

## **United Kingdom: Selected Issues**

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UNITED KINGDOM

**Selected Issues**

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Approved by the European Department

February 14, 2007

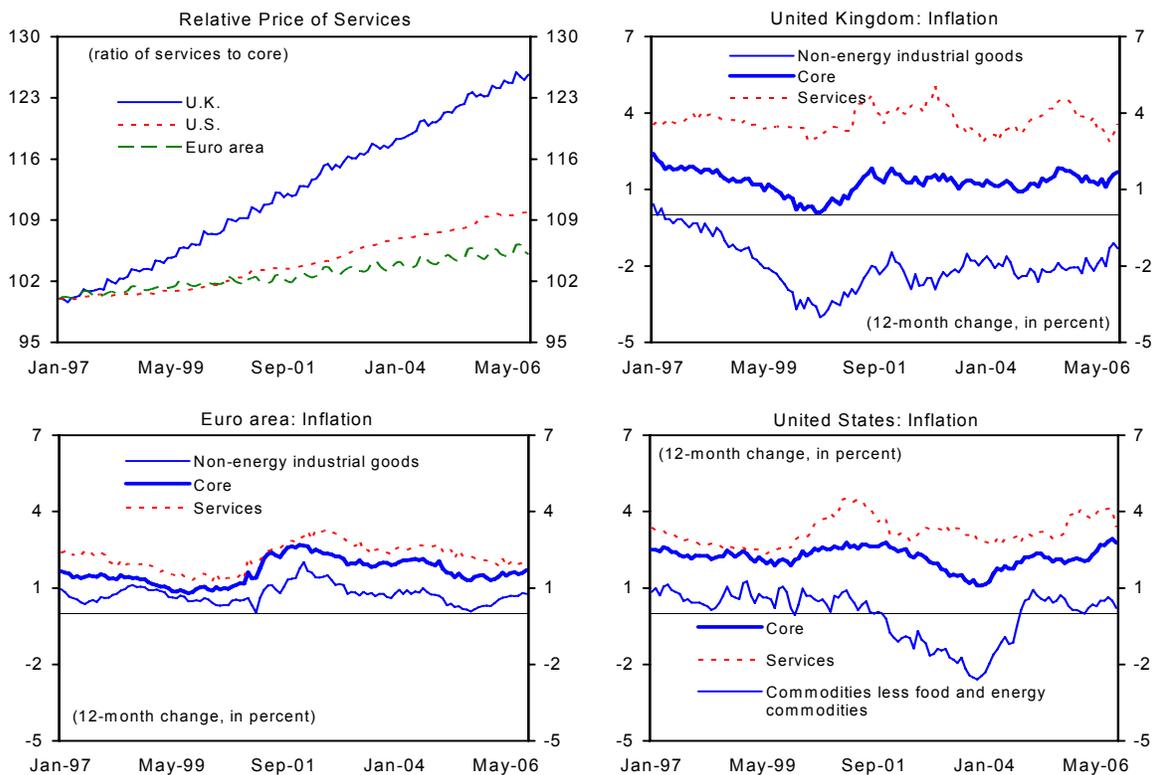
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# I. U.K. INFLATION AND RELATIVE PRICES OVER THE LAST DECADE: HOW IMPORTANT WAS GLOBALIZATION<sup>1</sup>

## A. Introduction

1. **Although inflation in the United Kingdom, the Euro area and the United States has been low and stable over the last decade, there has been an interesting difference in the composition of inflation.** While goods price inflation has generally been below service price inflation in all three, in the United Kingdom, this has been significantly more pronounced with goods price deflation offsetting strong and fairly stable inflation in services prices. This feature is even more notable if one focuses on core inflation and core goods prices (Figure 1). The net effect has been that the relative price of services has increased significantly more in the United Kingdom than in either the United States or the Euro area.

Figure 1. Inflation Stylized Facts



2. **The IMF's Global Economy Model (GEM) is used to estimate the relative importance of the various factors argued to have influenced the evolution of inflation and relative prices over this period.** A four-country/region version of GEM is used (see

<sup>1</sup> Prepared by Ben Hunt. A more detailed version of this paper is forthcoming as an IMF Working Paper.

Laxton and Pesenti (2003) and Hunt (2005) for detailed descriptions of GEM's structure and dynamic adjustment properties). The model is calibrated to represent the United Kingdom, the United States, the Euro area and emerging Asia. The factors considered include: an increase in tradable goods productivity growth in emerging Asia (the direct effect of globalization); an industrial country productivity growth differential between the tradable and nontradable sectors; an increase in U.K. tradable goods distribution efficiency; a permanent increase in the U.K. real effective exchange rate; and a permanent increase in the U.K.'s public sector consumption of nontradable goods.

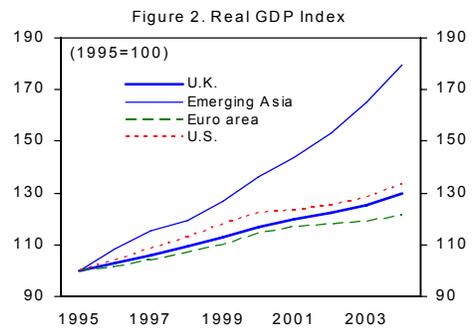
## B. Direct Effect of Globalization

### 3. This shock experiment has been calibrated to match two aspects of the recent historical period.

- The first is the relative 50 percent increase in the level of emerging Asia's GDP (Figure 2) with the driver of that growth differential concentrated in the tradable sector (Table 1).

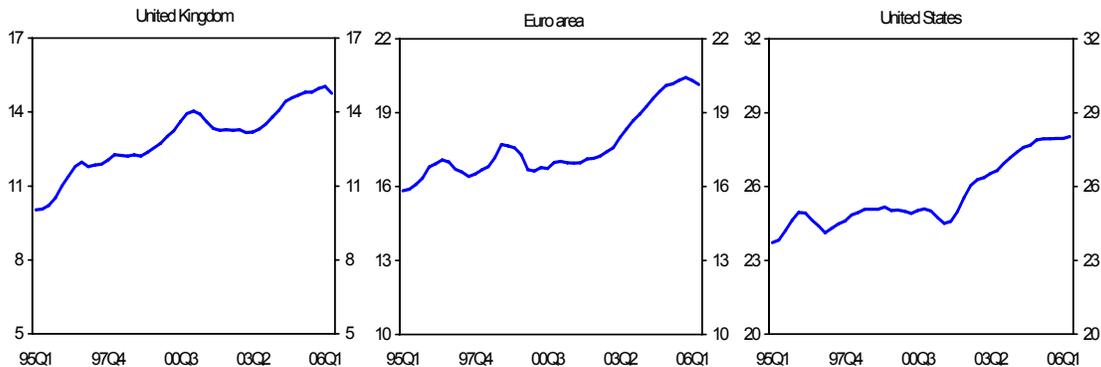
Table 1: Average Annual Labor Productivity Growth, 1995 to 2004

	U. K.	U. S.	Euro Area	Emerging Asia
Tradables	2.93	3.50	2.99	6.46
Nontradables	1.54	1.99	0.19	2.59



- The second is the approximately 5 percentage point increase in the share of goods from emerging Asia in industrial countries' imports (Figure 3).

Figure 3. Share of Imports from Emerging Asia (as a percent of total imports)

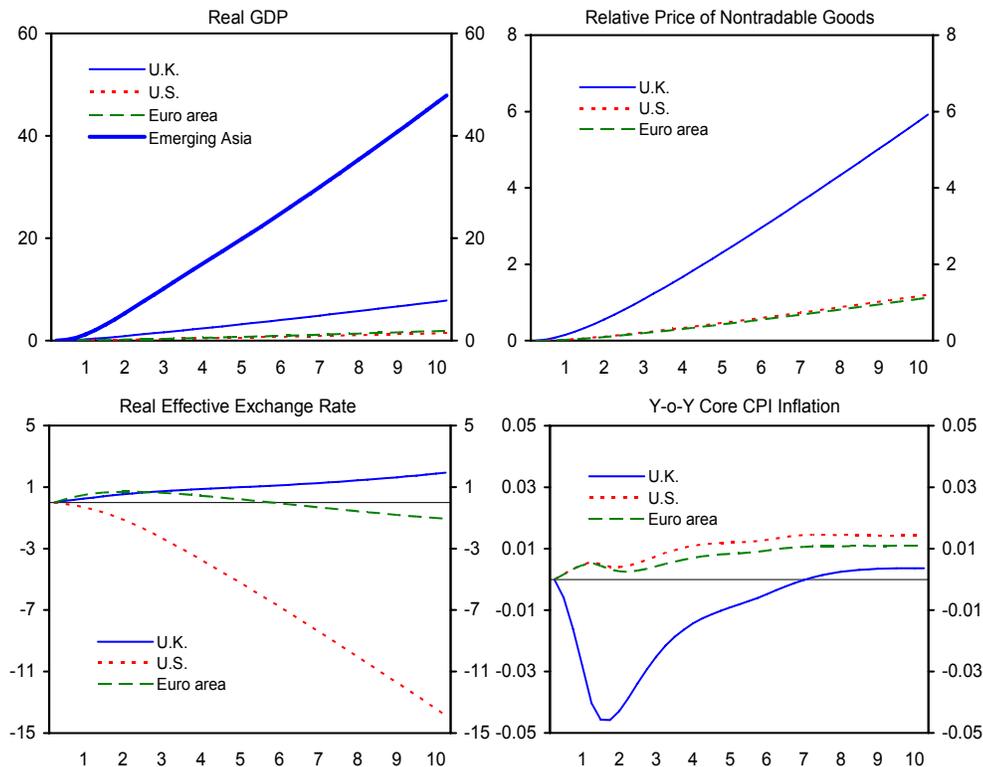


Sources: Eurostat and Direction of Trade Statistics.

