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Brexit and Sterling Depreciation: Impact on Selected Economies

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14.1 Introduction

The already observed short-term impacts of Brexit include a depreciation of the pound sterling, stock market declines and a freeze in investment. Meanwhile, various estimates of the long-term effect of Brexit on the UK's GDP point to a significant reduction in the UK's GDP growth rate (see Fig. 14.1 and Chang 2017, p. 11). One of the main concerns is the need to negotiate new trade deals and possible barriers in trade with the EU, which would not necessarily be replaced by greater free trade elsewhere. Another important aspect is the uncertainty that the Brexit vote has created in markets worldwide. Some companies could be delaying investment decisions, while awaiting details on what a Brexit deal would mean for tariffs and other trade barriers (Andy Palmer, Tokyo, August 2017).

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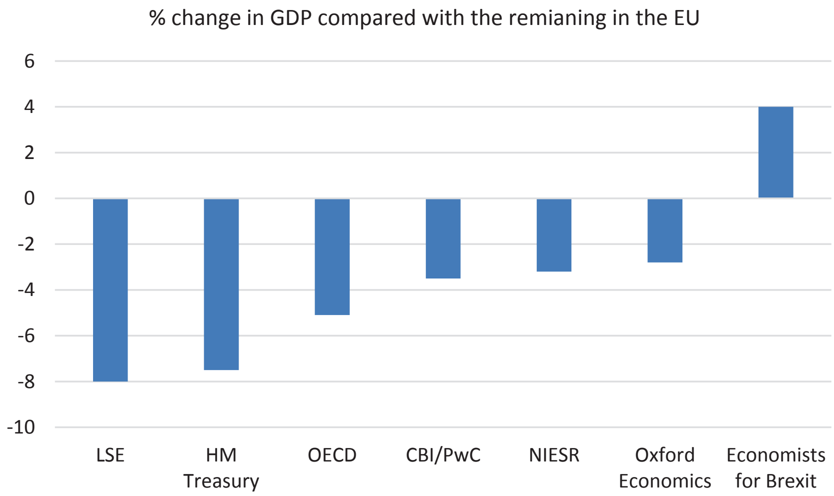

Fig. 14.1 Estimates of long-term effect of Brexit on national income (*Source* own compilation based on Giles [2016])

In this study, however, we concentrate on one of the most dramatic and already visible economic consequences of the Brexit decision. On the night of the decision itself, the pound suffered its biggest one-day fall against the dollar. On 27 June 2016, the pound fell to trade at 1.315 against the dollar, hitting a 31-year low. The depreciation was a signal that investors' expectations about the UK's economic performance had deteriorated. It seems that investors were expecting that leaving the EU would impose a long-term and permanent economic cost on Britain.

In this study, we apply an advanced econometric tool known as the global vector autoregressive model (GVAR).[1] Economists from the *European Bank for Reconstruction and Development* (see EBRD 2016), for example, use the GVAR model to assess the impact of Brexit on economic growth in the EBRD region. They distinguish two scenarios, a soft Brexit, where trade relationships are kept at

[1]To the best of our knowledge, the GVAR methodology was not used to study the effects of the pound's depreciation after the Brexit vote in any other study.

close to the present level, and a hard Brexit, where trade relationships between the UK and the EU are significantly disrupted. Their results show that both scenarios decrease the level of economic growth in the EBRD region, where, under a hard Brexit, the impact is much more severe.

The aim of this chapter is to assess the impact of an unexpected depreciation of the sterling on economic growth and on stock price indices in the UK and in selected other economies. The main hypothesis is that a depreciating sterling has significant effects on both economic growth and stock price indices in these countries.

The structure of the chapter is as follows. Section 14.2 concerns the transmission of negative exchange shocks in the UK. Section 14.3 describes the global vector autoregressive model. Sections 14.4 and 14.5 present the results obtained from the GVAR model. Section 14.4 discusses the impact of the sterling's depreciation on GDP in the UK and selected other economies. Section 14.5 focuses on the impact of sterling depreciation on stock prices in the UK and in the selected economies. The last section concludes.

