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U.K. Inflation and Relative Prices over the Last Decade: How Important was Globalization?

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IMF Working Paper

European Department

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Abstract

In this paper, the IMF's new Global Economy Model (GEM) is used to estimate the relative importance of a number of factors argued to explain the differences in the trends in core inflation and relative prices in the United Kingdom, the Euro Area and the United States. The simulation results indicate that while the direct effect of globalization has had a larger effect in the United Kingdom than in either the United States or the Euro Area, it explains only a portion of the developments and U.K. specific factors played an important role.

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I. INTRODUCTION

A long-lived feature of the inflation process has been the gap between the rates of goods and service price inflation. The resulting rise in the relative price of services has most often been attributed to differing rates of productivity growth between the two sectors of the economy as outlined in Baumol (1967). Notionally, there is more scope for adopting labor saving technical progress in goods production and this results in a persistent gap in the rates of change in output prices, given labor mobility enforces nominal wage equality in the two sectors. In several countries, this gap between goods and service price inflation has become more pronounced over the last decade and an open-economy variant of Baumol, globalization and the growing impact of cheap goods from emerging Asia, is often cited as being an important factor.

While the gap between goods and service price inflation has widened in the United Kingdom and the United States (and in other countries as well) over the last decade, the widening has been significantly more pronounced in the United Kingdom with goods price deflation offsetting strong and fairly stable inflation in services prices. Consequently, the relative price of services has risen substantially more in the United Kingdom. In addition to the impact of globalization, several other factors, such as appreciation of the pound and increased public demand for services have also been argued to have had an important impact on U.K. inflation and relative prices. In this paper, simulation analysis with the IMF's Global Economy Model (GEM) is used to estimate the relative importance of these various factors on the different evolution of inflation and relative prices in the United Kingdom. GEM is particularly useful for such an exercise because its multiple goods framework, incorporating tradable and nontradable goods, allows for the analysis of the evolution in these relative prices.

The results illustrate that although globalization has had a larger impact on inflation and relative prices in the United Kingdom because of its relative size and openness, U.K. specific factors have also played an important role. The simulation results suggest that the import of competitively priced goods from emerging Asia (the direct impact of globalization) has had a six fold larger impact on the relative price of services in the United Kingdom than in the United States and the Euro area. However, this direct effect of globalization accounts for only about 25 percent of the increase in U.K. relative service prices that has occurred over the 1997 to 2006 period. The within-country productivity gap between the tradable and nontradable sectors, (original Baumol) accounts for roughly another 25 percent. The 1996–97 appreciation of the pound is estimated to account for almost 15 percent and the increase in public sector demand for nontradables almost 10 percent. The remaining 25 percent of the increase in the relative price of services evident in the data could be accounted for by a 15 percent improvement in distribution sector efficiency. However, while this magnitude of improvement is plausible, it cannot be supported as precisely by the available evidence as can the magnitude of the other shocks considered.

Several other interesting results are also found in the simulation analysis. To generate closer-to-real-world dynamics with a rational expectations model, the shocks are implemented under the assumption that agents do not have perfect foresight and must generate forecasts of the expected persistence in the shocks. As agents learn and generate more accurate forecasts, the downward pressures on overall inflation generated by productivity growth and efficiency gains in the distribution sector start to wane, even when the shocks continue for an extended period. This suggests that the benign inflation environment enjoyed in the United Kingdom over the last ten years should not necessarily be assumed to continue simply because there is believed to be considerable scope for these processes to be ongoing into the foreseeable future. A closely related point is the level of the neutral interest rate for the United Kingdom. The simulation analysis illustrates that with the various factors putting persistent downward pressure on inflation over the last decade, interest rates were often below neutral. Policymakers will need to be cautious about relying on the average level for short-term interest rates over the past decade as a guide to estimate the level of the neutral interest rate going forward.

The simulation analysis also suggests that two of the factors considered, rapid emerging Asia productivity growth and efficiency gains in the distribution sector have accounted for a considerable portion of U.K. growth over the last decade. As the scope for this to continue dissipates, estimates of sustainable growth in the United Kingdom will need to be adjusted accordingly. Given the uncertainty about how quickly these factors will wane, policymakers should be cognizant of this when assessing the risks surrounding their economic outlooks. Finally, the analysis also illustrates that the ongoing structural change in the U.K. economy away from the production of tradable goods and toward the production of nontradable goods reflects an optimal response to global developments. Combining the various factors leads to an increase in the share nontradables in GDP quite similar to the increase in the share of services in U.K. GDP that has occurred over the last decade.

The remainder of the paper is structured as follows. Section II presents a brief overview of GEM. Section III considers the explanations advanced in the literature for the rising relative price of services and examines how the related features in the data have evolved over the last decade. In addition, this section maps these aspect of the data into simulation experiments that can be run on GEM. The simulation analysis is presented in Section IV. Section V concludes.

II. AN OVERVIEW OF THE GLOBAL ECONOMIC MODEL

GEM is a large multi-country macroeconomic model derived completely from optimizing foundations. The version of GEM used here, characterizes the behavior of four countries/blocks: the United Kingdom, the Euro area, the United States and emerging Asia. In each country there are households, firms, and a government. Households maximize utility derived from the consumption of goods and leisure. Firms combine capital and labor to maximize the net income from the production of nontradable and tradable intermediate

goods. Firms also produce the final nontradable good. Governments consume goods financed through nondistorting taxes and adjust short-term nominal interest rates to provide nominal anchors.

A. Households

Households are infinitely lived, consume the nontradable final good, and are the monopolistic suppliers of differentiated labor inputs to all domestic firms. Households exhibit habit persistence in their consumption behavior contributing to real rigidities in economic adjustment. Monopoly power in labor supply implies that the wages households receive contain a markup over the marginal rate of substitution between consumption and leisure. Because wage contracts are subject to adjustment costs, aggregate nominal rigidities arise through the wage bargaining process.

Households own all domestic firms and the domestic capital stock, which they rent to domestic firms. The market for capital is competitive. Capital accumulation is subject to adjustment costs that also contribute to gradual economic adjustment. Labor and capital are immobile internationally. Households only trade short-term nominal bonds internationally. These bonds are denominated in U.S. dollars and issued in zero net supply worldwide.

B. Firms

Firms produce three types of goods: nontradable final goods, nontradable intermediate goods and tradable intermediate goods. Intermediate goods are assumed to be differentiated, giving rise to the market power that enables firms to charge a mark-up over the marginal cost of production.

The final good is produced by perfectly competitive firms that use nontradable and tradable intermediate goods (domestic and/or imported) as inputs. There are distribution cost (specified as units of nontradable goods) associated with the delivery of tradable intermediate goods to the final goods producer. The final good can be consumed by domestic households or the government, or used for investment. The structure of final good production reflects the preferences of households and firms over all intermediate goods and, consequently, international trade is driven by the interaction of preferences and relative prices.

Intermediate goods are produced by firms under conditions of monopolistic competition. Consequently, prices contain a markup over marginal cost. Firms in the intermediate goods sectors combine capital and labor under CES technology. Prices of intermediate goods are subject to adjustment costs that, along with slowly adjusting wages, give rise to the gradual adjustment of prices in response to economic disturbances. Intermediate nontradable goods are used in the production of nontradable final goods. Tradable intermediate goods are used either in the production of domestic nontradable final goods or in the production of foreign nontradable final goods.

C. Government

Government spending falls exclusively on final non-tradable goods. Government spending is financed through a nondistorting tax. The government controls the national short-term nominal interest rate with the objective of providing a nominal anchor for the economy. The nominal anchors in the United Kingdom, the United States and the Euro area are inflation rates. For emerging Asia, the nominal anchor is stability in the nominal exchange rate between the emerging Asian currency and the U.S. dollar.

D. Parameterization

Currently, parameter values for GEM are derived through calibration.¹ Specific parameter values are determined by balancing several factors: empirical estimates available in the literature; the desired steady-state characterization of the economies; and the model's dynamic adjustment properties. The focus of the calibration for this exercise has been the steady state characteristics, in particular the trading relationships among the four blocks. Empirical evidence on markups and the expenditure shares of GDP in each of the blocks have also been incorporated into the calibration. However, because the shocks under consideration are long-lived, and the focus of the analysis is to understand the longer-term trends in relative prices, less attention has been given to precise calibration of quarterly adjustment dynamics. Nominal and real adjustment cost parameters are identical in all blocks although nominal and real dynamics will differ because of different proportions of liquidity constrained households and different markups in goods and labor markets. The calibration of the relative sizes and trading relationships among the four blocks are presented in Table 1 and have been chosen to be consistent with the data as of 1995. (The calibration of all the model's parameters are available from the author by request.)