4. **The shock is implemented assuming that people must learn about its persistence.** When agents have perfect foresight under long-lived shocks that have significant implications for wealth, rational expectations models, like GEM, can produce adjustment dynamics unlike that seen in actual data (see Hunt and Rebucci (2006)). To address this and generate closer-to-real-world adjustment dynamics, the shock is implemented assuming that each period, agents must generate forecasts of the shocks' persistence. In this shock, the learning is calibrated so that agents initially learn slowly about the persistence. However, as the duration of the shock increases, agents start to learn more quickly.

5. **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 a number of key macro variables are presented in Figure 4. The first point to note is that the level of emerging Asia's GDP increases by roughly 50 percent over ten years. The U.K. relative price of nontradables increases by roughly 6 percent 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

Figure 4. An Increase in Tradable Sector Productivity Growth in Emerging Asia  
(percent or percentage point deviation from baseline)



depreciate.<sup>2</sup> The appreciation in the U.K. effective exchange rate exerts 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. Similarly, the shock results in more downward pressure on core CPI inflation in the United Kingdom because of 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. This reflects the fact that agents eventually learn about the persistence of the productivity increase in emerging Asia and the implications for the future prices of imported tradables. The consequent implications for lifetime wealth leads households to increase current consumption, eventually generating mild excess demand.

### C. Including the Additional Factors

6. **Although globalization has had a considerably larger impact in the United Kingdom, it explains only a portion of the different inflation performance.** The simulation results from the previous section suggest that the direct effect of globalization can explain about 25 percent of the increase in the relative price of nontradable goods in the United Kingdom over the last ten years. Adding the remaining factors cited as important for driving relative price and inflation developments over the last decade helps explain the remainder. These factors include:

- the within-country productivity differential between the tradable and nontradable sectors (Table 1);
- a 15 percent improvement in distribution efficiency in the United Kingdom phased in over 10 years;
- an increase, over 10 years, in U.K. public demand for nontradable goods matching the observed 4 percentage points increase in the U.K. public expenditure-to-GDP ratio;

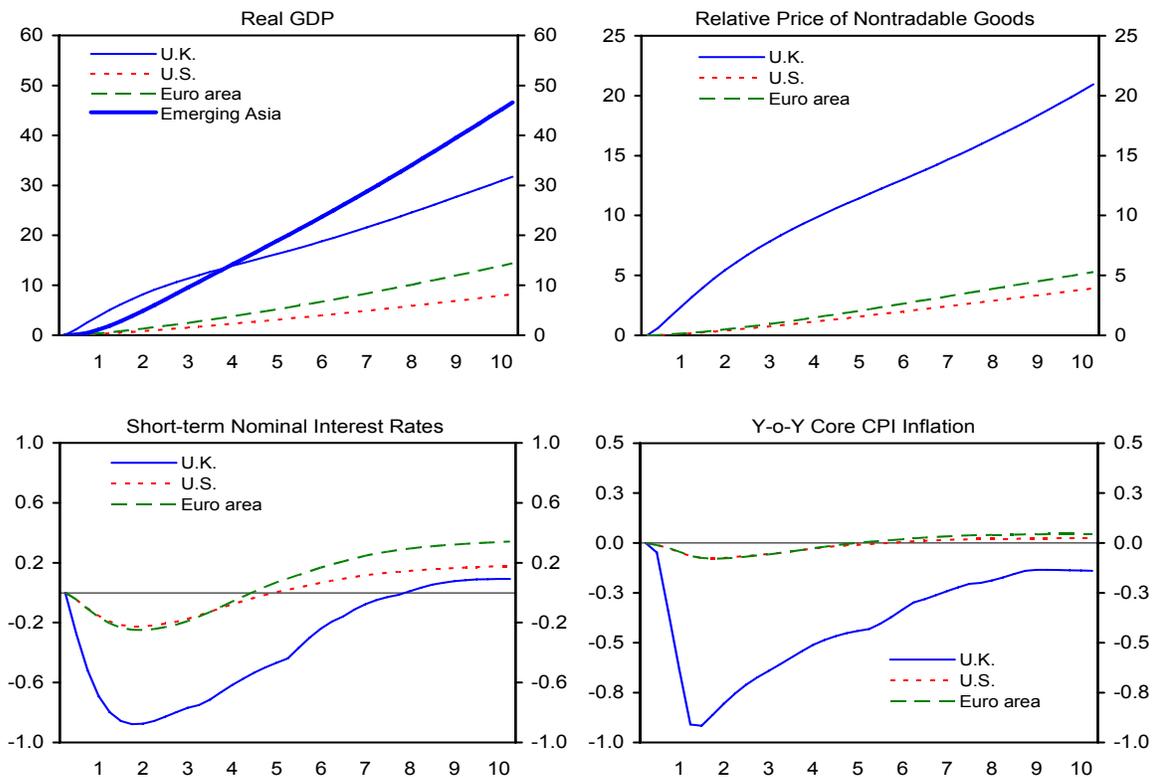
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<sup>2</sup> The appreciation of the U.K. real effective exchange rate reflects the absolute levels of trade from emerging Asia. Although as a percent of GDP, imports from emerging Asia are larger in the United Kingdom than in either the United States or the Euro area, the levels of imports from emerging Asia are significantly larger in the United States and the Euro area. Consequently, to ensure that current accounts are sustainable in the long run, emerging Asian currencies must appreciate more relative to the dollar and the Euro than the pound. The pound, although it also depreciates 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.

- an appreciation of the U.K. real effective exchange rate similar to that seen over the 1996-97 period;<sup>3</sup> and
- to capture uncertainty, the shocks are again implemented assuming that agents must form forecasts of the shocks' persistence. For all but the exchange rate shock, agents learn slowly.

7. **These shocks combined go a long way toward explaining several key stylized facts.** In the combined simulation, the relative price of nontradables in the U.K. rises by just over 80 percent of the observed increase. 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. The simulated 4.1 percentage point increase in the share of nontradables in U.K. GDP (not shown) matches the 4 percentage point increase in the data.

Figure 5. Combined Experiment  
(percent or percentage point deviation from baseline)



<sup>3</sup> To construct these charts, the impact of a smaller exchange rate appreciation than seen historically was scaled up and added to the simulation combining all the other factors. This was necessary since it was not possible to solve the model with an exchange rate appreciation shock as large as occurred historically.

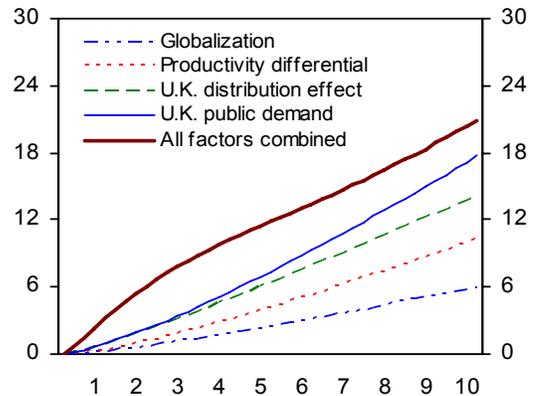
8. **The simulation results suggest that although globalization accounts for an important part of the increase in U.K. relative service prices and the moderation in core inflation, U.K. specific factors also played a significant role.** The direct effect from

competitively priced imports from emerging Asia is estimated to account for approximately 25 percent of the increase in the relative price of services. The within U.K. productivity gap between the tradable and nontradable sectors and increased efficiency in the U.K.

distribution sector account for roughly another 35 percent. The increase in public sector demand for nontradable goods is estimated to account for just under 10 percent and just over 10 percent is estimated to arise from the 1996-

97 increase in the U.K. real effective exchange rate. Overall the model and the shocks considered do a reasonable job of explaining why relative service prices have evolved differently in the United Kingdom. Because of its relative size and openness, globalization has had a larger impact in the United Kingdom, but other factors are also important to understand the behavior of inflation and relative prices.