14.2 Transmission of Exchange Rate Shocks in the UK

The depreciation of the domestic currency makes imports more expensive while making exports cheaper. It should cause imports to fall while causing exports to rise. This, in turn, should cause domestic employment as well as wages to rise. But for that to happen, demand for exports must increase.

Theoretically, the impact of the exchange rate on the trade balance and, consequently, on aggregate demand, depends on the Marshall-Lerner condition. It states that currency depreciation will have a positive impact on the trade balance when the sum of the absolute values of price elasticity of exports and imports is greater than one. This is because one can distinguish between a quantity effect and a cost effect.

The quantity effect means that, after currency depreciation, customers buy more domestically produced goods. Both domestic customers buy fewer imported goods and foreign customers buy more exported goods, which generates a positive effect on the trade balance. The cost effect means that, because of higher import costs after currency depreciation, more may be spent on imports initially when consumption patterns remain the same. This generates a negative effect on the trade balance. If the quantity effect is greater than the cost effect, then the Marshall-Lerner condition is fulfilled, meaning an improvement in the balance of trade.

However, Aiello et al. (2015), for example, show that the long-run level of exports appears to be unrelated to the real exchange rate for the UK. As a consequence, a further depreciation of the sterling could lead to sharp price increases because of higher import prices with no offsetting effect for exports. Moreover, British exporters are highly integrated with global supply chains. According to OECD data, the import content of UK exports is around 23%, compared with around 15% for the USA and Japanese exports (see Skidelsky 2016). This means that British exporters need imported inputs. Because of an increase in import prices, also export prices are less competitive. As a result, economic growth in the UK is expected to decrease rather than increase if the sterling depreciates.

It is interesting to note that Paul Krugman argues that a weaker pound should not be viewed as an additional cost of Brexit but as a part of an adjustment. He writes that Britain is experiencing a version of what is known as Dutch disease. The London City's financial experts are crowding out manufacturing by keeping the currency strong. Thus, a weak pound helps British manufacturing. The UK faces the prospect of largely increased transaction costs between Britain and the rest of Europe, which creates an incentive to move financial services away from the smaller economy (the City of London) into the larger (Europe). Such a move can be prevented by paying lower wages and therefore increasing competitiveness. In effect, the UK needs a weaker currency to offset the adverse impact of its smaller market.

14.3 Research Methodology

We apply a global vector autoregressive (GVAR) model to assess the impact of depreciation of the pound on selected economies. The GVAR model comprises a compact model of the whole world economy designed to explicitly model economic and financial interdependencies at the national and international levels.

Originally, the global vector autoregressive model was proposed by Pesaran et al. (2004), and it was further developed by Dees et al. (2007). It is possible to use the GVAR model to investigate a number of different problems (see, e.g., Cesa-Bianchi et al. [2012], note 2).

We use the modified GVAR Toolbox 2.0, which contains the necessary procedures in Matlab and a user-friendly interface in Excel (see Smith and Galesi 2014).

The GVAR model consists of individual country vector error-correcting models that include both domestic and foreign variables. The foreign variables are constructed on the basis of trade and financial linkages between countries. The individual country models are linked together, and the model is solved for the world as a whole.

Therefore, estimation of the GVAR model is a two-step procedure. First, we estimate small VARX models for each country that are conditional on the rest of world. The country-specific models comprise domestic, foreign and optionally global variables or dominant unit variables. Second, by using the spillover matrix we link individual countries' models into one global VAR model.

Let us consider N countries. We define the following VARX * (P, R) model for country i:

$$x_{it} = \alpha_{i0} + \alpha_{it} t + \sum_{p=1}^{Pi} \Phi_{ip} x_{i,t-p} + \sum_{r=0}^{Ri} \Lambda_{ir} x^*_{i,t-r} + u_{it}, \quad (14.1)$$

where $x_{i,t}$ is vector $1 \times k_i$ of domestic variables, $x^*_{i,t}$ is vector $1 \times k^*_i$ of foreign variables, $x^*_{it} = \sum_{j=0}^{N} \omega_{ij} x_{jt}$, $\omega_{ii} = 0$, ω_{ij} are weights that are calculated on the basis of bilateral trade or financial flows matrix, $\sum_{j=0}^{N} \omega_{ij} = 1$.

