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Brexit and financial stability: An agent-based simulation☆

Aristeidis Samitas[a,*], Stathis Polyzos[b], Costas Siriopoulos[a]

[a] College of Business, Zayed University, Khalifa City, P.O. Box 144534, Abu Dhabi, United Arab Emirates
[b] Department of Business Administration, Business School, University of the Aegean, 8 Michalon Str, Chios 82100, Greece

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ABSTRACT

As the UK and the EU prepare to start negotiations for Brexit, it is important for both sides to comprehend the full extent of the consequences of this process. In this paper, we employ an agent based simulation framework in order to test for the short-term and long-term effects of Brexit on financial stability on both sides of the Channel. The relative strength of the UK economy and the banking sector vis-à-vis the EU is taken under consideration. Our results confirm predictions in the relevant literature regarding the output cost of Brexit, with particular emphasis on the EU, and show that financial stability is an important issue, with the banking system suffering significant losses on both sides, particularly over the longer term. Our findings also suggest that policymakers should take into account dynamic effects that may be caused by UK banks moving to the EU after Brexit. The model results show that if banks in the UK chose to move across the Channel, the negative effects in the EU are mitigated.

1. Introduction

The news that Brexit won in the referendum of June 2016 came as a shock to most, since predictions and exit polls had foreseen a clear victory for Remain. The referendum results immediately triggered heavy discussion in the news, with respect to the anticipated results of Britain leaving the EU, with most analysts predicting a significant cost to both the EU and the UK, focusing particularly on the banking sector. This paper attempts to quantify these results and link them to financial stability, by simulating the effects of Brexit using an agent based approach, similar to Riccetti et al. (2016). Our aim is to examine if Brexit will have an impact on financial stability and also how it will influence the real economy, through the financial sector channel. We build a virtual unified economy, which includes banks, firms and households with unimpeded goods and capital flows between them, and implement a sudden separation of a particular subset of agents, which can no longer trade freely with the rest. We must note that our model concentrates on effects driven by the banking sector and, as such, offers a different perspective from research based on the trade channel (e.g. Dhingra et al., 2016a).

The likely effects of a potential Brexit have been in the spotlight in the academic literature in the past years, even before the official referendum was announced. Describing the process as a debate between economics and politics, Jensen and Snaith (2016) analyse the political side of the process and suggest that the decision for the referendum has been a political one. From the economic point of view, most researchers explained how such a scenario would be harmful for both sides of the Channel. Gropp (2016) linked pre-election poll data to stock market returns and showed a negative link between share returns and Brexit votes, particularly in bank shares. However, it seems that markets did not doubt Britain's capability of handling the Brexit fiscally, since Gropp concluded that increasing pro-Brexit poll data resulted in increasing demand for UK government bonds.[1]

Most researchers consider the real economy effects. Dhingra et al. (2016a) focus on trade restrictions (tariff and non-tariff barriers) and show that a significant loss in GDP can be anticipated, which they estimate to be between 1.3% and 2.6% for the UK and between 0.12% and 0.29% for the EU. The estimates of Ottaviano et al. (2014) are similar for the UK (between 1.23% and 3.09%), but the income loss could be as high as 9.5% in the pessimistic case, once dynamic long-term losses are factored in, while Ebell et al. (2016) estimate the GDP loss to 2.7%. Note that all the above figures do not take into account the cost of trade negotiations with non-EU countries, which are currently governed by the EU common policy (e.g. the USA or BRICS). Similar conclusions can be found in Boulanger and Philippidis (2015).

Barrett et al. (2015) focus on FDI[2] and the energy sector and

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* Corresponding author.
E-mail address: Aristeidis.Samitas@zu.ac.ae (A. Samitas).
[1] Interestingly, this "flight-to-safety" effect is only visible with UK government bonds and not with other "safe" bonds, like the German government bond.
[2] FDI: Foreign Direct Investment.

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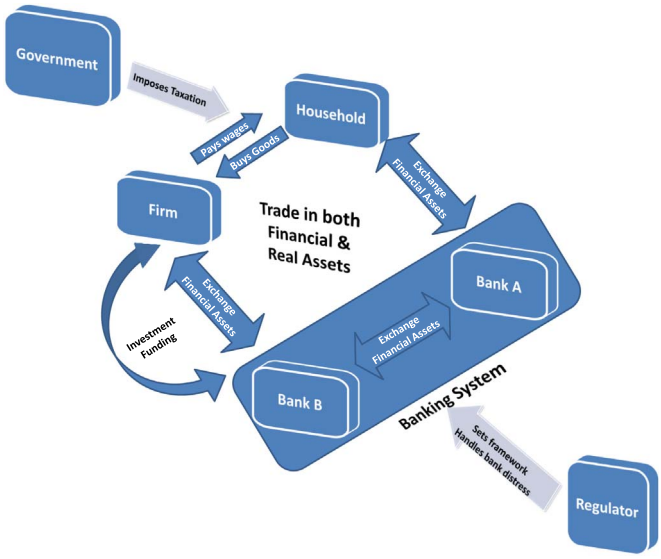

Fig. 1. Graphical representation of the virtual economy.

describe a series of issues that may need to be addressed due to the diminishing attractiveness of the UK in FDI. They propose that the Brexit deal may reduce UK access to the EU market by 25% to 50%. The loss in FDI is estimated to be as high as 22% (Dhingra et al., 2016b), an effect further exacerbated by the financial sector multinational enterprises. Uncertainty may also be an important parameter here. Jones and Olson (2015) examine the effects on the UK and Japan of uncertainty in the US and show that, among others, uncertainty shocks tend to reduce foreign output and induce depreciation of domestic currency. It is not unreasonable to expect similar effects on the EU, stemming from Brexit uncertainty in the UK.