Table 1: Key Steady State Calibration

	United Kingdom	United States	Euro Area	Emerging Asia
Relative Size	0.070	0.400	0.380	0.150
Imports/GDP	0.300	0.050	0.060	residual
From				
United Kingdom	0.000	0.005	0.020	0.062
United States	0.050	0.000	0.020	0.062
Euro Area	0.200	0.015	0.000	0.023
Emerging Asia	0.050	0.030	0.020	0.000

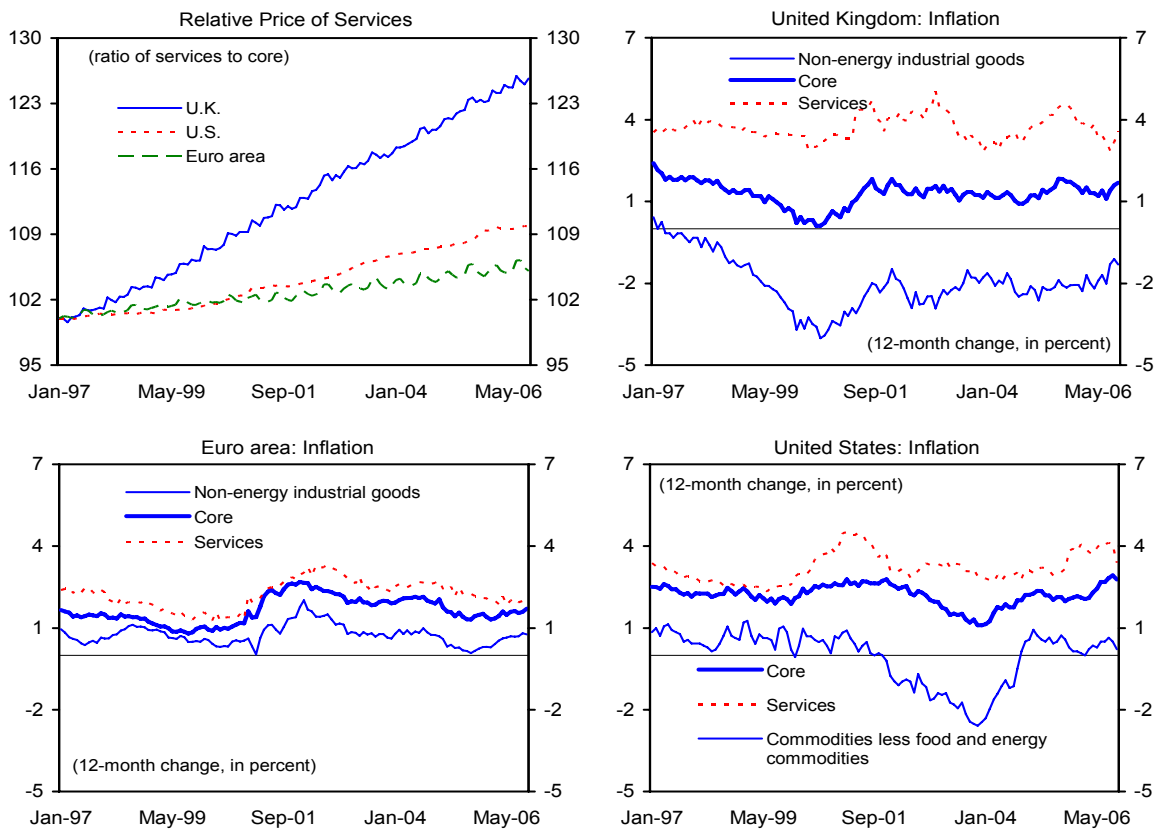
¹ Work is underway applying the Bayesian estimation technique employed in Smets and Wouters (2002) and outlined in Schorfheide (2002) to small versions of GEM to enhance the data coherence of the model's parameter values.

III. THEORY AND EVIDENCE

A. Inflation and Relative Prices

While service price inflation has notably exceeded goods price inflation in the last ten years in the United Kingdom, the Euro area and the United States, this gap has been considerably more pronounced in the United Kingdom. If one considers services versus core goods price inflation as presented in Figure 1, this difference is even more pronounced. Consequently, the core relative price of services has risen by 25 percent in the United Kingdom versus roughly 10 percent in the United States and 5 percent in the Euro area.

Figure 1: Inflation Stylized Facts



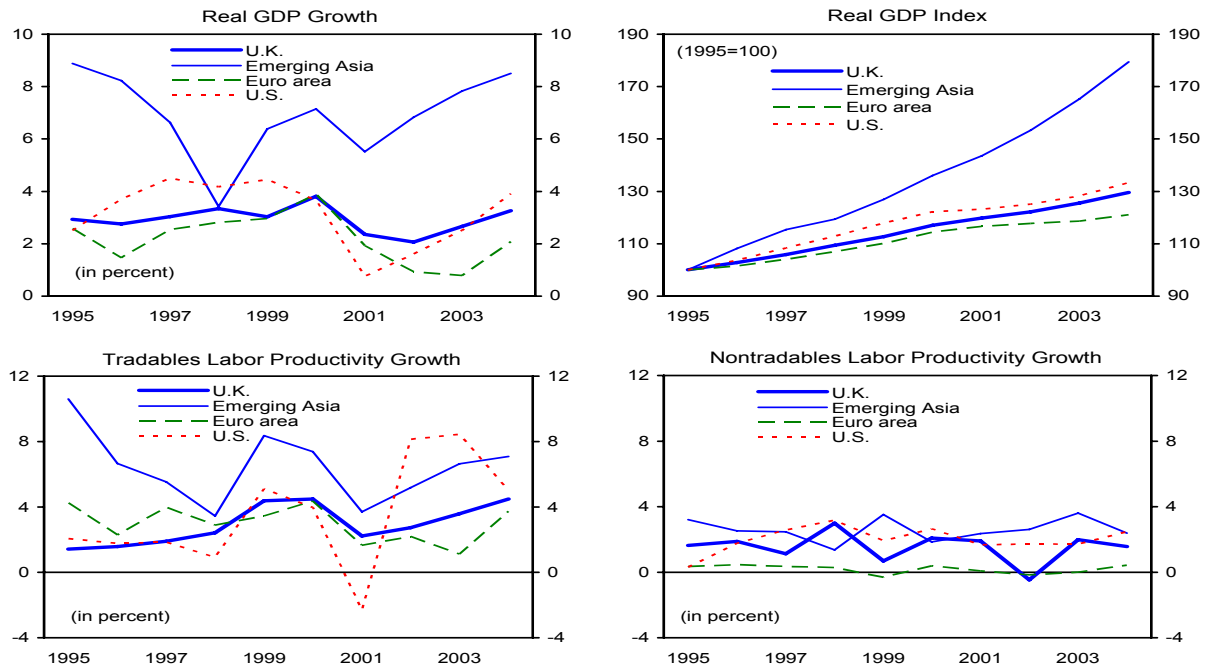
In the literature, three explanations for the persistent gap between service and goods price inflation are advanced. The original Baumol (1967) explanation of faster productivity growth in the goods producing sector, increased demand for services (De Gregorio and others (1994)), and measurement error (Brauer (1993)). More recently, the standard Baumol explanation has been extended to incorporate the impact of globalization on relative prices through its effect on productivity and trade as in Chen and others (2004). In addition, long-lived movements in exchange rates (Clark (2003)) and downward pressure on mark-ups from heightened global competition (Clark (2003), Bowman (2003) and Chen and others (2004))

have been pointed to as explanations for temporary but persistent changes in the magnitude of the gap between goods and service price inflation.

B. Productivity and Trade

Emerging Asia's real GDP has been growing much faster than the major industrial countries, resulting in the level of emerging Asia's GDP growing by roughly 50 percent more over the ten-year period 1995–04 (Figure 2).² The growth rates in labor productivity also graphed in Figure 2 indicate that this has been driven primarily by more rapid productivity growth in the tradable goods sector with the average gap in the range of 3–3½ percentage points (Table 2). In addition, there has been a within country sectoral productivity gap. Over the period, tradable sector productivity growth has exceeded that in the nontradable sector by 1.5 percentage points in the United Kingdom and the United States and by almost 3 percentage points in the Euro area. Clearly these productivity developments could have had a significant impact on the evolution of relative prices over the last decade.

Figure 2: Real GDP and Labor Productivity Growth



² These productivity growth rates are based on data contained in the IMF's CGER database. Emerging Asia comprises China, Hong Kong, India, Indonesia, South Korea, Malaysia, the Philippines, Singapore, Thailand and Taiwan.