The model can be written in the following error correction form:

$$\Delta x_{it} = \mu_i + \sum_{j=1}^{r_i} \gamma_{ij} ECT_{ij,t-1} + \sum_{p=1}^{P} \widetilde{\Phi}_{ip} \Delta x_{i,t-p} + \sum_{r=0}^{R} \widetilde{\Lambda}_{ir} \Delta x^*_{i,t-r} + e_{it},$$

where r_i is the number of cointegrating relations.

We define vector $z_{it} = \begin{pmatrix} x_{it} \\ x^*_{it} \end{pmatrix}$, which, for a given country, contains its domestic as well as foreign variables. We can rewrite the model as:

$$A_{i0} z_{it} = a_{i0} + a_{i1} t + A_{i1} z_{i,t-1} + \cdots + A_{ip} z_{i,t-Pi} + u_{it},$$

where $A_{i0} = \left(I_{k_i}, -\Lambda_{i0}\right)$, $A_{ij} = \left(\Phi_{ij}, \Lambda_{ij}\right) j = 1, \ldots \max(P_i, R_i)$, $\Phi_{ij} = 0$ for $j > P_i$ and $\Lambda_{ij} = 0$ for $j > R_i$, $z_{it} = W_i x_t$, where W_i are $\left(k_i + k^*_i\right) \times k \left(k = \sum_{i=0}^{N} k_i\right)$ link matrices calculated on the basis of trade flows and $x_t = \left(x'_{0t}, x'_{1t}, \ldots, x'_{Nt}\right)'$. Further, the model can be written as:

$$A_{i0} W_i x_t = a_{i0} + a_{i1} t + A_{i1} W_i x_{t-1} + \cdots + A_{ipi} W_i x_{t-pi} + u_{it},$$

Finally, by stacking the individual country models, we arrive at the global VAR model with domestic variables only:

$$G_0 x_t = a_0 + a_1 t + G_1 x_{t-1} + \cdots + G_p x_{t-p} + u_t, \qquad (14.2)$$

$$G_0 = \begin{pmatrix} A_{00} W_0 \\ A_{10} W_1 \\ \ldots \\ A_{N0} W_N \end{pmatrix}, G_j = \begin{pmatrix} A_{0j} W_0 \\ A_{1j} W_1 \\ \ldots \\ A_{Nj} W_N \end{pmatrix}, a_0 = \begin{pmatrix} a_{00} \\ a_{10} \\ \ldots \\ a_{N0} \end{pmatrix},$$

$$a_1 = \begin{pmatrix} a_{01} \\ a_{11} \\ \ldots \\ a_{N1} \end{pmatrix}, u_t = \begin{pmatrix} u_{0t} \\ u_{1t} \\ \ldots \\ u_{Nt} \end{pmatrix}.$$

G_0 is known from the estimation of individual country models. We thus multiply both sides of Eq. (14.2) by G_0^{-1} and we get the GVAR(P) model:

$$x_t = b_0 + b_1 t + F_1 x_{t-1} + \cdots + F_p x_{t-P} + \varepsilon_t, \qquad (14.3)$$

where $b_0 = G_0^{-1} a_0$, $b_1 = G_0^{-1} a_1$, $F_j = G_0^{-1} G_j \quad j = 1, \ldots, p$, $\varepsilon_t = G_0^{-1} u_t$. Equation (14.3) is solved recursively.

After estimating the GVAR model, generalised impulse response functions (GIRFs) are calculated. It is important to note that, because of a large number of variables, it is difficult to use standard impulse response functions that assume orthogonal shocks (see Sims 1980). GIRFs were introduced by Koop et al. (1996). The shape of the GIRFs does not depend on the ordering of the variables. The GIRFs may be represented by the following equation:

$$\mathrm{GIRF}(x_t, n, \varepsilon_{jlt}) = E\left[x_{t+n} | \varepsilon_{jlt} = \sqrt{\sigma_{jj,ll}}, I_{t-1}\right] - E[x_{t+n} | I_{t-1}] \quad (14.4)$$

where I_{t-1} is an information set at time $t-1$, $\sigma_{jj,ll}$ is the diagonal element of the variance–covariance matrix Σ_ε corresponding to the lth equation in the jth country and n is the horizon.

