

Brexit and foreign investment in the UK

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Summary. We explore the likely effect of Brexit on inward foreign direct investment (FDI) through its possible effect on the benchmark variables that characterize the macroeconomy. For this we propose the use of a Markov regime switching structural vector auto-regression to distinguish between the volatile and stable states of the economy and account, among other effects, for the contemporaneous effects that the frequency of FDI innately generates. Our findings suggest that, if Brexit triggers a sterling depreciation in the current economic climate, this will fuel a prolonged negative effect on FDI. FDI flows may be positively affected (at most) by a sterling depreciation after Brexit only if this event drives the UK economy to a period of highly volatile growth, inflation, interest and exchange rates: a scenario that is rather unlikely. And, even then, the sterling depreciation benefits would last for only a short period of time.

Keywords: Brexit; Currency volatility; Economic growth; Inward investment; Markov switching; Structural vector auto-regression

1. Introduction

Since the outcome on the UK's exit ('Brexit') from the European Union (EU) referendum there has been much comment on the likely nature of the UK's trading relationship with the EU and the rest of the world. However, despite its importance to the UK economy, the effect on inward foreign direct investment (FDI) received little comment during the referendum debate, and only more recently have the positions of, for example, the Japanese car makers in the UK been the focus of attention. This is despite the fact that the UK has been for 40 years not merely open to inward investment but has actively sought foreign investment across all sectors. Many UK and non-UK firms have taken the opportunity to develop supply chains that cross into and out of the UK several times. The position of these firms, and the capacity for the UK to continue to attract inward FDI, is potentially one of the most important economic aspects of the UK's leaving the EU.

It is well known that the UK has a long running trade deficit, but what has received much less attention is the extent to which the adverse long-term effects of this have been offset by the quantity of inward FDI that the UK attracts. Hitherto, any analysis of the likely effect of Brexit in terms of firm location decisions has focused on seeking to explore the extent to which such decisions have historically been influenced by the UK's membership of the EU. A more targeted approach would be to explore the short and long-term dynamics of FDI into the UK, and to use

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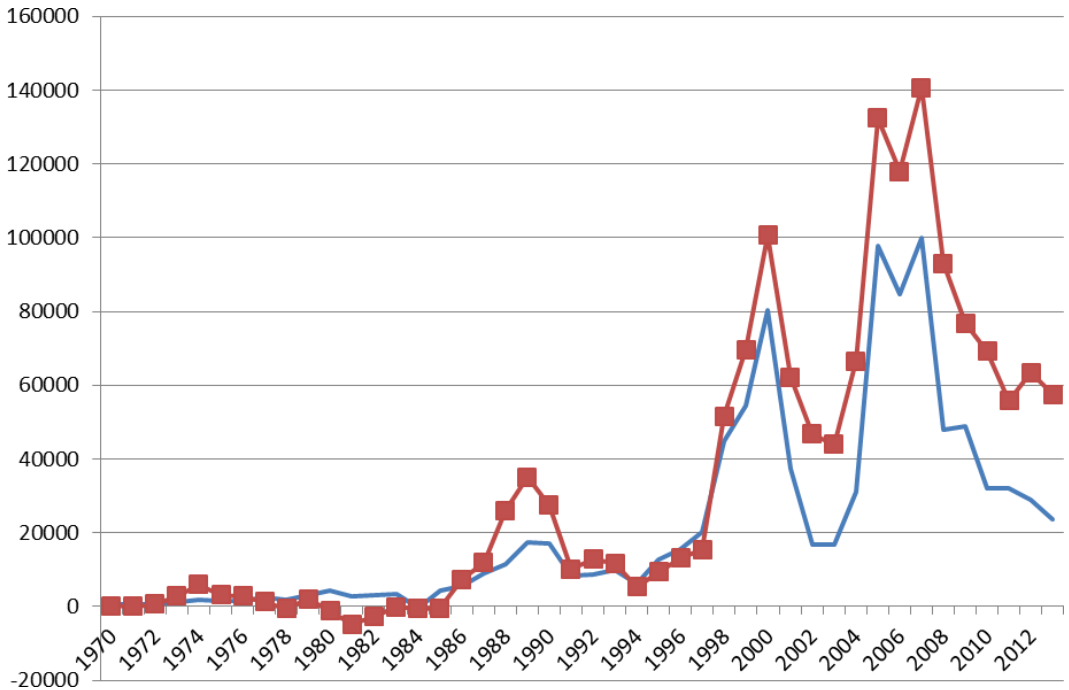


Fig. 1. When the UK trade deficit masks inward FDI: —■—, the UK's quarterly trade deficit (in billions of pounds); —, the UK's FDI inflows (in billions of pounds)

them to infer the implications of Brexit. This is the approach that we propose. Consequently, the purpose of this paper is to explore the likely effect on inward investment of Brexit, with a particular focus on distinguishing between the long-term drivers of inward investment into the UK, and the effect of short-term volatility.

This is a very timely issue. In the run up to, and since the referendum on, the UK's membership of the EU in June 2016, a debate has developed both within the academic literature, but most notably within the popular press, concerning the potential effect on the UK economy of a looser relationship between the UK and EU, through Brexit (see for example Crafts (2016)). However, the focus of this discussion, even 20 months after the referendum, has been on the effect on 'trade', with the focus being on the trade in finished goods, rather than, say, the importance of value chains that cross countries, sometimes several times. Politicians now appear to be waking up to the importance of inward investment following, for example, warnings from the Japanese Ambassador.

The importance of this issue stems from the fact that Brexit will be the first example of a developed economy leaving a customs union, but also from the fact that inward investment is particularly consequential to the UK economy. The UK is one of the most, if not the most, open economies in the world and has been running for a long time a well-known trade deficit. This, however, is largely masked by the amount of inward FDI that the UK attracts (Fig. 1).

In many sectors, more than 50% of the value added in the UK is generated by foreign-owned firms, and overall more than 50% of the private sector research and development in the UK is foreign owned. Because of this, supply chains in many high value sectors are dominated by foreign firms and, by extension, many of the UK's regions are reliant on inward investment for economic development.

Even more interestingly, Brexit raises a more general issue that the literature on FDI has yet to address. In particular, there has been a plethora of papers focusing on the effect of joining a free-trade area or a customs union and especially the EU; still, we know surprisingly little about a reverse move, leaving a free-trade area or a customs union, since the noteworthy instances are too few to draw even speculative conclusions. (The Seychelles and Madagascar left the Southern African Development Community for a period, and membership of the Central European Free Trade Agreement when a country joins the EU. To the best of our knowledge these are the only examples of countries leaving a customs union.) The naive approach, which was sometimes offered by politicians in the run up to the referendum and indeed by some for the 12 months up to the 2017 UK general election but dismissed almost unanimously by policy makers, academics and the popular press, would be simply to assume that the effect on FDI would simply be zero, with new opportunities offsetting any detrimental effects. And yet, what may happen to (inward) FDI is more than an important concern; it is a centrepiece economic criterion to make a decision to remain or not in a free-trade area or a customs union. Given that the country that considers such a move is the UK, and that the union that it involves is the EU, having a framework to study how FDI could possibly react to such an event is as timely an issue as it can ever be.

Moreover, although a relevant literature is starting to develop concerning Brexit and inward investment, this merely extends the literature on spatial distributions of FDI to the question of Brexit (see for example Bruno *et al.* (2016) or Simionescu (2017)). Specifically, the objective so far in this literature has been to determine the magnitude of the (positive) 'EU effect' in explaining FDI into the UK and, by doing so, to infer the (likely negative) effect post Brexit. This logic, however, is flawed, as it is likely to understate both the competing gravity effect of the UK having to compete with the EU for foreign investment, but also the effect of the volatility regime within which the UK will be leaving the EU and whether or not this event will affect it. This was ignored, for example, by Gudgin *et al.* (2017) in their analysis of the effects of Brexit. In this respect, by proposing to examine the dynamics of inward FDI in relation to the macroeconomy by using the structural vector auto-regression (SVAR) paradigm, we are offering a more complete picture of the impact of Brexit on inward FDI.

