National Institute of Economic and Social Research

Reindustrialising the United Kingdom

Xuxin Mao, Stephen Millard, Paul Mortimer-Lee, Hailey Low, Joanna Nowinska and Kemar Whyte

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Abstract

In this report, we examine whether a lower value of sterling could lead to an improvement in the United Kingdom's investment and growth performance and separately the conditions under which this lower value of sterling could be maintained. We find that there may be a case that manufacturing has shrunk too far as a proportion of the economy with a negative effect on UK productivity growth. But attempting to reindustrialise solely via engineering a large sterling devaluation will, at best, only work in the short run as the resulting rises in inflation and unit labour costs will wipe out any gains in competitiveness. Our suggested answer to the problem of low productivity growth in the United Kingdom is that there is a need to increase business investment as a proportion of GDP, though this will require a change in the savings behaviour of both the private and public sectors. Once business investment is increased, then, an appropriate currency strategy, alongside other policy tools, can play a supportive and positive role in supporting higher levels of GDP growth given the right economic environment.

Keywords: Reindustrialisation, exchange rate depreciation, investment, productivity growth

JEL classification: F31, L52, O14 and O25

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Reindustrialising the United Kingdom

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Reindustrialising the United Kingdom

1 Purpose of the Report

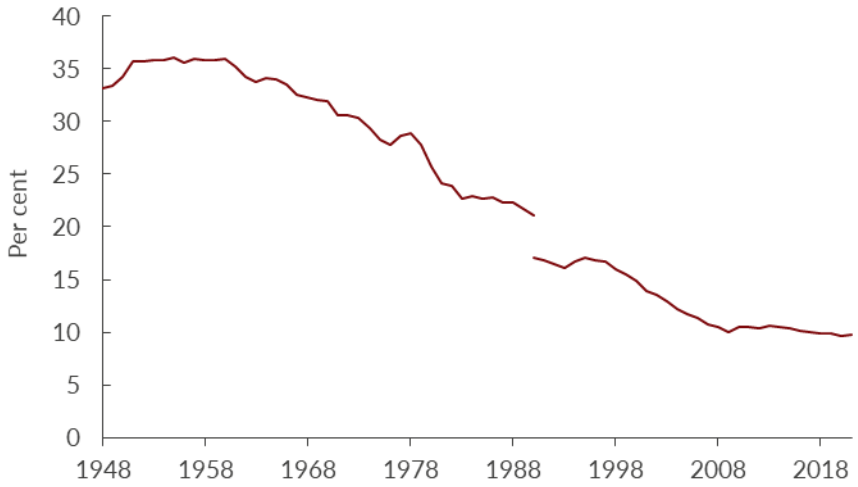
The purpose of this report is to examine the following two questions in the context of the United Kingdom:

a. Can a lower exchange rate lead to an improvement in the economy's investment and growth performance?
b. What are the conditions under which the exchange rate can be held at a low value?

2 Motivation

As is well known, the United Kingdom has seen a long period of deindustrialisation, by which we mean a reduction in the share of manufacturing output in GDP matched by a rise in the share of services. This can be seen most clearly in Figure 1, below, which shows that the share of manufacturing output in UK GDP has fallen from around 35 per cent in 1950 to around 10 per cent today.

Figure 1: Share of manufacturing in UK total value added

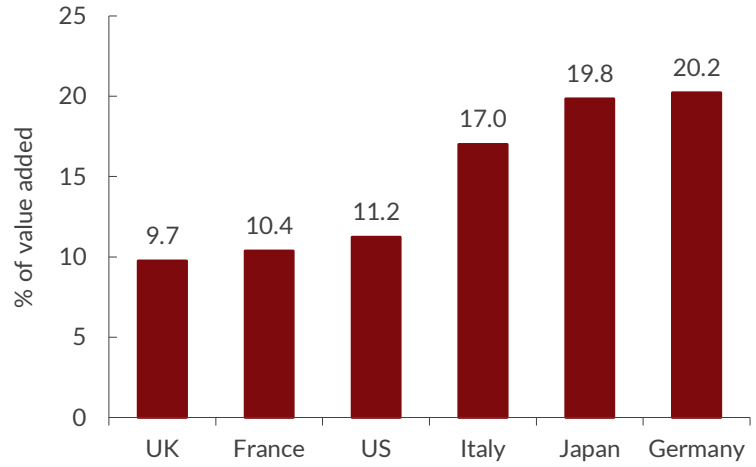


Source: Bank of England Millennium Dataset and OECD.

Note: Prior to 1990 based on SIC 1980; after 1990 based on SIC 2007.

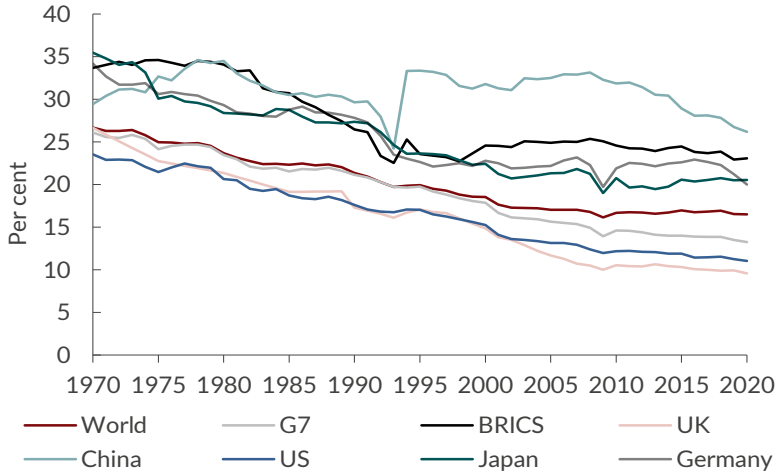
When people talk of 'the industrialised countries' they are talking about rich economies with high living standards. Industrial development has been at the heart of several countries' development strategies, including success stories such as Japan, South Korea, and China. Many of the fastest-growing economies over recent decades have seen rapid industrial development. Against this background, does it matter that the UK has the smallest share of Industrial output in GDP of any country in the G7 (Figure 2)? Or that it has seen the most significant decline in manufacturing share of all the G7 economies since 1970 (Figure 3)?

Figure 2: Share of Value Added in Manufacturing



Source: OECD; most recent data

Figure 3: Manufacturing to GDP Ratio (1970-2020)



Source: UNCTAD

The decline in manufacturing matters. Manufacturing is an important employment sector, with about 2.6 million workers in the United Kingdom, about 7 per cent of total jobs. Productivity growth is often faster in manufacturing than in services, so a small manufacturing share in GDP means slow overall productivity growth. From 1997 to 2021, output per hour worked in the manufacturing sector increased by more than 151 per cent, compared with only 31 per cent in the economy as a whole. Manufacturing accounts for about two-thirds of the private sector's Research and Development. Manufacturing uses as inputs a large share of the outputs of other industries – the ratio of gross output to net output is around 2 ½ to one, showing that many other sectors depend on manufacturing as a customer. Other firms distribute manufacturing goods as well as providing inputs. Manufacturing is unevenly distributed across the country, employing a higher proportion of workers in the East and West Midlands and a much lower proportion of workers in London, so weak manufacturing can imply regional disparities in incomes, jobs, and prosperity. Finally, problems with global supply chains, together with the

war in Ukraine, suggest a motivation for reshoring manufacturing activity in order to improve the resilience of the economy to such foreign shocks.

If we wanted to reindustrialise the UK economy, how would we do it? Mills (2022) makes the following argument. If sterling were to depreciate by around 20 per cent, this would make manufacturing more profitable, given that about 70 per cent of UK manufacturing inputs are priced in sterling (and so would become cheaper in terms of foreign currency) whereas close to 100 per cent of UK manufacturing exports are priced in foreign currency. He argues that this increase in profitability would lead manufacturing firms to increase investment and become larger: ie, the United Kingdom would reindustrialise. He then goes on to argue that this would lead to a growth rate of around 3 per cent in the United Kingdom, much higher than we have seen of late. The purpose of this report is to critically assess this mechanism and examine whether or not following this policy would be feasible or desirable.

The rest of this report is laid out as follows. We first review the relevant literatures on competitiveness and exchange rate passthrough. We then examine the effects of a large exchange rate depreciation, first by looking at the data and then using two macroeconomic models: a DSGE model and our global econometric model, NiGEM. We then examine the feasibility of lowering sterling in practice, before closing with some concluding thoughts on the feasibility and desirability of a reindustrialization policy in the United Kingdom. To anticipate our results, we find that there may be a case that manufacturing has shrunk too far as a proportion of the economy with a negative effect on UK productivity growth. But attempting to reindustrialise via engineering a large sterling devaluation will, at best, only work in the short run as the resulting rises in inflation and unit labour costs will wipe out any gains in competitiveness. Our suggested answer to the problem of low productivity growth in the United Kingdom is that we need to increase business investment as a proportion of GDP, though this will require a change in the savings behaviour of both the private and public sectors.

3 Relevant Literature

In this section, we discuss the relevant academic literature for our project. We first discuss the literature on competitiveness before moving on to tackle the literature on the effects of movements in the exchange rate on import and consumer price inflation.

3.1 Competitiveness

Competitiveness at the macro level has developed to be one of the most broadly covered, yet still not clearly defined research areas of modern international economics. Its modelling and measurement is difficult due to the existence of definitional ambiguities (Berger and Bristow, 2009; Bowen and Moesen, 2007; Siggel, 2010; Waheeduzzaman and Ryans, 1996). Despite the existing definitional ambiguities, there is a consensus that international competitiveness is a multi-faceted concept that should be analysed at different levels of aggregation (Berger, 2008): company level (micro), industry/cluster level (mezzo) and national level (macro).

At the macro level, competitiveness is often evaluated through growth accounting. A large tranche of the literature in this area deals with modelling macro-competitiveness, expressed in the GDP per capita terms, with the main determinants including exchange rates and interest rates (Zorzi and Schnatz, 2010), capital investment (Landau, 1990), economic freedom (Bujancă and Ulman, 2015) or quality of institutions (Huemer *et al*., 2013). Other research has viewed competitiveness as a function of cheap and abundant labour and/or available resources (Huggins and Izushi, 2015).

In recent times, the macro competitiveness discourse has been enriched by socio-environmental factors. Studies stress the necessity for finding a balance between actions aimed at boosting national productivity levels, responsible use of natural resources, and the development of social welfare (Samans *et al*., 2015; Thore and Tarverdyan, 2016). These goals 'beyond GDP' and the strategies to address them belong to the research area of 'sustainable national competitiveness'. Attempts have been made to model conditions for sustainable and sustained competitiveness of a nation, based on productivity enhancements, environmental conditions, socio-political stability, and human resources (Doryan, 1993). The conditions for improving each of these competitiveness dimensions can be enabled by institutions which encourage sustainability.

There is a general consensus that labour productivity, through its impact on production processes and production costs (Auzina-Emsina, 2014), constitutes a key factor influencing a nation's competitiveness. Krugman, (1996) argues this is the only meaningful way of discussing competitiveness on the level of a whole economy. Some studies have highlighted significant productivity variations across regions and industries (Gugler *et al*., 2015), pointing to the emergence of innovative clusters of related firms and industries operating within a given location and their importance in shaping national competitiveness (Delgado *et al*., 2014). Another section of the literature, drawing on evolutionary economics, associates the ability to compete with patterns in export specialisation (Castellacci, 2008). From this standpoint, national competitiveness is the ability to adjust a given nation's export structure to global

trade trends through shifts towards specialisation based on knowledge and innovation (Wysokińska, 2012).

The evolution of productivity and trade structure within various industries starts from efforts at the single-firm level. It is important to analyse national competitiveness through the prism of cumulated micro-success of internationally competitive companies acting within national boundaries (Chesnais, 1986). In this regard, the relative economic success of a country is measured by the share of domestic firms in the total consumption of a particular good or category of goods (ie, the market). This economic success can be evaluated through a domestic market lens – reflected in domestic market shares – and/or through a global market lens – reflected in the export volumes of the domestic competitive firms. (See Papadakis, 1994; 1996).

Within the literature, there is a consensus that the competitiveness of a nation is stimulated by its ability to innovate. (See for eg, Atkinson and Ezell, 2012; Castellacci, 2008; Dosi and Soete, 1991.) Roper and Hewitt-Dundas (2015) argue that innovation need not be rooted in the efforts of single domestic companies, but rather can emerge as an outcome of complex interconnections between domestic and foreign companies operating within industries in the home economy. As multinational enterprises continuously spread their value chains across global locations, destinations with particular locational advantages emerge (Gugler *et al*., 2015), creating platforms for increased levels of cooperation and innovation. In this way, clusters of geographically concentrated companies within a particular industry and/or group of industries, are born (Delgado *et al*., 2014). Emerging from this cluster theory, the mezzo level of international competitiveness analyses clusters as stimulators for national competitiveness through linkages and spillovers of information, skills, and technology across firms and industries (Huggins and Izushi, 2015).

There are many methods available to measure the competitiveness of an economy. However, Huemer *et al*. (2013) argue that most of these approaches fail to distinguish between how the effects of markets on competitiveness differ from politically-induced changes in competitiveness. While disentangling the two is not straightforward, it is essential given discussions about competitiveness differentials, eg, among EU Member States. To analyse the extent to which governments can influence overall competitiveness by setting policy variables, Huemer *et al*. (2013) propose an index of competitiveness which measures the institutional factors that governments can directly affect, termed the Institutional Competitiveness Index (ICI). Together with a standard index comprising price and cost competitiveness indicators (PCI), they obtain the Total Competitiveness Index (TCI). They compare this indicator and its components to a well-established index of overall competitiveness, ie, the Global Competitiveness Index of the World Economic Forum (WEF). The results of the analysis point

to the importance of evaluating institutional factors, such as structural reforms, as a critical benchmark for competitiveness assessment and policy advice, particularly within Europe.

3.2 Exchange rate passthrough and its evolution

One way of improving competitiveness is to depreciate the currency. However, if the depreciation leads to a rise in import prices and inflation, the improvement in competitiveness may only be temporary. Exchange Rate Passthrough (ERPT) measures the extent to which domestic prices respond to exchange rate shifts. A high ERPT would mean a substantial inflation impact and a low competitiveness effect.

ERPT can refer to the extent of passthrough to import prices or to consumer prices. Most published studies concentrate on the first of these. Ihrig *et al.* (2006) examine the passthrough of exchange rate changes to import prices for the G7, looking at the period 1975 to 2004 and splitting the sample in 1990. They find that the average G7 long-run passthrough coefficient from the exchange rate to import prices had fallen from 0.715 to 0.475 (Table 1), with the UK declining less than average, from 0.76 to 0.59. They also look at exchange rate passthrough to consumer prices, again finding a decline in ERPT between the two periods. However, the decline in ERPT was not statistically significant except for Italy and France (Table 2). One of the issues with the study is choosing a common break point for the two sub-samples, whereas Clarida *et al.* (1998) suggest policy regimes changed at different times in different countries.

