, then they may be forced to cut back lending as set out under the credit channel.⁽¹⁾

There is strong evidence that both the credit and funding channels played an important role for the transmission of world shocks to the UK economy in the global financial crisis. Broadbent (2012) points out that major UK banks' losses were, in large part, on their non-UK portfolios (Chart 7) which, in turn, is likely to have led them to restrict their lending to the UK economy. Furthermore, lending from non-resident UK banks to the United Kingdom weakened more sharply than credit from resident UK banks over 2007–09 (Chart 8).⁽²⁾ And Aiyar (2011) argues that every 1% reduction in UK banks' external funding was associated with a 0.5%–0.6% contraction in the flow of domestic lending.⁽³⁾ These results are all consistent with both credit and funding channels operating.

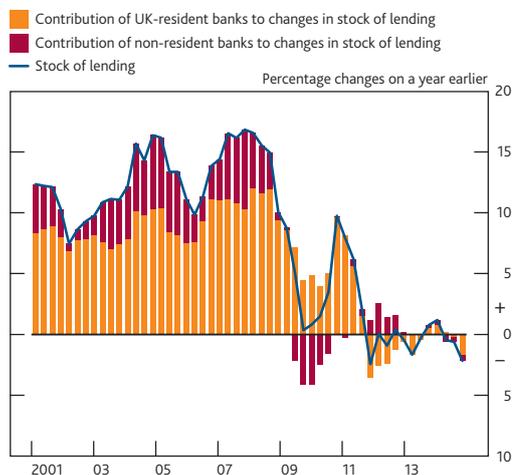
Chart 7 Losses of major UK-owned banks by portfolio, 2008–11^(a)



Sources: FSA regulatory returns, published accounts and Bank calculations.

(a) Losses are defined as the sum of impairment, write-off, trading book and goodwill losses. Impairments and write-offs are taken from Financial Services Authority (FSA) regulatory returns. These data are indicative. Goodwill impairments are calculated on a *pro-forma* basis and may be subject to error. Non-UK entities include banks and other financial institutions. Due to sampling and definitional differences, these may not match those disclosed in published accounts or in the Bank of England's *Bankstats*. Banks covered in the chart are: Barclays, Co-operative Bank, HSBC, Lloyds, Nationwide, Royal Bank of Scotland and Santander.

Chart 8 Contribution of UK-resident and non-resident banks to UK credit growth^(a)



Sources: BIS locational database and Bank calculations.

(a) UK credit growth defined as lending to the non-financial private sector, government and other financial companies.

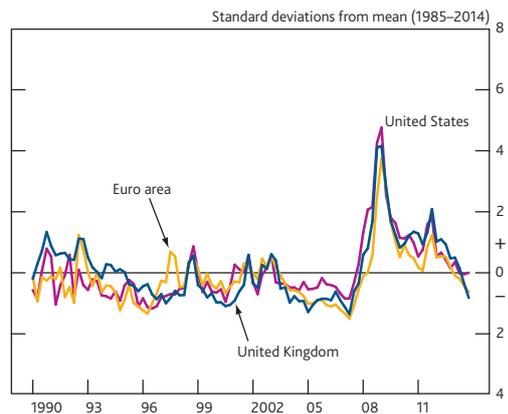
(iii) Non-banking channels

Around half of UK foreign assets and liabilities are held outside the banking system (for instance via portfolio and foreign direct investment) so world shocks can propagate to the UK economy through non-banking financial channels as well. For instance, there may be 'wealth effects' whereby UK households and firms cut back their spending if a shock abroad causes them to suffer losses on their foreign financial investments. And this could be exacerbated if the fall in the value of their assets also limits their ability to borrow. Alternatively, investment decisions by foreign agents might affect UK asset prices. A shock abroad, for example, could potentially cause UK asset prices to fall if foreign investors were to sell their UK holdings and repatriate capital. UK asset prices might rise, by contrast, if foreign investors view UK assets as a safe haven following a shock. While the empirical literature in this area is still at a relatively early stage, some recent research suggests that this channel could be significant for the transmission of shocks. Arslanalp and Poghosyan (2014), for example, estimate that international flows to the UK bond markets over 2008–12 reduced ten-year government bond yields by 20–30 basis points.

Uncertainty

Beyond the trade and financial channels, world shocks can also propagate to the UK economy by affecting the level of uncertainty. Macroeconomic uncertainty refers to how wide households and firms perceive the range of their possible future incomes to be. Chart 9 shows summary measures of

Chart 9 Measures of uncertainty across countries^(a)



Sources: Eurostat, ONS, Thomson Reuters Datastream and Bank calculations.