Figure 6. U.K. Relative Price of Nontradables



#### D. Conclusions

9. **Looking ahead, policymakers need to recognize of how the key factors that have driven inflation over the last decade may evolve.** First, these factors have exerted considerable downward pressure on inflation which the simulation results suggest allowed the policy interest rate to be on average notably below the neutral rate. Should these factors wane, the average policy rate over the past decade may not provide a reliable guide to judge the degree of tightness in monetary policy. Second, even if productivity catch-up in emerging Asia and efficiency gains in U.K. distribution are processes that will continue for some time, these simulation results also suggest reasons for caution. As agents learn about the persistence in these processes, the downward pressure on core CPI inflation starts to dissipate. This occurs because households current consumption starts to become more influenced by their expected future real income gains arising from more competitively priced tradable goods. The resulting demand pressures may start to diminish the downward impact that these factors have on overall inflation. The monetary authority will need to be cognizant of this risk.

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## II. THE MACROECONOMIC EFFECTS OF IMMIGRATION IN THE U.K.<sup>1</sup>

### A. Introduction

1. **The United Kingdom was one of the first countries to allow the new EU members immediate access to its labor markets after their accession in May 2004.**<sup>2</sup> The transitional arrangements set out in the Accession Treaty allow countries to choose to limit free labor movement for a period of up to 7 years, with reviews of the policy after the second and fifth years. Only Ireland, the U.K., and Sweden chose not to impose restrictions in 2004. In the summer of 2006, Greece, Portugal, Finland, and Spain also decided to lift all restrictions for the ten accession countries, and six other member states adopted a more liberal policy. The U.K. will also accept workers from Bulgaria and Romania starting in 2007, although subject to tight quantity restrictions.

2. **Although the existing statistics are imperfect, they suggest that a substantial number of workers from the new member states have arrived in the U.K. since May 2004.** Data sources on immigration include the International Passenger Survey, the Worker Registration Scheme, and the Labor Force Survey.

- The International Passenger Survey (IPS), the official data source on migration, counts as immigrants those who state an intention to reside in the U.K. for at least a year upon entering the country. Based on that, the net flow of immigrants from the eight accession countries (A8) was 49,000 in 2004, and 64,000 in 2005. The survey is voluntary and covers a very small sample of all passengers. It does not capture people who change their intentions once in the country, even though it attempts to adjust for that error. Overall, the survey is likely to understate net A8 migration.
- All employees from the eight accession countries are required to register under a Worker Registration Scheme (WRS). Between May 2004 and September 2006, 510,000 people have registered, equivalent to an annual increase of approximately 0.7 percent of the labor force. The WRS is the most frequently cited data source, however it is subject to two major caveats. First, it measures only the gross inflow of workers. There is no de-registration requirement, so people who work in the U.K. for a short time and then return to their country would still be counted in the statistics. Second, the self-employed are not required to register in the WRS.

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<sup>1</sup> Prepared by Dora Iakova. A more detailed version of this paper is forthcoming as an IMF Working Paper.

<sup>2</sup> Citizens of Cyprus and Malta were allowed to work in the U.K. prior to 2004, so the change in the regime applied only to the remaining eight accession countries (Estonia, Czech Republic, Hungary, Poland, Lithuania, Latvia, Slovenia, and Slovakia). They will be referred to as A8 in the rest of the text.

- The Labor Force Survey (LFS) provides an estimate of the stock of A8 migrants. Based on that measure, between May 2004 and September 2006, the stock of A8 migrants increased by about 265,000 (Blanchflower et al, Table E), equivalent to an annual inflow of about 0.35 percent of the labor force. However, only households residing at their current address for at least six months are covered by the survey, so recent migrants and most temporary workers are excluded.

3. **Discussions of the macroeconomic effects of immigration have become a focus of policy and media attention, following this surge in labor flows.** The effects on growth, wages, and unemployment are widely debated, even though the existing empirical evidence is still scarce. Riley and Weale (2006) estimate that the inflow of workers from the new member states in 2004 and 2005 has contributed 0.2 percent to GDP growth. Using regional data, Gilpin et al. (2006) and Blanchflower et al. (2007) find that immigration is not related to the rise in unemployment in 2005/06.

4. **The existing theoretical and empirical literature on immigration is based almost exclusively on partial equilibrium, static models.**<sup>3</sup> These models, at best, provide guidance only to the expected short run effects on the labor market. Static analysis predicts that an increase in one factor of production reduces its relative price, therefore wages would fall after an increase in labor supply (or unemployment would rise in the presence of wage rigidities). Since accession-related migration is a truly exogenous shock to labor supply, mild initial downward pressure on wages might appear. However, open economies adjust dynamically, and the long-term effects on the labor market are likely to differ from the short-term effects.

5. **Using a general equilibrium dynamic model, this paper explores the likely evolution of the economy after a rise in immigration.** The model has an overlapping-generations structure, calibrated to reflect the demographic profile of the United Kingdom. The following questions are addressed. What is the impact of immigration on economic growth, capital accumulation, consumption, and the current account? Do the short-term macroeconomic effects of an immigration shock differ from the long-run effects?

## B. Description of the Model

6. **The analysis is based on Multimod—a dynamic general equilibrium model with demographic features.**<sup>4</sup> Consumers are assumed to have a finite planning horizon, which affects their consumption/savings decisions. The production function is of the simple Cobb-

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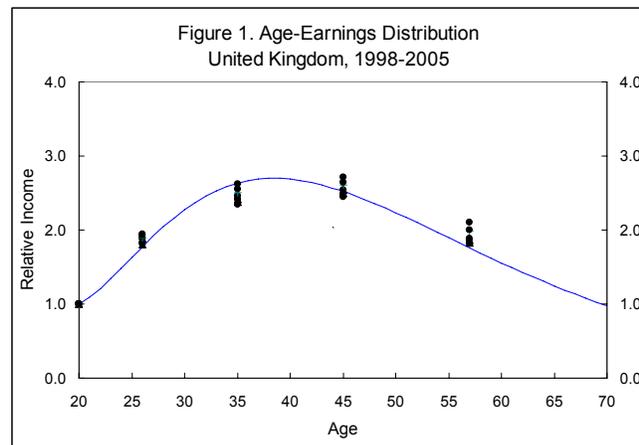
<sup>3</sup> A recent exception is Barrell et al. (2006). That study uses a general equilibrium macroeconomic model to illustrate the effects of changing net migration on output and unemployment in the U.K. and Germany.

<sup>4</sup> See Laxton et al. (1998) for a description of Multimod. Faruqee and Laxton (2000) and Faruqee (2002) contain a detailed discussion of the demographics features of the model.

Douglas type, with capital and homogeneous labor as the factors of production. Investment behavior is based on the Tobin's Q-theory—investment growth accelerates when the expected marginal product of capital is greater than its cost. Perfect capital markets are assumed, allowing firms to borrow freely at the world interest rate. An endogenous tax rate ensures that the ratio of government debt to GDP converges to a target level.

7. **Demographic developments affect both the supply and the demand sides of the economy.** On the supply side, earnings are presumed to be a good indicator of changes in relative productivity and labor supply that occur over an individual's working life. The pattern of earnings over time is hump-shaped—as workers accumulate experience, their productivity and earnings increase. After peaking in middle age, earnings gradually decline into retirement. The rate of participation in the labor market follows a similar pattern. Changes in the age structure of the population will thus affect the effective labor supply. On the demand side, individuals are assumed to smooth consumption based on their anticipated life-cycle income. Younger individuals tend to be net borrowers, since their current income is below their permanent income. Middle-age individuals, whose relative earnings are at their peak, save for retirement. Therefore, changes in the age profile of the population will also have an impact on aggregate consumption and savings.

8. **The baseline scenario is calibrated to reflect broadly the main features of the UK economy.** The age-earnings profiles for the U.K. are presented in Figure 1. They are estimated using data on actual hourly earnings from the Annual Survey of Hours and Earnings for the period 1998–2005. An exponential function is fitted through the age-earnings profiles to approximate the time-series pattern of a person's lifetime earnings. The earnings are adjusted for the labor force participation rates of the different age cohorts (obtained from the Labor Force Survey), and normalized relative to the per capita earnings of the youngest cohort. The earnings profile thus represents the average earnings per person (not per worker) within each age category. All other parameters of the model have been set to match the respective U.K. values: the labor share of output is 69 percent, the steady state capital-output ratio is 2.3, total factor productivity growth is 1.3 percent, and the long-run real interest rate is assumed to be 4 percent. Since the results are presented in deviations from the baseline, they are quite robust to changes in the calibration parameters.