Our sample consists of 55 economies (see Table 14.1). The economies together cover more than 90% of global GDP. When deciding on the choice of countries, in the first step we take all the countries included in the BIS effective exchange rate indices—60 economies plus the euro area (broad weights). We end up, however, with 55 economies, because we notice that including Algeria, Chinese Taipei, Malta, the United Arab Emirates and Venezuela makes the model unstable, which is probably due to low quality of data for these countries.

The euro-area countries are grouped into the euro-area region. We use quarterly observations. The data span is from 1995Q1 to 2016Q3. The main data used in the model are real GDP, the price level (CPI), the stock market index, the real effective exchange rate (REER) and the short-term interest rate for each country. We complement the data for domestic economies with the level of oil prices to take into account the situation in commodity markets. Economic ties between countries are approximated by bilateral flows of exports and imports of goods that are available on an annual basis. The matrices of trade flows are constructed

Table 14.1 Countries and regions included in the GVAR model

Euro area	Argentina	Malaysia
Austria	Australia	Mexico
Belgium	Brazil	New Zealand
Cyprus	Bulgaria	Norway
Estonia	Canada	Peru
Finland	Chile	Philippines
France	China	Poland
Germany	Colombia	Romania
Greece	Croatia	Russia
Ireland	Czech Republic	Saudi Arabia
Italy	Denmark	Singapore
Latvia	Hong Kong	South Africa
Lithuania	Hungary	Sweden
Luxembourg	Iceland	Switzerland
Netherlands	India	Thailand
Portugal	Indonesia	Turkey
Slovakia	Israel	United Kingdom
Slovenia	Japan	United States
Spain	South Korea	

on the basis of International Monetary Fund statistics, namely the *Direction of Trade Statistics (DOTS).* The sources of the data used in the model are described in detail in Sznajderska (2018).

14.4 The Impact of Sterling Depreciation on GDP in the UK and Selected Other Economies

Below we present an impulse response analysis for the estimated GVAR model. The impulse response functions, which are for instance presented in Figs. 14.2, 14.4 and 14.5, refer to the time profile of the effects of sterling depreciation on all the variables in the model. The horizontal axis shows quarters after the shock.

We analyse a negative one-standard deviation shock to the real effective exchange rate (REER) in the UK (see Fig. 14.2), which corresponds to a 1.47% decrease in the REER at the time of impact.

The obtained results show that an unexpected depreciation of the sterling could have statistically and economically significant effects on

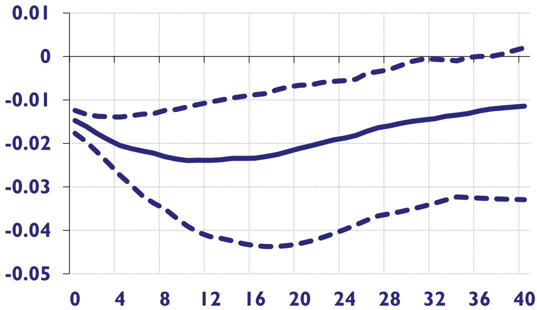

Fig. 14.2 The shock—sterling depreciation (*Note* Bootstrap mean estimates with 90% bootstrap error bounds)