(a) Uncertainty indicators for the United Kingdom, euro area and United States include option-implied volatility of exchange rates and equity prices, survey measures of confidence and measures of the dispersion of earnings growth expectations over the next twelve months. The uncertainty indicator for the United Kingdom also includes: dispersion of annual GDP growth forecasts, measures obtained from press articles citing 'economic uncertainty' and measures from the Confederation of British Industry's *Quarterly Industrial Trends* and *Service Sector* surveys related to companies' capital expenditure.

- (1) While bank lending creates deposits at the aggregate level, a given individual bank needs to make sure it is able to attract and retain some kind of funds in order to keep extending more loans. See McLeay, Radia and Thomas (2014).
- (2) Hills and Hoggarth (2013) find evidence that lending from non-resident banks was more volatile than lending from resident banks in most advanced economies during the financial crisis.
- (3) Barnett and Thomas (2013) find that credit supply shocks account for most of the weakness in UK bank lending since the financial crisis.

uncertainty for the United Kingdom, the euro area and the United States, each based on a number of underlying indicators.⁽¹⁾ While some of the changes in UK uncertainty may reflect domestic factors, the close correlation of uncertainty measures across countries since 2007 suggests that it may have been a channel for the transmission of world shocks to the United Kingdom. The start of the US sub-prime crisis in 2007 and euro-area crisis from 2010, for example, are likely to have increased the uncertainty of UK households and firms about the domestic economy and prospects for their own income and revenue. Consistent with events abroad generating increased uncertainty in the UK private sector, the Deloitte survey of UK chief financial officers in 2012 Q2 reported a fairly high probability — 36% — of a break-up of the euro area over the following year.

There are several ways in which elevated uncertainty can dampen demand. Bernanke (1983) and Bloom (2009), for example, suggest that households postpone spending when economic prospects become more uncertain because their incentive to 'wait and see' how the economy evolves increases. Firms reassess their prospects for demand, leading them to postpone investment. Finally, elevated uncertainty may push up borrowing costs for households and firms as investors demand greater compensation against future risks. Previous Bank analysis suggests that uncertainty shocks, including uncertainty driven by foreign factors, can have material impacts on UK GDP.⁽²⁾

Interaction of channels of transmission

It is important to note that the trade, financial and uncertainty channels described in this section rarely operate in isolation. Instead, they are active simultaneously, and feedback loops among channels can amplify the effect of shocks. To that extent, the estimates in **Table A** should be taken with a degree of caution.

The uncertainty channel, in particular, can amplify both trade and financial mechanisms. This is because it leads consumers and firms to be unsure about what the ultimate effect of world shocks will be. A financial shock, for example, such as an isolated failure of a financial institution abroad, might be transmitted through credit channels. But it could also affect households' and firms' sense of economic uncertainty. The

academic literature suggests that if domestic agents become more uncertain in response to events abroad, this can amplify their response to shocks, via second-round effects through the trade and financial channels. Taglioni and Zavacka (2013), for instance, find that exporters' production plans are heavily affected by their uncertainty about the foreign trading environment.

Conclusions

The UK economy is highly exposed to foreign economic developments due to its trade and financial openness. And given the major world events that have occurred since 2007, the global economy has been an important influence on UK output and inflation over the recent past. These events include the global financial crisis in 2007–08, severe gyrations in global commodity prices over 2008–11 and, since 2010, the euro-area crisis.

Model-based estimates suggest that world shocks played a very important part in the 2008–09 downturn in the United Kingdom and account for around two thirds of the weakness in the level of UK GDP since 2007, relative to its pre-crisis trend. Transmission through the trade channel, however, can only account for around a fifth of the impact of these shocks on the United Kingdom. Financial channels and uncertainty are likely to have been more important.

An awareness of the impact of world shocks and the channels through which they transmit has been a key feature of UK monetary and financial policy, particularly since the crisis. The loosening in monetary policy by major central banks in late 2008, for instance, attempted to support economic activity at the height of the financial crisis while avoiding exchange rate volatility.⁽³⁾

The analysis in this article affirms the importance of understanding the international environment for policymakers. Doing so allows domestic monetary and financial policy to be set in a way which takes into account the impact that world shocks are expected to have going forward. And understanding the linkages between the United Kingdom and the rest of the world can help to assist the Bank in its aim to support the setting of policies in international fora.

(1) Each summary measure combines the underlying indicators into a single uncertainty index using a statistical technique called 'principal component analysis'. This method involves extracting from a set of related variables a smaller number of new variables, called principal components, which explain most of the variation in the original set.

(2) See Haddow *et al* (2013).

(3) In October 2008, the Bank of Canada, Bank of England, European Central Bank, Riksbank, Swiss National Bank and US Federal Reserve reduced their key policy rates by 50 basis points simultaneously.