Table 1: Long-run exchange rate passthrough into import prices

	1975-1989 (1)	1990-2004 (2)	Change (3) = (2) - (1)
United States	0.657	0.320	-0.337*
	(0.109)	(0.104)	
United Kingdom	0.763	0.590	-0.173
	(0.080)	(0.090)	
Japan	1.137	0.609	-0.528**
	(0.133)	(0.109)	
Italy	0.626	0.465	-0.161
	(0.155)	(0.179)	
Germany	0.384	0.291	-0.093
	(0.050)	(0.047)	
France	0.487	0.163	-0.324**
	(0.065)	(0.048)	
Canada	0.951	0.890	-0.061
	(0.197)	(0.101)	
Average	0.715	0.475	-0.239
Average (ex Canada)	0.676	0.406	-0.269

† Standard errors in parentheses.
*, ** indicate that the decline in pass-through is statistically different from zero at the 10 percent level and the 5 percent level, respectively.

Source: Ihrig *et al.* (2006)

Table 2: Long-run estimates of exchange rate passthrough into consumer prices

	1975-1989 (1)	1990-2004 (2)	Change (3) = (2) - (1)
United States	0.014	-0.019	-0.033
	(0.123)	(0.031)	
United Kingdom	0.200	0.042	-0.157
	(0.115)	(0.087)	
Japan	0.031	0.005	-0.026
	(0.034)	(0.021)	
Italy	0.359	-0.018	-0.377**
	(0.083)	(0.033)	
Germany	0.010	0.023	0.013
	(0.035)	(0.042)	
France	0.275	-0.002	-0.277*
	(0.150)	(0.063)	
Canada	0.050	-0.083	-0.133
	(0.042)	(0.064)	
Average	0.134	-0.007	-0.142

† Standard errors in parentheses.
*, ** indicate that the decline in pass-through is statistically different from zero at the 10 percent level and the 5 percent level, respectively.

Source: Ihrig *et al.* (2006).

For the UK, Figures 4 and 5 show estimates of ERPT for import and consumer prices Ihrig *et al.* (2006) using rolling regressions with a fifteen-year fixed window. The import price coefficient is consistent with other evidence, but the passthrough to consumer prices in later years is surprisingly low.

Figure 4: ERPT into core import prices

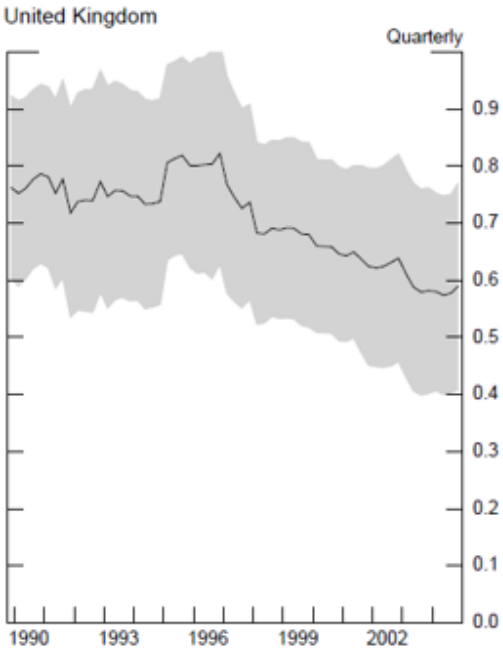
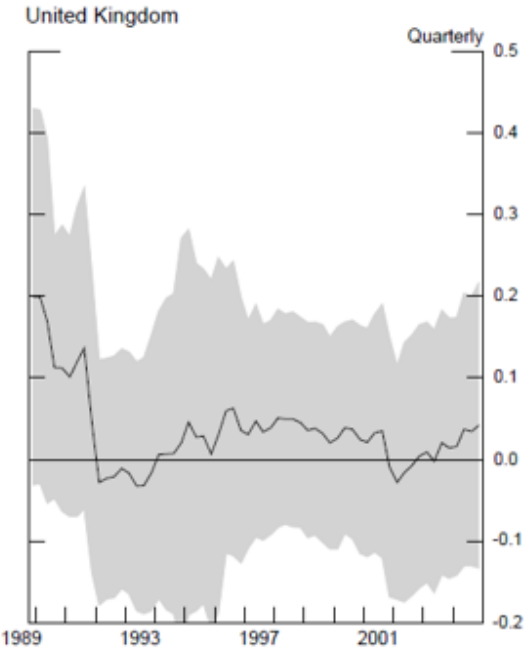


Figure 5: ERPT into consumer prices



Source: Ihrig *et al.* (2006).

Gagnon and Ihrig (2004) develop a model stressing a leading role in lowering ERPT for the adoption of inflation-stabilisation objectives by central banks. Supporting this, they find a statistically significant role for inflation variability in explaining the lower ERPTs in later periods. At least at the second stage (import price transmission into consumer prices), changes in monetary policy regimes appear to have been significant. Table 3 shows their estimates of ERPT into consumer prices over the entire sample period, 1971Q1 to 2003Q4, and over two sub-samples, the break being at 1980 or 1981 for the United States, United Kingdom, Germany, and Japan; 1984 for Canada, Austria, Finland, Ireland, Netherlands and Switzerland; 1987 for France, Belgium, Italy, Portugal and Spain; the early 1990s for Australia, New Zealand, and Sweden; and 1993 for Greece. Table 3 shows a pronounced downward shift in ERPT between the earlier and later sub-samples. The ERPT coefficient for consumer prices in the United Kingdom is broadly consistent with an ERPT into import prices in the range of 0.6 to 0.75 and a passthrough from import prices to consumer prices of around 20 per cent (import volumes being equivalent to 24 per cent of GDP from 1975 to 2004). However, relying on such rules of thumb may lead to errors if circumstances change.

Table 3: Long-run rates of ERPT to consumer prices

	Entire Sample	First Sample	Second Sample
Australia	0.14 (0.07)	0.09 (0.08)	0.01 (0.04)
Austria	0.11 (0.07)	0.06 (0.10)	0.04 (0.02)
Belgium	0.20 (0.08)	0.21 (0.09)	0.02 (0.02)
Canada	0.37 (0.11)	0.30 (0.14)	0.04 (0.06)
Finland	0.01 (0.14)	-0.11 (0.21)	0.00 (0.03)
France	0.23 (0.12)	0.17 (0.07)	0.01 (0.03)
Germany	0.11 (0.04)	-0.13 (0.11)	0.12 (0.03)
Greece	0.52 (0.11)	0.28 (0.12)	0.27 (0.21)
Ireland	0.29 (0.09)	0.18 (0.11)	0.06 (0.04)
Italy	0.37 (0.12)	0.33 (0.09)	0.08 (0.06)
Japan	0.21 (0.09)	0.26 (0.12)	0.02 (0.02)
Netherlands	0.16 (0.07)	0.08 (0.11)	0.06 (0.03)
New Zealand	0.42 (0.10)	0.29 (0.09)	0.01 (0.05)
Norway	0.28 (0.15)	0.11 (0.17)	-0.05 (0.06)
Portugal	0.43 (0.08)	0.37 (0.08)	0.17 (0.16)
Spain	0.18 (0.09)	0.14 (0.07)	0.03 (0.03)
Sweden	0.02 (0.07)	0.05 (0.05)	0.02 (0.02)
Switzerland	0.15 (0.09)	0.18 (0.14)	0.07 (0.08)
United Kingdom	0.15 (0.05)	0.18 (0.08)	0.08 (0.05)
United States	0.27 (0.12)	0.19 (0.36)	0.03 (0.06)
Average	0.23	0.16	0.05
Inflation targeters	0.22	0.18	0.03
Non-targeters	0.23	0.15	0.06

Standard errors in parenthesis.

Source: Gagnon and Ihrig (2004)

Sekine (2006, p.23) sums up the general view by saying, 'the timing of a decline in second-stage passthrough in the United States broadly coincides with a change in the Fed's monetary policy towards interest rate setting that is more reactive to expected inflation (Clarida *et al*., 2000). Second-stage passthrough shifted down at the time of adoption of a *de facto* fixed exchange rate regime (United Kingdom) and participation in the ERM (Italy).'

The nature of the exchange rate shock has an important bearing on ERPT. For example, small and transient exchange rate fluctuations will have trivial effects on prices, while a large persistent shock will have a substantial impact. Bonadio *et al.* (2018) analyse the 11 per cent appreciation of the Swiss franc on 15 January, 2018, when the Swiss National Bank abandoned its policy of resisting a currency appreciation against the euro. For imports invoiced in euros, the import price response was complete beginning the day after the appreciation. For imports invoiced in Swiss francs, the adjustment began on the second day and was complete after two weeks.

Forbes *et al.* (2018) examine for the UK how ERPT varies according to what drives the exchange rate change. They argue for a low ERPT if the exchange rate move follows from a domestic demand shock, but a high passthrough if the driving force is a domestic monetary shock. Considering an appreciation, they propose that a positive demand shock leading to an exchange rate appreciation will also see increased firm price mark-ups in response to stronger demand, limiting the effect of the appreciation on domestic prices. In contrast, if the appreciation resulted from tighter domestic monetary policy, that would reduce domestic demand and therefore firms' mark-ups. Thus, passthrough (in this case, a negative effect on the CPI) would be more significant in the second case than in the first for the same appreciation. They also explore the impact of persistent and transitory global shocks and shifts in the exchange rate driven by risk attitude. Their finding of significantly different effects on UK import prices according to the source of the exchange rate shift explains different ERPTs across different appreciation episodes.

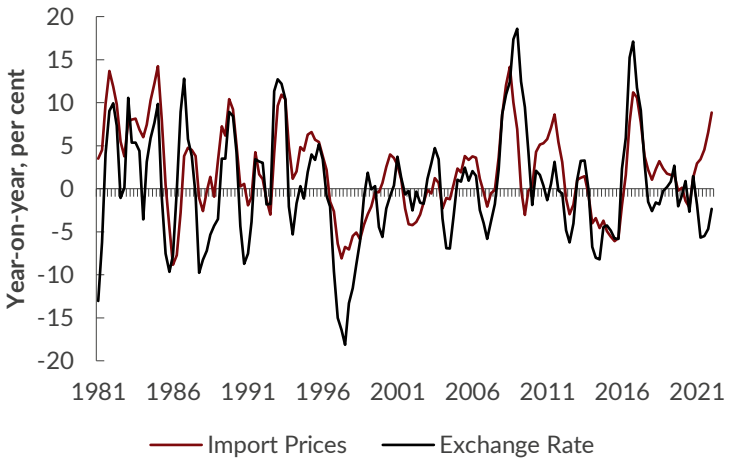
The literature suggests that passthrough varies according to the history of inflation in various economies, the inflation-targeting framework and the credibility of the authorities (eg, Karagoz *et al.*, 2016). Takhtamanova (2008, p.23) suggests four influences on the degree of ERPT: the degree of real exchange rate passthrough to the prices of individual firms (which in turn depends on the elasticities of the demand and cost functions faced by individual firms), the fraction of imports in the CPI basket, the fraction of flexible-price firms in the economy, and the credibility of the monetary authority. On this set of explanations, low inflation reduces the share of flex-price firms, while increased central bank credibility also reduces ERPT. As Gagnon and Ihrig (2004) argue, economic agents expect monetary tightening to be the response to an exchange rate depreciation by an inflation-targeting central bank.

The degree of competition in different industries affects their passthrough (Auer and Schoenle, 2016; Feenstra *et al.*, 1996). Importers face different degrees of competition from domestic suppliers across the cycle, helping to explain low passthrough in the UK following sterling's exit from the ERM in 1992.

3.3 Passthrough in the United Kingdom

Figure 6 shows a strong relationship between annual import price inflation and the annual change in the effective exchange rate (with a depreciation being plotted as a positive number – that is, a rise in the price of foreign currency in terms of sterling). However, as a scatter plot of the same data in Figure 7 shows, passthrough varies.

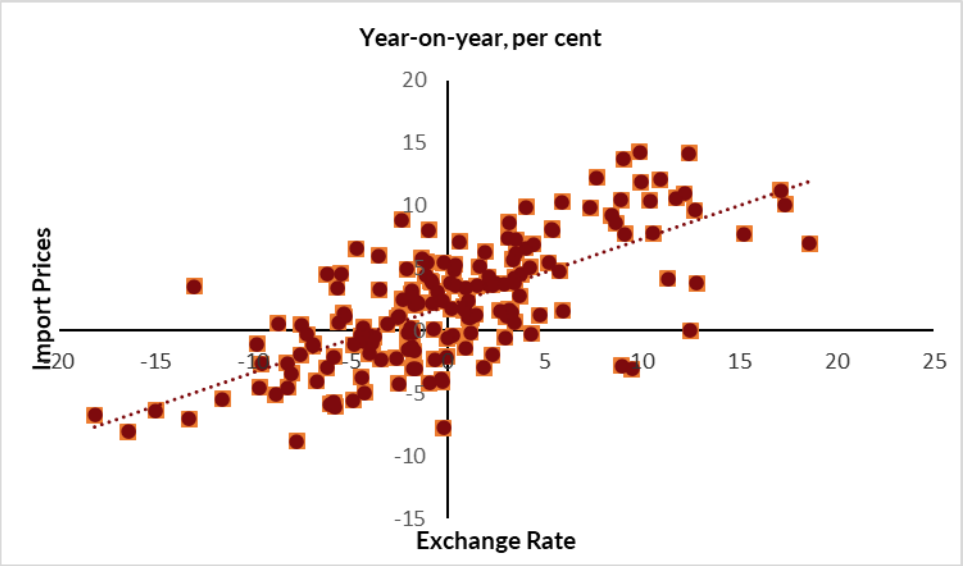
Figure 6: Import price growth and sterling exchange rate changes



Source: ONS, Bank of England

Forbes *et al.* (2018) show different UK ERPT responses for different forms of domestic shock and global shocks. The passthrough is large when the impetus for an exchange rate shift is domestic monetary policy – 85 per cent after six quarters. Passthrough is smallest when the exchange rate change results from a domestic demand shock – only around 40 per cent after five quarters.

Figure 7: Import price growth and sterling exchange rate changes



Source: Bank of England, ONS

Another striking feature is a large passthrough to domestic import prices from global shocks. This is important when global shocks are a significant cause of exchange rate movements, as was the case in 2007-2009 and 2013-2015, and is currently the case because of the strong US dollar. A given weakness in a country's effective exchange rate has a larger impact on passthrough if the weakness is against the dollar rather than against all currencies equally, reflecting widespread dollar invoicing. When the dollar appreciates or depreciates, dollar prices do not change equally in the opposite direction, meaning that prices change when expressed in a basket of all global currencies. Countries with higher shares of dollar invoicing in imports experience higher ERPT (Boz *et al.*, 2017). Forbes *et al.* (2018) decompose movements in the UK exchange rate according to the shocks that caused them and use this decomposition to calculate how passthrough to import prices varied by episode for large exchange-rate movements (Table 4).