9. **An immigration shock is introduced into the model as an increase in the number of young workers in the economy.** This is based on existing empirical evidence for

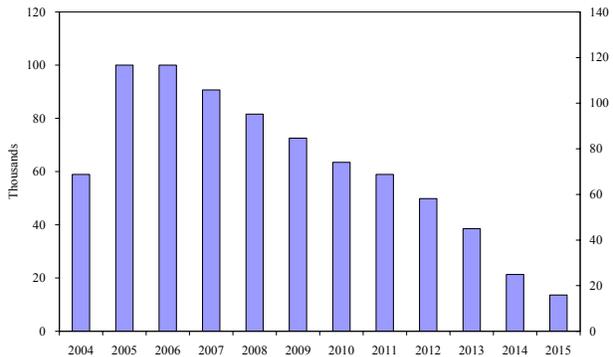
the U.K. and Ireland, which suggests that more than 80 percent of the new A8 immigrants are between 18 and 34 years of age, and practically all are employed. Based on the latest Home Office Accession Monitoring Report (November 2006), 43 percent of all WRS applicants were aged between 18 and 24, and further 39 percent were between 25 and 34. Virtually all are working – 98 percent of applications for National Insurance Numbers made by accession country nationals in the two years after accession were for employment purposes.<sup>5</sup>

**10. The size of the immigration shock is chosen to broadly match the recent U.K. experience and academic estimates of the total migration potential from the new member countries.**

Specifically, it is assumed that 100,000 young workers from the new member states entered permanently the U.K. labor market in 2005 and 2006 respectively.<sup>6</sup> A gradual reduction in net migration is assumed over the next ten years as other countries open their labor markets and the number of potential immigrants declines (see Figure 2). Estimates of both actual and potential migration are highly uncertain,

so this scenario should be taken only as an illustration and should not be interpreted as a forecast or a judgment on the actual migration flows.

Figure 2. Assumed Net Migration



### C. Simulations

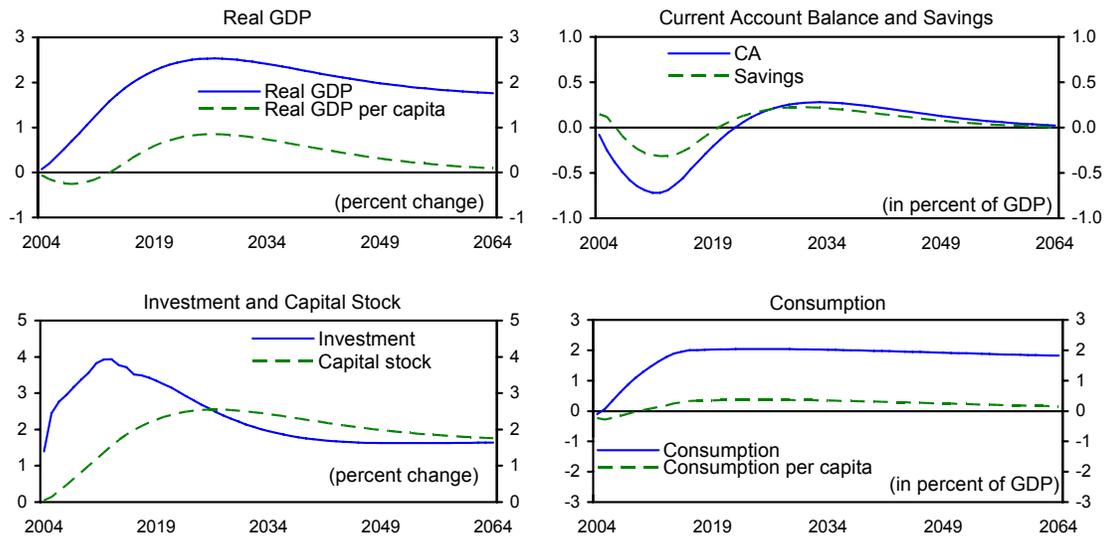
**11. The immigration shock is modeled as an exogenous increase of the number of young workers.**<sup>7</sup> The simulations are performed in two steps. First, a current population projections scenario is estimated (based on the 2004 Government Actuary Department population projections). Next, an immigration shock is introduced and the results are compared to the baseline simulation. The results are presented in Figure 3 (expressed in percentage point deviations from the no-immigration baseline).

<sup>5</sup> To prevent “welfare tourism”, the U.K. has restricted access to social benefits for new A8 immigrants during the first year of employment. That probably accounts for the fact that practically all immigrants hold jobs and the percentage on welfare is much smaller than that of the native population.

<sup>6</sup> The assumed historical net migration is broadly based on the LFS statistics. The assumptions are made purely for illustrative purposes and do not represent a judgment on the actual net inflow.

<sup>7</sup> It is appropriate to make this assumption here since A8 migration represents a truly exogenous shock, and its magnitude was largely unanticipated. Net migration from other countries is relatively steady and predictable, and is incorporated into the population and labor force projections made by the Office of National Statistics.

Figure 3. Macroeconomic Effects of Immigration  
(Deviations from a no-immigration baseline level)



12. **Immigration boosts investment growth.** Following a positive labor supply shock, the marginal product of capital goes up, while the marginal product of labor (and real wages) decline. That induces accumulation of capital to the point where its marginal product and marginal cost (determined by the world interest rate) are equalized. As capital increases, the marginal product of labor increases, reversing the initial downward pressure on real wages. In steady state, wage growth would be the same as before the immigration shock (assuming constant productivity).

13. **Both total and per capita output and consumption increase in the medium term.** Total output and consumption are higher at all horizons as the number of workers increases permanently. Per capita output declines for the first few years as the young immigrants are initially less productive than the average person (remember the hump-shaped profile of the age-earnings distribution).<sup>8</sup> As they accumulate experience, productivity increases (above that of the average worker), raising per capita output and. In the long run, per capita real GDP and consumption return to baseline.

14. **The current account initially deteriorates and then improves relative to the baseline.** The deterioration in the initial years mainly reflects the rise in investment. The tendency of young workers to be net borrowers (or, in the case of immigrants, to send

<sup>8</sup> This result assumes that the new immigrants have the same labor participation profile, and the same productivity as an average person of that age. In fact, immigrants may have higher labor participation rate (at least initially). Taking this into account could reduce the magnitude of the initial mild decline in per capita output. However, it is reasonable to assume that, over time, the labor force participation rate of the immigrants will converge to that of the native population (that has been true for the older immigrant cohorts, see Salt and Millar (2006)).

remittances abroad) also contributes to the deterioration of the current account. Later, when immigrants reach the peak of their earnings potential, they save a substantial share of their earnings. That accounts for the improvement of the current account in the medium term. As the A8 workers reach retirement age and start consuming their saved assets, the current account returns to its initial value.

15. **The results are sensitive to some of the assumptions in the model.** *First*, immigrants are assumed to have exactly the same skill distribution and productivity as the native workers. While this is broadly true for the stock of immigrants in the U.K. (see Salt and Millar, 2006), the sectoral distribution of immigrants from the new member states suggest that they may be less skilled than the average worker. That would reduce the estimated effects. *Second*, the model assumes perfect flexibility in the labor and goods markets: there is no unemployment and economic output is continuously at potential. Relaxation of these assumptions could influence the adjustment dynamics. For example, the minimum wage sets a floor on the adjustment of real wages in some unskilled occupations. That could lead to a temporary rise in unemployment. *Third*, the production function is assumed to be Cobb-Douglas. Changing the form of the production function (for example allowing for worker complementarity)<sup>9</sup> could produce higher positive effects. *Finally*, the magnitude of the macroeconomics effects are proportional to assumed size of the migration shock: if the model is extended to include a fixed factor of production (land), the effects would vary with the size of the shock.

#### D. Conclusions

16. **The results of this analysis suggest that the macroeconomic effects of an immigration shock are broadly favorable.** Both total and per capita output and consumption increase in the medium term (as immigrants become more productive and investment growth accelerates). The current account initially deteriorates, but gradually improves relative to the no-immigration baseline. Any downward pressure on wage growth would be only temporary. As capital accumulates to meet the needs of the new workers, wages would grow in line with the rising marginal productivity of labor.

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<sup>9</sup> Both academic studies and the press often suggest that immigrants take jobs that are not attractive for the locals (or would not even exist if it was not for the immigrants). That increases the efficiency of the labor market and may induce an increase in the labor force participation of the local workers. That effect could be modeled as labor complementarity in the production function. Borjas (2001) suggests another channel through which immigrants may improve economic efficiency—by locating in regions with the highest marginal product of labor.