Annex

Constructing VAR models to estimate the impact of world shocks on the United Kingdom

This annex sets out how the suite of vector autoregression (VAR) models used in this article to estimate the impact of world shocks on UK GDP were constructed. It starts with general modelling principles, and then briefly outlines the differences between the four modelling approaches.

Generally speaking, a VAR is a statistical model that allows for an examination of the linear interdependencies between the variables of interest. For example, this framework allows estimation of the relationship between key global variables and UK GDP.

The model used in the article can be thought of as consisting of two segments: the world block (modelled as a single economic entity) and the UK block. All variants of the model are estimated on quarterly data spanning the period from 1987 Q1 to 2013 Q4.⁽¹⁾

In the baseline specification, the world block consists of:⁽²⁾⁽³⁾

- **A measure of world activity:** world GDP, weighted by countries' shares in UK exports.⁽⁴⁾
- **Measures of world prices:** world export prices excluding oil⁽⁵⁾ and oil prices in US dollars.⁽⁶⁾
- **Measures of financial conditions:** the spread between the three-month US dollar interbank rate and the three-month US Treasury bill rate; and the VIX index (Chicago Board Options Exchange Market Volatility Index of the S&P 100).

The UK block consists of UK GDP, UK CPI (both in percentage changes on a quarter earlier) and Bank Rate (in per cent). The UK block is therefore relatively simple: this is because the modelling exercise concentrates on the impact of world shocks on the United Kingdom (separately identifying the impact of the UK-specific shocks is beyond the scope of this article).

The baseline specification is estimated using ordinary least squares (OLS), and the structural shocks are identified recursively (an identification technique often referred to as Cholesky identification). This means that the ordering of the variables in the VAR is significant, as shocks to variables ordered first affect all the variables that follow on impact, but not *vice versa*. As explained in the main text, the ordering reflects the assumption that the United Kingdom is a small open economy: shocks associated with world variables will have an impact on the United Kingdom instantaneously, but the UK-specific shocks will not impact on the world variables. So the world block is ordered first, and the UK block follows.⁽⁷⁾

The second approach is similar to the baseline specification, except that the measure of world activity is constructed by combining a large set of cross-country activity data, using principal component analysis.⁽⁸⁾ The advantage of this method is that the principal component summarises the information content of a large number of indicators efficiently.⁽⁹⁾

The third variant of the model differs from the baseline in the way it is estimated: in this case, Bayesian techniques are employed to estimate the parameters. The Bayesian approach is useful relative to OLS, in this instance, given the relatively large number of parameters to be estimated.

The fourth specification is also estimated using Bayesian techniques, but introduces an alternative identification technique: the sign restrictions identification. In this approach, structural shocks are identified on the basis of the sign of responses of the variables to the shock.⁽¹⁰⁾ These sign restrictions are intended to accord with economic intuition. For example, a positive world demand shock is assumed to raise both world output and inflation. Shocks to world prices and world financial shocks are assumed to have the characteristics of a supply shock, in that global output and prices respond in opposite directions (for example, an adverse shock to world prices depresses global output and raises global inflation). Finally, the shocks to world prices and the world financial shocks are differentiated through their impact on the financial variable, the VIX (which is assumed to rise in response to the adverse financial shock, but decline in response to the shock to world prices).⁽¹¹⁾ The responses of UK variables to any of the world shocks are unrestricted: this is because those responses are the key results of the article, and so it is important to allow the data and the model to determine those responses independently.

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- (1) All variants of the model are specified to be of order two; that is, each variable is regressed on the last two quarters' values of all variables (including itself).
 - (2) World activity and world price measures are in percentage changes on a quarter earlier. The spread is measured in percentage points, and the VIX is measured in index points.
 - (3) Inclusion of the exchange rate into these models does not change any of the headline results, so it is omitted from the models shown in this article for ease of exposition.
 - (4) World GDP is constructed using data for the real GDP growth rates of 143 countries weighted according to their shares in UK exports.
 - (5) World export prices are constructed using data for export prices of 52 countries, weighted according to their shares in UK imports. The sample does not include any major oil exporters. Prices are in foreign currency (from a UK perspective).
 - (6) In some specifications world export prices including oil are used instead.
 - (7) The ordering of the variables within each block follows standard principles of identification in these types of models. For example, it is assumed that fast-moving financial variables will react instantaneously to any shocks to activity, but the world financial shocks will only have an effect on world activity with a delay.
 - (8) In total, 56 seasonally adjusted quarterly growth rate series are used in the principal components analysis estimation.
 - (9) Specifically, the first principal component is the single indicator that explains most of the comovement of the wide range of data.
 - (10) In this specification only one measure of financial stress — the VIX index — is used.
 - (11) There are other ways in which these shocks could be identified, and the headline results are robust to alternative identification techniques.

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