Table 4: UK passthrough coefficients to import prices by episode

Shocks	*1996-7 appreciation*	*2007-9 depreciation*	*2013-2015q1 appreciation*	*Full sample FEVD[(b)]*
Supply	10%	21%	14%	10%
Demand	33%	20%	22%	25%
Monetary policy	19%	11%	17%	17%
Exchange rate	24%	13%	0%	21%
Persistent global shock	6%	18%	25%	14%
Transitory global shock	8%	17%	23%	13%
Unadjusted pass-through to import prices (not controlling for foreign export prices)	*-0.67*	*-0.86*	*-0.99*	*-0.79*

Source: Forbes *et al.* (2018)

Forbes *et al.* (2018) also look at the passthrough of exchange rate shocks to consumer prices, where the effect is much smaller, reflecting the share of imports in GDP, and the lags are longer: four quarters for the full impact to be felt with import prices but eight quarters with consumer prices. They estimate that passthrough to consumer prices varied widely according to different episodes, from 8 per cent in the 1996/97 appreciation to 18 per cent in the 2013-2015Q1 appreciation.

4 Effects of a Large Exchange Rate Depreciation

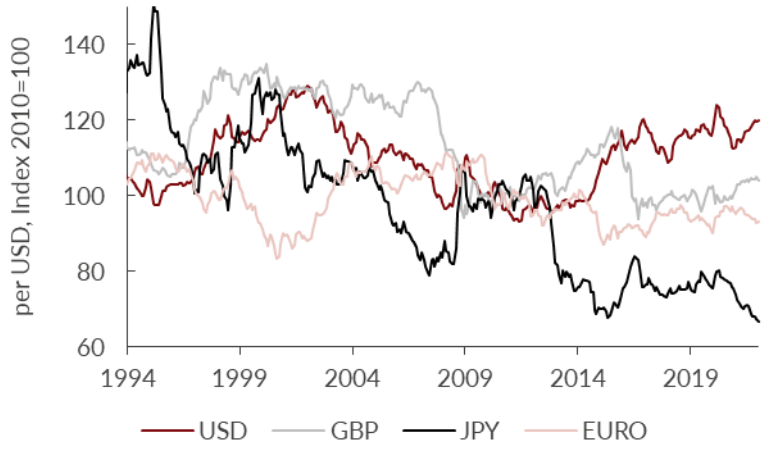
In this section, we discuss the question of whether a large exchange rate depreciation could result in an increase in the relative size of the manufacturing sector, ie, in reindustrialisation. We start by considering the empirical evidence for a relationship between the nominal and real exchange rates and the size of the manufacturing sector as well as looking at the observed relationships between the exchange rate, the terms of trade, competitiveness and profitability and also look at China and Singapore as two case studies for reindustrialisation. We then use two macroeconomic models to carry out simulations of a large exchange rate depreciation. We first using a calibrated dynamic stochastic general equilibrium (DSGE) model to gain some intuition for the effects of such a depreciation. We then use our global econometric model (NiGEM) to put some numbers onto these effects for the United Kingdom. The empirical evidence and the models suggest that the effects of an exchange rate depreciation are relatively quickly nullified by rises in inflation and unit labour costs, though there are temporary positive effects on exports and GDP and a more persistent effect on productivity. Of course, this analysis leaves to one side the question of how such an exchange rate depreciation might be achieved. This point is taken up in Section 5, below.

4.1 Some empirics for the United Kingdom

4.1.1 The relationship between the exchange rate and manufacturing

The UK currency has been free-floating since its ejection from the ERM in 1992. It was strong in the boom years leading up to the financial crisis, but then fell sharply because the UK was disproportionately affected by the recession in financial services. A strong recovery in the sterling exchange rate followed in the wake of the euro crisis, which encouraged funds from Germany and other Northern European countries which previously went to Southern Europe to divert to the UK, worsening competitiveness. These inflows sharply reversed following the 2016 Brexit vote, resulting in manufacturing profitability exceeding that in services in 2017 and 2018 for the first time in two decades. The real exchange rate is currently seven per cent below the average of 1997 to 2021 (Figure 8).

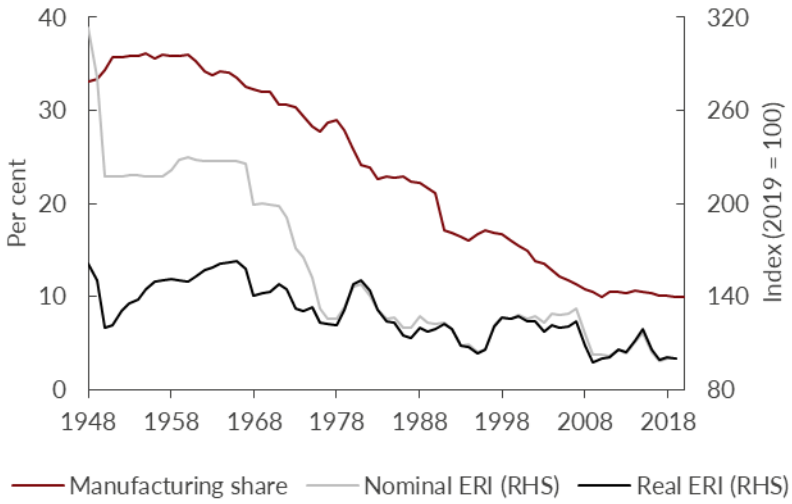
Figure 8: Real Broad Effective Exchange Rate



Source: FRED

Figure 9 shows the relationship between the sterling nominal and real exchange rates and the share of manufacturing in UK value added over a much longer time period. We can see that the sterling nominal effective exchange rate steadily declined from the end of the second world war until around 1977; it then stayed relatively flat until the global financial crisis since when it has fallen further. At the same time, the real effective exchange rate also declined, though by much less: the real exchange rate has depreciated by 38 per cent while the nominal exchange rate has depreciated by 68 per cent. This difference makes the point that much of the nominal exchange rate depreciation – though not all of it – will be passed through into higher consumer prices domestically. Against this, the share of manufacturing in UK output has more or less continuously trended down, at least until the global financial crisis, since when it has flattened off.

Figure 9: Share of manufacturing in UK total value added and the real and nominal sterling effective exchange rates



Source: Bank of England Millennium Dataset

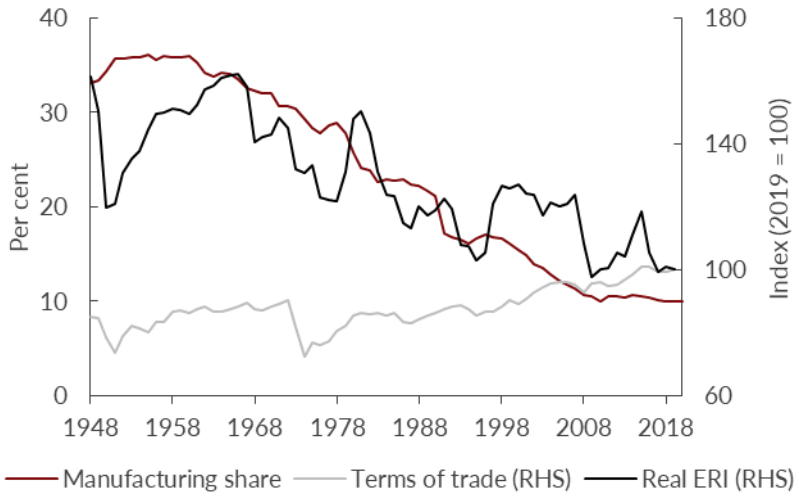
Our belief is that the data in Figure 9 clearly show that falls in the exchange rate have not been able to arrest deindustrialization in anything other than the very short run. Indeed, the relationship shown in Figure 9 suggests that the falling exchange rate is a symptom, like deindustrialisation, of the larger macro forces at play.

4.1.2 The relationship between the exchange rate and competitiveness

The problem with the standard story is that it needs a fall in the exchange rate to result in a persistent (if not permanent) increase in competitiveness. But, if we look at the longer-run data, it is not clear that a declining real exchange rate is accompanied by an increase in competitiveness. Figure 10 shows that while the real exchange rate has declined, the terms of trade – one potential measure of competitiveness – have risen by 15 per cent since around 1995, having been flat for the preceding 50 years. A rise in the terms of trade implies that UK exports are becoming more expensive relative to UK imports. If we export and import the same goods, then this implies that we are becoming less competitive over time, and this might explain the fall in the share of manufacturing over time. Alternatively, it could simply mean that UK exporters have 'moved up the value chain' and are producing relatively more expensive goods than the countries from which we import. Either way, it is worth reiterating that this has happened against the background of a flat to falling real exchange rate. This pattern implies a fall in the relative price of non-traded goods and services within the United Kingdom relative to the relative price of non-tradables in the rest of the world. That is, productivity growth in non-tradables in the United Kingdom relative to productivity growth in tradables has been higher than elsewhere in the world. Again, this could signal that the UK traded goods sector has become less competitive but could alternatively signal that the UK

non-traded goods and services sectors have become relatively more productive compared with similar sectors in the rest of the world.

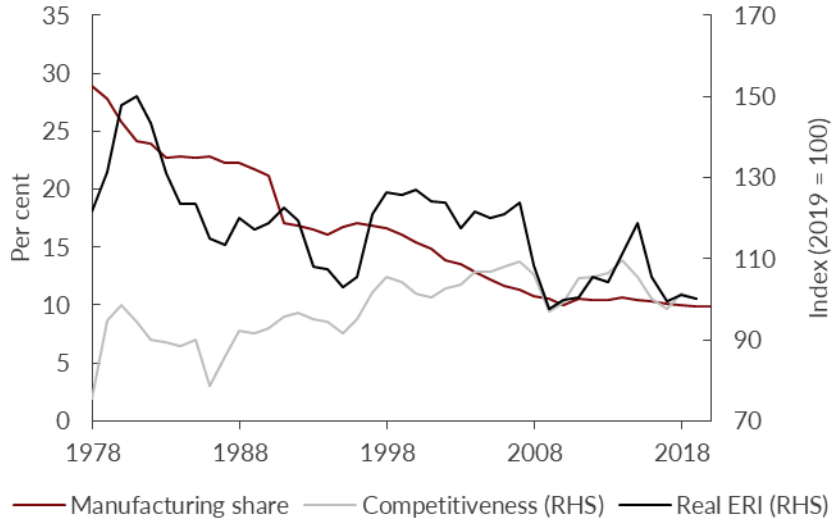
Figure 10: Terms of trade and the real exchange rate



Source: Bank of England Millennium Dataset and ONS.

An alternative – and arguably better – way of measuring competitiveness is to compare UK export prices with the export prices of UK exporters' competitors. This measure is shown in Figure 11. As can be seen, UK export prices rose relative to the export prices of UK exporters' competitors between 1978 (the earliest point for which we have calculated this measure) and the global financial crisis. Since then, competitiveness has risen and fallen, remaining roughly unchanged overall. This measure appears to correlate quite well with movements in the share of manufacturing in UK GDP.

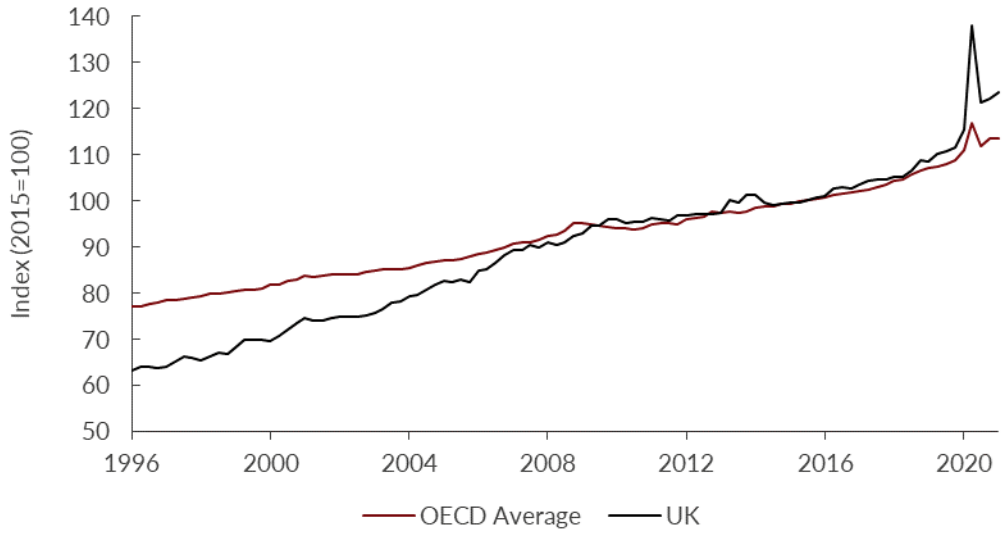
Figure 11: UK export price competitiveness and the real exchange rate



Source: Bank of England Millennium Dataset and NiGEM database

But, although an exchange rate depreciation can improve price competitiveness, at least temporarily, what matters in the long run is cost competitiveness. One way of gauging this more directly is to examine unit labour costs in the United Kingdom relative to the rest of the world. Unfortunately, the OECD data on unit labour costs,which allows us to compare across different countries, consists of indices set equal to 100 in 2015. This means we can only compare changes in unit labour costs rather than the actual levels. Figure 12 suggests that unit labour costs in the United Kingdom rose relative to the OECD average between 1996 and the global financial crisis. This would imply a loss of competitiveness over this period, which coincided with a rise in the Terms of Trade and a fall in the share of manufacturing in UK GDP. Between the global financial crisis and the Covid-19 pandemic, UK unit labour costs rose roughly in line with the OECD average, while manufacturing held its share of UK GDP.

Figure 12: Unit labour costs in the United Kingdom and the OECD

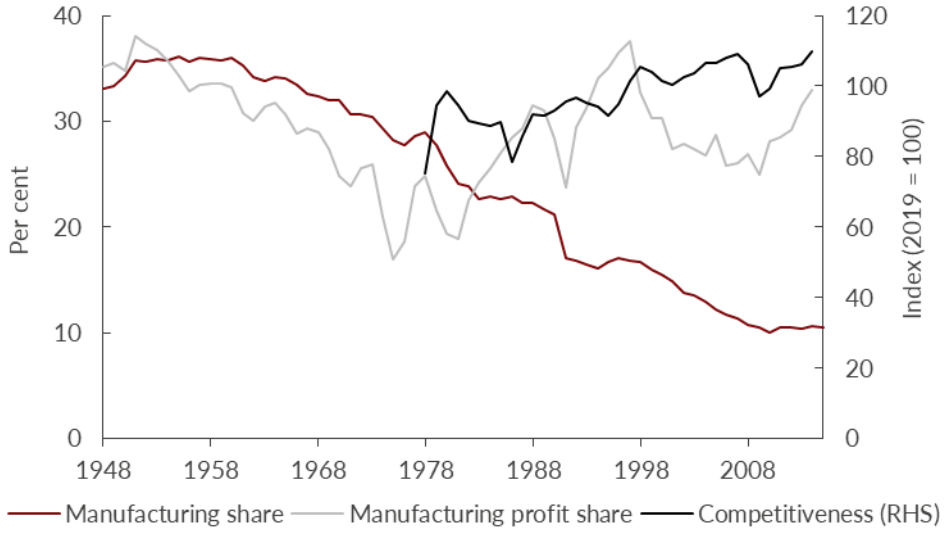


Source: OECD

4.1.3 The relationship between competitiveness and profitability

Mills (2022) emphasises the importance of a lower exchange rate in bringing about reindustrialisation as it would improve manufacturing profitability and encourage a movement out of services and into manufacturing. The evidence for the United Kingdom suggests that depreciating the exchange rate will not necessarily lead to a long-run increase in competitiveness as the positive effects of a sterling depreciation have tended to be nullified by subsequent rises in costs. But what about profitability? We examine the relationship between manufacturing competitiveness and profitability in Figures 13 and 14, below.