Specifically, we adopt the Markov regime switching SVAR framework of Ehrmann *et al.* (2003) and depart substantially from the existing FDI literature in several ways but do so primarily for three reasons: first, to make a distinction between periods of economic stability and periods of economic uncertainty, a feature that, apart from the fact that it enables us to make reasonable conjectures about the post-Brexit economic environment, it allows us to treat economic uncertainty as a systemic feature rather than an exogenous variable; second, to capture the contemporaneous effect of the structural shocks, which is a feature that is crucial given the low frequency (quarterly) measure of FDI, and which, surprisingly, has hardly been raised as an issue in this literature; third, to address the problem of having to deal with composites of the structural shocks that the reduced form VAR is subject to, which is a fundamental feature for isolating the effect of the different macrovariables. (This third point is also the reason why SVAR models were developed in the first place, namely to incorporate in theoretical models (structures) the fine performance of (the atheoretical) VAR models at data fitting and forecasting.) As a result, it becomes possible to analyse robustly how shocks of each macrovariable in isolation affect inward FDI flows. Subsequently, the question about the possible effect of Brexit on inward FDI can break down into a question of whether Brexit will drive the UK into a period of economic uncertainty or not and a question of how shocks of the different macrovariables affect inward FDI in each period. Consequently, we offer an approach that seeks to deepen our understanding of FDI flows, their drivers and how they fit into the context of a macroeconomy, which is also essential when it comes to discussing a multifaceted event such as Brexit.

Using macroeconomic data since the 1960s, we show empirically that the greatest changes in the structure of inward investment have been caused by currency fluctuations and economic uncertainty. This is perhaps not surprising when we consider how FDI is funded, and that entry decisions are essentially based on the difference between the cost of investment (which one assumes the parent incurs initially in its home country) and the discounted cash flow from that investment, which is earned in local currency. When our results are used as the prism through which to portend the effect of Brexit on the UK's inward FDI, we find that, if Brexit triggers a sterling depreciation in the current economic climate, this will fuel a prolonged negative effect on inward FDI. Inward FDI flows may be positively affected only by sterling depreciation after Brexit if the latter drives the UK economy to a period of highly volatile growth, inflation, interest and exchange rates, which is a scenario that is rather unlikely. And, even then, the sterling depreciation benefits cannot last long.

The rest of the paper is organized as follows. Section 2 places our work within the FDI time series literature and Section 3 provides some theoretical considerations about examining the FDI aspect of Brexit. Section 4 presents our model whereas Section 5 presents our econometric methodology. Section 6 discusses our empirical results. Finally, Section 7 contains our concluding remarks.

The data that are analysed in the paper and the programs that were used to analyse them can be obtained from

<https://rss.onlinelibrary.wiley.com/hub/journal/1467985x/series-a-datasets>

2. Overview of the foreign direct investment time series literature

The literature on time series analysis of FDI flows into the UK, or indeed on time series analysis of macrolevel FDI data in general, has advanced surprisingly little since the analysis of Barrell and Pain (1997). Typically, this has sought to address two classes of problem. The first, which is often within the standard Granger causality framework, involves estimating the relationships either between FDI and trade or between FDI and economic growth (see for example Nair-Reichert and Weinhold (2001)). The second, overwhelmingly within a standard univariate time series setting, builds on Barrell and Pain (1997) to identify the determinants of FDI into, or from, a given country (see for example Basu *et al.* (2003)).

In this respect, the multivariate time series set-up that we propose here seeks to build on the existing literature following the works of Shan (2002), De Santis *et al.* (2004) and more recently Tolentino (2010). This set-up develops from Tolentino's (2010) critique of the existing literature, concerning

'the tenuous assumptions concerning the exogeneity and endogeneity of the variables; and additional identification problems arising from temporal restrictions when variables are themselves policy projections'.

In particular, we propose two methodological innovations in the empirical analysis of FDI flows. The first involves the use of structural, rather than reduced form, VAR modelling. This enables us to isolate the effect of the (structural) shocks on the FDI (in contrast, the error terms in a reduced form VAR are composites of the structural shocks and therefore may be misleading with regard to the effect of each variate on FDI). Equally importantly, it enables us to identify the contemporaneous effect of the other variables on FDI. This is particularly relevant for data with low frequency sampling (FDI data are released every quarter but the effect of the other variables on FDI is very unlikely to be so slow, which in turn means that at such low frequency

it will inevitably manifest as contemporaneous). The second involves the use of a Markov regime switching approach to capturing uncertainty. In other words, instead of incorporating economic uncertainty in our model through some volatility proxying variable, we view it as a systemic feature of the economy that manifests by varying the effect of the examined variables on FDI. In this way, we can account for a large class of possible non-linearities, including for example structural changes or periodicity of the business cycles, which is also a very attractive characteristic when trying to gauge the effect of multifaceted events such as Brexit, with obvious increases in volatility and economic uncertainty (among other types).

The remainder of this section discusses another key factor that influences FDI which we also account for in our model, namely currency fluctuations.

2.1. Importance of currency fluctuations

The existing literature explores the importance of both the level and the volatility of exchange rates in explaining FDI (see for example Pain and van Welsum (2003)). The literature discusses, though largely fails to isolate, the competing forces arising from exchange rate fluctuations. The essential premise is that, on the one hand, an appreciation in a country's exchange rate may deter foreign investors as investing becomes nominally more expensive in home country currency. On the other hand, currency appreciation increases the nominal value of assets that are held in the host country, and potentially increases the discounted future profit flows of the foreign investors (denominated in home currency) so retention of foreign investment becomes more likely. These competing relationships explain why researchers such as Görg and Wakelin (2002) have been unable to determine the nature of the relationships between FDI and currency fluctuations, and why Pain and van Welsum (2003) referred to the 'Gordian knot' in terms of the relationships between currency fluctuations and, in modelling terms, the identification problem.

However, although the existing literature is rather contradictory, what is clear is that currency fluctuations, and uncertainty over currency, have been linked to changes in FDI in various settings. This issue is explored in a more recent literature that explores the relationship between currency fluctuations and uncertainty that may deter FDI. Boateng *et al.* (2015) have provided a recent example of this theme, arguing that, of the two competing effects that exchange rates may have on FDI, they expect the initial cost that is associated with currency appreciation to outweigh the potential for greater returns over time, though they acknowledge that this is an empirical question. Blonigen (1997) extended this argument, allowing for the possibility of different firms responding differently to shocks in currency movements. In turn he found a strong inverse relationship between currency movements and inward FDI into the USA. This is a similar finding to the work of Goldberg and Kolstad (1995) who argued that, when firms are engaged in FDI to achieve the lowest cost location for a given activity, then currency uncertainty deters FDI. Currency uncertainty, unlike what we do here, is not viewed as an effect of the state of the economy at specific points in time.

A key question in the wake of Brexit, therefore, is how the uncertainty, in the periods both before and after the British Government invoked Article 50 of the Lisbon Treaty, will manifest itself. For example, there is an expectation that sterling will be both more volatile and subject to a devaluation. (To some extent this scenario materialized immediately after the announcement of the referendum results but it remains to be seen whether this will characterize the post-Brexit period.) This would typically trigger inflation pressures, though it may also boost exports. Therefore, a focal aspect, and contribution, of our analysis is about the effect that this uncertainty will have on FDI, in both the short and the longer term.

The essential arguments were summed up in Russ (2004). The relationships between exchange

rates, FDI and exchange rate volatility depend on the nature of the shocks that impact on the firm. Russ (2004) for example showed that, where volatility arises, it is the source of the volatility that determines the response in terms of FDI flows, which is something that was not considered in the literature discussed above. This develops the earlier argument by Campa (1993) that the precise nature of the relationship between currency volatility and FDI depends on the nature and level of sunk costs that are required to facilitate entry into the host country, which is in itself a function of the expected level of currency volatility. The findings of Russ (2004) are particularly pertinent for the debate concerning Brexit, as they highlight that not merely volatility in the real economy, but the source of that volatility is likely to impact on the relationship between currency fluctuations and FDI. This issue was explored in more detail by Chenaf-Nicet and Rougier (2016). The analysis here is analogous to the analysis on gross capital flows. For example, Lane and Milesi-Ferretti (2012) explored the effect of the recent financial crisis on aggregate flows by using a cross-country model. Their underlying premise is to link exchange rates flexibility to current account fluctuation, exploring the role that capital flows play in this adjustment. They found that, in countries with exchange rate pegs, the post-crisis adjustment process occurred through a change in 'private non-banking flows' and that countries with large current account deficits experienced large-scale capital outflows. This suggests that, in terms of the relationship between currency fluctuations, that between customs union membership and FDI is worthy of further consideration.