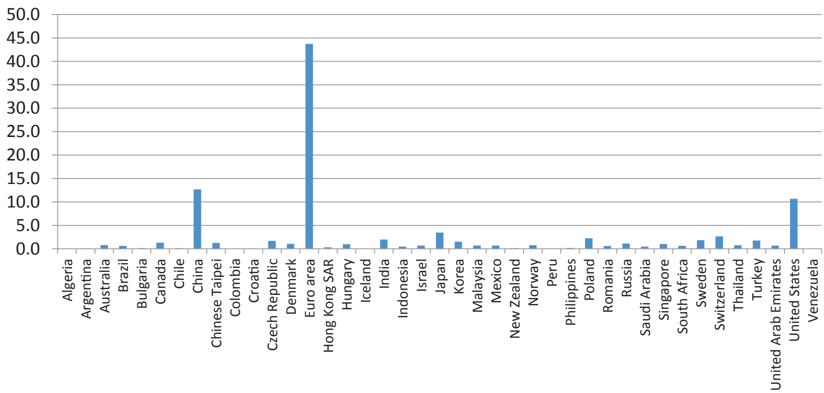

Fig. 14.3 BIS trade weights for UK (*Note* The trade weights are derived from manufacturing trade flows and capture both direct bilateral trade and third-market competition by double-weighting [see Klau and Fung 2006 for explanation of the weighting scheme])

other economies. Figure 14.4 shows the reaction of real GDP in the UK and in selected other economies.

After an unexpected depreciation of the real effective exchange rate in the UK, GDP declines in the majority of countries. In the UK, GDP decreases by a maximum 0.6% after 15 quarters. In other words, it can be easily calculated that a 1% depreciation of the REER would imply a 0.4% decrease in real UK GDP after 15 quarters. A negative effect of the depreciation on GDP is not obvious, because depreciation could have a positive effect on exports. But this effect seems to be dominated

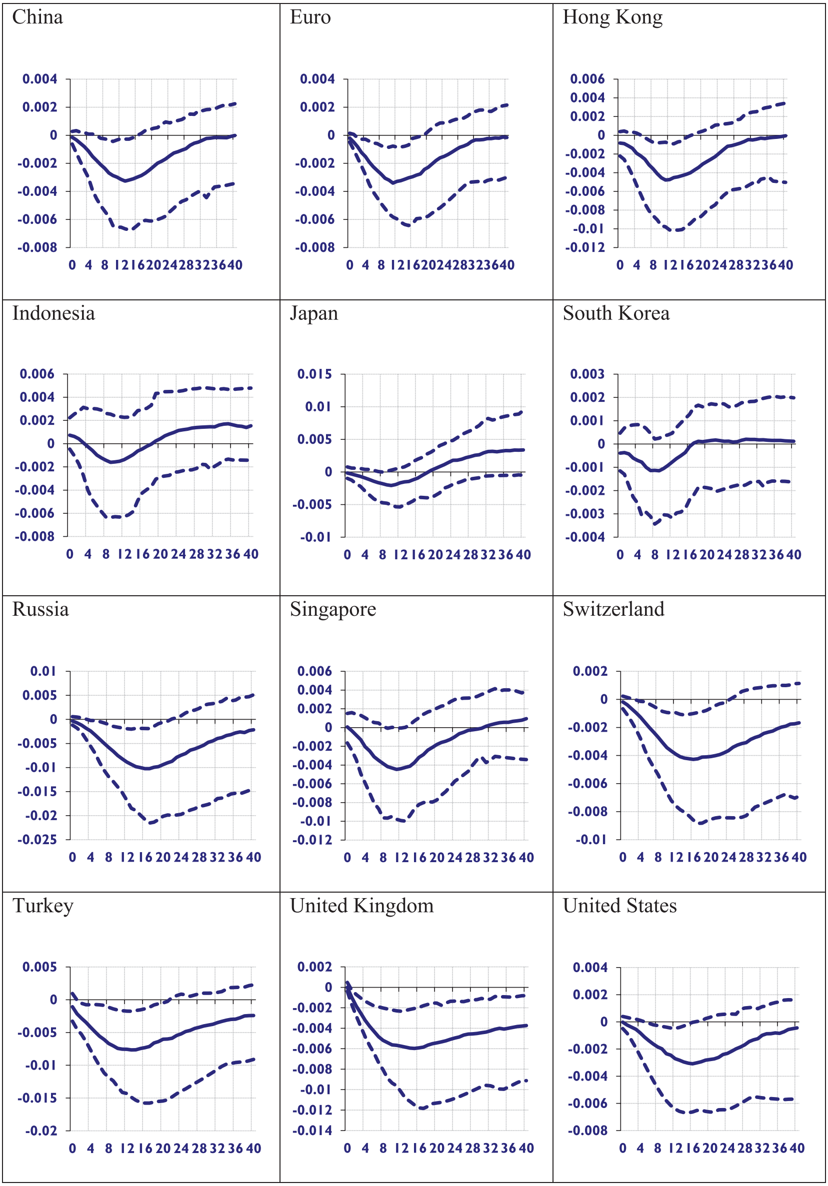

Fig. 14.4 Impulse responses of GDP to one-standard deviation shock to REER in UK (*Note* Bootstrap mean estimates with 90% bootstrap error bounds)