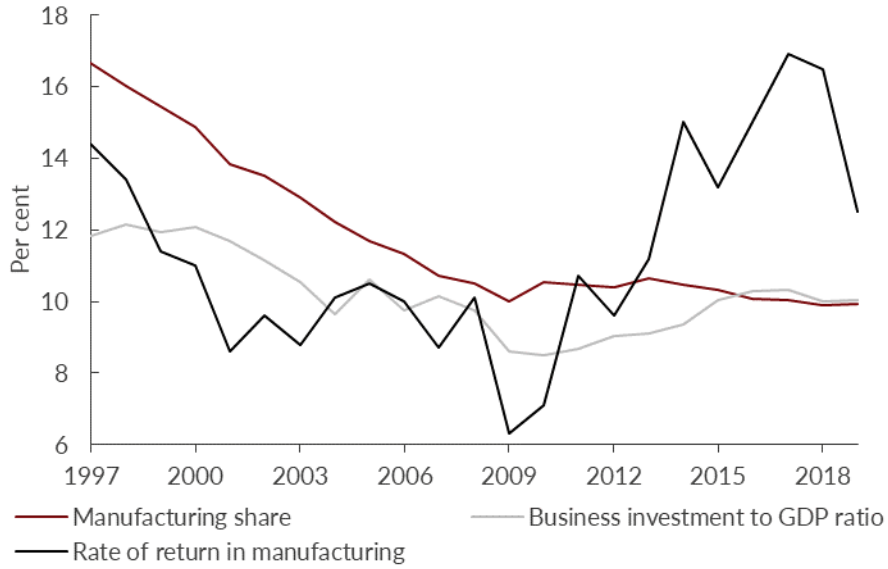
Figure 13: Profitability, competitiveness and share in total value added



Note: Competitiveness defined as the price of UK exports relative to that of other countries' exports

Source: Bank of England Millennium Dataset and NiGEM Database

Figure 14: Rate of return on capital in manufacturing, competitiveness and manufacturing's share in total value added



Source: Bank of England Millennium Dataset, ONS and NiGEM Database

Figure 13 suggests that, between 1948 and roughly 1980, profit margins in manufacturing were falling together with the share of manufacturing in GDP. However, from around 1985 onwards manufacturing profit margins settled at a higher rate, while the industry became less competitive and its share in GDP continued to fall. Similarly, Figure 14 suggests that the rate of return on capital fell ahead of the financial crisis but has since picked up. At first, this pick-up was associated with a worsening of UK price competitiveness, since around 2014 price competitiveness has improved along with profitability.

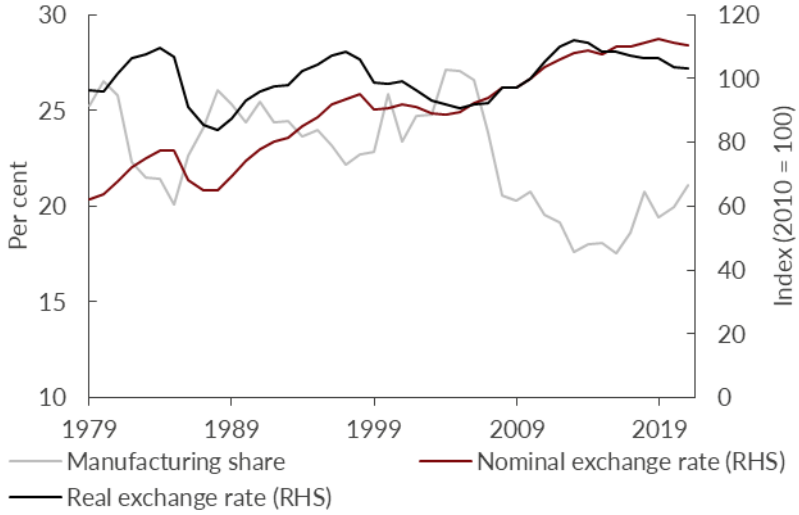
4.2 What have other countries done?

So how have other countries been able to ensure that depreciating their exchange rate would lead to improved competitiveness and higher profitability? Our view is that other countries have been able to improve their competitiveness and profitability for reasons unconnected with their exchange rates. Below, we consider a couple of case studies: Singapore and China.

4.2.1 Singapore

As shown in Figure 15, between 1979 and the early 2000s, manufacturing represented roughly one quarter of Singapore's economy. That share fell during the global financial crisis to around 20 per cent, where it had reminaed since. During this period, apart from the depreciation between 1985 and 1988, the Singapore dollar has appreciated in value. At the same time the real exchange rate has fluctuated within a relatively small band. The bottom line is that there seems to be no clear relationship between the real or nominal exchange rate and the share of manufacturing in the Singaporean economy.

Figure 15: Share of manufacturing in Singaporean total value added and the real and nominal exchange rates



Source: World Bank and IMF

So, why does manufacturing form a relatively high share of Singapore GDP? Singapore's industrialisation resulted from policies put in place between 1959 and 1965, in particular:

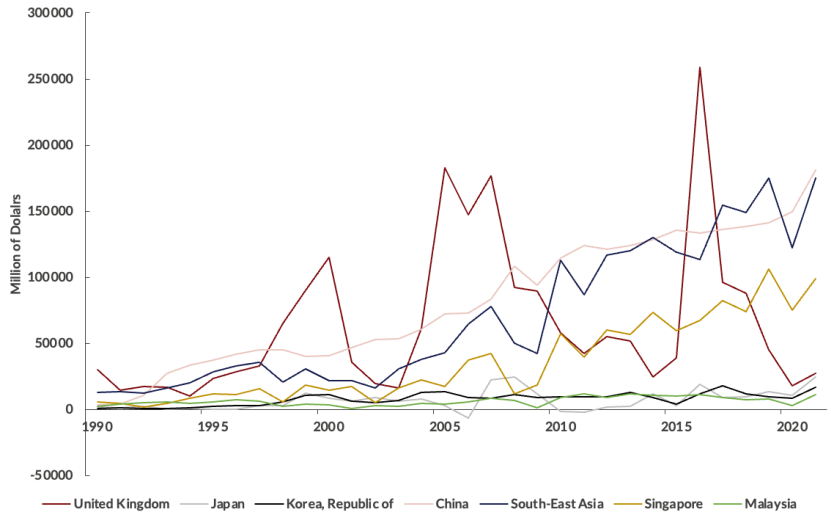
- State intervention to promote industrialisation
- Attracting investment through free trade
- Continuous investment into human capital, R&D, innovation and infrastructure
- Forward-looking governance that fills the needs of the nation

Singapore's world-class manufacturing ecosystem did not materialise overnight but was bolstered by active government initiatives enabling multinational corporations (MNCs) to collaborate easily with research and tertiary institutes to develop innovations through apprenticeships, internships, etc. As an example of this government encouragement of nascent

industries, Singapore's foray into the biomedical space started 30 years ago with the aim of building the research and manufacturing infrastructure foundations, attracting, and nurturing biomedical talents to catalyse private sector activities. As a result, 8 out of the world's top 10 pharmaceutical companies have set up facilities in Singapore and 5 out of the world's top 10 selling drugs are manufactured there (EDB Singapore).

Singapore's access to ASEAN and the fact it has one of the lowest corporate tax rates (17 per cent) acts to attract Foreign Direct Investment (FDI) inflows. Business-friendly policies make it easy for companies to set up. There are no taxes on capital gains and dividend income and an extensive network of double tax agreements (DTA) with more than 80 countries whose key benefits are a) avoidance of double taxes, b) lower withholding taxes and c) preferential tax regime. Over the last 30 years, Singapore went from only having FDI inflows of 16 per cent relative to UK FDI inflows to attracting 3.5 times more FDI inflows than the UK and 56 per cent of South- East Asia total FDIs inflows (Figure 16). However, the implementation of the Base Erosion and Profit-Sharing initiative (BEPS 2.0), an international scheme to ensure tax consistency, will leave Singapore with less scope to use tax incentives to attract new investment. One measure that is expected is the inclusion of a global minimum corporation tax of 15 per cent and multinational enterprises will face top-up taxes in any jurisdiction where they currently pay an effective rate of below 15 per cent. So, Singapore will have to focus on increasing productivity and improving the quality of the workforce, rather than any further cuts in corporation tax, to stay competitive. In the recent annual budget, the finance minister announced a S$4 billion top-up to the National Productivity Fund to attract high-quality investments. The fund was established in 2010 to support businesses in their endeavours to improve productivity and upskill the workers and processes (Ovais, 2023).

Figure 16: FDI inflows



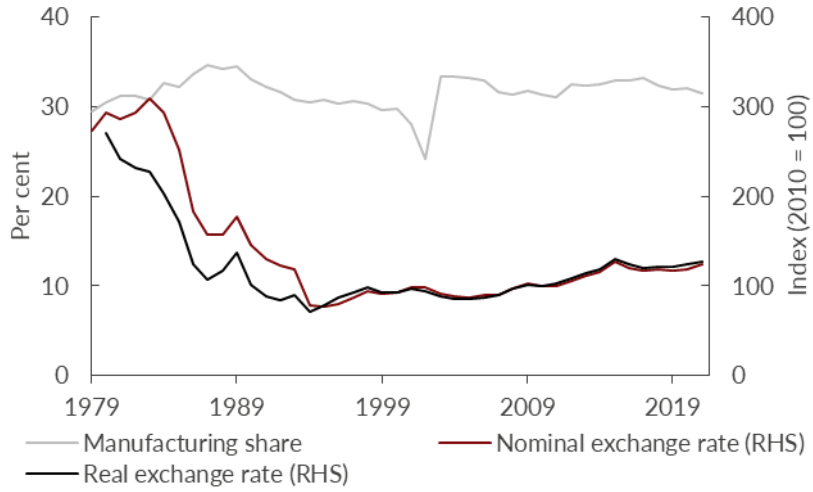
Source: United Nations Conference on Trade and Development (UNCTAD)

Finally, despite having policies that are friendly and welcoming for foreign investors, other countries have failed to attract as much FDI as Singapore. This points to the importance of strong corporate governance, and a track record of a stable and trusted policy environment. Alesina *et al.* (1996) point to the importance of stable, sound and consistent policies by the government for promoting economic growth. In the case of Singapore, the vision and efforts of the early years laid a solid foundation for the nation's future. Attracting top global companies to set up in the city-state ensured that Singapore could be entrenched in global value chains.

4.2.2 China

Over the past four decades the Chinese economy has transformed from being largely agricultural to a manufacturing powerhouse. Between 1970 and 2010, manufacturing represented roughly a third of Chinese GDP. At the same time, the Chinese economy grew at an average annual rate of 8.9 per cent and this increased China's share of global GDP from 1.6 per cent to 18 per cent (at PPP rates). Figure 17 shows that between 1983 and 1995, the renminbi depreciated by 75 per cent. The Chinese government adopted a policy of sterilization – in particular through using its foreign currency earnings to buy US assets – in order to make sure that the exchange rate depreciation did not result in inflation. As a result, the real exchange rate also fell by 65 per cent over this period. But, the share of manufacturing within the Chinese economy did not change over this period. Since 1995, the renminbi has appreciated by 68 per cent (60 per cent in real terms) with relatively little impact on the share of manufacturing in the economy. Indeed, the share of manufacturing in Chinese GDP has only really been falling since 2011, probably on account of the slowdown in advanced economy growth, from 31.1 per cent in 2011 to 27.4 per cent in 2022.

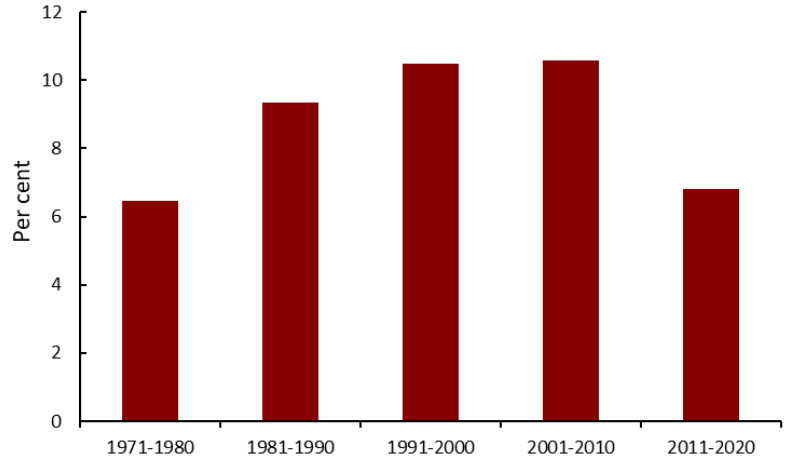
Figure 17: Share of manufacturing in Chinese total value added and the real and nominal exchange rates



Source: UNCTAD and IMF

Though it is clear that there is no particular relationship between the exchange rate and the size of the Chinese manufacturing sector relative to its GDP, it could be argued that it was the depreciation of the renminbi, and the maintenance of a low exchange rate, that led to the high Chinese GDP growth that we saw through this period. Indeed, as shown in Figure 18, Chinese GDP growth rose from 6.5 per cent in the 1970s to 9.3 per cent in the 1980s as the renminbi was depreciating to 10.5 per cent in the 1990s and 2000s while the exchange rate remained low.

Figure 18: Average annual rate of GDP growth in China



Source: NiGEM database

But, it is unlikely that the exchange rate depreciation on its own can explain the high Chinese GDP growth as there are a number of other factors that enabled the Chinese economy to thrive as a manufacturing powerhouse including its strong business ecosystem, massive and untapped labour supply and low taxes and duties. Perhaps most importantly, with a population of approximately 1.4 billion, China has a large supply of labour. As this labour migrated from the countryside to the cities, firms were able to keep wages very low relative to advanced economies; in turn, this means that Chinese unit labour costs – and hence export prices – remain low relative to advanced economies. Also, China does not follow an elaborate and extensive set of laws related to minimum wages or working conditions (including employment protection) as compared to, eg, the United Kingdom. The large pool of labour also means that firms have been able to take advantage of economies of scale, hence lowering the cost of production. For the same reason, seasonal and sudden spikes in labour demand are also easily accommodated.

To summarise, the renminbi devaluation was able to play a positive supporting role in enabling export-led GDP growth in China because the large under-utilised labour force ensured that wages did not rise in response to the exchange rate depreciation and so Chinese exporters were able to remain highly competitive. But, the low exchange rate policy did not result in an increase in manufacturing's share of Chinese GDP.