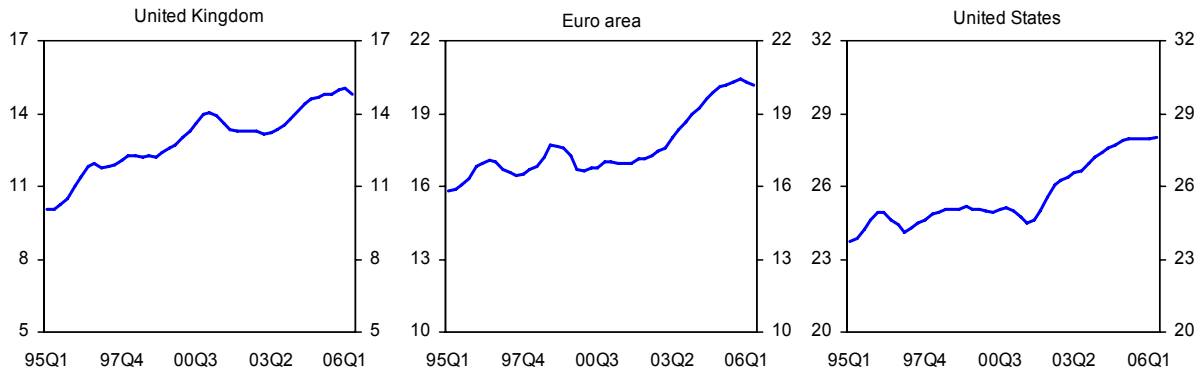
Table 2: Average Annual Labor Productivity Growth 1995 to 2004

	United Kingdom	United States	Euro Area	Emerging Asia
Tradable Sector	2.93	3.50	2.99	6.46
Nontradable Sector	1.54	1.99	0.19	2.59

The increase in the price competitiveness of imports from emerging Asian countries has also had an important impact on the share of industrial country imports coming from this part of the world. The behavior of import shares (Figure 3) illustrates an upward trend in the share of U.K., U.S., and Euro area imports coming from emerging Asia. Over the 1995 to 2005 period, the share of imports from Emerging Asia has increased by roughly 5 percentage points in all three. This increased share of competitively priced goods from emerging Asia could also have had an important impact on relative prices and inflation.

Figure 3: Share of Imports Coming from Emerging Asia

(as a percent of total imports)



Sources: Eurostat and Direction of Trade Statistics.

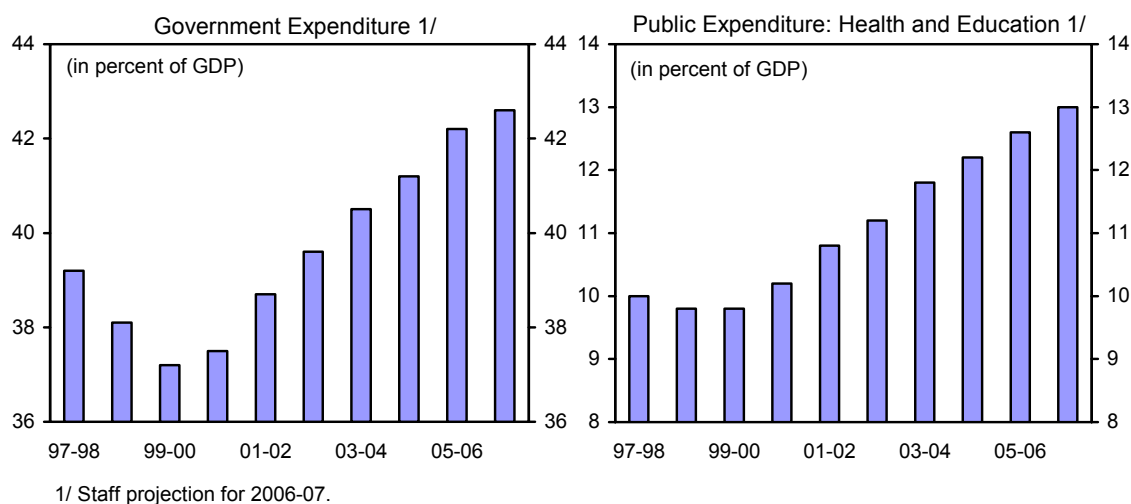
All three dimension of the recent historical experience with productivity growth and trade can be precisely mapped into simulation experiments for GEM. Tradable sector productivity growth in the emerging Asia block can be increased sufficiently to replicate the growth gap between emerging Asia and the major industrial countries considered. The increase in trade shares can be incorporated, but must be imposed.³ Adding the within industrial country productivity growth differential can also be implemented precisely.

³ Because the behavioral structure of the model does not yield this result on its own, it is necessary to impose the increase in the share of imports from emerging Asia exogenously. This can be supported by the fact that industrial country firms have actively sought out production capacity in emerging Asian economies to service domestic markets. The model structure does not allow for such behavior to be captured.

C. Changes in the Composition of Demand

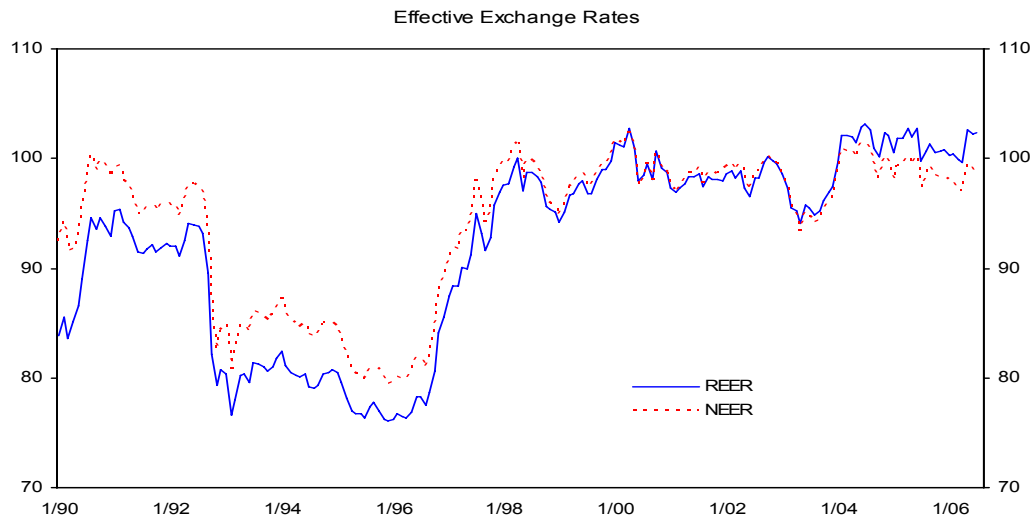
One notable feature of the composition of demand in the United Kingdom over the last ten years was the large increase in public demand. Government expenditure as a share of GDP increased from 39 percent in 1997 to 43 percent in 2006. With this increased expenditure coming largely in health and education, this can be interpreted as primarily an increase in demand for nontradables (Figure 4). With the level of public expenditure and its composition exogenous in GEM, implementing the increase in U.K. public consumption of nontradables is straight forward.

Figure 4: Public Demand



D. Sterling Appreciation

Over 1996–97 the U.K. real effective exchange rate appreciated significantly. Although it is difficult to ascertain the exact cause, the paths of the nominal and real effective exchange rates in Figure 5 suggest that the exchange rate could have been influenced by changes in the monetary policy framework. The sharp depreciation that occurred in 1992 coincided with the United Kingdom's withdrawal from ERM. Although inflation targeting was formally adopted at that time, the Bank of England was not granted operational independence until 1997. Uncertainty about the effectiveness of the monetary policy regime between 1992 and 1997 could have been a key factor underlying the depreciated exchange rate.

Figure 5: Sterling

It is not, however, possible to engineer a shift in the equilibrium exchange based on changing perceptions of the efficacy of alternative monetary policy frameworks without making assumptions about the implications for such things as sustainable growth, the level of public debt, and net foreign assets. However, it is possible to engineer temporary, but long-lived, movements in the real effective exchange rate using changes in the risk premium demanded on U.K. assets. This can be thought of as a reduced-form proxy for the underlying structural factors. Empirical evidence, based on estimates of the risk premium on U.K. assets presented in Groen and Balakrishnan (2004), suggests that a significant shift occurred in 1996–97.

E. Efficiency Gains in the U.K. Distribution Sector

There are several pieces of evidence suggesting that efficiency gains in the distribution sector may have been an important factor putting downward pressure on goods prices in the United Kingdom. Evidence of the change occurring in the U.K. retail sector presented in Burt and Sparks (2003) shows a pickup in merger and acquisition activity in the retail sector in the latter half of the 1990s compared to the first half.⁴ Estimates of productivity growth by sector in the United Kingdom presented in Oulton and Srinivasan (2005) provide evidence of relative efficiency gains in the wholesale and retail sectors in the 1990s. At the end of the decade, these sectors accounted for 12.5 percent of total value added, yet accounted for 15 percent of the increase in total factor productivity and 17 percent of the increase in labor productivity over the decade. The only sectors of the 34 examined that outperformed retail and wholesale in terms of productivity growth were: oil and gas; chemicals and

⁴ However, the number of mergers and acquisition in the last half of the 1990s was similar to that in the last half of the 1980s.

pharmaceuticals; electrical and electronics; communications; finance; and business services. In addition, the estimates suggest that productivity growth in retail accelerated in the latter half of the 90s compared to the first half.