In addition to understanding the wider issue of Brexit, we seek to develop the existing literature which explores the relationship between currency volatility and FDI flows. Much of the recent literature in this area examines the effect of the euro, either in terms of the overall effect of FDI into the EU, or in terms of membership of the euro of a given country. A more recent literature, however, seeks to distinguish between the euro effect and the EU effect in terms of explaining FDI flows. This is essentially an empirical extension of the work of Flam and Nordström (2008) based on the theoretical underpinnings of Goldberg and Kolstad (1995) and this line of analysis highlights another important aspect of our contribution, namely in that we seek to separate volatility in FDI flows from volatility that is generated elsewhere in our model. Dinga and Dingová (2011) attempted for example to distinguish between the euro effect and the EU effect, in explaining FDI flows. Dinga and Dingová (2011) showed that, whereas the euro effect declines as one allows for intercountry heterogeneity, the EU effect is positive and stable in explaining bilateral FDI flows. This suggests that there are two elements to the positive effect that the UK's membership of the EU has on its FDI flows. Firstly, there are the trade creation effects, which are associated with attracting FDI into the EU, from where firms can service EU markets. In addition, there is a positive effect of intra-EU FDI, as companies perceive greater certainty in the relationships between countries, and in institutions, when seeking to locate certain activities.

Theoretically, this links the time series literature on volatility in currency more coherently to the theoretical literature on FDI decisions. Schiavo (2007) for example found that, building on the underpinnings of FDI of for example Markusen and Venables (1998), who argued that customs unions have a positive effect on FDI by reducing currency uncertainty. This is essentially an extension of the theoretical approach, treating customs unions or currency unions as a way of reducing transaction costs and extending the boundaries of the firm (see for example Horstmann and Markusen (1996)).

Overall, we therefore seek to develop this literature in two ways. First, we treat volatility as a systemic feature. This is an empirical challenge which the macroeconomic literature has addressed most recently with the Markov regime switching SVAR models that we propose as a fruitful approach. It is our assertion that Brexit will generate volatility in sterling which in turn

will lead to more volatility in FDI flows, at least for a relatively short period of time. As such, it is essential to be able to treat volatility as a systemic feature of the economy and not merely as one of the explanatory variables. As we show below, this is both theoretically and methodologically important given the question at hand. Second, although the underlying long-run trend in FDI is of interest, we build on the sizable literature on FDI that suggests that, at the firm level, sector level and indeed the macrolevel, there is a high degree of persistence in FDI flows, such that any instability in FDI flows will lead to a reduction in the short run.

3. Importance of Brexit for foreign direct investment

As is well understood, inward investment is of vital importance to the UK economy, not least because of the employment opportunities that foreign firms create, often in areas of high unemployment. Unsurprisingly, there are microeconomics-based debates concerning training effects, productivity spillovers and secondary employment but possibly the most important contribution that inward FDI makes to an economy is in mitigating the effects on an almost permanent trade deficit (see Fig. 1). In this respect, those championing Brexit often comment on how trade would be unaffected, so long as the UK were to stay within some looser trading arrangement with the EU, clearly assuming that inward investment would remain unchanged. These debates, however, are essentially taking place in a vacuum, given the paucity of knowledge about the drivers in the variation of FDI into the UK over the past 50 years.

The empirical analysis that studies the effect of joining a customs or currency union typically simply adds a dummy variable to the model in question to make a distinction between the periods before and after the economy entered a union. However, given the lack of examples of countries leaving customs unions, the most common approach when seeking to examine the likely effects of exit (primarily in the mainstream press) is to reinterpret the evidence on the effect of joining from the perspective of the reverse process. This is a fundamentally flawed approach since it disregards even the causes or directions of wider shocks that are associated with such a move as well as any possible asymmetry. Perhaps more importantly, the pervasive modelling approach that has been adopted so far is founded on exogenously defined dummy variables to study the before and after joining the union effect, effectively ignoring the significant econometric advances of the last three decades. Therefore, the approach that we propose is radically different from the rest of the location analysis that has been performed in emerging literature in this area (see for example Bruno *et al.* (2017) and Simionescu (2017)) and sheds some light on how Brexit may affect inward FDI. We do this by building on the notion of examining the response of inward FDI to shocks of the key macroeconomic variables, and subsequently associating this with the wider economic environment. Before discussing our approach, however, it is worth examining briefly what the literature has concluded in terms of the relationship between FDI and customs union membership.

3.1. Foreign direct investment and customs union membership

The initial literature that examined the potential effect on FDI flows on a country's accession to a customs union essentially extended the well-understood concepts of 'trade creation' and 'trade diversion' to the issue of FDI. This then makes a series of predictions concerning both FDI flows into a country from outside the customs union, and also regarding intraunion FDI. Much of the analysis that seeks to link FDI decisions of firms to country level decisions regarding economic integration is based on the analysis of Rowthorn (1992).

These can be summarized as follows: firstly, that a country's membership of a customs union

makes it more attractive for inward investment from outside the region (Collie, 2011), with a general increase in ‘interbloc’ FDI (Donnenfeld, 2003). This is in turn related to the ‘optimal tariff’ literature; see for example Blonigen and Cole (2011), who applied the model of Blanchard (2010) to the case of Chinese accession to the World Trade Organization. Theoretically, one could adopt a similar analysis to the case of Brexit, concluding that the UK may seek to attract ‘tariff jumping’ FDI at the expense of the EU. This is, however, not a position that those advocating Brexit have yet adopted, for fear that retaliation from the EU would cause a reduction in FDI to the UK from outside the EU. Bajo-Rubio and López-Pueyo (2002) for example argued that Spain became more attractive for non-EU inward investment as the EU moved towards the single market in 1992.

The second argument concerns the expected reduction in intrabloc FDI, as firms seek to capture economies of scale by concentrating activities and then benefitting from free trade to service the different national markets. Here, the theoretical predictions concerning a reduction in intra-EU FDI turned out to be somewhat wide of the mark; see for example Cantwell (1987) or more recently Cardamone and Scoppola (2015). This essentially is because the theoretical analysis failed to consider fully the relative importance of a reduction in the costs of co-ordinating activities across locations within a customs union, compared with the economies-of-scale effects in production. The single market significantly reduced the costs of co-ordinating activities across European countries and, as a result, multinational firms remained dispersed with the EU. Indeed, although firms have expanded into accession countries seeking lower production costs, they have also retained activities near customers in rich markets. (This is often illustrated with reference to the automotive industry, which has, within the EU, retained a relatively dispersed production network, with very high levels of intrafirm trade; see for example Rhys (2004).) The evidence, however, suggests that this effect in the case of the EU has not materialized, as firms have sought to take advantage of the reduction in costs of co-ordinating activities within the EU, and to engage in technology transfer as they seek the lowest cost locations for a given activity (Barrell and Pain, 1999).

This highlights a key question within the Brexit debate. Whereas it is difficult to characterize the specific ‘leave’ position on this issue, it is clear that the dominant paradigm among leavers hardened through 2017, evolving from a stated intention to stay in the customs union, to, by March 2018, a stated intention to leave it. However, it is certain that the ‘harder’ the Brexit, that is to say the further the UK is removed from the pillars of the single market, the more challenging the business environment will be for inward investors seeking to use the UK as a gateway to Europe; and, in the same vein, the inevitably higher transaction costs will make the UK less attractive for FDI from the rest of Europe.

Of potentially equal importance is the association of Brexit with uncertainty in the business environment. The exact mechanisms by which trade will be administered and the associated costs for UK-based firms in co-ordinating activities in Europe are still uncertain. Predictably, such costs will only increase if the UK seeks to diverge substantially from EU regulations and standards. (Consider for example the institutions and regulations that govern the single market, such as vehicle emissions requirements. Firms within the EU face one set of emissions requirements, and so co-ordinate activities across EU plants, with very large volumes of intrafirm trade. The same can be said of food standards, electrical equipment etc. If these regulations were to diverge, then the cost of co-ordinating activities would increase.) In this spirit, Los *et al.* (2017) examined the spatial distribution of the likely effects of Brexit and highlighted the issue of value chains that cross between the UK and the EU a number of times. When they speculated on the likely outcome for these post Brexit, they made the point that the outcome for many multinational firms will be to relocate supply chains to the EU, and then merely to

import the finished product into the UK. In turn, this poses two related questions, the first regarding the effect on investment that is already here, and the second regarding the effect on future investment. Los *et al.* (2017) made a very persuasive argument concerning why some investors in the UK may leave, and, acknowledging that some FDI into the UK is reinvestment by existing firms, we focus on the prospects for future investment. This is consistent with our findings regarding new investment.

At the same time, the level of uncertainty in the business environment can be viewed as both a determinant and an effect of the broader state of the UK economy in the aftermath of Brexit. In this respect, its subsequent effect on FDI may be conditioned on the prevalent stable or unstable economic regime in the post-Brexit era which we characterize, following the mainstream paradigm, as the low or high volatility regime respectively. Consequently, our analysis focuses on how inward investment responds to changes in the variables that reflect the macroeconomic environment within which firms operate. At the same time we must allow for the fact that this environment has changed over the years and is likely to change because of Brexit, even for the short run. We do this by employing a time series approach to track the dynamic relationship between FDI and the principal macrovariables, namely an SVAR model, to separate also the effect of the different structural shocks on FDI, which we build within the Markov regime switching framework, to encompass the possible effect of uncertainty that this dynamic relationship might exhibit. This is what we explore in detail in Section 5.