4.3 Results from a Dynamic Stochastic General Equilibrium (DSGE) model

In this subsection, we use an economic model to examine the mechanism linking an exchange rate depreciation to reindustrialization and increased growth put forward in Mills (2022).[1] By doing so, we can provide some intuition as to what is needed for this mechanism to work, ahead of generating numerical results using NiGEM. In a nutshell, Mills (2022) argues that a fall in the exchange rate, by making UK manufacturing more competitive, will lead to an increase in profitability, which, in turn will encourage more investment in, especially, the application of technology and the harnessing of power. It is this investment that leads to faster productivity growth, which has been sadly lacking in the United Kingdom for a long time now but particularly since the financial crisis.

The model is one of a small open economy where UK firms are price-takers on world markets. In the long run, the nominal exchange rate moves so as to ensure that the law of one price holds for traded goods while, in the short run, it moves so as to ensure that uncovered interest parity holds. We have two sectors domestically: a 'manufacturing' sector producing traded goods and a 'services' sector whose output cannot be traded. Investment is carried out exclusively by the manufacturing sector. Finally, the growth rates of technology in the manufacturing and

[1] The model is laid out in full in the Annex of this report.

services sectors are exogenous, with technological progress assumed to be higher in the manufacturing sector.

4.3.1 Some initial results for the manufacturing sector

We assume that manufacturers use labour, capital (made up of traded goods) and imports to produce the traded good. We assume that the manufacturers are based in a small open economy and, as a result, are unable to affect the world price of traded goods. They are assumed to price their goods in foreign currency terms. This means that an exchange rate depreciation will – other things equal – lead to a reduction in their domestic costs expressed in foreign currency and, so, an increase in profits. In turn, this increase in profits would lead to a rise in investment and a (temporary) rise in the growth rate.

But, other things are not equal. The reduction in costs would encourage firms to increase their output. But this would require more labour, pushing up wages. Indeed, without any other change their workers would already have suffered a fall in their real wages as a result of the exchange rate depreciation. We might expect this to lead to a fall in labour supply and/or demands for higher wages. In the long-run, we find that profitability is determined by the elasticity of output with respect to capital and so will be unaffected by movements in the exchange rate.

It is worth expanding on this argument a little, particularly given our earlier results on China. China was able to greatly expand manufacturing output by employing more labour without having to pay higher wages. This was because there was a large pool of under-utilised workers in the countryside living on a subsistence income; the higher wages available in manufacturing (relative to their subsistence income) attracted them to the cities where they could be profitably employed at the going wage rate. Firms did not need to raise wages in order to attract these additional workers. In a developed economy, however, this pool of labour typically does not exist. Where unemployment is high, firms can hire additional workers without having to raise wages much, if at all. But where unemployment is low – as is the case in the United Kingdom at the moment – for a firm to hire additional labour, it must offer a wage high enough to tempt workers away from their current jobs and/or high enough to attract new entrants to the labour force towards them rather than their competitors.[2] This will mean that labour costs will increase, cutting into any increase in profits that resulted from the exchange rate depreciation. Increased automation may obviate to a degree the need to hire additional labour to increase output. But this would be costly to implement and, so, its implementation

[2] We can note that at full employment, any differential in the starting salaries of workers across sectors will reflect the relative difficulty of recruiting workers into that sector, together with differences in non-pecuniary costs and benefits of working in that sector. Given that, even if it is the case that starting pay in the manufacturing sector is higher than in the services sector, attracting more workers into the manufacturing sector will still require a rise in manufacturing wages relative to service-sector wages.

would again cut into profits. In addition, the capital needed to implement automation is typically imported and priced in foreign currency and, so, would not be cheaper as a result of the exchange rate depreciation.

Leaving aside the link between the exchange rate and profitability, we can also use our model to examine the link between investment and growth. Along a balanced-growth path we find that a higher capital (or investment) to output ratio is associated with a higher growth rate. But, this is an association (ie, correlation and not causation); a higher capital/investment to output *does not lead* to a higher growth rate. Finally, we can also note that the long-run level of the exchange rate has no effect on the capital or investment to output ratio. These ratios are determined solely by the weight that firms put on future profits vis-à-vis current profits, the elasticity of goods production with respect to capital, the depreciation rate of capital and the rate of technological progress.

All that said, it is still important to see the effect of an exchange rate depreciation on the share of traded goods producers in the economy as a whole, as a way of proxying whether an exchange rate depreciation can lead to reindustrialisation. So, we next consider the short and long-run effects of an exchange rate depreciation within our model.

4.3.2 Effects of an exchange rate depreciation

We consider the effects of a permanent 25 per cent depreciation of the exchange rate, achieved via a temporary exchange rate risk premium shock that affects the uncovered interest parity condition. As discussed above, the depreciation will lead to a temporary increase in profitability that results in an increase in investment. This increase in investment requires greater output from the traded goods sector, which leads to an increase in employment in this sector and an increase in imports. It also requires borrowing from abroad, ie, a fall in our holdings of net foreign assets. This is shown in Figure 19. Figure 20 shows the effect of the exchange rate depreciation on the trade balance. After an initial negative effect resulting from the increase in foreign borrowing required to finance the increase in investment, the trade balance improves: the 'J-Curve' effect. The trade surpluses eventually ensure that net foreign assets finish higher than initially.

Figure 19: The effect of an exchange rate depreciation

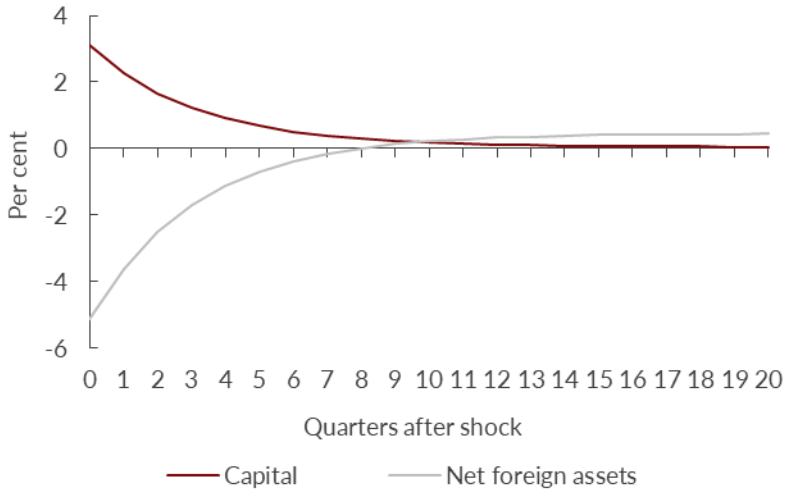
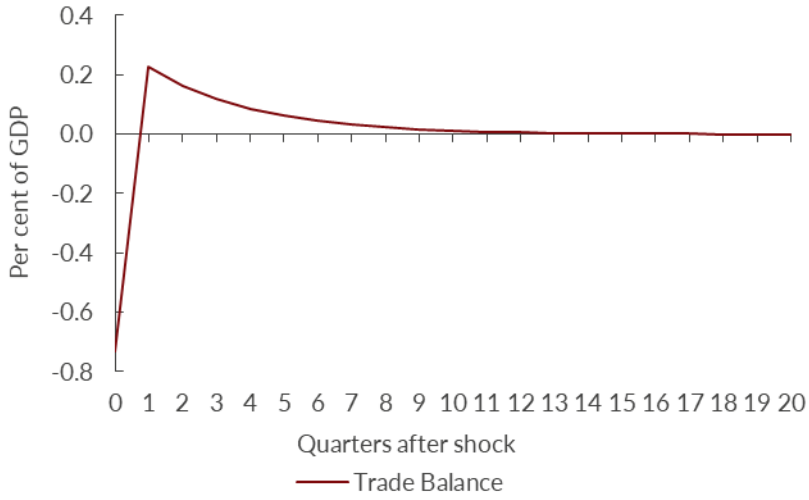


Figure 20: The effect of an exchange rate depreciation on the balance of trade



As the traded goods producer prices in foreign currency, the 25 per cent exchange rate depreciation means that the price of goods domestically rises by 25 per cent. This leads households to cut back on their consumption of goods and increase their consumption of services, as shown in Figure 21. In turn, this leads to an increase in services output as shown in Figure 22. And, as also shown in Figure 22, the increase in services output outweighs the eventual fall in goods output with the result that GDP rises. In other words, the exchange rate depreciation results in a temporary increase in growth. But the increase in demand for services, and the employment needed in this sector, puts upwards pressure on wages and the price of services as shown in Figure 23. And this increase in prices leads to subsequent falls in services consumption and, so, aggregate consumption as shown in Figure 21. In turn, this means that GDP eventually falls.

Figure 21: The effect of an exchange rate depreciation

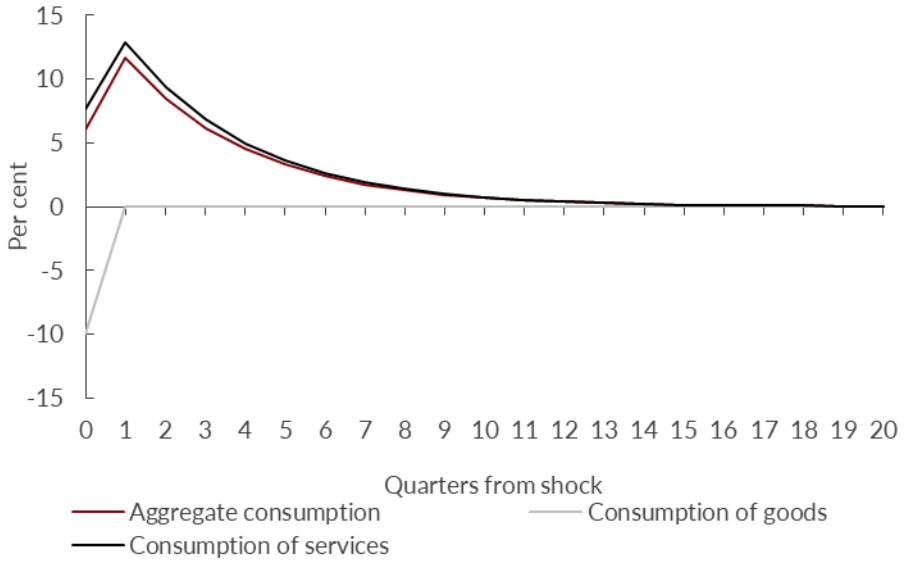


Figure 22: The effect of an exchange rate depreciation

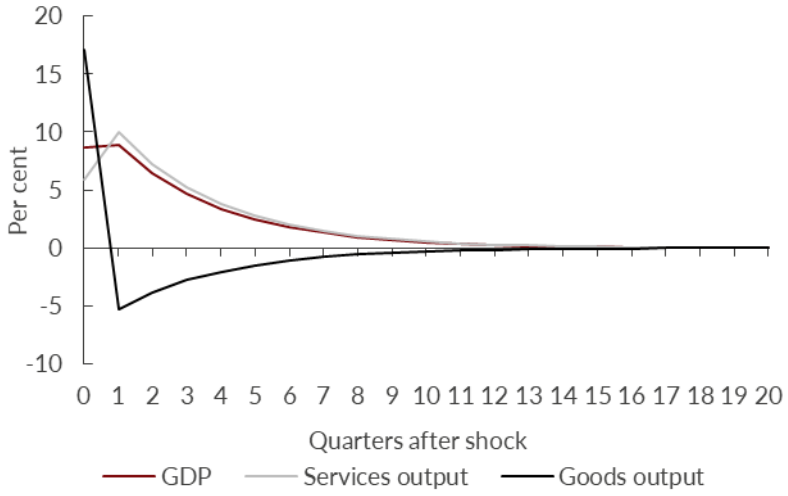
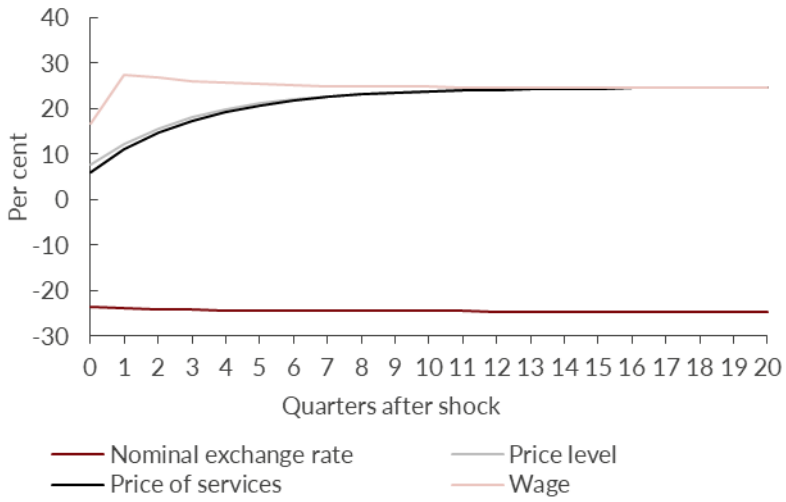


Figure 23: The effect of an exchange rate depreciation



Figures 21-23 make clear that the exchange rate depreciation has no long-run effect on output and consumption. Eventually, the depreciation is passed entirely into nominal wages and prices in the domestic economy. In addition, our results suggest that a nominal exchange rate depreciation has no long-run effect on the share of goods in GDP (proxying for manufacturing's share), the investment to GDP ratio, profitability or growth, contrary to the analysis laid out in Mills (2022). This result is in line with the empirical evidence presented earlier in Figure 9 that suggested no long-run relationship between the nominal or real exchange rates and the share of manufacturing in the UK economy.

4.4 Using NiGEM to analyse the effects of an exchange rate depreciation on competitiveness, productivity and output

The analysis of the previous subsection was based on a heavily 'stylised' model but was, nonetheless, able to tell us about the mechanisms at play. In this subsection, we carry out a set of simulations using our global econometric model, NiGEM, to examine the *quantitative* effects of a sterling depreciation in a model that captures the interlinkages between countries that were missing from the DSGE model. NiGEM is NIESR's flagship macroeconomic model, the leading global macroeconomic model, used by both policymakers and the private sector across the globe for economic forecasting, scenario building and stress testing.[3]

To investigate the effects of a depreciation in the exchange rate, we first simulated a 25 per cent depreciation brought about by an exchange rate risk premium shock. As can be seen from Figure 24, the real exchange rate does not fall by as much and then appreciates over time as

[3] For a complete description of NiGEM, see Hantzsche *et al.* (2018).

the higher UK inflation relative to the rest of the world kicks in (Figure 25). The terms of trade worsen (ie, export prices fall relative to import prices) and competitiveness improves (Figure 26), but the effect wears off relatively quickly as unit labour costs increase (Figure 27). This is despite an improvement in productivity of around 2.5 per cent. Our NiGEM simulation suggests that the positive effect on profitability (as measured by the profit share) is small, but this reflects the small share of manufacturing – whose profitability increases – in GDP. Finally, Figure 28 suggests that the depreciation leads to a rise in exports and investment at the expense of falls in imports and consumption. The overall effect on GDP is positive; GDP is 4.3 per cent higher after two years, though this effect falls over time. That said, the effect is much more persistent than was suggested by the DSGE model. Unfortunately, NiGEM does not allow us to examine the effect of the depreciation on the share of manufacturing in GDP, but with exports rising it could be expected that this share would increase.