An improvement in distribution efficiency can be implemented in GEM by reducing the proportion of nontradables required to deliver tradables to the household. However, the available evidence cannot be used to explicitly quantify the magnitude of the efficiency gains to include in the simulation analysis. It simply provides support for the argument that increased efficiency in the distribution sector could have been an important factor underlying price developments. Consequently, this shock will be treated as a residual. Once the other shocks have been implemented, the distribution efficiency gain is calibrated to be just large enough to allow the model and all the shocks to replicate the historical experience. Its plausibility can then be assessed.

F. Markups

Fluctuations in markups have also been pointed to in the literature as potentially having a temporary effect on the gap between goods and service price inflation. In theory the import of more competitively priced tradable goods erodes domestic firms' market power, putting downward pressure on markups and temporarily reducing domestic goods price inflation. However, there is little evidence to suggest that this has been an important factor in the United Kingdom over the last 10 years. Evidence presented in Ellis (2006) suggests that while there has been a notable decline in manufacturing markups over that last 30 years, markups have been relatively stable over the last 10 years.

G. Incorporating Uncertainty

The analysis also incorporates uncertainty about the persistence of the shocks. Under long-lived, perfect-foresight shocks that have significant implications for wealth, rational expectations models can produce adjustment dynamics unlike that seen in actual data (see for example Hunt and Rebucci (2005)). To address this and generate closer-to-real-world adjustment dynamics, the shocks are implemented assuming that each period, agents must generate forecasts of the shocks' persistence. To implement this the following signal extraction problem is integrated into the simulation analysis:

$$\begin{aligned}\Delta O_t &= P_t + T_t, \\ P_t &= \rho \cdot P_{t-1} + \varepsilon_t, \\ T_t &= 0 \cdot T_{t-1} + v_t,\end{aligned}$$

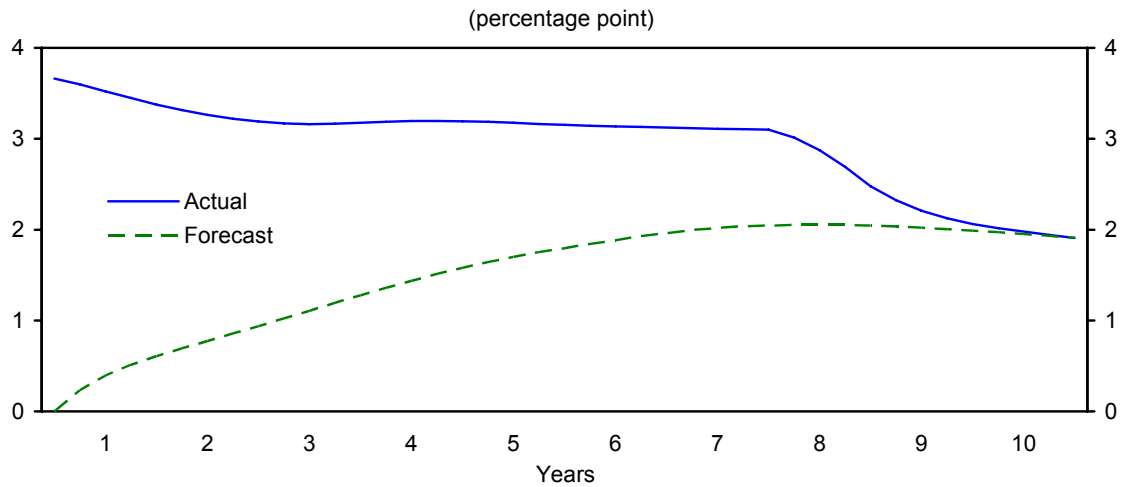
where ΔO_t is the change in the observed variable for which an expectation must be formed, P_t is the unobserved persistent component, T_t is the unobserved temporary component, ρ is the autoregressive coefficient on the persistent component, $\varepsilon_t \sim N(0, \sigma^2)$, and $v_t \sim N(0, \sigma^2)$.

Given the model and the observed change in period t , the Kalman filter generates optimal estimates of the persistent and temporary components for period t . These estimates are then used along with the model to generate forecasts for the variable in question beyond period t . At period $t+1$, a new observation is received and estimates of the persistent and temporary components for period $t+1$ are generated. These in turn are used to generate new forecasts and so on.

In this simple model, the speed with which agents learn about the persistent component of the shock depends on their view of the relative magnitude of the variances of the persistent and temporary components. If agents use a model in which they expect the variance of the persistent component to be high relative to that of the temporary component, then they will learn quickly about persistent shocks. If, on the other hand, this relative variance is expected to be low, they will learn rather slowly. The relative variance can be time invariant or time varying, depending on what is required to deliver the desired speed of learning. (Ideally one would attempt to match the historical evolution of expectations when they can be extracted from available data.)

This signal extraction model is used for four of the five shocks considered in the paper, the increase in emerging Asia tradable sector productivity growth, the within country productivity growth gap, the risk premium shock on U.K. assets, and the efficiency gains in the U.K. distribution sector. For all but the risk premium shock, the learning is calibrated as illustrated in Figure 6. However for the risk premium shock, agents learn quickly about its persistence when it arrives, once it disappears, the persistent strength in the exchange rate initially surprises agents. This was calibrated to match the evidence that for an extended period of time after the 1996–97 sterling appreciation, agents expected the exchange rate to weaken.

Figure 6: The 3-Year Ahead Acceleration in GDP Growth in Emerging Asia



IV. SIMULATION ANALYSIS

A. Direct Effects of Globalization

The shock experiment has been calibrated to match three aspects of the recent historical period. The first is the relative 50 percent increase in the level of emerging Asia's GDP. The second is the concentration in the tradable sector of the productivity gap underlying this growth differential. The last is the approximately 5 percentage point increase in the share of goods from emerging Asia in industrial countries' imports.⁵ As noted, to capture uncertainty about the persistence of the shocks, a signal extraction problem is imbedded in the simulation to proxy agents' learning process.

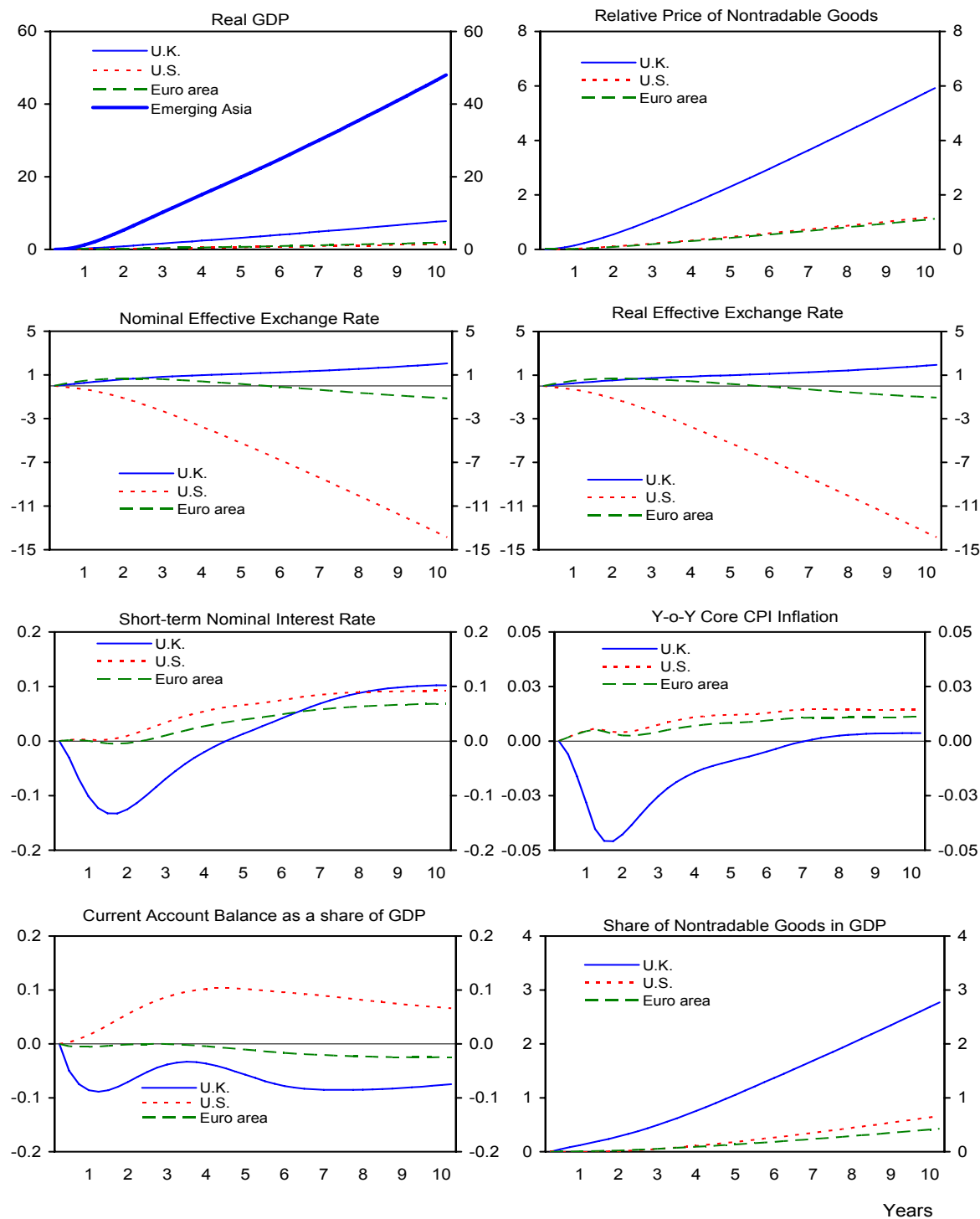
The key result is the significantly different impact of the shock on relative prices in the United Kingdom compared to the United States and the Euro area. The resulting solution paths for key macro variables are presented in Figure 7. The first point to note is that the level of emerging Asia's GDP increases by roughly 50 percent over ten years. The relative price of nontradables increases by roughly 6 percent in the United Kingdom versus just over 1 percent in the United States and the Euro area. This occurs for two reasons. First, imports from emerging Asia make up a larger share of the final consumption bundle in the United Kingdom. Second, the real effective exchange rate in the United Kingdom appreciates while the real effective exchange rates in the United States and (eventually) in the Euro area depreciate. This helps to exert downward pressure on the prices of all U.K. imports. Because the United Kingdom is much more open, this has a large positive wealth effect and demand for nontradable goods increases more, further increasing the relative price of nontradables.