Outside the UK, Oliver (2016) presents a thorough review of relevant views from all sides, including the US and other non-EU states. Even though the analysis is pointed mainly on the political economy of Brexit, the central idea is that one can anticipate negative economic effects. Similar conclusions are reached in the presentation of individual country views in Möller and Oliver (2014), with most analyses focusing on the adverse economic effects of Brexit. Regarding Italy, in particular, Bagnai et al. (2017) simulate a potential exit from the EU and show that it would have a short-term cost of a 1.1% loss in GDP, which would be recovered in approximately five years. Developing countries in the EU are also likely to suffer from the loss of capital inflows, with the banking sector taking some of the burden (Slesman et al., 2015).

In general, economists have always notoriously favoured globalisation as a method of maintaining financial stability and improving efficiency (Samuelson, 1939). Costinot and Rodriguez-Clare (2013) show that trade barriers can be beneficial domestically only when they are imposed unilaterally; in other cases, they need to be unrealistically high to achieve positive results. Ghosh (2016) uses an exhaustive data set and demonstrates that globalisation in the banking sector significantly lowers the risk of a banking crisis. Kose et al. (2003) also show that globalisation favours stability, but may increase consumption volatility up to a certain point.

On the other hand, Broner and Ventura (2016) showed that the actual effect of globalisation is dependent upon the particulars of each economy. However, they do note that for developed economies, the outcome is most likely to be positive. Edison et al. (2002) showed that even though financial integration is not *per se* linked to economic success, we should be careful in rejecting openness as a means to achieve economic growth. Specifically in the EU, Bayoumi and Eichengreen (2017) show that member countries do not experience output disturbances symmetrically, suggesting that there are issues that could result in a suboptimal currency union. Other researchers (Gourinchas and Jeanne, 2006) have shown that globalisation in the financial sector does not benefit growth directly, particularly in developing countries, but can have indirect long-term positive effects through the productivity channel.

This paper contributes to four aspects of the existing literature. First, to the best of our knowledge, our work is the first to examine the effects of Brexit through the financial sector channel, both on bank stability and on the real economy. Second, our paper adds to the discussion linking the financial sector to the real economy (De Bandt et al., 2008, Costeiu and Neagu, 2013). Third, it evolves our single economy object-oriented framework to a two-economy model (Samitas and Polyzos, 2015, Polyzos and Samitas, 2015b). Lastly, it adds to recent findings on the cost of Brexit, by taking into account financial stability.

The paper is structured as follows: Section 2 describes the research methodology, by presenting our model as well as the implementation of Brexit. Section 3 demonstrates the empirical results and the resulting outcomes, with respect to output cost and banking crises. Section 4 concludes and presents policy implications.

2. Methodology

2.1. Model description

We have developed and employed an object-oriented model for financial simulations, based on the behaviourist characteristics of economic agents. The model describes the transactions that can take place among agents. The principles of object-oriented modelling, which are implemented in the model, ensure that economic agents exchange data (information and assets) accurately and that other structures use this data in the appropriate manner. Object oriented modelling is an implementation of agent based economics (Tesfatsion, 2006), where the economy is described as a constant interaction between heterogeneous agents, with differing (and often clashing) rational objectives.[3] There is no single equilibrium; in contrast, multiple dynamic equilibria are reached as the outcome of the aforementioned interactions. Our agent-based system can perform multi-period simulations of the banking environment and includes four types of economic agents: the Banks, the Firms, the Households and the Regulator. Only one regulator can exist in the model, while the number of banks, firms and households can be set at will. The general model structure is based on Tsomocos (2003) and Goodhart et al. (2004) and is demonstrated in Fig. 1. It must be noted that such a setup is popular in agent based models, such as Riccetti et al. (2016) or Rashid et al. (2011). All types of agents share some common features and functions.

Banks can perform transactions with each other and with their customers (firms and households) using another object class, the Financial Asset. Agents (Banks, Firms and Households) trade in financial assets and in real assets (goods and services), under the regulatory framework set by the Regulator, with taxation being collected by the central Government. Households can trade only with Firms and Banks, while Banks can also trade with each other. With respect to Banks, Households deposit their cash there and can take out loans, if required. Also, Households receive money from Firms (wages) and Firms receive money from Households in exchange for goods and services. It should be noted that Firms generate income for Households based on their productive capabilities, which depend heavily both on the Banks' willingness to finance investment projects and on the interest rate offered. The latter is affected by the general economic

[3] It must be noted that, even though agent based models are generally forward-looking, expectations on particular variables, such as prices, interest rates, etc., are usually not modelled. On the other hand, other forward-looking models (e.g. Gorodnichenko and Shapiro, 2007) examine how agents' expectations affect the optimal policy choice. In this sense, forward-looking behaviour is not considered a given in all situations.