Figure 24: The effect of an exchange rate risk premium shock on the nominal and real exchange rate

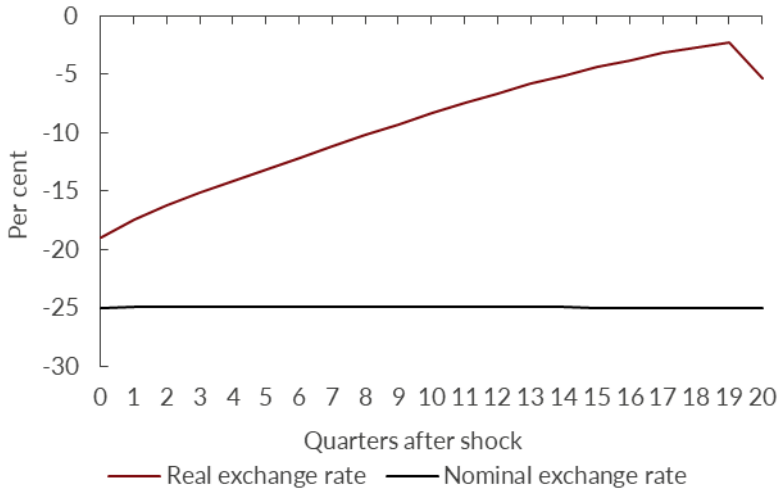


Figure 25: The effect of an exchange rate depreciation on inflation

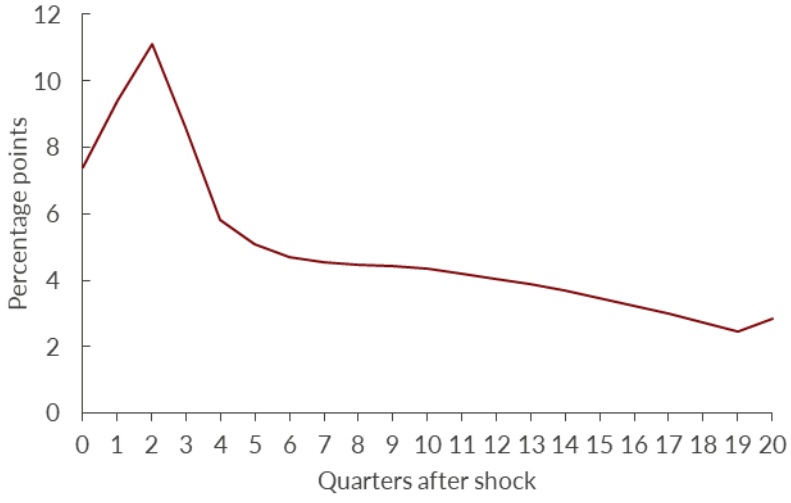


Figure 26: The effects of an exchange rate depreciation on the terms of trade and competitiveness

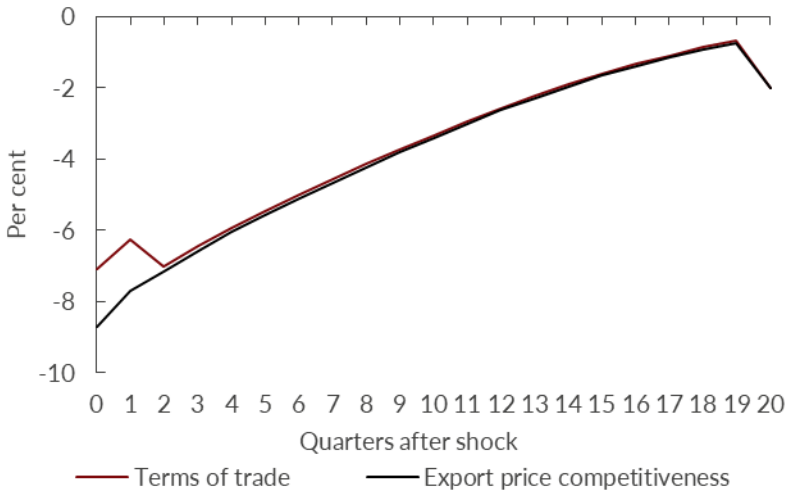
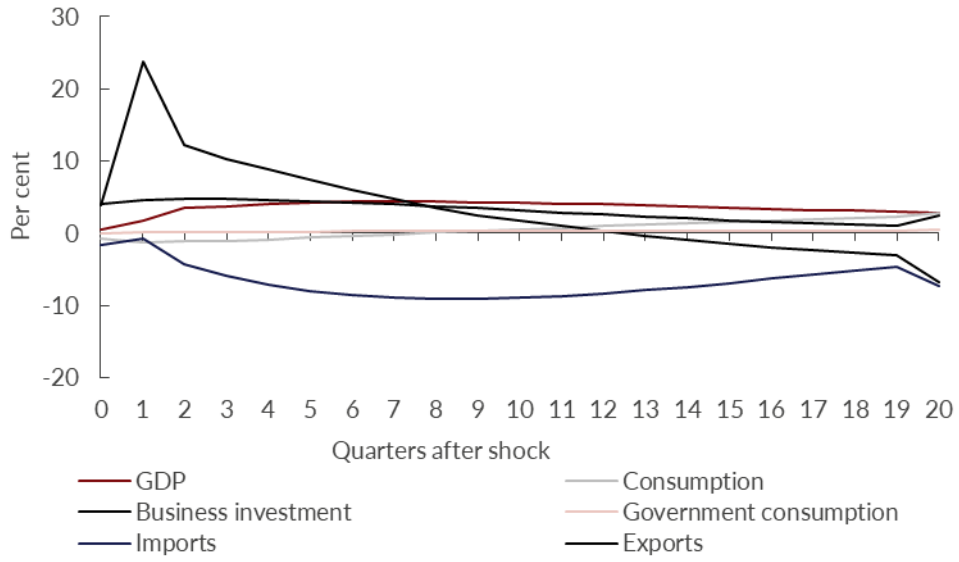


Figure 27: The effects of an exchange rate depreciation on unit labour costs and productivity

Figure 28: The effects of an exchange rate depreciation on GDP and its components



To examine the extent to which the effects of an exchange rate depreciation might depend on the source of the shock, we examined the effects of a 25 per cent depreciation of the sterling nominal effective exchange rate brought about by a persistent loosening in monetary policy. Again, the real exchange rate does not fall by as much as the nominal exchange rate and higher inflation ensures that the real exchange rate quickly returns to its initial level (Figure 29). The effect on inflation itself is a little stronger than for the exchange rate risk premium shock (Figure 30) but the response of inflation follows the same qualitative pattern.

Figure 29: Effects of a persistent monetary loosening on the real and nominal exchange rates

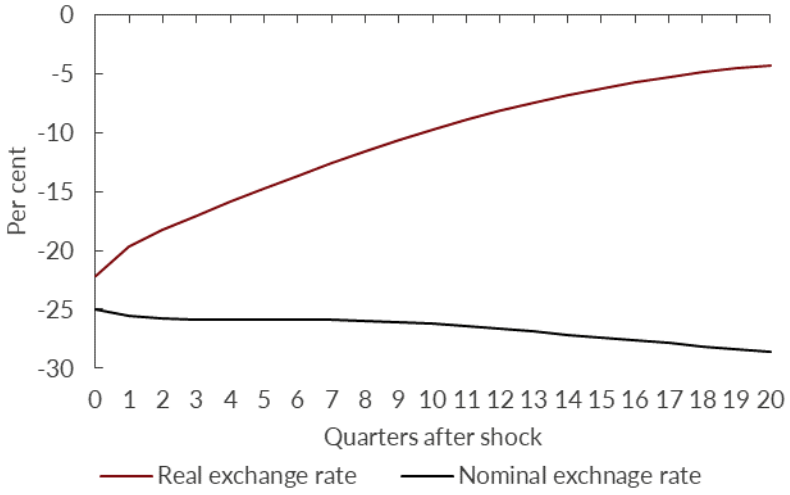
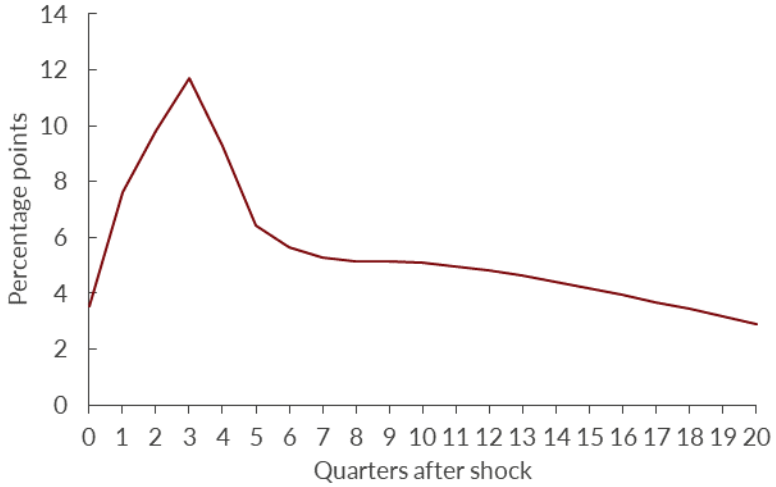
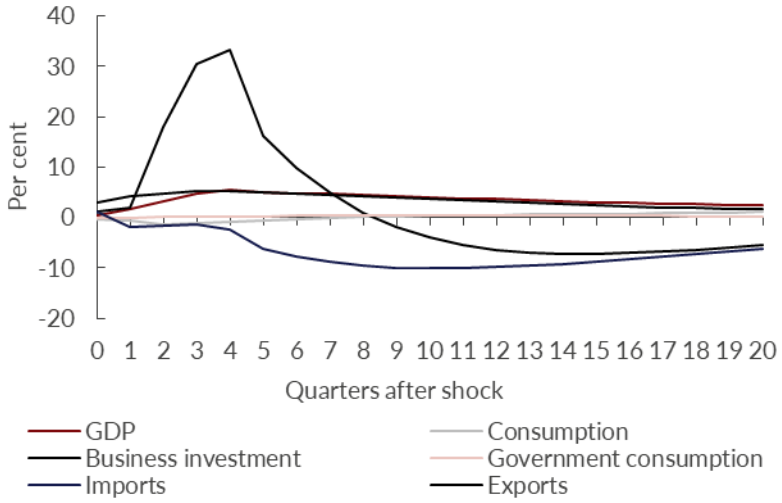


Figure 30: The effect of an exchange rate depreciation on inflation



The effects on other variables are qualitatively the same, but the quantitative effects are slightly larger. Productivity rises by 2.6 per cent, exports by 5.3 per cent and GDP by 5 per cent, though these rises are all short-lived (Figure 31).

Figure 31: Effects of an exchange rate depreciation on GDP and its components



4.5 Conclusions

A large nominal exchange rate depreciation can lead to *temporary* increases in exports, investment and GDP at the expense of consumption. However, after a while these gains are wiped out by rises in inflation and, importantly, unit labour costs. The precise speed and extent of passthrough of the depreciation into inflation depends upon what caused the exchange rate depreciation in the first place. The empirical evidence from the United Kingdom, and the experience of China and Singapore, suggest that it is not an overvalued exchange rate that explains deindustrialization. Rather, it is other factors affecting investment in manufacturing and productivity growth that are actually explaining both the real and nominal exchange rate and the share of manufacturing in GDP. That is, the exchange rate and manufacturing's share are both *endogenous* variables. The evidence simply does not support the contention that simply by depreciating the exchange rate, an economy could bring about reindustrialization; other policies to support investment and productivity growth need to be in place.

5 How Can the Exchange Rate Be Held at a Lower Level?

5.1 The exchange rate policy trilemma

Even if movements in the exchange rate can lead to improvements in competitiveness and reindustrialisation, following a policy of competitive exchange rate depreciation can only work where governments are able to control their exchange rates. But, doing so may be incompatible with other policy targets. This is made clear by the literature on the so-called 'policy trilemma', an important issue in open-economy macroeconomics. Seminal studies from Fleming (1962) and Mundell (1960, 1961a, 1961b, 1963) initiated the policy trilemma literature. Developed in the early 1960s, the MF model, along with the Uncovered Interest Parity (UIP) theory, still occupies centre stage in academic discussions about stabilisation policies for the open economy (eg, Isard, 1995; Boughton, 2003; Bernanke, 2017; Aizenman, 2019).

The theory starts from the observation that countries have three policy goals from which to choose when making fundamental decisions about managing their international monetary policy agreements: financial integration with the global capital market, exchange rate stability, and monetary independence. Synonymous with the 'impossible trinity', the policy trilemma asserts that market forces restrict the ability of a country to meet the three policy objectives simultaneously.

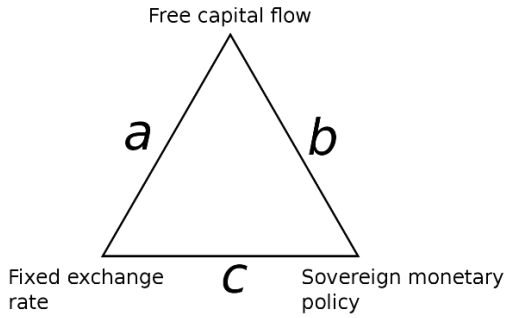
As illustrated in Figure 32, only one side of the trilemma triangle is achievable at a given time. A country can accomplish only two out of its three policy goals- financial integration, exchange rate stability, and monetary independence:

Side a: An economy can fix its exchange rate with one or more countries and have a free flow of capital with others. If it chooses this scenario, independent monetary policy is not achievable because interest rate fluctuations would create currency arbitrage stressing the currency pegs and causing them to break. For example, if the UK government wanted to keep the Pound fixed against the Euro, then the United Kingdom would need interest rates similar to the ECB. If the market thought the Pound was overvalued, capital would flow out of UK into the Eurozone – putting downward pressure on the Pound. Therefore, in response, the UK government would need to increase interest rates (and attract hot money flows) in order to maintain the value of the Pound and the fixed exchange rate peg. It means that in a recession the Bank of England could not cut interest rates because if it did, the Pound would fall in value.

Side b: An economy chooses a free flow of capital among all foreign nations and an autonomous monetary policy. Given monetary autonomy, fixed exchange rates among all nations and the free flow of capital are mutually exclusive. As a result, only one can be chosen at a time. So, if there is a free flow of capital among all nations, there cannot be fixed exchange rates. For example, if the government was worried about inflation, it could increase interest rates. These higher interest rates would cause an appreciation in the currency. Countries which wished to promote growth would cut interest rates, but lower interest rates would cause hot money flows out of the economy and lead to a fall in the exchange rate.