The appreciation of the U.K. real effective exchange rate reflects the absolute levels of trade from emerging Asia. Although as a percent of GDP, imports from emerging Asia are larger in the United Kingdom than in either the United States or the Euro area, the levels of imports from emerging Asia are significantly larger in the United States and the Euro area. From emerging Asia's perspective, exports to the United States and the Euro area represent much larger shares of GDP. Further, increasing the shares of emerging Asian goods in the industrial countries' imports results in strong demand for Asian exports. To equilibrate current accounts, emerging Asian demand for imports from the United States and the Euro area must increase significantly. This is achieved through falling import prices from the United States and the Euro area driven by the emerging Asian currency appreciating more relative to the dollar and the Euro than the pound. The pound, although it also depreciates

⁵ Because the behavioral structure of the model does not yield this result on its own, it is necessary to impose the increase in the share of imports from emerging Asia exogenously. This can be supported by the fact that industrial country firms have actively sought out production capacity in emerging Asian economies to service domestic markets. The model structure does not allow for such behavior to be captured.

Figure 7: The Direct Effect of Globalization

(percent or percentage point deviation from baseline)



relative to emerging Asian currencies, appreciates sufficiently against the Euro and the dollar to more than offset the effect in the real effective exchange rate.

The shock results in more downward pressure on core CPI inflation in the United Kingdom than in either the United States or the Euro area. This limited impact of the direct effect of globalization on Euro area and U.S. inflation is consistent with Ball (2006). The greater impact in the United Kingdom primarily reflects the greater share of low cost imports in the U.K. consumption bundle. However, it is interesting to note that the downward pressure on inflation gradually dissipates, and nominal and real interest rates eventually rise above baseline in the United Kingdom. This reflects the fact that agents eventually learn about the persistence of the productivity increase in emerging Asia and the implications for the future price of imported tradables. The consequent implications for human wealth leads households to increase consumption, eventually generating mild excess demand. This is reflected in persistent current account deficits in the United Kingdom (albeit small ones).

There are two reasons why these simulation results may understate the direct impact on relative prices of the increasing industrialization of emerging Asia. First, from the U.K.'s perspective, imports from emerging Asia, the United States and the Euro area represent only 65 percent of U.K. imports. With the U.K.'s real effective exchange rate appreciating, there would also be additional downward pressure on import prices from the other countries not included here. This would also put additional upward pressure on U.K. service prices via the associated wealth effect. Second, the key role of exchange rates in GEM is to equilibrate net foreign asset positions. This shock is done under the constraint that there are no permanent changes in net foreign asset positions in the long run. Consequently, exchange rates move rather quickly to ensure there is minimal disequilibrium in current accounts. In reality, many other factors influence exchange rate dynamics. Slower adjustment of exchange rates would result in larger fluctuations in current accounts and import prices, leading to larger changes in relative prices along the adjustment path.

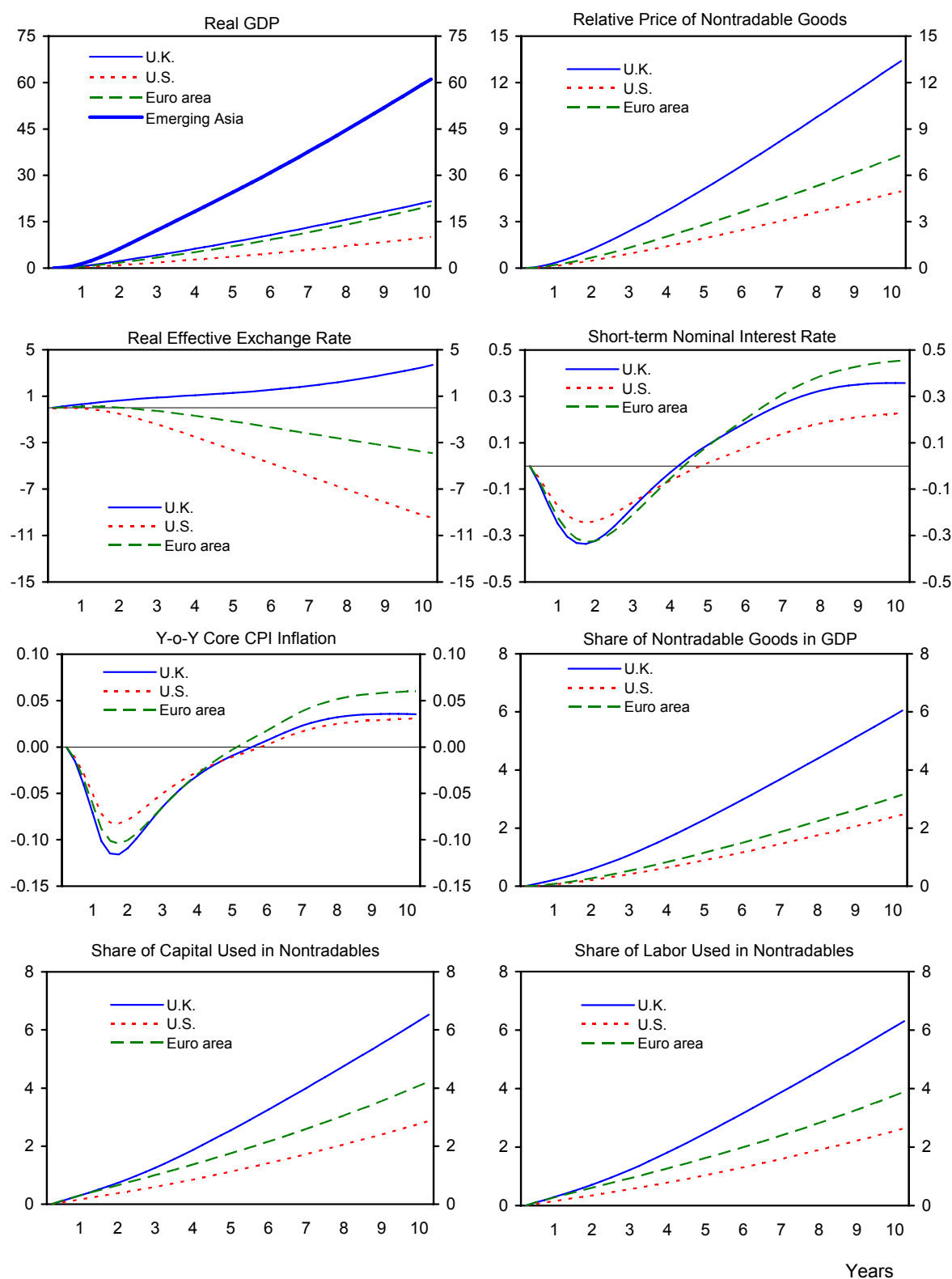
B. Adding the Within-Country Productivity Gap

Here, the industrial country productivity growth differentials between tradables and nontradables are added to the direct effects of globalization simulation. Because this increases real GDP in the industrial countries, the magnitude of the increase in emerging Asia's tradable sector productivity growth must be scaled up to maintain the appropriate gap. The relative increase in Asian GDP is benchmarked against U.S. GDP because GDP increases the least in the United States. Figure 8 traces out the adjustment paths for several key macro variables. Again, the shock is implemented under uncertainty with the same speed of learning.