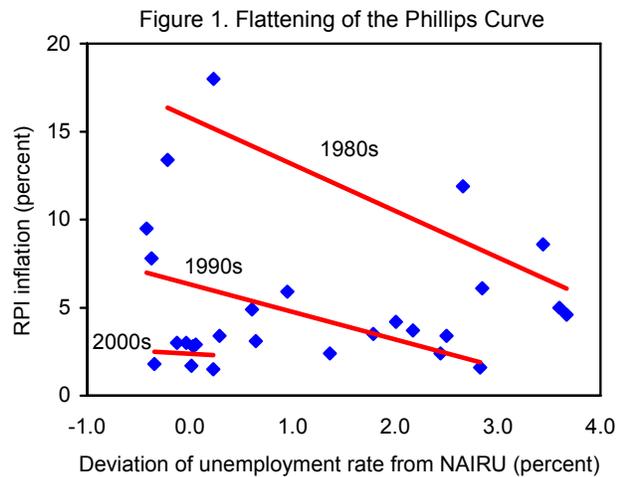
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### III. FLATTENING OF THE PHILLIPS CURVE: IMPLICATIONS FOR MONETARY POLICY<sup>1</sup>

#### A. Introduction

1. **Globalization is widely seen as one of the forces behind the weakening link between inflation and measures of economic slack in the UK.** Since the early 1990s, inflation in the UK has remained low and steady, and its correlation with measures of economic slack has weakened (the link between these variables is often referred to as “the short-run Phillips curve,” Figure 1). Flattening of the Phillips curve has been observed in other industrial countries as well and has been attributed, in part, to globalization forces.<sup>2</sup> Due to increased competition from abroad, businesses have less scope to raise prices when demand rises. Increased trade and investment flows have made goods prices less sensitive to domestic demand pressures. Indeed, goods price inflation has borne very little relationship to estimates of demand pressures in the UK over the last decade. More recently, labor mobility has also increased. This could lead to further flattening of the Phillips curve if it results in declining sensitivity of service sector wages and prices to demand shifts.



2. **What are implications of a flattening of the Phillips curve for monetary policy?** On one hand, the reduced sensitivity of inflation to demand shocks makes the central bankers’ job easier, since they need to worry less about temporary imbalances between demand and supply. On the other hand, responding to inflation shocks becomes more difficult - the central bank needs to move interest rates and aggregate demand more to bring inflation back to target. This paper will explore how the flattening of the Phillips curve affects the optimal monetary policy response to shocks.

<sup>1</sup> Prepared by Dora Iakova. A more detailed version of this paper is forthcoming as an IMF Working Paper.

<sup>2</sup> Borio and Filardo (2006), and Mody and Ohnsorge (2006) provide empirical cross-country evidence for globalization-related flattening of the Phillips curve. Over the last few months, the issue has come up in numerous speeches by monetary policymakers, including Charles Bean, Donald Kohn (Boston Fed Governor), and Lucas Papademos (ECB Vice President).

## B. Analytical Approach

3. **The analysis is conducted using a small macroeconomic model with rational expectations, which captures the key channels of monetary policy transmission.** The behavioral equations for the UK consist of an output gap equation, an inflation equation (expectations-augmented Phillips curve), an interest-parity exchange rate relationship, and a monetary policy response function (an instrumental rule which relates the nominal interest rate to the expected deviation of inflation from target and the output gap). A full description of the model is presented in Berg et al. (2006). The UK is treated as a small open economy, with a foreign sector comprising of a weighted average of the euro area and the United States. The foreign sector is described by equations for the output gap, inflation, and the monetary policy reaction function. The models' parameter values are estimated from quarterly data over the period 1993 to 2005, using a Bayesian approach (Geweke, 1999).
4. **To consider the implications of a change in the sensitivity of inflation to domestic demand pressures, two versions of the model are employed.** The first version uses the estimated parameter values (the parameter on the output gap in the Phillips curve is 0.3). In the alternative version, the coefficient on the output gap in the Phillips curve is reduced to 0.1 (implying less responsiveness of inflation to domestic demand pressures), with the rest of the model unchanged.
5. **The dynamic adjustment of key macro variables after various shocks differs significantly under the two models.** Demand shocks have much smaller effect on inflation under a flat Phillips curve. Therefore, interest rates need to move very little. The weak policy response makes the demand shock more persistent (the output gap volatility increases). Shocks to inflation cause greater volatility in both inflation and output, since unwinding the effect of such shocks requires more aggressive movement of interest rates and domestic demand. In the next section, this intuition is formalized (by presenting the efficient policy frontiers), and the interest rate rules that best match the policymakers' preferences over inflation and output gap variability are derived for both models.

## C. Optimized Monetary Policy Response Rules

6. **Stochastic simulations are used to derive the best achievable combinations of inflation and output gap variability for each state of the economy.** The efficient policy frontier (which traces the lowest possible combinations of inflation and output gap variability) is constructed by estimating the monetary policy reaction function that minimizes the policymakers' objective function (1) for different values of the preference parameters over inflation and output gap variability ( $\lambda_\pi / \lambda_y$ ).

$$L = \sum_{t=0}^{\infty} [\lambda_\pi \cdot (\pi_t - \pi^T)^2 + \lambda_y \cdot (ygap_t)^2 + \lambda_r (rs_t - rs_{t-1})^2] \quad (1)$$

The monetary policy reaction function in this analysis is restricted to a simple interest rate rule: the nominal interest rate is a function of the lagged interest rate, the deviation of expected inflation from target, and the output gap. Rules of that type deliver outcomes that closely approximate the fully optimal monetary policy response.

7. **The achievable combinations of inflation and output variability are less favorable when the Phillips curve is flatter** (Figure 2). The central bank needs to generate greater volatility in the real economy to achieve any desired level of inflation variability (and vice versa). The choice of location along the frontier depends on the specific policy preferences. The coefficients in the optimized rules for several typical specifications of policy preferences are shown in Table 1. The preferences considered are equal distaste for inflation and output variability, increasingly greater distaste for inflation variability, and increasingly greater distaste for output variability. In practice all central banks, including those with inflation targeting regimes, care to some extent about variability in the real economy, so the coefficient on the output gap is always greater than zero (Bernanke, 2003). A fixed weight is assigned to the variability of interest rates in all scenarios.

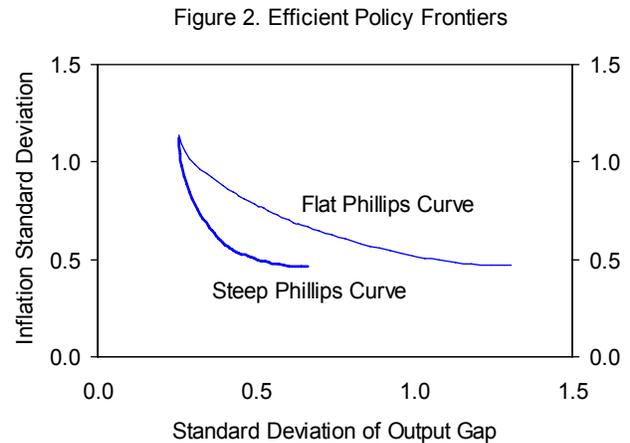


Table 1. Optimized Response Rule Coefficients

Distaste for the Variability of:		Steep Phillips Curve		Flat Phillips Curve	
Inflation	Output Gap	Inflation	Output Gap	Inflation	Output Gap
Medium	Very Strong	4	5.5	2	6
Medium	Strong	4	4.5	2.5	5
Medium	Medium	4.5	3	3	3.5
Strong	Medium	6.5	3	5	3.5
Very Strong	Medium	8	2.5	6.5	3

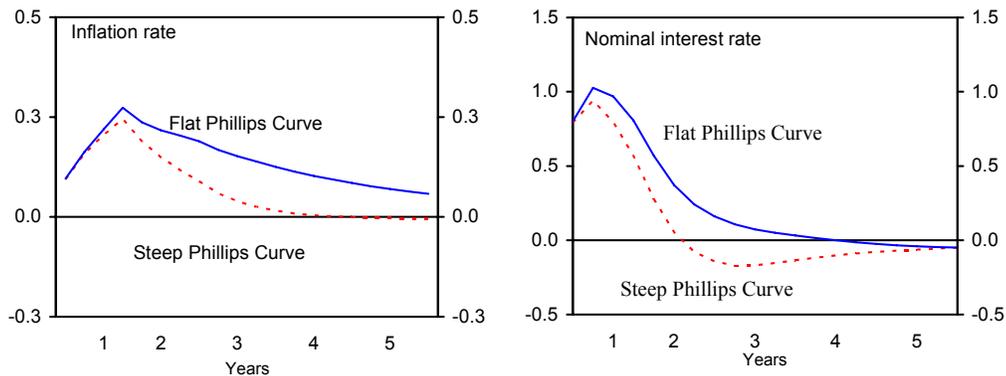
Note: The first two columns specify the preferences of the authorities over the variability of deviations of inflation from target and the output gap.

8. **The direction of change in the optimized coefficients of the interest rate rule is consistent across these preferences.** When the responsiveness of inflation to demand pressures declines, the optimal coefficient on the expected inflation deviation from target

declines, while the optimal coefficient on the output gap increases.<sup>3</sup> What is the intuition? In a flat Phillips curve environment, policymakers would respond more actively to demand pressures to prevent them from affecting inflation (since that would be costly to reverse). Such policy would reduce both inflation and output gap volatility after a shock to aggregate demand. On the other hand, the response to inflation shocks is attenuated, since unwinding the shock quickly entails greater output gap variability. In that case, the optimized policy will reduce output gap volatility, but inflation will take longer to go back to target. On balance, adjusting the interest rate rule in a way that is optimal for the new structure of the economy would reduce volatility in the real economy and, in some cases, the volatility of inflation, compared to maintaining an unchanged rule.