by more expensive imports of intermediates or increased interest rates, which weakens investment and consumption. Indeed, our results show a statistically insignificant increase in the level of prices and a statistically significant decrease in the level of interest rates in the UK.

In accordance with the obtained results, a depreciation of the REER in the UK (by 1.47% at the time of impact) causes a statistically significant reduction in real GDP in the euro area (by a maximum 0.3% after 12 quarters) and in the USA (maximum 0.3% after 16 quarters). The reaction of real GDP is statistically significant in countries such as China (maximum 0.3% after 13 quarters), Hong Kong (maximum 0.48% after 11 quarters), Russia (maximum 1% after 16 quarters), Singapore (maximum 0.4% after 11 quarters), Switzerland (maximum 0.4% after 16 quarters) and Turkey (maximum 0.76% after 14 quarters). On the other hand, the reaction of real GDP is statistically insignificant in countries including Indonesia, Japan and South Korea (see Fig. 14.4).

Figure 14.3 shows the trade links between the UK and the other economies. The euro area, China and the USA are the main trading partners of the UK. Our results indicate that sterling depreciation has statistically significant effects on these economies. The impact of an exchange rate shock on these economies seems to work through decreased domestic demand in the UK. It is worth noting that the effect is not significant for Japan and South Korea, both of which are among the UK's main trading partners (Fig. 14.4).

14.5 The Impact of Sterling Depreciation on Stock Prices in the UK and Selected Other Economies

In what follows, we consider the impact of the Brexit vote on stock prices. As a result of the Brexit decision, the FTSE 100 index was down 2.6% and the FTSE 250 (more closely tied to the UK economy) was down 7% on Friday, 24 June 2016. Many British companies were hit hard. But, as J. Treanor and K. Allen wrote in *The Guardian* on