In the simulation, the relative price of nontradable goods in the United Kingdom increases by a further 7 percentage points. Interestingly this is larger than the 6 percentage points increase

Figure 8: Adding the Within-Country Productivity Gap

(percent or percentage point deviation from baseline)



in relative nontradables prices in the Euro area where the tradable sector productivity growth gap is larger (2.8 percentage points versus 1.5 percentage points in the United Kingdom). It is also greater than the 4 percentage point increase in the United States where the tradable sector productivity growth gap is the same as in the United Kingdom. Again this larger impact on U.K. relative prices reflects the U.K.'s greater openness. With imports more important in the U.K. consumption bundle, the decline in the price of Euro area and U.S. tradable goods driven by the productivity improvements has a larger impact. In addition, with U.K. exports being a larger share of U.K. GDP, the Balasa Samuelson effect on the U.K. exchange rate is larger and the pound appreciates further against the Euro and the dollar, putting additional downward pressure on import prices. Again it is worth noting that the downward pressure on CPI inflation dissipate as agents learn about the persistence of the increase in productivity growth.

It is also interesting to note the impact of the tradable sector productivity gap on the share of nontradables in GDP and the allocation of capital and labor across sectors. Given household preferences, faster productivity growth in the foreign and domestic tradables sectors leads to a significant increase in the share of nontradables in GDP. The share of nontradables increases by 6 percentage points in the United Kingdom, by 2½ percentage points in the United States, and by 3 percentage points in the Euro area. Accordingly, the shares of both capital and labor employed in the nontradables sectors rise.

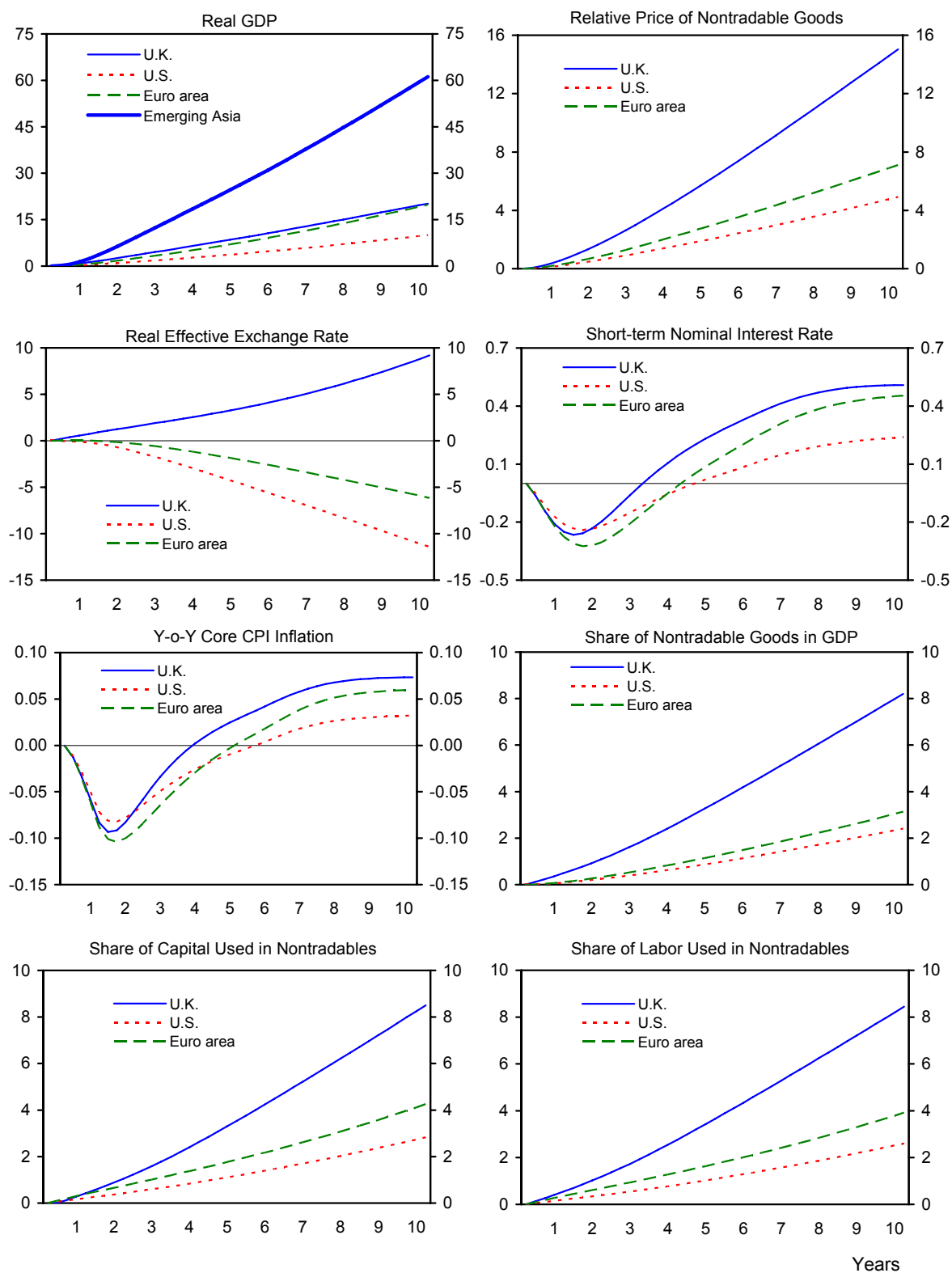
C. Adding the Increase in U.K. Public Sector Demand for Nontradables

Government expenditure as a share of GDP in the United Kingdom increased from 39 percent in 1997 to almost 43 percent in 2006. Adding this 4 percentage point permanent increase in U.K. public expenditure over a ten-year period to the simulation of faster tradable sector productivity growth yields the paths for key macro variables presented in Figure 9. The increase in government demand further increases the relative price of nontradables over ten years by almost 2 percentage points. On balance, the addition of the increased public demand exerts only modest upward pressure on inflation and requires only slightly higher policy interest rates.

Given the representative agent structure of GEM, there are good reasons to believe that these effects may be underestimated. The infinitely-lived household fully understands the implications of the government's intertemporal budget constraint and adjusts their expected labor income appropriately (the labor income tax adjusts to satisfy the government budget constraint). Consequently, private demand for consumption (and investment) goods is impacted negatively which helps accommodate the increased demand by the public sector without significant inflationary pressure. However, in reality, households are likely less Ricardian and more substantive increases in the price of nontradable goods may have occurred because of the increase in public demand.

Figure 9: Adding the Increase in U.K. Public Sector Demand for Nontradables

(percent or percentage point deviation from baseline)



D. Sterling Appreciation

The model could not be solved for a change in the risk premium on U.K. assets large enough to replicate the 1992–96 depreciation of sterling and its subsequent recovery in 1996–97, and therefore adding it to the simulation built up to this point was not possible. Consequently, results are presented for a risk premium shock that is roughly one-third of the size that would be required to replicate the historical behavior. The shock is implemented as an increase in the risk premium demanded on U.K. assets. The risk premium is increased sufficiently to result in roughly a 5 percent depreciation in the U.K. nominal and real effective exchange rates that lasts for five years. The shock is also implemented using the Kalman filter signal extraction framework, although here it is assumed that agents learn quickly about the persistence of the shock once it hits. The re-appreciation of the exchange rate that occurs after five years comes unexpectedly and for several years after the exchange has recovered, agents are surprised by its continued strength. Allowing expectations to evolve in this manner appears to be consistent with general expectations. For a period following the 1996–97 appreciation, forward markets tended to price in a depreciation and the Bank of England on several occasions commented on sterling’s “overvaluation” during this period, for example see Wadhvani (2000).