9. **What are the implications of the optimized rule for the actual nominal interest rate movement?** Figure 3 illustrates the nominal interest rate move after a shock to inflation under the two possible structures of the economy.<sup>4</sup> The dotted line is the optimal response under a steep Phillips curve, while the solid line shows the optimized response under a flat Phillips curve. Even though the policymaker reacts less aggressively to any given deviation in inflation from target when the Phillips curve is flatter, after an inflation shock the cumulative increase in the interest rates (both nominal and real) would be greater, since inflation would stay above target longer. After a demand shock, the reverse holds true: interest rates would move less, since the expected deviation of inflation from target is smaller.

Figure 3. Impulse Responses to an Inflation Shock  
(percentage points deviation from baseline)



<sup>3</sup> The absolute magnitude of the coefficients depends on the weight attached to interest rate variability in the loss function. Higher weight attached to interest rate variability produces lower coefficients. Therefore the fact that the coefficients shown are greater in magnitude than the typical coefficients used in practice is of no particular significance.

<sup>4</sup> The central bank is assumed to have greater dislike for inflation variability relative to output gap variability in the illustrated scenario (the ratio  $\lambda_\pi / \lambda_y$  is 3).

10. **These results hold as long as inflation expectations remain anchored.** Under a flatter Phillips curve, inflation goes back to target more slowly than before after a shock to inflation (even for unchanged policy). For expectations to remain anchored, people must understand that this is a natural consequence of the structural change in the economy, and not a reflection of the ability of the policymaker to affect inflation. Enhancing the public understanding of the effect of structural changes (and possible policy changes) through communication is important to keep expectations anchored. If expectations are influenced by the actual deviations of inflation from target, the monetary policy response to inflation shocks would be more aggressive than the optimal response under stable expectations.

#### **D. Conclusions**

11. **This paper sheds light on the monetary policy implications of a particular structural change – reduction in the responsiveness of inflation to domestic demand pressures.** The main findings are the following:

- The short run trade-off between inflation and output gap variability is worse under a flatter Phillips curve. Achieving the same level of inflation variability entails greater output gap variability (and vice versa). The implications of the structural change for the volatility and speed of adjustment of macroeconomic variables have to be communicated clearly to the public to ensure that inflation expectations remain anchored around the target.
- A central bank that cares both about inflation and deviations of output from potential should respond relatively less to deviations of inflation from target and relatively more to deviations of output from potential in deciding its monetary policy stance. That would help reduce the volatility of the output gap after an inflation shock, and the volatility of both output and inflation after a demand shock.
- Even when the response to a given deviation of inflation from target is attenuated, interest rates would need to stay higher longer after a positive shock to inflation, since deviations of inflation from target are more persistent when the Phillips curve is flatter. If inflation expectations are influenced by the actual deviations of inflation from target, the interest rate response would need to be even more aggressive. Conversely, the cumulative interest rate movement would be smaller after a demand shock.

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## IV. THE GOLDEN RULE AND THE ECONOMIC CYCLE<sup>1</sup>

### A. Introduction

1. **Since its introduction in 1998, the golden rule has played a key role underpinning the U.K. fiscal framework.** The golden rule stipulates that over the economic cycle, the government should borrow only to invest and not to fund current spending. More specifically, it requires the current budget to be in balance or surplus on average over the economic cycle. The rationale for focusing on the current budget is to protect investment spending, which is particularly important in the United Kingdom given significant infrastructure needs. The rationale for the “over the cycle” formulation is to allow automatic stabilizers to work without jeopardizing long-term fiscal sustainability. This formulation of the rule provides an ex-post test of whether the golden rule has been met. By identifying economic cycles and in turn the cyclical effects on public finances, it also aims to assess the underlying structural fiscal position.

2. **While the golden rule is widely seen as having constrained discretion, the “over the cycle” formulation of the rule gives rise to two drawbacks.** First, automatic stabilizers may not be allowed to operate fully, because procyclical fiscal tightening may be required toward the end of a cycle to ensure that the golden rule is met. Second, the ex-post test of fiscal performance requires precise dating of the economic cycle, which leads to controversy since alternative methodologies can yield significantly different interpretations of the cycle.

3. **Against this background, the objective of this paper is to investigate an alternative modus operandi for the golden rule that would address both of these drawbacks.** Specifically, the paper examines the merits of making the fiscal rule exclusively forward-looking and independent of the dating of the cycle by aiming for current balance or better over a rolling time horizon. An estimated simple open economy model of the U.K. economy is used to compare fiscal performance under different ways of implementing the golden rule. The paper focuses on the following three issues: How does the uncertainty associated with precise dating of the cycles affect the implementation of fiscal policy? How big is the risk of procyclicality in fiscal policy implementation? Are there other implications of having a forward-looking formulation?

### B. Methodology

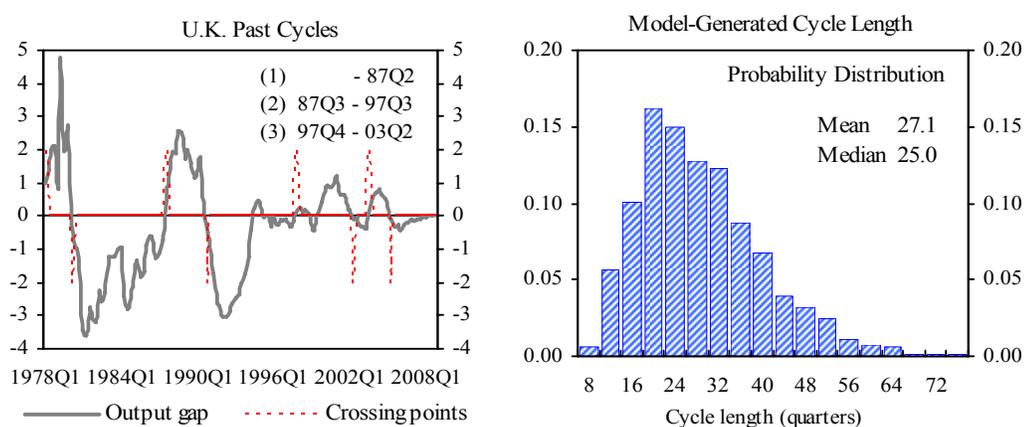
4. **The paper estimates an open-economy “New Keynesian” model with rational expectations.** Parameters in the model are estimated using the Bayesian technique for a

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<sup>1</sup> Prepared by Keiko Honjo. A more detailed version of this paper is forthcoming as an IMF Working Paper.

sample period of 1992Q4-2006Q4.<sup>2</sup> The model is simulated under various stochastic shocks that fit the historical U.K. data. To evaluate performance of alternative specifications of the fiscal rule, simulations are conducted over 1000 draws that last for 100 quarters.

5. **A similar approach to that used by the Treasury is adopted to define a cycle in terms of the crossing points between trend and actual output.** To select only those “decisive” crossing points and exclude temporary movements around a zero output gap, four consecutive quarters of either a positive or negative output gap following a change in its sign are required in order to define crossing points. Applying this definition to the staff’s estimates of the U.K. output gap, three cycles can be identified during the period since the late 1970s. The chart below suggests that cycles have become shorter and their amplitude shallower over time. In the simulations conducted, the average cycle length is 27 quarters.



6. **In the model, fiscal balances are determined by two components: automatic stabilizers and discretionary policy.** Automatic stabilizers are computed using the same elasticities with respect to contemporaneous and lagged output gaps estimated by the Treasury in 2003.<sup>3</sup> The discretionary component aims at achieving the fiscal rule, given the effects of automatic stabilizers.<sup>4</sup> Fiscal policy decisions are made every four quarters and reflect updated macroeconomic forecasts.

7. **Under the current formulation of the golden rule, discretionary policy is determined by the remaining length of the cycle, the cumulative balance since the**

<sup>2</sup> See Berg and Laxton (2006) and Honjo and Hunt (2006) for a detailed description of the basic model used.

<sup>3</sup> The estimates based on the empirical analysis suggest that a 1 percent increase (decline) in output relative to trend reduces (increases) the elasticity of the current balance with respect to output is 0.7, of which 0.5 comes from contemporaneous and 0.2 from lagged output gaps. These coefficients are obtained by regressing spending and revenue ratios to GDP on estimates of contemporaneous and lagged output gaps.

<sup>4</sup> Note that a positive (negative) gap in the fiscal balance implies a surplus (deficit).

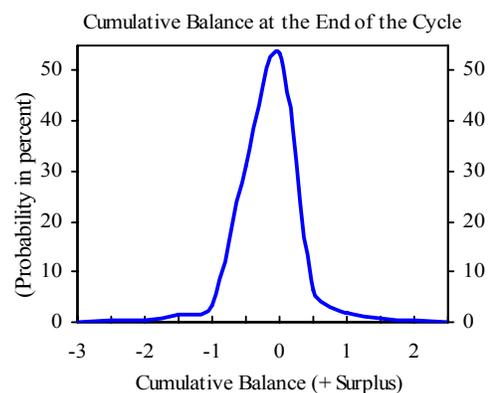
**beginning of the cycle, and the expected change in the cumulative balance till the end of the cycle.** It is assumed that any adjustment required to achieve current balance or surplus over the economic cycle is introduced smoothly and gradually over the remainder of the cycle. To match the non-negativity constraint on the cumulative balance as required by the golden rule, the fiscal authorities are assumed to take the measures necessary to achieve cumulative balance over the cycle if they face a projected cumulative deficit. However, if the authorities face a projected cumulative surplus, then they are assumed not to “overspend” to offset the projected surplus.