There is of course a voluminous literature on the effect of inward FDI on the UK, most of it based on sectoral or regional data, examining questions such as employment effects, contrasting different regions of the UK, or alternatively the productivity or technology transfer effects. Typically, this seeks to build on, or to challenge, the policy agenda concerning the beneficial effects of FDI, mainly at a local level.

Equally, there is a large literature, which conceptually is based at the level of the firm, and essentially seeks to explain why a firm would choose a particular location, or why some locations prove more popular for FDI than others. These typically adopt a panel structure and focus on combinations of demand (market size) and location factors (labour costs).

As such, the time series analysis, much of which is nearly 20 years old, takes this as a starting point, and then seeks to explain observed macrolevel FDI flows in terms of other macroeconomic variables.

4. The model

The standard approaches to modelling the FDI decision start with one of two perspectives. The first perspective, which is built for example on Rowthorn (1992) or Horstmann and Markusen (1996), is based on the assumption that a firm has two options in terms of servicing a foreign market (or three, including licensing), namely exporting and investing, and that typically the decision to service that market has already been made. Analyses with respect to economic integration then seek to explore both the relative importance of factor endowments, relative cost and market structure, and how these will change after a country enters a customs union. Such changes are in turn used to explore potential location decisions of firms from within and outside the customs union, after a union has been created. Ekholm *et al.* (2007), for example, linked location decisions to production and trade costs post the formation of a customs union.

Initially, we may consider that the problem determining the effect of leaving a customs union is analogous to this. However, in the case of the UK leaving the EU, what is rather expected is the UK's 'opting out' of the set of institutions that enforce the union while retaining some form of membership of the free-trade area. Moreover, as the debate develops, it becomes evident

that the main concern of business leaders and commentators, as well as policy makers, is not the likely changes in inward investment into the UK that such an event may bring, but rather the uncertainty that it will engender in terms of future investment flows. Consequently, it seems natural to base an analysis on the theoretical contribution of Antras *et al.* (2009) who linked FDI to risk or volatility. There is a large empirical literature which seeks to link FDI decisions to risk, though typically this is in terms of either sovereign risk (see for example Aizenman and Marion (2004)), or the extent to which corruption increases agency problems and other transactions costs, and therefore deters FDI (see for example Javorcik (2004) and Wei (2008)). (It should be pointed out that the applied and theoretical literature finds rather complex relationships between for example corruption and FDI, dependent on first-mover advantage, the cohort of indigenous firms and the potential for first-mover advantage; see for example Hakkala *et al.* (2008).)

We therefore adopt the approach that is used within the empirical literature, which is to treat the FDI decision as a subset of the investment literature. The essential model of FDI is based on the probability that a firm enters a given location (model I):

$$P(\text{Entry}) = \phi_1 \left\{ \sum_{p=0}^T \left(\frac{1}{1+r} \right)^p \prod_{t+p}^e \right\}$$

where T is the expected life of the investment, and r is the discount rate. This is clearly unobservable, but it can be written as a function of a vector of country level characteristics (model II):

$$\sum_{p=0}^T \left(\frac{1}{1+r} \right)^p \prod_{t+p}^e = \phi_2(x_{1i}).$$

Within a time series setting, this is then operationalized, following Campa (1993) who introduced exchange rates into a model of the FDI decision at the firm level. The analysis, which is based on option theory, seeks to link the firm level decision to enter a market through foreign production. This links the investment decision, not merely to the expected returns and the sunk costs of entry, but also to the level of uncertainty, i.e. the volatility of the exchange rate:

$$\int_0^{\infty} (R_t p - w) \exp(-\rho t) dt = \frac{R_0 p}{\rho - \mu} - \frac{w}{\rho} \geq Rk$$

where R_t is the value of the exchange rate at time t , μ is the drift of the exchange rate, p is the dollar price of the good, w represents the variable costs in foreign currency of producing the good and ρ is the discount rate. According to this equation, the firm will enter as long as the expected value of future dividends is greater than the cost of entry k . A model using pricing theory will transform the previous equation on the decision to enter by the firm in the following equation:

$$\frac{\hat{R}p}{\rho - \mu} - \frac{w}{\rho} - \frac{\hat{R}p}{(\rho - \mu) \beta(\sigma)} = \hat{R}k$$

where \hat{R} is the critical value of the exchange rate that triggers entry, $\beta(\sigma)$ is a known function of the volatility of the exchange rate and $f'(0) < 0$. Therefore, the higher the volatility of the exchange rate, the higher the level the exchange rate must be for the firm to decide to exercise its option to enter the market. As Campa (1993) illustrated, the present model gives clear predictions on the effects of exchange rate uncertainty on foreign investment. It predicts that the higher the uncertainty σ , and the degree of sunk investments k that are necessary to enter the market,

the more valuable the option to enter will be and the fewer events of entry we shall observe. In contrast, the higher the exchange rate and its rate of change, the higher the expectation of future profits from entering the market will be. Finally, the lower the variable costs of production w with respect to other competitors, the more likely it is that entry will occur.

The link between this approach, and the trade-theory-based analysis of FDI of Rowthorn (1992) and De Fraja and Norman (2004) was provided by Bergstrand and Egger (2007), who linked FDI decisions to market size as well as distance, providing justifications for the use of gravity equations to analyse FDI patterns (see for example Barba Navaretti and Venables (2004)). Omitting uncertainty from this highlights why previous analyses have found no relationship between currency and FDI flows. As the host currency appreciates, the cost in home country currency of the investment increases, but so do expected returns.

Uncertainty, however, cannot simply be ignored. As model I demonstrates, when we introduce uncertainty, then, whereas the expected return may not change, the variation or risk that is attached to that investment increases, and the investment becomes less likely. But even in this model the focus is on the expected value, rather than the variance, if that proxies uncertainty. In fact, as was discussed by Blonigen and Piger (2014), although uncertainty is acknowledged as an essential factor, it is seldom explored in the literature. In this respect, our approach is similar to the underpinnings of Campa (1993), who sought to link investment to uncertainty. In their case, uncertainty is assumed that it can be explicitly pinpointed through fluctuations in the real exchange rate and went on to show that exchange rate variability reduces domestic investment. Also, they argued that these effects may be understated when we impose a model with stable parameters. In our case, uncertainty is a systemic characteristic of the regime that the economy finds itself in at each point in time. (Overall, in the Markov regime switching framework the high volatility economic regime is generally associated with high currency uncertainty, and that the low volatility regime is generally associated with low currency uncertainty. However, it does allow for (short-lived) spells of high currency uncertainty during the low volatility regime and low currency uncertainty during the high volatility regime.) In the context of the above model, this could be translated as setting $\beta(\sigma)$ to be also dependent on the economy regime as identified through its projection on the interlinked dynamics of the main variables that characterize a macroeconomy such as economic growth, inflation and policy rates. Therefore, it should be expected that if uncertainty is important then economic regimes that are characterized by higher volatility will attract lower levels of investment. (There has been much speculation concerning why the UK did not suffer a larger fall in growth after the referendum, though evidence is now emerging from the Office for National Statistics that the ‘Brexit bounce’ was fuelled by consumer spending, whereas long-term investment has declined.)

In this spirit, our model seeks to link inward FDI to a vector of macroeconomic variables and specifically to the shocks that each of the macroeconomic variables might exhibit. For this we estimate an SVAR model identified by using a very flexible (sign restrictions) scheme. In this way, we can capture the contemporaneous effect of changes of each macrovariable onto FDI flows and, through the respective impulse–response graph, how this effect evolves over time. Furthermore, we build our model within the Markov regime switching framework to make a distinction between periods of high and low volatility in the economy, proxying in effect the periods of high and low economic uncertainty. This enables us to observe how uncertainty, as a feature of the whole economy now, influences the effect of the macrovariable shocks on inward FDI. Finally, we endeavour to improve the robustness of our analysis by also looking at mainstream variants of our model to explore whether our results are consistent across different sets of modelling assumptions.

In effect, a key objective of this approach is to combine the understanding that has been derived from the earlier time series analysis, which focused on providing econometric explanations of the observed variation in FDI flows, with the wider understanding of the relationship between FDI and development. Consequently, our work can also be seen as an endeavour to develop the well-understood albeit empirically limited literature (based on panel data analysis, building for example on Borenzstein *et al.* (1998)) that examines the contributions that inward FDI can make to growth. Exploring the effects of Brexit within this framework becomes then a natural application to showcase the value of this approach.