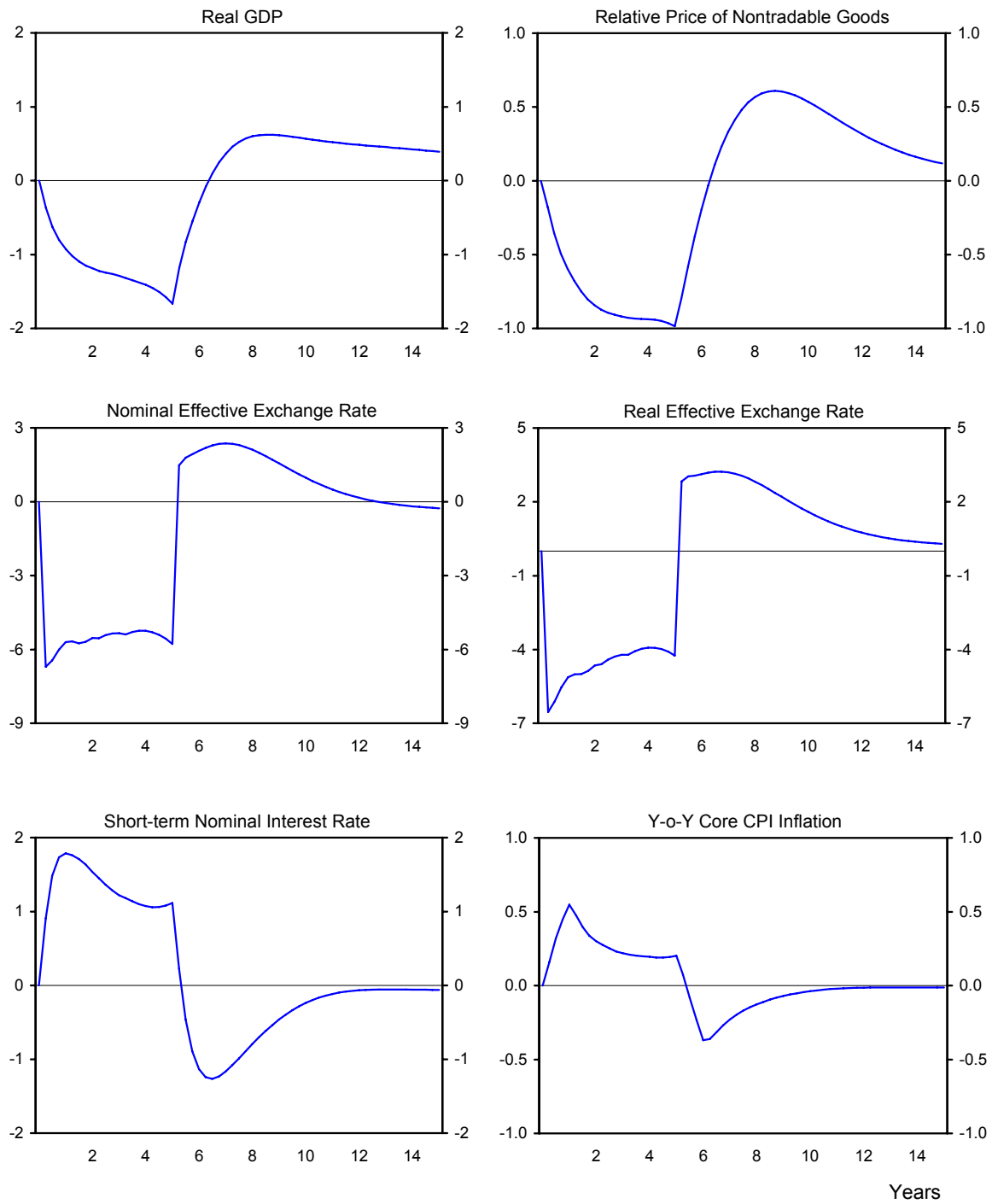
The simulation results suggest that the 1996–97 appreciation in the exchange rate could have made an important contribution to the evolution of relative prices over the last ten years. The adjustment paths for several key macro variables are presented in Figure 10. Although the shock is implemented as a disequilibrium phenomenon and so should be interpreted cautiously, it illustrates a number of useful points. The period of exchange rate depreciation is one of above baseline interest rates, above target inflation, weak output, and a declining relative price of services. Once the exchange rate recovers, these phenomenon reverse. Inflation pressures ease, output recovers, and interest rates fall below baseline. From their trough, the relative price of nontradables increase by just over 1 percent after ten years, although there is some overshooting along the way. Although the model is nonlinear, other work with GEM has shown that scaling up the shock-minus-control paths leads to reasonable approximations when very large shocks are not feasible to implement. Thus scaling the results accordingly and ignoring the overshooting, suggests that the 1996–97 appreciation could account for just over 3 percentage points of the increase in the relative price of nontradable goods.

E. Adding Improved Efficiency in U.K. Distribution

The available evidence provides support for the argument that increased efficiency in the distribution sector could have been an important factor underlying price developments. However, it cannot be used to explicitly quantify the magnitude of the efficiency gains to include in the simulation analysis. Consequently, the experiment is calibrated to be what is necessary, given the impact of the other shocks, to allow the model to replicate the increase

Figure 10: Sterling Appreciation

Percent or Percentage Point Deviation From Baseline



in the relative price of nontradables in the United Kingdom over the last ten years. Adding an estimate of just over 3 percentage points arising from the 1996–97 exchange rate appreciation to the simulation experiment built up to this point leaves just over 6 percentage points of the increase in the relative price of nontradables to be explained by improved distribution sector efficiency. An improvement of 15 percent, phased in over ten years, is sufficient to accomplish this. This experiment is also implemented assuming that agents must learn about the persistence of the shock. The speed of learning has been calibrated to be identical to that under the productivity increase.

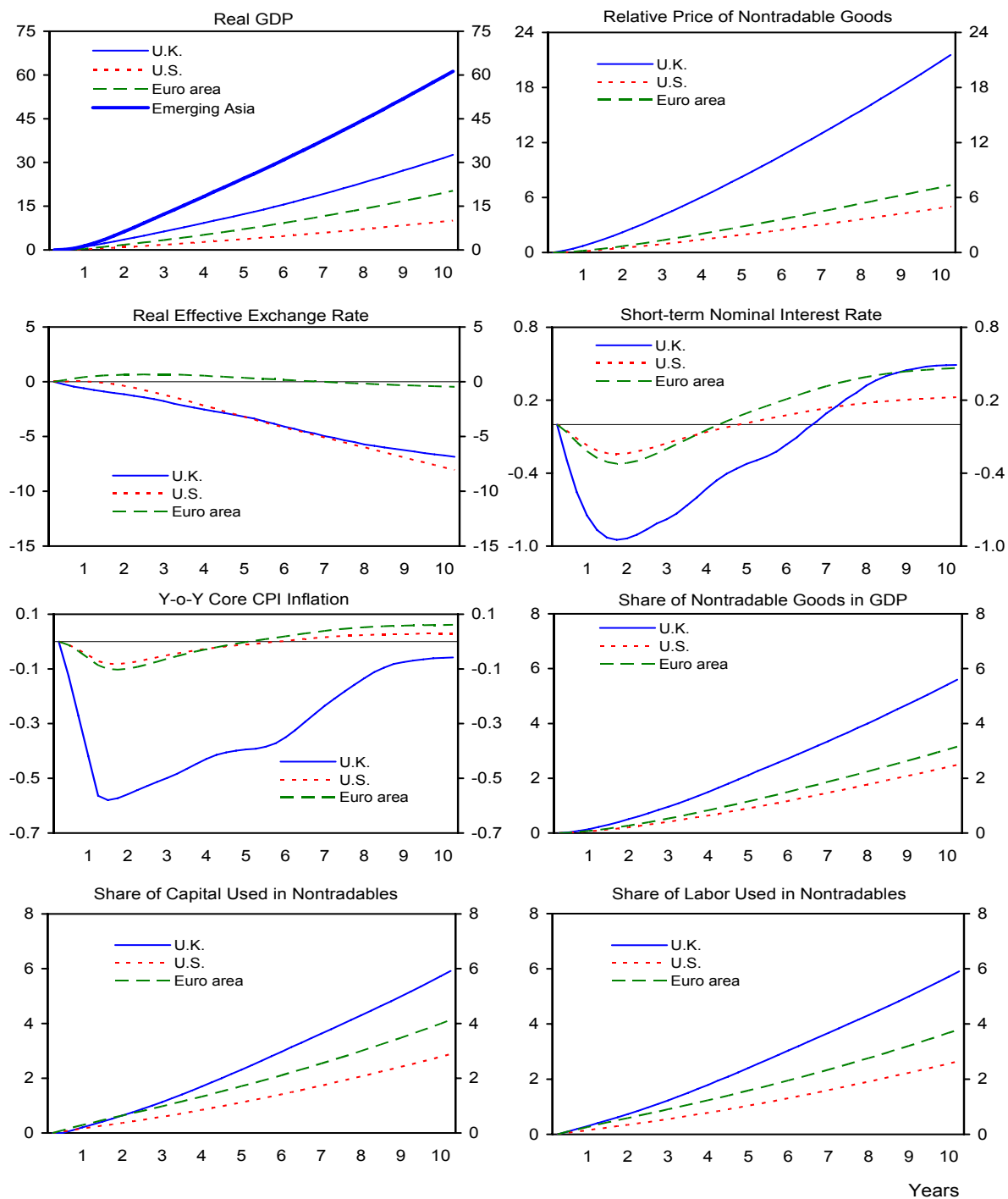
As can be seen in Figure 11, a 15 percent improvement in U.K. distribution efficiency has a significant impact on the evolution of relative service prices and inflation. Inflation falls considerably further below baseline, as efficiency gains have a large impact on inflation in tradable goods prices. This impact on CPI inflation is much larger than the impact of tradable sector productivity growth. This is because the upward pressure on relative nontradables prices arising from the wealth effect owing to slower inflation in tradable goods prices, is partially offset by the reduction in demand for nontradable goods in distribution. The net impact is an increase of roughly 6 percent in the relative price of nontradable goods. As was the case with the productivity shocks, as agents learn about the persistence in the efficiency gains, the downward pressure on inflation moderates.⁶