Side c: If a country chooses fixed exchange rates and independent monetary policy it cannot have a free flow of capital. Again, with an autonomous monetary policy, fixed exchange rates and the free flow of capital are mutually exclusive. For example, suppose China wished to keep its exchange rate fixed but it wished to cut interest rates to boost growth. In this case, there is downward pressure on the Yuan. Investors wish to sell Chinese currency and buy dollars. However, if the Chinese government restricted capital flows, preventing the Chinese buying dollars and moving currency out of the country, then it can artificially keep the value of Yuan high.

Figure 32: Policy Trilemma



Source: Oxelheim (1990)

The challenge for a government's international monetary policy comes in choosing which of these options to pursue and how to manage them. Generally, most countries favour side b of the triangle because they can enjoy the freedom of independent monetary policy and allow the policy to help guide the flow of capital. In practice, most fixed exchange rates rarely last. Countries invariably agree to devalue the currency if needed. Rey (2015) argues that the trilemma is not as simple as it appears. She believes that the majority of countries are faced with only two options, or a dilemma, since fixed currency pegs are not usually effective, leading to a focus on the relationship between independent monetary policy and free capital flow. The trilemma effectively becomes a dilemma between capital mobility and independent monetary policy. In theory, a government may wish to impose capital controls, but in practice, investors and individuals may seek ways around it. Also, once you impose capital controls, it may discourage investment and decrease confidence.

Typically, countries pursuing policies of 'export-led growth' (eg, China) would see the build-up of large current account surpluses, which would trigger an appreciation in their currency. In such circumstances, they normally impose capital controls, ie, operate on Side c of the Policy Trilemma shown in Figure 32. For example, the Chinese government has intervened extensively to devalue the renminbi, in particular through using its foreign currency earnings to buy US assets. Through intervening in the bond markets, China was able to sell its surplus currency to buy assets priced in dollars, ensuring that the renminbi is kept lower than it would actually be if it was left to self-regulate in a free market.

5.2 How might the United Kingdom government lower the real sterling exchange rate?

Given that real effective exchange rates are I(1) processes, if the authorities can lower the real exchange rate, it should remain low for a long time. Moreover, the evidence on exchange rate pass through (ERPT) discussed in Section 3, above, suggests that the benefits of a lower nominal exchange rate will not be squandered in higher inflation that will unwind the intimal benefits. The two findings are consistent; in fact, the second underpins the first. Thus, there are benefits to lowering the real exchange rate that can persist for a long time, perhaps permanently. The question is therefore how to lower the real exchange rate? Figure 9 suggests that shifts in sterling's real effective exchange rate have mostly been due to significant shifts in the nominal rate, so the question boils down to how to reduce the nominal exchange rate.

The obvious place to start is the foreign exchange market. The foreign exchange (FX) market is forward-looking, so an important element in cheapening sterling is being explicit that an objective is to lower the real effective rate. The authorities being clear that improving competitiveness is an objective will help to lower the exchange rate quickly. However, it has to be equally clear that the authorities will follow polices that avoid the competitiveness gains simply being frittered away in higher inflation – the macro-economic strategy of the government has to be consistent with keeping inflation low and maintaining overall macro-economic balance.

There are, however, dangers with being too explicit about ambitions for the exchange rate. For example, the United Kingdom being labelled as a 'currency manipulator' by the US Treasury would lead to trade retaliation, and perhaps not only by the US. To avert these dangers, the policy would need to be presented as a policy to promote investment and growth, alongside reducing macro-economic imbalances. Since the United Kingdom has a sizeable current account deficit, it would be difficult to casts this as a predatory exchange rate policy. The government should not be too explicit so that political pitfalls are circumvented, but not so opaque that the markets miss the message about the future value of the pound.

The foreign exchange value of sterling is one influence on the ability to achieve simultaneous macro-economic equilibrium both internally and externally. Softer sterling is an expenditure switching policy (from domestic demand to net trade) and an expenditure augmenting policy. If the economy starts off from a position of full employment, a lower exchange rate requires accompanying expenditure reducing polices. Otherwise, inflation will rise, and interest rates will follow, pushing the real exchange rate back up.

The domestic policies appropriate to accompany a weaker exchange rate include lower public expenditure and higher taxation. Either will reduce domestic absorption and leave room for an improvement in net trade and investment. Blochliger *et al.* (2012), found that large fiscal consolidation episodes started with an objective of improving competitiveness. Currency depreciation was part of the typical package, to improve growth and reduce unemployment.

Bacon and Eltis' argument that the public sector's claim on resources is excessive would suggest that expenditure reduction is a better policy. Blochiger *et al.* (2012 found that most successful episodes of fiscal consolidation concentrated on expenditure). Another reason to favour reducing expenditure over increasing taxes is that a lower exchange rate will raise prices, reducing real wages. If, in addition, taxes are raised, the likelihood of a wage reaction to higher inflation would rise, threatening an erosion of competitiveness gains (Alesina and Perotti, 1994).

However, expenditure cuts are difficult to implement at short notice and the size of the exchange rate reduction we are contemplating is considerable. It can be argued, therefore, that tax increases could be implemented more quickly and so should feature prominently in the strategy, at least to begin with. The rebuttal to this is that the financial markets, including the foreign exchange market, are forward looking. If the fiscal strategy were announced in advance, the exchange rate and longer-term interest rate markets would respond immediately to price in future fiscal tightening. Expenditure cuts do not need to start immediately but should be pre-announced.

A further persuasive case for an expenditure-based (EB) fiscal tightening rather than a tax-based (TB) tightening is that monetary policy, and therefore the exchange rate, reacts more to the former than the latter. This greater reaction to EB tightening is because the fiscal multiplier, as shown in NIGEM, is larger for EB policies. This larger multiplier is because 'leakages' into saving and imports are larger for EB and TB fiscal measures (Barrell *et al.*, 2012). EB tightening in NIGEM (on which the Barrell, Holland and Hurst results are based) reduces GDP more than TB tightening for a given size of fiscal shock, and so leads to larger cuts in interest rates and a softer exchange rate. However, Alesina *et al.* (2015) and Favero and Giavazzi (2015) found that over thirty years, multi-year EB fiscal consolidation was less costly in lost output longer-term than TB policies, which they attributed not to different monetary policy responses but to more favourable effects on business confidence and investment in EB consolidations. One issue with their work is not distinguishing between free floating exchange rate countries and those in exchange rate management regimes (such as EMU, and before it, ERM). Since most past fiscal tightening episodes have had the objective of budgetary consolidation (Leigh *et al.*, 2011, Beetsma *et al.*, 2012)), whereas we are contemplating a fiscal tightening with a different objective, the effects may be different from past episodes. Contrasting with this analysis, Ravn *et al.* (2012) and Monacelli and Perotti (2010) found that

historically higher government spending resulted in a real exchange rate depreciation. How a fiscal impulse affects the exchange rate depends upon, *inter alia*, the monetary environment. A fiscal tightening when there are fears that the budget deficit will be financed by money printing will see an exchange rate appreciation. We believe that the United Kingdom is in this second position.

Announcing a more restrictive fiscal policy would feed expectations of lower interest rates under the current inflation targeting framework, and this would lead to a lower exchange rate. NIGEM simulations suggest that for every 1 per cent of GDP in fiscal tightening, the exchange rate would decline by about 0.8 percentage points. A permanent fiscal tightening of 5 per cent of GDP achieved by cutting government current consumption by 5 per cent relative to the base would lower the effective exchange rate by an approximate 5 – 6 per cent throughout the years. This would boost exports by an average of 1.3 per cent and decrease imports by 6 per cent. Manufacturing production would rise as a result. To achieve a reduction in the exchange rate of 25 per cent would therefore require a substantial cut in government current consumption of at least 25 per cent.

Benetrix and Lane (2013) found that, for the United Kingdom and a few other countries with floating exchange rates, a reduction in government absorption of 1 per cent of GDP generates a peak real depreciation of the exchange rate of about 3.5 per cent in year 3. Achieving a 25 per cent real deprecation of sterling on this basis would require a fiscal tightening of 7 per cent of GDP. This looks virtually impossible to achieve through expenditure cuts alone.

The key question is whether other policies, such as announcing an exchange rate target, could reduce the extent to which fiscal policy might need to be tightened. The history of the United Kingdom and attempts to fix the exchange rate is not a happy one, with 1967 devaluation, the 1972 exit from 'the snake in the tunnel' (Goodhart, 2011) and the ignominious ERM exit in 1992 being recent examples. However, these are all instances where the United Kingdom attempted to fix the exchange rate at too high a level. In these circumstances, the monetary authorities can easily run out of foreign currency to support the exchange rate. In the case where the objective is to hold the exchange rate below rather than above the equilibrium level, by definition, the authorities cannot run out of domestic currency – they can supply as much of it as they need to hold the exchange rate down.

If the policy of potentially unlimited intervention is credible, the central bank would not need to sell a single pound on the foreign exchanges to hold sterling down, in fact not even a penny. Mario Draghi's promise to 'do whatever it takes' to stabilise euro area bond spreads in 2012 is a perfect illustration of what a credible commitment by a central bank can do.

Switzerland's experience in 2015 where the Swiss National Bank (SNB) tried to cap the rise in the Swiss franc is relevant to this discussion, as the SNB had to give up the fight in the face of a massive accumulation of foreign exchange reserves that boosted domestic money supply and asset prices, including real estate. Could the United Kingdom face the same problems? Possibly, but there are three reasons to believe that the issues confronting the United Kingdom would be less than for Switzerland:

1) The same 'flight to safety' from the euro crisis that afflicted Switzerland would not apply to the United Kingdom, since sterling is less of a safe haven than the Swiss franc and the euro crisis is history.
2) UK markets are much larger than those of Switzerland and so would not be distorted to the same extent.
3) Crucially, the massive accumulation of government debt (almost all gilts) by the Bank of England during QE would allow a simple neutralization of any monetary stimulus arising from foreign exchange accumulation. For every pound the Bank put into the money market through FX intervention, they could commit to taking out by selling gilts.

The third point is crucial. The fact that the Bank of England accumulated £895 billion of bonds under QE (almost all government bonds) means that the commitment to sterilise the monetary effects of FX intervention would be credible. The market would understand that it could not force the authorities away from the desired FX rate due to excessive monetary growth and inflated asset prices – the Bank would just sell gilts to offset the monetary effects of FX intervention. At the same time, the reserve accumulation would provide the wherewithal for the United Kingdom to set up a sovereign wealth fund. One potential objection to the broader strategy of neutralizing FX intervention by the Bank selling gilts is that this could push up gilt yields. That is true, but the extent would be limited since the market's expectations about future spot interest rates and arbitrage between the short and long ends of the interest rate market would constrain the rise in gilt yields. Moreover, under a credible strategy, there would be no FX reserve intervention and therefore no gilt sales – government yields would not budge. A stronger objection is that putting sterling into the FX market through FX intervention and taking it out again through reverse QE would leave the supply of sterling unchanged. That misses the point, which is that a credible commitment to intervene in the FX market reduces the *demand* for sterling (because there are no anticipated FX gains) event though it leaves supply unchanged. Thus, sterilised intervention can persist for a considerable period, especially when the central bank has accumulated nearly £1 trillion of excess gilts. The fact that sterling has a near unit root means that if the authorities can stabilise sterling for a reasonable period (say 6 months to a year), there is a probability of holding the level for much longer.

How have other countries achieved a low level for the real exchange rate? Often, commentators refer to an exchange rate as 'undervalued' if it delivers a surplus on the current account and results in the rapid growth of the traded-goods sectors. On that basis, sterling is clearly overvalued as the United Kingdom has a permanent current account deficit and a shrinking traded-goods sector. However, looking at the external accounts alone is a partial view of what constitutes 'undervaluation' or 'overvaluation'. The exchange rate is a price that emerges from a general equilibrium process that achieves simultaneous internal and external economic balance in the real and financial spheres (for both stocks and flows), so that concentrating on real external flows alone is too narrow a definition.

Nonetheless, much of the literature concentrates on external flows in judging exchange rate overvaluation or undervaluation. For example, Rodrik (2008) found that a sustained undervaluation of the exchange rate was effective in raising trend growth, noting that a sustained undervaluation of 10 per cent to 20 per cent preceded many Asian countries' growth acceleration. Rodrik empirically identified several factors that promoted exchange rate undervaluation. Domestically, a lower share of government consumption in GDP increased undervaluation, as did a higher share of domestic saving in GDP. Externally, a less open capital account (which discouraged capital inflows to many of the countries he studied) also contributed to undervaluation, as did having a managed float or crawling peg rather than a freely floating exchange rate.

As emphasised in Section 5.1, above, discouraging capital inflows to the United Kingdom or trying to manage sterling's FX value (which has not had a particularly successful past, as seen in ERM exit in 1992 and earlier sterling devaluations) would involve giving up a degree of monetary autonomy since it is not possible to have more than two of a fixed exchange rate, free capital mobility and domestic monetary autonomy. If capital flows remained free, achieving a managed float would require interest rates to be adjusted consistent with that. But that might mean UK rates inconsistent with the UK inflation target. Thus, if reducing the real exchange rate were a policy objective and monetary policy were to be the chosen instrument then the Bank of England would need to tolerate inflation higher than 2 per cent where necessary to avoid operating against the FX objective.

Capital controls would run contrary to some of the United Kingdom's international undertakings and would probably be easily circumvented, while proving damaging to London's role as a financial centre. However, it is possible to introduce wedges (tax or regulatory) so that the interest rate necessary to control domestic demand is higher than the interest rate applying to foreign inflows. Regulatory or tax measures to increase the cost of mortgages in the United Kingdom are possibilities to achieve this while withholding taxes, eg, on gilts, are another candidate. The objective would be to raise rates paid to and by domestic residents and lower rates paid to foreigners.

Many countries have used sovereign wealth funds (SWFs) to help keep the exchange rate down. For example, Norway has a SWF to help intergenerational equity and to avoid 'Dutch disease.' A part of oil revenues today are not consumed by the current generation but are shifted forward to benefit future Norwegians by accumulating foreign assets. At the same time, current account inflows of foreign currency from oil sales are counterbalanced by financial account outflows in the form of foreign investments. This avoids excessive exchange rate appreciation wiping out domestic non-oil traded goods sectors (Brahmbatt *et al*., 2010).

Could the United Kingdom have a sovereign wealth fund? The objections are that current receipts from North Sea Oil and gas are small. They shrank form 0.7 per cent of GDP in 2008/09 to 0.03 per cent of GDP in 2019/20. Such amounts would not significantly affect sterling's FX valuation. A justification for larger invested amounts would be catching up on past investments that were, inappropriately, not made. Accumulation of foreign assets in an SWF out of domestic taxation would be politically contentious, not least because investing abroad would be challenged when UK investment is lacklustre. The way to minimise the possible backlash over a UK SWF is to fund it out of accumulated reserves generated by FX intervention to hold sterling at a cheap level. Since reserves would be bought with sterling funded by the sale of BoE gilts, no new money would be required, so the defence of the SWF would be that it would be that it would accumulate valuable interest-earning assets, while reducing government debt interest payments, without increasing taxes or reducing government expenditures and at the same time making British industry more competitive.