5. Data and econometric methodology

In general, our approach is to look at the possibility of Brexit through well-studied time series lenses. This allows us to ground our analysis explicitly on the UK and how its economy and FDI have reacted to exogenous shocks over the last century or so. Consequently, we bypass, instead of addressing head on, the insurmountable challenge of establishing analogies between Brexit in the UK and similar events in other countries—which historically do not exist.

However, an investigation of the effect of such an extraordinary event in this way dictates, to a large extent, the selection of variables: multiple-country data are hardly relevant because the topic is country specific; and industry level data are inherently unsuitable because of their very low frequency (typically annual) and short time span. A time series approach is therefore the most suitable route to yielding data-based conjectures about the ‘Brexit effect’. In this respect the macroeconomic literature has offered a solid platform to build on.

Subsequently, our data set spans the period 1963, quarter 1–2013, quarter 4 (quarterly frequency), and contains, apart from the UK’s FDI, the gross domestic product (GDP), consumer price index, foreign exchange rate against the US dollar and the policy interest rates. (The last observation of the sample is due to the FDI series—the Office for National Statistics has stopped updating the particular (long) FDI series that we are using.) For robustness, we also undertake our estimations by dropping the observations before the UK joined the European Communities in 1976 to ensure that our results are not affected by the inclusion of observations before the UK became a member of one of the early manifestations of what has now evolved into being the EU. In anticipation of what we report in the results section (Section 6), it is worth noting that our results are almost identical, as the model is robust to this change. Table 1 overviews the statistical properties of the variables, transformed accordingly (standardized values for FDI, differences for policy rate and log-differences for the rest) to ensure stationarity. (We discuss our adopted method of analysis further down but the familiar reader may also observe that we are effectively in the same set-up with the prevalent SVAR that solves a Neo-Keynesian dynamic stochastic general equilibrium (DSGE) model of a macroeconomy (see for example

Table 1. Statistical overview of the data

<i>Statistic</i>	<i>FDI</i>	<i>GDP growth</i>	<i>Inflation</i>	<i>Foreign exchange rate (returns)</i>	<i>Rate (difference)</i>
Mean	0.003	0.632	1.355	−0.274	−0.004
Standard deviation	1.002	0.998	1.460	5.025	0.263
Skewness	3.702	0.244	1.744	−0.760	0.410
Kurtosis	22.721	6.880	7.357	5.566	7.707

Arestis *et al.* (2016)), which we augment with an inward FDI variable. This is no coincidence: from another perspective, we are effectively interested in capturing how inward FDI interacts with the macroeconomy (or, more precisely, with the factors that are widely viewed as capturing the dynamics of the macroeconomy.)

In terms of methodology, we adopt a Markov regime switching SVAR approach. This involves a two-step procedure which brings together two important developments of VAR analysis: estimation within the Markov regime switching framework to control, for example, for the business cycle, and identification of the underlying contemporaneous effects to enhance the excellent performance of VAR models to fit time series data with theoretical underpinnings.

In particular, estimating a (reduced form) VAR within the Markov regime switching framework enables all estimated parameters to be state dependent. Schematically, it is given by

$$X_t = c(S_t) + \sum_{j=1}^p A(S_t) X_{t-j} + B(S_t) u_t, \tag{1}$$

$$\Omega(S_t) = E[B(S_t) u_t u_t' B(S_t)'] = B(S_t) \Sigma_u(S_t) B(S_t)' \tag{2}$$

where

$$X_t = \begin{pmatrix} \text{FDI}_t \\ y_t \\ \pi_t \\ r_t \\ \Delta l_t \end{pmatrix}, \quad c(S_t) = \begin{pmatrix} c_{1, s_t} \\ c_{2, s_t} \\ c_{3, s_t} \\ c_{4, s_t} \\ c_{5, s_t} \end{pmatrix}, \quad u = \begin{pmatrix} u_{1, s_t} \\ u_{2, s_t} \\ u_{3, s_t} \\ u_{4, s_t} \\ u_{5, s_t} \end{pmatrix}$$

and FDI, y , π and r signify inward FDI flows, GDP growth, inflation and foreign exchange rates against the US dollar (log-) returns, Δl the first difference of policy rates, S the regime (1 or 2 representing what are characterized as the low and the high volatility regime respectively) and u the innovation terms. (This is a typical approach in the SVAR literature aimed at making robust the estimation of the system against the highly persistent interest rates. Indeed, when we tried the levels of interest rates, in some cases the impulse–responses were explosive. The adoption of two regimes seems to be the tacit convention in the empirical literature, often justified by the fact that it comes with a plausible and yet natural interpretation of what each of the two regimes mean. It is worth noting, however, that it is also something that to a large extent is dictated by the available information since introducing more regimes intensifies the curse of dimensionality that VAR models suffer from. For example, in this particular instance, introducing a third regime would raise the number of parameters to be estimated to about 100 which would effectively discredit any inference that is drawn from such estimates owing to the inevitable lack of a sufficiently long sample. Consequently, we, along with other similar studies, are to some extent forced to follow the predominant paradigm—in fact, adopting two regimes appears to be inevitable given the low (quarterly) frequency of FDI and the span of the available data.) In this set-up, addressing the problem of identification effectively refers to identifying the impulse matrix $B(S_t)$, which can then be used to extract the contemporaneous interactions between the elements of X_t . Identification of $B(S_t)$ requires n^2 restrictions within each regime whereas estimation of $B(S_t)$ provides $[n(n + 1)/2]$ restrictions. This means that full identification requires another $n(n - 1)/2$ extra restrictions. Sims (1992) in his seminal SVAR paper derived these restrictions by ordering the endogenous variables recursively. We choose the recursive form of identification following the scheme of Ehrmann *et al.* (2003). In our models, we impose the restrictions that (normalized) FDI changes will respond positively to shocks in GDP growth, inflation and exchange rate growth and negatively to shocks in interest rate changes. However, it

is worth underlining that a main advantage of the aforementioned identification approach is that if a restriction is not valid then it will be rejected by the shape of the impulse–responses—i.e. the shape of the impulse–response graph will not display what the restriction dictates. (It is worth noting that, to maintain our degrees of freedom, our results regarding the various effects are symmetric (for example, exchange rate depreciations and appreciations for each regime would have the same effects in absolute magnitude on FDI albeit with different signs). Future studies may relax this assumption.)

Model (1) and (2) (model A) is sufficiently general to allow us to incorporate regime shifts for all parameters which means that it is not clear what distinguishes the various regimes. Changes in the unobserved state variable could be associated with the phase of business cycles (i.e. switches in the intercept), or with changes in the propagation mechanism (i.e. changes in the dynamic structure of the auto-regressive Markov regime switching VAR coefficients) or with changes of the Markov regime switching VAR errors (i.e. changes in the variance of innovations). Consequently, it is worth looking at the respective nested models to have a clearer picture about the source of the regime shifts.

Model A, the general model that is presented in equations (1) and (2), accounts for the joint contribution of all potential sources. In other words, apart from the effects that are contained in the other two models (business cycle and luck) it also accounts for shifts in the propagation mechanism, which are often views that are typically driven by changes in market expectations—see for example Stock and Watson (1988), Pesaran *et al.* (1993), Pivetta and Reis (2007) and Pancrazi and Vukotic (2013). Consequently, this model also captures the effect that changes in the formation of market expectations have on FDI.

Model B is built under the assumption that only the intercepts change across regimes, whereas the auto-regressive parameters and the variance–covariance matrix of reduced form shocks remain constant. In this set-up, regimes are identified as low and high growth and high and low inflation, in effect aiming at capturing the business cycle. Schematically, we have

$$X_t = c(S_t) + \sum_{j=1}^p A_t X_{t-j} + Bu_t, \quad (3)$$

$$\Omega = B\Sigma_u B' \quad (4)$$

where the impact matrix B remains constant across the different regimes (i.e. $B(S_t) = B$), which also means that, since only $c(S_t)$ changes, the profiles of the impulse–responses remain the same across the different regimes.