8. **Alternatively, the operational target of the golden rule could be changed from current balance or better “over the cycle” to aiming for current balance or better “at a 3-year ahead rolling horizon”.** In this case, the discretionary component of fiscal policy is aimed at achieving current balance (or better) in 3 years. As in the “over the cycle” formulation, fiscal adjustments are introduced gradually. For example, if a fiscal deficit of 1 percent of GDP is projected in three years with no policy change, 1/3 of the needed fiscal adjustment is introduced in the first year. To allow for the non-negativity constraint, if the expected 3-year ahead fiscal balance is in surplus, fiscal policy is assumed to let the automatic stabilizers operate for one year until the fiscal projections are revised in light of new developments.

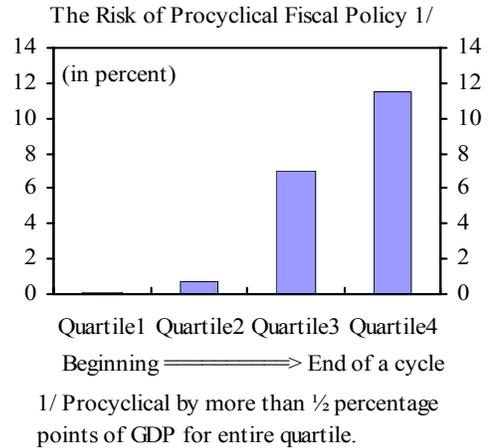
### C. Simulation Results

9. **The simulation results suggest a high degree of ex-ante uncertainty about the economic cycle, even though cycles are perfectly observable ex-post.** For example, a cycle that is initially forecast to begin with a strong period of upswing can change its course to a downturn following adverse shocks to the economy. Also, during a cycle, as different shocks hit the economy, the projected end of the cycle may shift unexpectedly and continuously. In addition, depending on the relative size and the composition of the shocks, downswings and upswings can differ in terms of their intensity or duration.

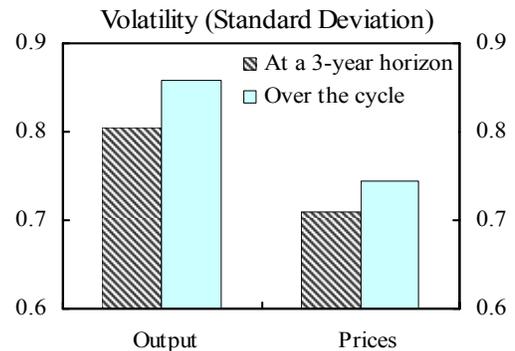
10. **The uncertainty about the end of the cycle has implications for achieving cumulative balance in the current formulation of the golden rule.** Simulations suggest that, under the “over the cycle” implementation of the golden rule, the 95 percent confidence interval for the cumulative balance at the end of the cycle is in the range of  $\pm 1$  percent of GDP. This implies that the golden rule would be breached nearly half of the time. This is because sometimes cycles end unexpectedly before the required adjustment can occur. However the likelihood of missing by a large margin—defined as more than  $\frac{1}{2}$  percentage point of GDP—is only about 15 percent.



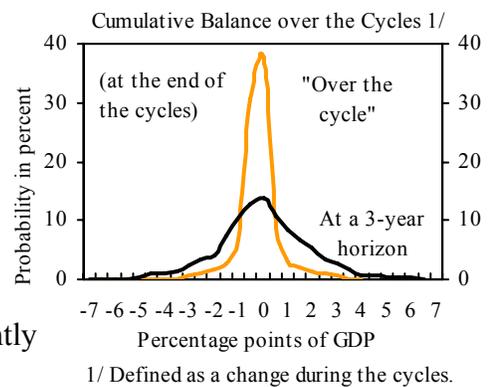
11. **Thus, in the over-the-cycle formulation, there is an important risk that fiscal policy becomes procyclical toward the end of the cycle.** In general, surpluses need to be accumulated during good times so as to compensate for deficits during bad times. However, if the projected end of the cycle is suddenly nearer, or if the downswings are longer or more intense than expected, achieving current balance or better over the cycle may require fiscal adjustment over a short period toward the end of the cycle. Simulation results suggest that, in trying to achieve current balance or better over the cycle, the risk of such procyclicality increases progressively as the cycle approaches the end. In particular, in about 12 percent of the simulated cycles, fiscal policy was procyclical during the entire last quarter of each cycle. In contrast, under the forward-looking 3-year rule, such risk is virtually zero. This is because early overperformance cannot be used to offset later underperformance.



12. **By reducing the risk of procyclical fiscal policy, the volatility of output and prices can be reduced.** In general, automatic stabilizers play an important role in lowering macroeconomic volatility. Both the “over the cycle” and the forward-looking formulation add stability to economic activity. However, because fiscal policy under the “over the cycle” formulation could be sometimes procyclical toward the end of the cycle, the forward-looking formulation reduces the volatility of output and prices by about 5 to 7 percent.



13. **Implementing the golden rule at a rolling horizon gets rid of procyclicality, but imposes a somewhat looser constraint on debt over any given cycle.** With the “over the cycle” formulation, the 95 percent confidence interval for the cumulative balance (equivalent in the model to the debt-to-GDP ratio) over economic cycles is  $\pm 5$  percentage points of GDP. In contrast, under the forward-looking formulation, the 95 percent confidence interval is slightly larger at  $\pm 7$  percentage points of GDP.



14. **These results—that a 3-year ahead formulation of the golden rule would tend to lower output and price volatility but raise debt volatility relative to an over-the-cycle formulation—are robust to different time horizons for the forward-looking formulation of the golden rule.** A comparison of fiscal performance using a 2-year ahead and 5-year ahead rolling time horizons suggests that the volatility of output and prices remain broadly unchanged from the results under the 3-year time horizon. Ex-ante, the projected fiscal balance is different, as the two-year ahead rule aims at achieving current balance or better in two years, while the five-year rule would aim for five-year ahead. However, ex-post, the realized fiscal balances are broadly similar with some small differences in the cumulative balance over the cycle. The volatility in the cumulative balance over the cycle remains large.

15. **The results presented in this paper are subject to a number of caveats.** The model specification is simple and abstracts from other important issues in assessing fiscal policy. For example, the model does not explicitly take into account movements in asset prices. This may be particularly important for the United Kingdom given the increasing role the financial sector plays in economic activity. Also, while the simulations use estimated parameters and shocks that fit the historical U.K. data, the true parameters may be different going forward.

#### **D. Concluding Remarks**

16. **The analysis presented in this paper suggests that there are pros and cons to a forward-looking formulation of the golden rule.** On one hand, a forward-looking formulation would not require precise dating of the economic cycle and would enhance macroeconomic stability by reducing the risk of procyclical fiscal policy. On the other hand, a forward-looking formulation increases debt variability. In addition, the successful implementation of a forward-looking rule continues to depend on unbiased revenue projections. Otherwise, there is a risk that fiscal slippages could accumulate, increasing the debt burden. Indeed, as the forward-looking rule does not provide an ex-post test of fiscal performance, the need for unbiased ex-ante forecasts is arguably even more important.

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## V. TRANSMISSION OF SHOCKS IN THE INTERNATIONAL BANKING SYSTEM AND IMPLICATIONS FOR LONDON AS A GLOBAL FINANCIAL CENTER<sup>1</sup>

### A. Introduction

1. **London is one of the world's biggest and most open financial centers.** It dominates international financial market activity, and is also home and host to some of the biggest financial institutions in the world. The financial sector in the United Kingdom offers a wide range of services, in areas such as asset management (hedge funds, mutual funds and pension funds), banking (commercial, investment and private banking), insurance and reinsurance, as well as access to major capital and commodity markets.
2. **The concentration of financial services and markets in one major hub clearly offers many advantages, to both market participants and the local economy.** There is an abundance of skilled labor, service suppliers and infrastructure; the economies of scale offer greater efficiency and cost savings, and provide the critical mass for ongoing innovation and growth. In turn, this contributes towards improving the liquidity, breadth and depth of financial markets, and attracting an increasingly diverse group of participants. The authorities also have strong incentives to ensure sound supervision and governance practices, as well as promulgate effective and efficient regulation to ensure stability and continued growth.
3. **The financial sector has been the second-fastest growth sector in the United Kingdom over the 1992–2004 period.** It expanded by an average real rate of more than 5 percent per annum during this period—more than double that of the overall economy. The financial sector currently accounts for an estimated 70 billion of national output, or almost 7 percent of GDP.
4. **However, London's role as a center for global finance raises the possibility of contagion through its financial sector.** Here, we define “contagion” as the transmission of idiosyncratic shocks among financial institutions. In particular, the banking sector in the United Kingdom represents a potentially important channel for contagion risk. It is the third-largest in the world by total assets, and banks have increasingly diversified their operations, both geographically and in terms of their business lines. Linkages could stem from direct equity exposures of banks in one another; direct exposures through loan books; deposit and funding sources locally and from overseas; payment and settlements systems; holdings of credit risk transfer (CRT) instruments written on assets held by local and/or overseas institutions.