The policies that would be consistent with achieving a softer real exchange rate would also free up resources from use in non-tradeable sectors. There would be a temporary reduction in living standards – either lower consumption per head if national savings increased or lower government consumption per head. Effectively, consumption today (private and public) would have to be lower to achieve higher rates of output growth and higher consumption than otherwise at a future date.

5.3 Conclusions

The literature on the exchange rate policy trilemma suggests that the UK government could only follow a policy of a competitive depreciation of sterling by giving up control over UK monetary policy or by imposing capital controls. Neither of these seem feasible in the current political climate, and both would carry their own economic costs. That said, if the UK government did want to pursue a competitive exchange rate policy the analysis above suggests that it would need to do the following:

- Announce a programme of progressive tightening of fiscal policy, concentrating on expenditure reductions.
- Introduce tax and regulatory wedges to increase interest rates paid by UK entities and reduce rates paid to foreigners.
- Announce a program of re-industrialisation, making clear that this requires lower domestic demand and a softer exchange rate.
- Make clear to the markets that its objective is to lower the effective exchange rate by about 25 per cent, without a specific level that speculators could aim to break.
- Set up a sovereign wealth fund, investing in foreign rather than UK assets.
- Relax regulatory restrictions on institutions investing abroad to encourage outflows of capital.
- Make it clear that FX intervention without limit will be deployed to support its FX actions.
- Tighten, and more strictly enforce, competition rules to minimise the price effects of weaker sterling.

6 General Conclusions

In this report, we have examined whether a lower value of sterling could lead to an improvement in the United Kingdom's investment and growth performance and separately the conditions under which sterling could be held low. We were motivated by the argument in Mills (2022) that a depreciation of sterling would make manufacturing more profitable and encourage reindustrialization and this, in turn, would lead to higher productivity growth in the United Kingdom.

We find that there may be a case that manufacturing may have shrunk too far as a proportion of the economy with a negative effect on UK productivity growth. But we found that attempting to reindustrialise solely via engineering a large sterling devaluation will, at best, only work in the short run. Specifically, although a large nominal exchange rate depreciation can lead to *temporary* increases in exports, investment and GDP, we found that, in a tight labour market, these gains would eventually be reduced by rises in inflation and, more importantly, unit labour costs. Further, the empirical evidence from the United Kingdom, and the experience of China and Singapore, suggest that it is not an overvalued exchange rate that explains deindustrialization but rather a general lack of investment that has led to deindustrialization, low productivity growth and falls in the real and nominal exchange rate. Although it was posited that a lower exchange rate when paired with a large surplus of labour may have played a positive role in China in supporting higher levels of GDP growth, the evidence does not support the contention that simply by depreciating the exchange rate on its own, an economy could bring about reindustrialization; other policies to support investment and productivity growth need to be in place.

Furthermore, we found that the UK government could only follow a policy of a competitive depreciation of sterling by giving up control over UK monetary policy or by imposing capital controls, neither of which seem feasible in the current political climate and both of which would carry their own economic costs. Our suggested answer to the problem of low productivity growth in the United Kingdom is that we need to increase business investment as a proportion of GDP, though this will require a change in the savings behaviour of both the private and public sectors.

Annex: A DSGE Model of a Small Open Economy

In this annex, we describe the DSGE model we use to examine the mechanism linking an exchange rate depreciation to reindustrialization and increased growth put forward in Mills (2022). In what follows, we describe the problems faced by households, firms and the government and derive the equations of the model. We then describe how we calibrate the model to UK data. The results we generated using the model are described in the main text.

Households

The representative household maximises the present discounted value of their utility, which they obtain from consumption, subject to their budget constraint. They consume the traded good, c_g, and services, c_g, which cannot be traded. We assume that aggregate consumption, c, takes the form:

$$c_t = c_{g,t}^{\alpha} c_{s,t}^{1-\alpha} \quad \textbf{(1)}$$

Where we have assumed a unit elasticity of substitution between goods and services. We denote the domestic price of the traded good as P_g, which will equal $\frac{P*}{s}$. So, an exchange rate depreciation of x per cent will lead to a rise in P_g of x per cent. We denote the price of the non-traded service as P_s and define the aggregate price level, P, as the minimum level of expenditure needed to buy one unit of aggregate consumption:

$$P_t = \frac{P_{g,t}^{\alpha} P_{s,t}^{1-\alpha}}{\alpha^{\alpha}(1-\alpha)^{1-\alpha}} \quad \textbf{(2)}$$

Consumption of the good and the service will be given, respectively, by:

$$c_{g,t} = \frac{\alpha P_t c_t}{P_{g,t}} \quad \textbf{(3)}$$

And

$$c_{s,t} = \frac{(1-\alpha) P_t c_t}{P_{s,t}} \quad \textbf{(4)}$$

The household's problem can be written as:

Maximise $\sum_{t=0}^{\infty} \beta^t \left(ln(c_t) - \frac{\zeta}{1+\sigma} h_t^{1+\sigma} \right)$

Subject to

$$B_t + \frac{B_{f,t}}{s_t} = (1 + i_{t-1})B_{t-1} + \frac{1 + i_{f,t-1}}{s_t} B_{f,t-1} + W_t h_t - P_t c_t + \Pi_t - T_t$$

where B denotes holdings of domestic bonds, B_f denotes holdings of foreign bonds (denominated in foreign currency), i is the domestic nominal interest rate, i_f is the foreign nominal interest rate, h denotes total hours worked, P denotes firm profits (distributed lump-sum to households) and T denotes lump-sum taxes paid to the government. Given there are no distortionary taxes we can assume without loss of generality that there are zero domestic bonds in equilibrium. If B_f is positive, the domestic economy is lending to the rest of the world and *vice versa*. We can think of B_f as denoting net foreign assets.

The first-order conditions for this problem imply:

$$\frac{1}{P_t c_t} = \beta(1 + i_t) E_t \frac{1}{P_{t+1} c_{t+1}} \quad \textbf{(5)}$$

$$\frac{1}{P_t c_t s_t} = \beta\left(1 + i_{f,t}\right) E_t \frac{1}{P_{t+1} c_{t+1} s_{t+1}} \quad \textbf{(6)}$$

$$W_t = \zeta P_t c_t h_t^{\sigma} \quad \textbf{(7)}$$

Equation **(5)** is the familiar Euler equation linking consumption to movements in the real interest rate. An increase in nominal interest rates implies lower consumption today relative to expected consumption tomorrow. Similarly, an increase in expected inflation implies more consumption today relative to expected consumption tomorrow. Equation **(7)** is the labour supply condition that links total hours worked to the real wage; the higher the real wage, the more people work.

More importantly for this report, equation **(6)** determines the exchange rate. Combining with equation **(5)** and taking logs gives the familiar uncovered interest parity condition:

$$E_t \Delta ln(s_{t+1}) = i_{f,t} - i_t \quad (8)$$

That is, if foreign interest rates are greater than domestic interest rates, the nominal exchange rate will be expected to appreciate to equalise the returns on domestic and foreign bonds when expressed in the same currency. So, a cut in domestic interest rates will lead to a temporary depreciation of the exchange rate, with the exchange rate then rising back to its long-run level. A permanent depreciation of the exchange rate requires a change in the steady-state of the model.

Traded goods producers

The representative domestic producer of traded goods combines labour, h_g, capital, k, and imports, M, to produce the traded good in order to maximise the present discounted value of its current and future expected profit streams, net of its investment. The capital stock is assumed to be made entirely of traded goods. We assume that there is a perfectly-competitive world market for these traded goods. That is, the domestic traded goods producers are assumed to be price-takers in world markets (including in their own domestic market). Note that this means that export prices will be the same as import prices, ie, the terms of trade will equal unity by assumption.

We can write the firms problem mathematically as follows:

Maximise $E_0 \sum_{t=0}^{\infty} \beta^t \left(\frac{P_t^*}{s_t} \left(y_{g,t} - I_t \right) - \frac{P_t^* M_t}{s_t} - W_t h_{g,t} \right)$

Subject to $y_{g,t} = A_{g,t} k_{t-1}^{\gamma_k} h_{g,t}^{\gamma_h} M_t^{1-\gamma_k-\gamma_h}$

$k_t = (1-\delta) k_{t-1} + I_t$

$A_{g,t} = \left(1 + g_g\right) A_{g,t-1}$

Where P^* denotes the (exogenous) world price of traded goods, y_g denotes gross (of investment) output of the traded good, I denotes investment, s denotes the nominal exchange rate, W denotes the nominal wage and g_g denotes the growth rate of technology in the traded goods sector.

The first-order conditions imply:

$$\frac{P_t^*}{s_t} = \beta E_t \frac{P_{t+1}^*}{s_{t+1}} \left(\gamma_k \frac{y_{g,t+1}}{k_t} + (1-\delta) \right) \quad \textbf{(9)}$$

$$M_t = (1-\gamma_k-\gamma_h) y_{g,t} \quad \textbf{(10)}$$

$$W_t h_{g,t} = \gamma_h \frac{P_t^*}{s_t} y_{g,t} \quad \textbf{(11)}$$

Given these first-order conditions we can calculate the firm's profit margin (equivalently the profit share):

$$\frac{\frac{P_t^*}{s_t}(y_{g,t}-I_t) - \frac{P_t^* M_t}{s_t} - W_t h_{g,t}}{\frac{P_t^*}{s_t}(y_{g,t}-I_t)} = \gamma_k \quad \textbf{(12)}$$

Clearly in this simple set up, profitability is constant. In particular, an exchange rate depreciation will not raise profitability! This, perhaps surprising result, is a function of the general equilibrium response of firms to an exchange rate depreciation. For given levels of output, investment, imports, employment and wages an exchange rate depreciation will lead to an increase in profitability as seen from the left-hand side of equation **(12)**:

$$\frac{\partial}{\partial s_t}\left(\frac{\frac{P_t^*}{s_t}(y_{g,t}-I_t) - \frac{P_t^* M_t}{s_t} - W_t h_{g,t}}{\frac{P_t^*}{s_t}(y_{g,t}-I_t)} \right) = -\frac{W_t}{P_t^*} h_{g,t} \quad \textbf{(13)}$$

But, with their real wage falling, workers would push for higher wages. With wages sticky in the short run, we might expect to see an increase in output as firms responded to the temporary increase in profitability but, in the long run, we would expect wages to rise in line with the domestic price of goods and this increase in wages would restore the equality in equation **(12)** (ie, bring profit margins back to g_k). So, we may expect to see a rise in profits and profitability in the short run as output rose. At the same time, we would expect investment to rise as more capital would be needed to support the higher level of output. But in the long run the exchange rate depreciation would be entirely passed on into nominal wages and profitability would return to its usual level.

As an aside, equation **(9)** also allows us to see the link between investment and growth. Along a balanced growth path with a constant nominal exchange rate and (for simplicity) a constant foreign price level, equation **(9)** implies:

$$\frac{k}{y_g} = \frac{\gamma_k(1+g_g)}{\frac{1}{\beta}-(1-\delta)} \qquad \textbf{(14)}$$

That is, the higher is the capital:output ratio in the goods sector, the higher is the growth rate. But note, it is not the higher capital:output ratio that is driving growth since we have assumed an exogenous growth rate. Rather we have just shown why the capital:output ratio is likely to be correlated with the growth rate. A final remark is that the long-run level of the exchange rate has no effect on the capital:output ratio in the goods sector! It is determined solely by the weight that firms put on future profits vis-à-vis current profits, *b*, the elasticity of goods production with respect to capital, g_k, the depreciation rate of capital, *d*, and the growth rate, g_g.

Services producers

We next consider the problem for the producers of non-traded services. To keep things simple, we assume that these are produced solely using labour. We also assume that the service sector is monopolistically-competitive and that services produces face costs of adjusting their prices. This reflects the fact that services prices are much more 'sticky' than goods prices and creates a need for monetary policy to correct this distortion. We can write the problem for firm *j* that produces services as follows:

$$\text{Maximise} \quad \sum_{t=0}^{\infty} \beta^t \left(P_{j,t} y_{j,t} - W_t h_{j,t} - \frac{\chi}{2} \left(\frac{P_{j,t}}{P_{j,t-1}} - 1 \right)^2 P_{s,t} y_{s,t} \right)$$

$$\text{Subject to} \quad y_{j,t} = A_{s,t} h_{j,t}$$

$$y_{j,t} = \left(\frac{P_{s,t}}{P_{j,t}} \right)^{\varepsilon} y_{s,t}$$

$$A_{s,t} = (1 + g_s) A_{s,t-1}$$

Where P_j is the price charged by firm *j*, y_j is output of firm *j*, y_s is aggregate service-sector output, h_j is employment in services and g_s denotes the growth rate of technology in the service sector, which will also equal the growth rate of service-sector output.

Assuming all the firms in this sector are symmetric and that there are a unit continuum of them, the first-order conditions for this problem imply:

$$\frac{W_t}{P_{s,t}} = \mu_t A_{s,t} \qquad \textbf{(15)}$$

$$\pi_{s,t}(1 + \pi_{s,t}) = \frac{(1-\varepsilon)}{\chi} + \frac{\varepsilon}{\chi} \mu_t + \beta E_t \pi_{s,t+1} (1 + \pi_{s,t+1})^2 \frac{y_{s,t+1}}{y_{s,t}} \qquad \textbf{(16)}$$

Where *m* denotes real marginal cost and p_s denotes the inflation rate in services. Equation **(15)** determines the demand for labour in the service sector and equation **(16)** is the 'New Keynesian Phillips Curve' (NKPC) for the service sector, linking current inflation to expected future inflation and real marginal cost.

Public sector

As we've assumed a zero supply of domestic bonds in equilibrium, the government simply balances its budget. We assume that the government only purchases non-traded services. Hence:

$$P_{s,t}G_t = T_t \quad \textbf{(17)}$$

Where G denotes government spending.

The central bank operates a Taylor rule:

$$i_t = i + \rho i_{t-1} + (1-\rho)\left(\phi_\pi \pi_t + \phi_y \widehat{y_t}\right) \quad \textbf{(18)}$$

Where *p* denotes the CPI inflation rate and $\widehat{y_t}$ denotes the (log) deviation of output from trend.

Market clearing

We close the model with the following market clearing conditions for goods, services and labour, respectively:

$$y_{g,t} = c_{g,t} + I_t + X_t \quad \textbf{(19)}$$

$$y_{s,t} = c_{s,t} + G_t \quad \textbf{(20)}$$

$$h_t = h_{g,t} + h_{s,t} \quad \textbf{(21)}$$

Where *X* denotes exports, which are assumed to be exogenous. That is, at the competitive world price, there will be a given level of demand for the domestic economy's traded goods. Aggregating the budget constraints of households and the government with the definition of profits for the two types of firms gives the balance of payments condition:

$$B_{f,t} - B_{f,t-1} = i_{f,t-1}B_{f,t-1} + X_t - M_t \quad \textbf{(22)}$$

Finally, we can write the definition of GDP as:

$$y_t = c_t + \frac{P_{s,t}}{P_t}G_t + \frac{P_{g,t}}{P_t}(I_t + X_t - M_t) \quad \textbf{(23)}$$

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