Finally, model C is built under the assumption that only the regime shifts are driven by luck, following the main bulk of the literature on the Great Moderation. In other words, the regime shifts are confined to the variance of structural innovations whereas the impulse matrix B is invariant across the S_t states, which is an approach that resembles those suggested by Rigobon (2003) and Rigobon and Sack (2003) for identification of SVAR through heteroscedasticity. However, it should be noted that here we relax the assumption that changes in the covariance structure occur at fixed points during the sample period. Schematically, we can have

$$X_t = c + \sum_{j=1}^p A(S_t) X_{t-j} + Bu_t, \quad (5)$$

$$\Omega = B\Sigma_u(S_t) B'. \quad (6)$$

Lanne *et al.* (2010) showed that identification of B can be achieved if

$$\Omega(S_t) = BB' \quad \text{for } S_t = 1,$$

and

$$\Omega(S_t) = B\Phi(S_t)B' \quad \text{for } S_t = 2, \dots, N$$

where $\Phi(S_t)$ is a diagonal matrix with positive elements. If there are only two regimes (i.e. $S_t = 1, 2$) identification requires that the elements of $\Phi(S_t)$ are distinct. Model C has been used in the Great Moderation literature to test the null hypothesis of ‘good luck’. (From a certain perspective it can also be considered the variant that is closest to the typical (single-regime) SVAR model since apart from the innovation term the other parameter estimates (the intercept and the coefficients of the lagged dependent variables) will be the same across the two regimes. Therefore, its impulse–responses should not be far from those that the simplest SVAR variant would yield.)

6. Results

Overall, the filtered probabilities of all three models (depicted in Fig. 2) fit well the commonly acknowledged periods of high and low volatility in the macroeconomic variables and more generally the periods of relative economic stability in the UK economy (e.g. the turbulent 1970s or the so-called UK Great Moderation from 1992 to 2008).

At this point, it is worth noting that, unlike the auto-regressive and especially VAR models, the fit of SVAR models is evaluated in the existing empirical literature overwhelmingly through reporting the values of information criteria, primarily for the model selection (reported in Table 2, together with the linearity—single-regime—test) and the impulse–response graphs, for ensuring that the estimated model is stable and well behaved. (Theoretically speaking, if we could specify up front and properly calibrate the underlying DSGE model of the UK economy that perfectly fits the data, then it would have been possible also to evaluate the fit of the SVAR estimates by comparing its impulse–responses with those simulated by the calibrated DSGE

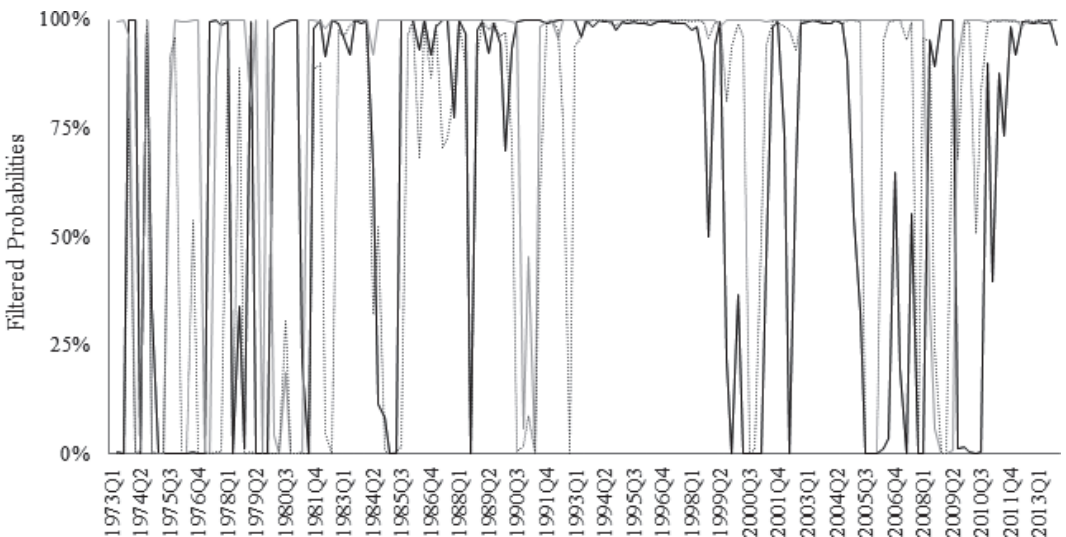


Fig. 2. Filtered probabilities of the three models: for model A (—) and C (· · · ·) the filtered probabilities are for being in the low volatility regime (regime 1) and for model B (— — —), for which volatility is the same in the two regimes, they are for being in expansion (regime 2)

Table 2. Model selection criteria and tests[†]

<i>Model</i>	<i>BIC</i>	<i>LR</i>
A	15.8 (16.17)	294.9
B	16 (16.33)	59.4
C	15 (15.03)	271

[†]BIC refers to the values of the Bayesian information criterion for a Markov regime switching SVAR of order 1; its values for a Markov regime switching SVAR of order 2 are reported in the parentheses. LR refers to the value of the likelihood ratio test against the presence of a single regime (linearity) and in all cases it is statistically significant at the 1% level.

model since the DSGE model would be the log-linearized approximation of the SVAR. However, in practice, this route is hardly accessible because even under the most implausible assumption that such a DSGE model can be conceptualized (and, crucially, become widely accepted), it may be of little practical use: although a DSGE model generally has a finite order VAR solution in all its variables, it is highly unlikely that this will also be so when only the observable variables are included (see for example Kapetanios *et al.* (2007).)

Moreover, it is also worth noting that, although, at first glance, it may seem tempting to remove some of the insignificant variables, to, maybe, improve the accuracy of the estimates of the impulse–responses, there are two important points that we should bear in mind. First, although the results are not reported, the dropped-out variables proved essential in identifying the regimes reasonably (in terms of the general perception of what was the state of the UK macroeconomy during the sample period considered). This should not be a surprise since the idiosyncratic elements of the remaining series are given more weight in the smaller-scale systems than they are when all the variables are used instead. Second, although uncertainty would still be a feature of the variables that comprise the (smaller-scale) system, the system itself would hardly be classified as mirroring the state of the macroeconomy, which, as we previously note, is actually essential for our analysis. (As we explained earlier, we have purposely adopted the same set-up with the prevalent SVAR that solves a Neo-Keynesian DSGE model of a macroeconomy, which we augment with an inward FDI variable.) For these two reasons, we do not consider the smaller-scale econometric models.

Fig. 3 depicts the results from fitting model A on our data. It shows that, in either regime, FDI flows are not affected by shocks in GDP growth or interest rates. In the low volatility regime, FDI flows increase either as a result of currency appreciation or, to a lesser extent, increased inflation. In the high volatility regime, FDI flows decrease because of a positive shock in the foreign exchange rate although the confidence intervals suggest that the effect is at the boundaries of statistical insignificance. (Our expression (positive or negative) in our context has no appraisal; it is purely the sign of the number of the shock (so a positive shock for the foreign exchange rate means a shock that increases the value of the foreign exchange rate, and since this is the pound–dollar rate this means that it can come either from a cheaper dollar, or from a more expensive sterling or both).) In either case, its effect on FDI flows tends to die out slowly.

Fig. 4. depicts the results from fitting model B to our data. It shows that the results are similar to those of model A in both regimes. FDI is not affected by shocks in GDP growth or inflation.