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<sup>1</sup> Prepared by Jorge Chan-Lau, Srobona Mitra and Li Lian Ong (all MCM). A more detailed version of this paper is forthcoming as an IMF Working Paper.

5. **This paper focuses on determining contagion risk among the world’s largest, systemic banks, focusing specifically on the major U.K. banks.** It should be noted that the exact nature of the links between the financial institutions is not explored here. Rather, the results are intended to represent “maps” that could guide the allocation of not unlimited surveillance and supervisory resources, so that more detailed links may then be identified as necessary. They could also focus cross-border collaboration and supervision between the U.K. authorities and their overseas counterparts.

6. **We essentially test three hypotheses on the global banking system.** First, given the increasing internationalization of financial services, are all banks similarly affected by common shocks to the global economy or financial system? Alternatively, is “home bias” still the dominant factor, notwithstanding the effects of globalization, and are banks predominantly influenced by domestic shocks, either because of their domestic focus or the local regulatory environment? Or, are different banks—irrespective of domicile—impacted differently by shocks, due to their increasingly different business and geographic mixes?

7. **We use the extreme value theory (EVT) framework to analyze contagion risk across the international banking system.** The EVT approach to contagion, which has gained acceptance in recent years, better captures the information that large, extreme shocks are transmitted across financial systems differently than small shocks.<sup>2</sup> Multivariate EVT techniques are used to quantify the joint behavior of external realizations (or “co-exceedances”) of financial prices or returns across different markets.

8. **In this paper, we test for the likelihood that an extreme shock affecting a major, systemic U.K. bank would also affect another large local or foreign counterpart, and vice-versa.** We assume that contagion risk is associated with extreme negative co-movements in bank soundness, or distance-to-default. In other words, we try to determine if extreme, but plausible, negative shocks to a particular bank’s stability could be associated with stresses experienced by other major banks in the international banking system.

## B. Method and Data

9. **We employ a binomial LOGIT model to determine the likelihood that an extreme shock to one major bank would cause stress to another large counterpart.** Specifically, we apply the model used in Gropp, Lo Duca and Vesala (2005) to estimate the probability that the (percentage) change in the distance-to-default (“DD”) of one bank falls in the 10<sup>th</sup> percentile left tail of the common distribution of the  $\Delta DD$ s across all banks (defined

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<sup>2</sup> See Chan-Lau, Mathieson and Yao (2004), Forbes and Rigobon (2001), Longin and Solnik (2001).

as “extreme values”), following large negative shocks to the *DDs* in another bank.<sup>3</sup> This is determined after controlling for country-specific and global factors.

10. **Our dataset includes the world’s top 24 largest exchange-listed banking groups by total assets, as at end-2005, according to Bankscope.** These comprise institutions from other major banking systems such as Belgium, France, Germany, Japan, the Netherlands, Spain Switzerland, the United Kingdom and the United States. All these banking groups are represented in London, and are important participants in the financial sector there and in other major overseas financial centers.

11. **Three control variables are used to account for common factors.** They are: the volatility in the respective local stock market index returns; changes in the slope of the local term structure (between one- and ten-year government bonds) to represent developments in the local real economy; and volatility in the Morgan Stanley Capital International (MSCI) All-Country World index (ACWI) returns to account for global market factors. These data are all obtained from Bloomberg L.P.

12. **The sample period, determined by data availability, is May 30, 2000 to August 2, 2006.** However, data for six banks are only available from later dates. Thus, only 18 banks are tested for the full sample period (the “main sample”); the other banks are subsequently added to the main sample as their data become available, and the tests are rerun.

### C. Results

13. **Our results reveal several key trends among the major international banks.** Broadly, we find that “home bias is a dominant factor in terms of contagion risk, although banks are also affected differently by idiosyncratic shocks to their major counterparts, possibly due to their different business and geographic mixes (Table 1). Individual banks are not similarly affected by common shocks to the real economy or financial markets, although the global banking system as a whole tends to be more exposed to these shocks during more turbulent periods, compared to the more benign times. Importantly, contagion risk across the major global banks has risen in recent years (Table 2).

14. **At a more specific, bank-by-bank level, the results are robust across the samples consisting of 18–24 banks.** A summary of the results follows:

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<sup>3</sup> The *DD* measure represents the number of standard deviations away from point where the book value of a bank’s liabilities is equal to the market value of its assets. It does not require specification of a particular channel of contagion, that is, the channel through which the transmission of shocks occurs. *DDs* are risk-neutral, that is, they do not take into account the possibility that risk preferences may be different during volatile versus benign periods.

- Contagion risk is significant among U.K. banks, with Barclays representing the consistent risk factor for its local counterparts; Barclays is also most exposed to contagion risk from foreign banks. The risk of contagion from U.K. to non-UK banks has increased over time, with HSBC representing the biggest contagion risk factor for foreign banks.
- The exposure of U.S. banks to each other appears to have intensified in recent years; the impact of U.S. banks on foreign banks has also increased. Morgan Stanley and Goldman Sachs are largely insulated from other banks; Morgan Stanley consistently represents the biggest contagion risk for other foreign banks, while Citigroup has also become more important in recent years.
- Contagion risk appears quite significant among European banks. Contagion risk from the French banks appears have increased over time, with shocks to Societe Generale having had the widest impact. In the meantime, banks such as Fortis (Belgium) and Santander (Spain) have become more exposed to shocks from elsewhere.
- Contagion risk for major Japanese banks has been limited. Japanese banks appear to pose little contagion risk to the other major international banks; Japanese banks are also largely insulated from shocks to major foreign banks.

Table 1. Significant Coexceedances,  
2000-2006  
(in percent of total bank transmission channels)

	Transmission to:	
	U.K. banks	Other banks
<u>Initial shock to:</u>		
U.K. banks	67	9
Other banks	4	13

Source: IMF staff calculations.

Table 2. Change in Significant Coexceedances,  
2000-03 to 2003-06  
(in percentage points)

	Transmission to:	
	U.K. banks	Other banks
<u>Initial shock to:</u>		
U.K. banks	0	9
Other banks	2	2

Source: IMF staff calculations.

## D. Conclusion

15. **London is indisputably one of the world's most important financial hubs.** The dynamism of its financial sector offers significant **Error! Bookmark not defined.**opportunities to financial services providers. However, the accessibility, innovation and integration that represent London's major competitive strengths also heighten participants' exposure to the risk of contagion through numerous channels when market events occur. Specifically, the banking sector is a potentially key conduit for contagion risk within the local financial sector and between financial systems across countries, with several

U.K. banks among the largest in the world and close to 500 international banks represented in London.

16. **Using an EVT framework, our findings provide some information on areas where risks may be concentrated in the international banking system.** Our results highlight relationships which may require closer supervision and surveillance, and a more detailed understanding of linkages by the local authorities. Overall, the risk of contagion among local banks is highest, while inter-linkages with foreign banks appear to have increased over time. Our findings could also help country authorities focus their collaborative supervisory efforts on specific areas, given their limited resources.

17. **Risk management has become very important for the banking sector.** The U.K. authorities appropriately emphasize that responsibility for mitigating risks to the financial system is shared between the private sector and the public authorities (BoE, 2006). In the private sector, risk management by banks has increasingly become more professionalized, ahead of the proposed introduction of new bank capital standards under Basel II. However, the authorities have identified several areas where risk management could be improved; they are also promoting greater use of stress-testing as a key risk management tool.<sup>4</sup>

18. **Greater emphasis is being placed on improving international cooperation in financial crisis prevention and management.** The U.K. FSA, its European regulatory counterparts and the European Commission support more efficient, risk-based cross-border collaboration among supervisors. Internationally, the existing tripartite of Switzerland, the United Kingdom and the United States is considered one of the most fully-developed examples of home/host collaboration in supervision. The U.K. authorities also acknowledge that managing the impact from a failure of a major global financial institution would require significant cross-border co-ordination. For example, the U.K. authorities have signed the EU Memorandum of Understanding for crisis management, which includes performing crisis simulation exercises at the EU level. Nonetheless, the U.K. authorities acknowledge that there is a need for further work on cross-border co-ordination and information sharing between national authorities in promoting financial stability.<sup>5</sup>

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<sup>4</sup> See BoE (2006) for a discussion of work that is under way and new work that may be required in this area.

<sup>5</sup> See Gieve (2006).

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