This final simulation experiment illustrates a number of additional points worth noting. First, the simulated increase in U.K. GDP suggests that these factors have accounted for a significant portion of U.K. growth over the last ten years. Forecasts of future sustainable growth should be mindful of the consequences of these factors possibly waning. The shift in the relative importance of tradables and nontradables in the U.K. economy over the last ten years is also well explained by the factors considered here. The simulated 5½ percentage point increase in the share of nontradables in U.K. GDP shown in Figure 11 is slightly above the 4 percentage point increase contained in the IMF’s CEGR database. However, if one includes the negative impact on the share of nontradables in GDP in the sterling appreciation simulation, which could not be added to this simulation, the net increase in the share of nontradables in GDP in the United Kingdom would be just under 4 percentage points, close to the increase in the data. The simulated increase in the share of nontradables in the United States of 2½ percentage points is slightly above the 2 percentage point increase in the data. However, the simulated increase of 3 percentage points in the Euro area does not match the 1 percentage decline in the data. Other factors not considered in these simulations must be driving this Euro area outcome.

⁶ Improvements in distribution efficiency likely also occurred in the United States over this period. Adding a U.S. distribution efficiency improvement would help the model more closely replicate U.S. relative services prices and thus the U.S.-Euro area gap. In addition, the strength the dollar exhibited over the last half of the 90s and early this decade, which is not incorporated in these simulations, would have also contributed to the rise in the U.S. relative price of services seen in the data.

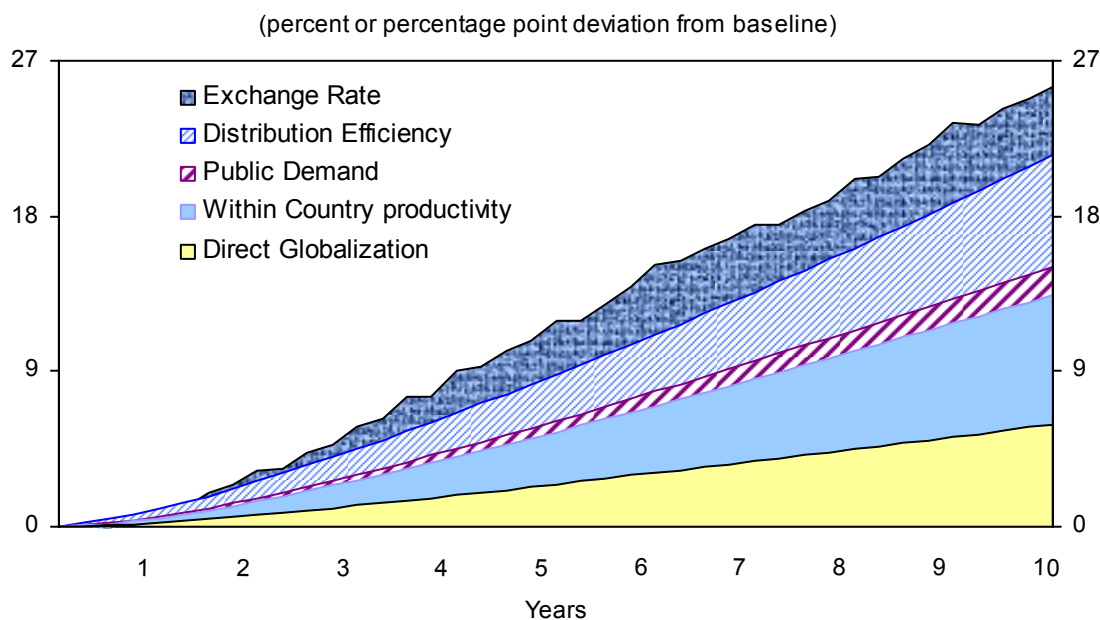
Figure 11: Adding Improved Efficiency in U.K. Distribution

(percent or percentage point deviation from baseline)



These simulation results suggest that globalization has had a larger impact on relative prices in the United Kingdom than in either the United States or the Euro area. However, U.K. specific factors also appear to be important in explaining the larger increase in the relative price of nontradables in the United Kingdom. The results suggest that the direct effect of globalization, the import of competitively priced tradable goods from emerging Asia, has increase the U.K. relative price of nontradables by 6 percentage points over the last ten years. This compares to just over 1 percentage point in the Euro area and the United States and accounts for roughly 25 percent of the increase in the relative price of U.K. nontradables seen in the data over the last ten years (Figure 12). The U.K. productivity gap between the tradables and nontradables sectors, which may also in part be arising from globalization pressures on tradable goods manufacturers, accounts for another 25 percent of the increase. The increased demand for nontradables by the U.K. public sector appears to account for just under 10 percent of the increase in the U.K. relative price of nontradables with the 1996–97 sterling appreciation accounting for just under 15 percent. An increase of 15 percent in distribution sector efficiency over the last ten years is sufficient to explain the remainder of the increase. Although the available empirical evidence cannot be used to verify an efficiency improvement of this magnitude, it does appear to be plausible.

Figure 12: The Contributions to the Increase in U.K. Nontradables Prices



V. CONCLUSIONS

Although the rising relative price of services has long been a feature of the economic landscape, the gap between inflation in goods and services prices has recently widened in industrial countries, and remarkably so in the United Kingdom. This paper uses a multi-sector New Open Economy Model to estimate the contribution of various factors to these developments. The results suggest that the original Baumol (1967) explanation of productivity growth in the goods sector exceeding that in the service sector has been an important factor driving this inflation differential. In addition, globalization has further extended this process as foreign productivity, particularly in emerging Asia, has made a considerable contribution. The differences in the results for the United Kingdom versus those for the United States and the Euro area illustrate how the impact on inflation and relative prices is a function of both size and openness. Faster productivity growth at home and abroad can be expected to have a larger impact on relative prices and inflation in smaller, more open economies. Another interesting result is that with preferences held constant, faster productivity growth in the tradable sector leads to an increase in the share of services in GDP. Although increased demand for services has been pointed to in the literature as an additional factor independent of faster tradable sector productivity growth, this result illustrates how the two can in fact be related.

In terms of the impact on U.K. relative prices, faster productivity growth, both foreign and domestic, accounts for roughly half of the 25 percent increase in the relative price of U.K. services over the last ten years. Other U.K. specific factors, such as sterling appreciation, increased public demand for services, and improved distribution sector efficiency account for the remainder. The results also illustrate that both faster tradable sector productivity growth and increased efficiency in the distribution sector can also influence overall inflation as well relative prices. Again because of its openness and relative size, faster productivity growth has had a larger impact on lowering inflation in the United Kingdom than in the United States or the Euro Area. However, improved distribution sector efficiency appears to have been more important in dampening U.K. inflation than faster tradable sector productivity growth. Further, expectations of the underlying persistence in both processes play an important role in determining the extent of the resulting disinflation pressure. As agents learn more about the underlying persistence and are able to generate better forecast of the future evolution of these processes, the disinflation pressures dissipate.

These simulations results suggest a number of relevant points for U.K. policymakers. First, even if faster tradable sector productivity growth and efficiency gains in the distribution sector continue for an extended period of time, the resulting disinflation pressures are likely to be more limited in the future if households start to fully anticipate them. The monetary authority will need to bear this in mind when generating the inflation forecasts that serve as the basis for policy settings. A closely connected point is the monetary authority's estimate of the neutral policy rate. These simulations suggest that over the last decade, there have been several factors that have dampened inflationary pressures and allowed interest rates to

be notably lower than they otherwise would have been. Consequently, using historical averages of interest rates as a guide to their neutral level could be misleading. Finally, faster emerging Asia productivity growth and distribution sector efficiency gains appear to have accounted for a significant portion of the United Kingdom's growth over the last ten years. The waning of these processes will have important implications for the U.K.'s sustainable rate of growth, and policymakers will need to factor this into their future assessments of risks surrounding their macroeconomic outlooks.

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