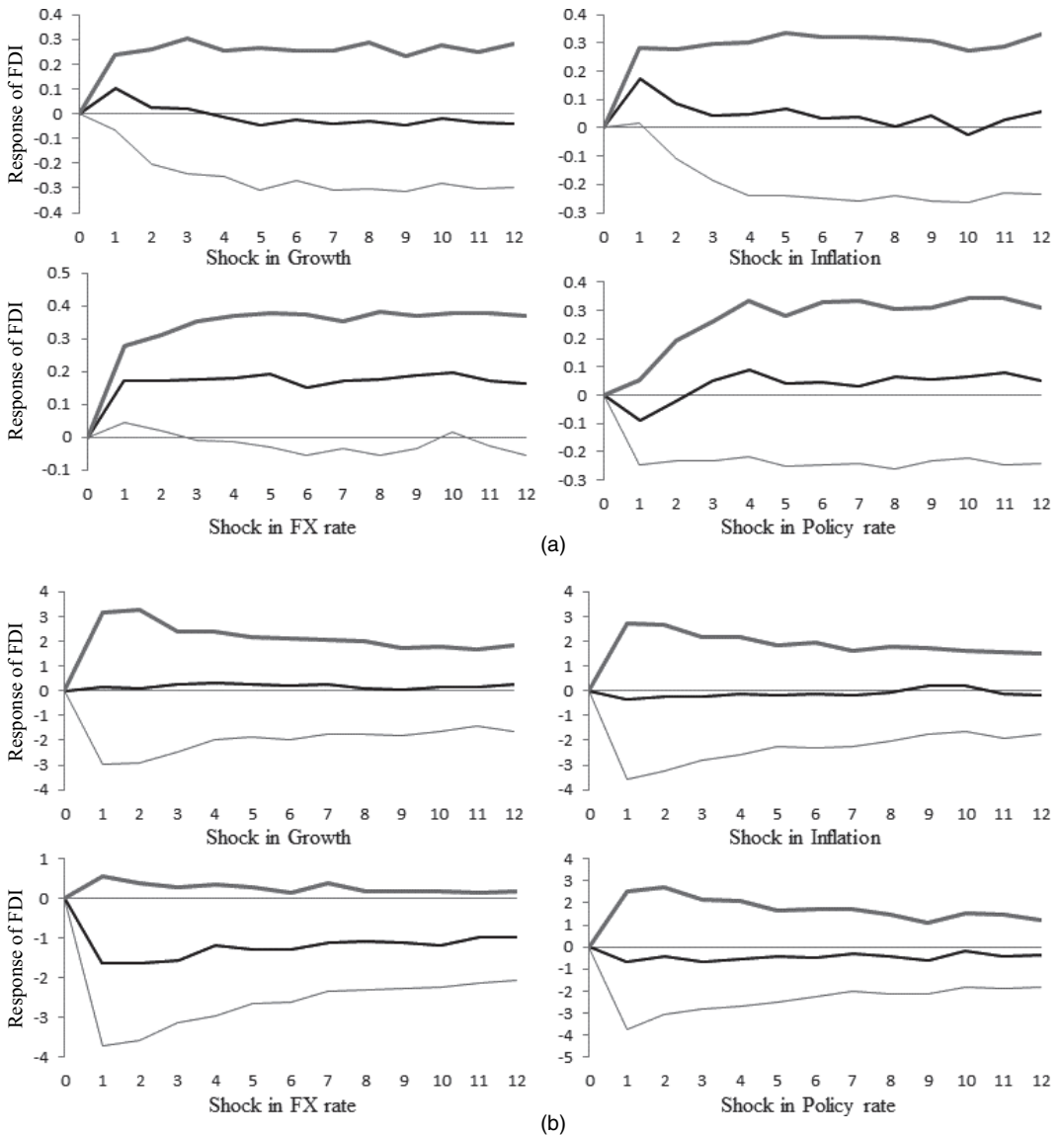


Fig. 3. Impulse–response graphs based on model A: (a) responses of the percentage change of the inward FDI to a shock of each variable based on the first (low volatility) regime of model A; (b) respective responses based on the second (high volatility) regime; the graphs also depict the 16% and 84% confidence intervals (see for example Uhlig (2005)) obtained by the bootstrap

In the low volatility regime FDI increases either by positive changes in the foreign exchange rates or positive interest rate changes, whereas in the high volatility regime FDI decreases either by positive changes in foreign exchange rates primarily or positive interest rate changes more severely initially and less so later. The confidence intervals indicate that the effect of foreign exchange rates is at the boundaries of being statistically significant whereas the effect of interest rate changes, although in the same direction, is clearly not significant.

Finally, Fig. 5. depicts the results from fitting model C on our data. Predictably, it shows

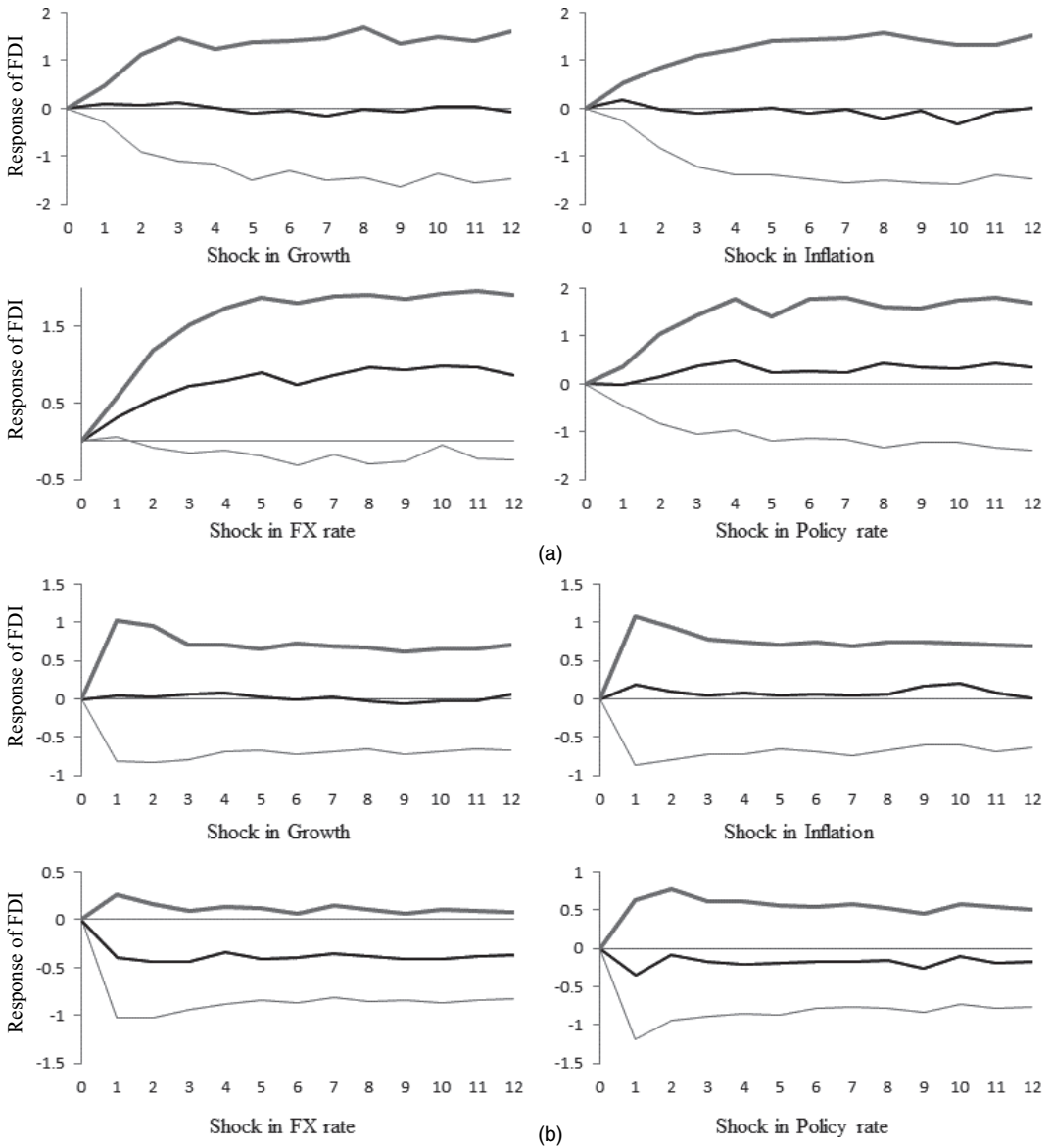


Fig. 4. Impulse–response graphs based on model B: (a) responses of the percentage change of the inward FDI to a shock of each variable based on the first regime of model B; (b) respective responses based on the second regime; the graphs also depict the 16% and 84% confidence intervals obtained by the bootstrap

that the results are roughly averaging the effect of the two regimes of model A and model B. Specifically, FDI flows are not affected by shocks in growth and inflation, whereas the effect of foreign exchange rate and interest rate changes is negative albeit insignificant (marginally in the former case, and overtly in the latter).

Overall, the purpose of our approach has been to explore in more detail the relationship between inward investment into the UK and the principal macroeconomic variables, while accounting for uncertainty. For this, we have explored the key distinction between periods of

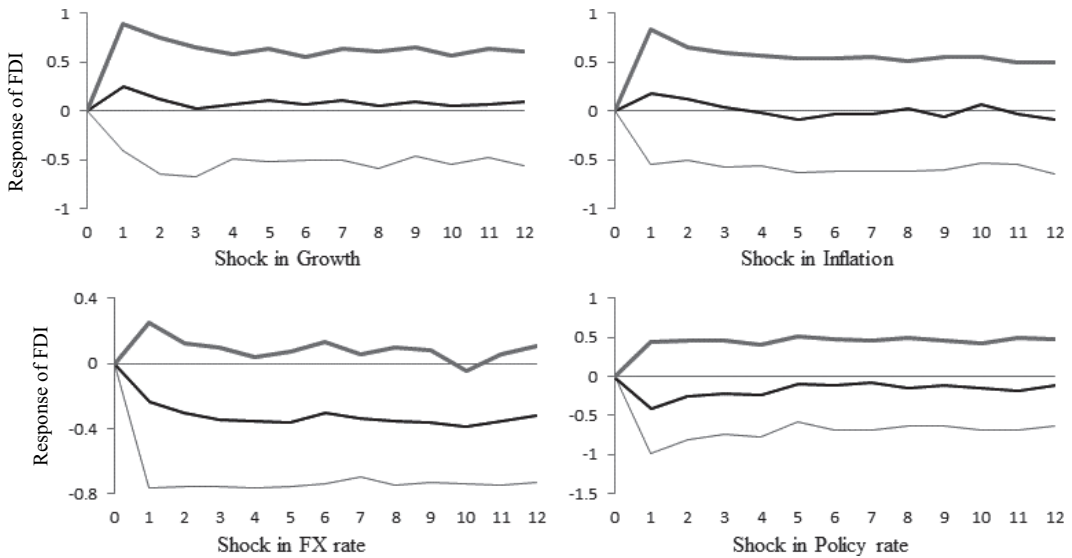


Fig. 5. Impulse–response graphs based on model C: responses of the percentage change of the inward FDI to a shock of each variable based on model C; the graphs also depict the 16% and 84% confidence intervals obtained by the bootstrap

high and low volatility, which are found to coincide often although not always with periods of recession and expansion respectively, by using a Markov regime switching specification of an SVAR to isolate the effect of a shock in each variable on FDI. The results show, perhaps not surprisingly, that, in periods of high volatility, a positive shock in exchange rates only (i.e. a one-period appreciation of exchange rates) deters FDI. Conversely, a negative shock in exchange rates (i.e. a one-period depreciation of exchange rates) increased the growth of inward investment, hence spurring FDI. However, this effect, although substantial in size, was hardly statistically significant.