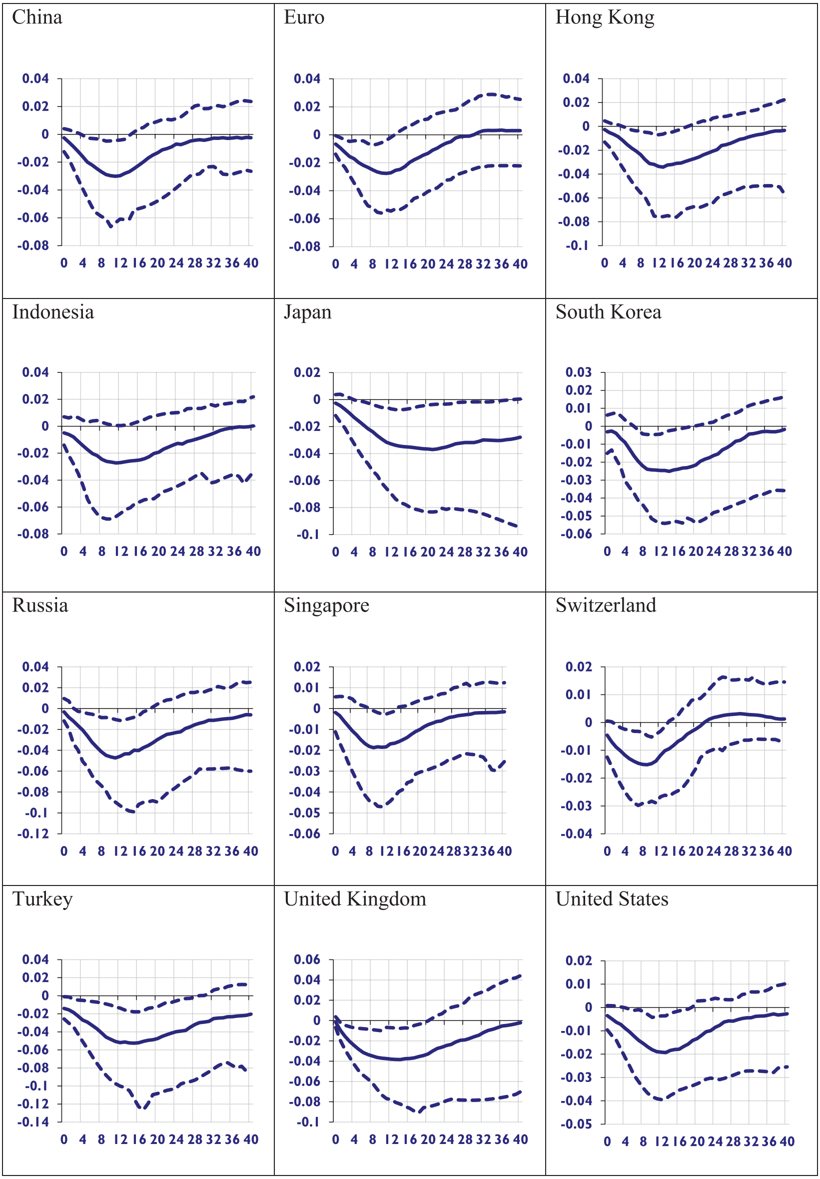

Fig. 14.5 Impulse responses of stock prices to one-standard deviation shock to REER in the UK (*Note* Bootstrap mean estimates with 90% bootstrap error bounds)

Monday, 27 June 2016: "*The fallout from the vote is being felt around the world. Italy's main index fell 4%, extending Friday's record losses of 12.5%. In Germany and France there were losses of 3%. At the time of the London close, on Wall Street the main share indices were all down more than 1%*". Thus, we study the reaction of stock prices to an unexpected exchange rate shock in the UK in selected other countries around the world.

Figure 14.5 shows the impulse response functions. First of all, a depreciating sterling causes a decrease in the stock price index in the UK. The stock price index in the UK decreases by a maximum 0.4% after 14 quarters following the analysed shock (see Fig. 14.2 for the shock).

As the result of the shock, stock price indices decrease in a statistically significant way in a number of countries, such as China (by a maximum 0.3% after 11 quarters), the euro area (by a maximum 0.27% after 11 quarters), Hong Kong (by a maximum 0.34% after 13 quarters), Japan (by a maximum 0.37% after 21 quarters), South Korea (by a maximum 0.25% after 14 quarters), Russia (by a maximum 0.47% after 11 quarters), Singapore (by a maximum 0.19% after nine quarters), Switzerland (by a maximum 0.15% after eight quarters), Turkey (by a maximum 0.5% after 15 quarters) and the USA (by a maximum 0.19% after 13 quarters). The reaction is not statistically significant for Indonesia. The results show high financial linkages between the UK stock market and stock markets in the other economies. This means that problems on the London Stock Exchange spill over greatly to many other financial markets, decreasing their competitiveness.

14.6 Conclusions

Brexit is "a major, significant financial shock" that could create "a whole bunch of economic, financial, political and also geopolitical uncertainties" (Nouriel Roubini, World Economic Forum in China). The spillover effects may appear all over the world. This is because the UK has strong trade linkages with other economies, on the one hand, and strong financial linkages, on the other, while the City of London is one of the world's largest financial centres.

In this chapter, we have discussed one of the consequences of Brexit, namely the depreciation of the British currency. We have analysed the effects of an unexpected exchange rate shock in the UK using the global vector autoregressive model.[2] The model enables concise analysis of the global economy as a whole. It takes into account economic linkages among a large number of economies.

Our results are in favour of the view that the UK leaving the EU will slow growth in Britain and reduce its competitiveness. Moreover, the results show that a further depreciation of the pound sterling will slow growth in a number of other countries, negatively affecting their competitiveness.

Also, an unexpected depreciation of the sterling appears to greatly affect financial markets all over the world. It could cause a decrease in the stock price index in the UK and most other economies included in our model.

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