In contrast, in periods of low volatility, the results are effectively reversed; and, although the effects are at the boundaries of statistical significance, they are persistent since they affect the growth of FDI and not just its level. And, on top of that, inflation seems also to have a lesser albeit statistically significant role to play. This result is one that to the best of our knowledge has not been reported in the empirical literature. In the theoretical literature by Campa (1993), there is only a speculation that uncertainty deters FDI. This, however, is expressed in a different manner from the few (typically cross-country panel studies) that seek to link within-year currency fluctuations to FDI flows. We show that the situation is rather more complex than this, as expressed by the ‘Gordian knot’ discussion of Pain and van Welsum (2003), but that, unlike previous analyses, we can highlight the precise nature of the relationship between exchange rate changes and FDI. It appears that, in periods of low volatility, the prospect of increased returns (in home currency) resulting from an appreciation in sterling increases the volume of FDI, whereas, in periods of high volatility, the increases in risk mean that the high cost in home currency deters FDI. Conversely, the prospect of decreased returns resulting from a depreciation in sterling decreases the volume of FDI in periods of low volatility, whereas, in periods of high volatility, the increases in risk mean that the low cost in home currency attracts FDI. Interestingly, in either regime, the FDI flows seem unaffected by shocks in growth and interest rates.

6.1. *How can the results be used to examine the effect of Brexit on foreign direct investment*

If we take the results at face value then the question about the possible effect of Brexit on inward FDI is essentially answered by making informed conjectures about

- (a) whether Brexit will drive the UK into a period of economic uncertainty that will manifest in the macrovariables or not and
- (b) what will happen to exchange rates and inflation (primarily) and to interest rates (secondarily).

In terms of conjecture (a) it seems only reasonable to assume that there will be a period of economic uncertainty although, in the near-zero growth, inflation and interest rates period, such uncertainty is still debatable as it can manifest in the macrovariables. In fact, it seems more likely that the economy will remain in the low volatility period or return to that quite quickly. Besides, by examining the filtered probabilities of all three models (see Fig. 2) it becomes evident that, whenever the economy moved to the high volatility regime, it did not stay there for long and soon reverted to the low volatility regime. In terms of conjecture (b) there was a depreciation of exchange rates following the referendum, which, depending on the strength of the exchange rates transmission mechanism, will cause further inflationary pressures that the Bank of England may try to counter by increasing interest rates, which in turn should also reverse, at least partially, the exchange rate depreciation. However, our results suggest that the effect of the exchange rates on FDI is much stronger (and significant) than the effect of inflation and interest rates. Consequently, it is reasonable to expect that the overall outcome will be a substantial and persistent decrease in inward FDI. Our results suggest that any short-term benefits from the high volatility regime are statistically insignificant; besides, such a scenario is rather unlikely when growth, inflation and interest rates are near zero.

7. Conclusions

This paper seeks to make two contributions. First, we explore why there is a lacuna between the theoretical literature which predicts an inverse relationship between host country exchange rate appreciation and FDI flows, and the empirical literature which at best finds only a weak relationship that is relatively unstable over time. We explore this in the context of two alternative states of the world: one in which the economy is in a low volatility regime, and one in which it is in a high volatility regime.

Second, in terms of the UK's potential Brexit, we obtain findings that are informative on two levels. Firstly, there is a high degree of uncertainty over Brexit and what the effects on the UK economy will be. Although the advocates of the UK's leaving the EU changed their position through 2017, and are adamant that they now wish the UK to leave the customs union, there is a high degree of uncertainty around the effects of withdrawing from many of the institutions that support and manage the free-trade area. At the time of writing (September 2018) this appears to be the dominant position of the Conservative Party, but they are facing opposition, not just from the political opposition, who seem to favour staying in the customs union, but also from within their own party, and from bodies such as the Confederation of British Industry and the Institute of Directors. As many business leaders and political commentators are arguing, this may lead to a period of instability, following the referendum and the period afterwards while the terms of exit (and re-entry into the free-trade area) are negotiated, although it is quite unclear about whether, how and to what extent this instability will manifest itself in the macrovariables. In terms of the future, we can at this stage speculate that the possibility that the UK will 'crash

out' of the EU with no deal makes more likely that inward FDI may be deterred for longer. Indeed, United Nations Conference on Trade and Development (2018) data suggested that FDI in the UK in new activity was down 90% since the referendum.

Perhaps the greatest effect of Brexit in terms of its effect on inward FDI is not Brexit itself, but what it implies. We have not discussed in any detail in this paper the prospects for foreign investors leaving the UK (though of course a significant proportion of new FDI is (re)investment by existing firms). However, compared with other forms of capital inflow, it is clear that foreign disinvestment will be slower than other forms of capital outflow. Nevertheless, although it is doubtlessly true that these other forms of capital outflow will have a faster detrimental effect on the UK economy, to understand the significance of FDI flows, we need to understand the nature of foreign investment decisions. As Driffield and Munday (2000) showed, foreign investment into the UK occurs with a 2–3-year lag between the decision's being taken and the investment. This holds for expansion or reinvestment as well as for new investment. For example, decisions regarding the location of new production lines in the automobile sector for 2021 have already been taken, and decisions for 2024 are due by 2020. As such, the lack of new investment is similar in effect to exit, as it implies *de facto* a relocation away from the UK. It is also likely to cause a move of supporting sectors and supply chains away from the UK, and an increase in imports.

It is reasonable to assume, for example, that on the basis of the present direction of travel of the UK Government, and its so-called neo-liberal agenda, we shall see an increase in the types of policies that are designed to improve UK cost competitiveness. This means, for example, further increases in labour market flexibility, reductions in employment protection and greater trade with low cost locations such as Asia although it is still a matter of some debate, even within the governing party.

At the same time, however, it is palpable that Brexit already puts and will continue to put pressure on UK exchange rates. One hitherto unexplored relationship concerns the interaction between uncertainty and currency depreciation. In times of uncertainty, devaluation of currency deters new investment, irrespective of the fact that it makes the investment 'cheaper' in a firm's home currency. Taken together, therefore, it is not clear that many macroeconomic policy responses are open to the government to alleviate the impact of Brexit on inward investment. Rather, building on the wider work in this area, the results suggest a micro- or place-based approach to alleviating uncertainty experienced by firms. As a result of these pressures, the UK may pursue more interventionist policies directly targeting inward investment, such as the types of incentive that were paid before the UK entered the single market. Such policies have proved popular with inward investors, and, allied to the greater labour market flexibility in the UK compared with countries such as Germany and France, have long been linked with the historically high levels of inward investment in the UK. The UK may be in position to offer more favourable inward investment incentives when not bound by EU rules on state aid, though they tend to work only in the short term. Rather, as Los *et al.* (2017) suggested, what is required is a series of interventions to protect supply chains, through for example investment in skills, and boosting small firms through access to finance, so that more activity along the whole chain is attracted to the UK. The effectiveness of this, however, will depend on the relative tariff and non-tariff barriers of supplying the UK from the EU or vice versa. Moreover, our results suggest that, to remain competitive in attracting inward investment, the incentives that are offered will need to be sizable and may contravene the trade relationships that the UK will seek to form with the EU. There has been some speculation that reduced tax rates may offset some of the negative effects of Brexit, though at the same time tax competition may alienate the EU even further. Irrespectively therefore of what precise institutional arrangements the UK agrees with the EU,

we expect inward investment to fall in the medium term, though some trade-offs may be possible as sector level agreements develop. It is this area where we feel that future work should focus.

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