United Kingdom: Selected Issues

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Selected Issues

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I.   The Impact of Rising Energy Prices[1]

In this paper, a variant of the IMF's Global Economy Model that incorporates energy is used to examine the impact of rising energy prices on the major industrial countries (US, euro area, Japan, UK, and Canada). For all countries except Canada, permanently higher energy prices imply a permanent reduction in supply capacity. While energy price increases lead to a temporary spike in inflation proportional to the energy intensity of consumption, there are no persistent inflation effects provided (i) the monetary authority fully incorporates the negative supply-side implications into the policy setting process and (ii) labor suppliers are not able to resist the required decline in their real consumption wage. If policymakers attempt to support aggregate demand above potential supply, then second-round persistent inflation effects emerge, which are exacerbated if labor suppliers are able to temporarily resist part of the required decline in real wages.

A.   Introduction

1.   **The rise in oil prices since the beginning of 2004 has had an important impact on the United Kingdom and other large industrial countries.** Inflation, which had long been subdued, even during the high-tech boom years of the late 1990s, has accelerated in most industrial countries. GDP growth, while still healthy in most industrial countries, has slowed relative to expectation. In this paper, a variant of the IMF's Global Economy Model (GEM) is used to estimate the contribution of rising oil prices to these developments.

2.   **The model incorporates energy (oil and natural gas) as a final consumption good as well as a primary input in the production process.** Because energy enters the consumption basket directly, increases in energy prices quickly affect household welfare through their impact on the level of consumer prices and thus households' real wage. With energy entering the production process, increases in energy costs affect overall aggregate supply capacity as firms reduce output and factor utilization rates given the real increase in their costs structures.

3.   **The analysis of the impact of permanently higher energy prices focuses on three key issues:**

- the likely implications for the level of economic activity;
- the magnitude of the direct impact on headline inflation; and
- the mechanisms through which permanently higher energy prices could lead to persistently high inflation.

4.   **The remainder of the paper is structured as follows.** In Section B a brief, non-technical outline of GEM is presented focusing on how energy is integrated into the model's

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[1] Prepared by Ben Hunt.

structure. The calibration of the model is also outlined in this section. A technical description of the incorporation of energy into GEM is presented in the Appendix. Section C presents some simulation results of a stylized permanent increase in energy prices on major industrial countries. This section also contains the simulation results for the U.K. economy of an increase in energy prices that mimics the increase that has occurred in oil prices since the beginning of 2004 using futures prices to guide the evolution about the shocks expected persistence. The implications of some alternative responses of the monetary authority and wage bargainers are also examined in this section. Some conclusions are offered in Section D.

B.   The Global Economy Model - GEM

5.   **GEM is a large multi-country macroeconomic model derived completely from optimizing foundations.** The version used here characterizes the behavior of two countries, home and foreign. The home country is alternatively calibrated to represent the major industrial economies, the United Kingdom, the Euro Area, the United States, Japan and Canada. In each case, the foreign country represents the rest of the world. The model describes the behavior of three types of agents: households; firms; and government. Below, only a brief overview of GEM is presented and the interested reader can look to Laxton and Pesenti (2003) and Hunt and Rebucci (2005) for a more detailed description of the model's structure and properties.

Households

6.   **Households are infinitely lived, consume a bundle of goods, are the monopolistic suppliers of differentiated labor inputs to all domestic firms, and own the capital stock.** 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 rent the capital stock to firms in a competitive market. Capital accumulation is subject to adjustment costs that contribute to gradual economic adjustment. Capital and labor are immobile internationally and households only trade short-term nominal bonds internationally.

7.   **Households consume energy goods directly along with other tradable and nontradable goods.** The households final consumption bundle is given by:

$$A = f(N, Q, M, Q_E, M_E), \tag{1}$$

where A is the bundle of final goods consumed by households, N represents nontradable goods, Q represents domestically produced tradable goods, M represents imported tradable goods, Q_E represents domestically produced energy goods, and M_E represents imported energy goods. The function, f, is a constant elasticity of substitution (CES) aggregator.

Firms

8. **Firms produce three types of goods: nontradable goods; non-energy tradable goods; and a tradable energy good.** Goods are assumed to be differentiated giving rise to market power that enables firms to charge a markup over the marginal cost of production. Non-energy goods prices are subject to adjustment costs that along with slowly adjusting wages gives rise to the gradual adjustment of prices in response to economic disturbances.

9. **Firms combine capital, labor and energy to produce the tradable and nontradable goods.** The production process is given by:

$$Y = f(K, L, Q_E, M_E), \tag{2}$$

where Y denotes the output of tradable and nontradable goods (N, Q), K is the capital input, L is the labor input, Q_E is the domestically produced energy input, and M_E is the imported energy input. The production technology, f, is assumed to be Cobb Douglas, implying unitary elasticity of substitution among factors of production. However, firms face adjustment costs in both capital and energy that reduce the short-run elasticity of substitution below unity.

10. **Energy producing firms combine capital, labor and land to produce the tradable energy good.** The production technology is given by:

$$Q_E = f(K, L, Land), \tag{3}$$

where Q_E is domestically produced energy, K represents the capital input, L the labor input, and *Land* is the known available reserve of energy. The production technology, f, embodies constant elasticity of substitution.

Government

11. **Government consumes a bundle of goods identical to that consumed by households.** Government spending is financed through a non-distorting tax. The government controls the national short-term interest rate with the objective of providing a nominal anchor for the economy, which here is assumed to be the rate of CPI inflation. Figure 1 contains a simplified pictorial representation of GEM's structure incorporating energy.

Figure 1. Simplified GEM Structure

I - Investment
C - Private Consumption
G - Government Consumption
A - Final Nontradable Good
N - Intermediate Nontraded Good
Q - Intermediate Tradable Good
M - Imported Intermediate Tradable Good
E - Energy: Domestically Produced and Imported
K - Capital
L - Labor
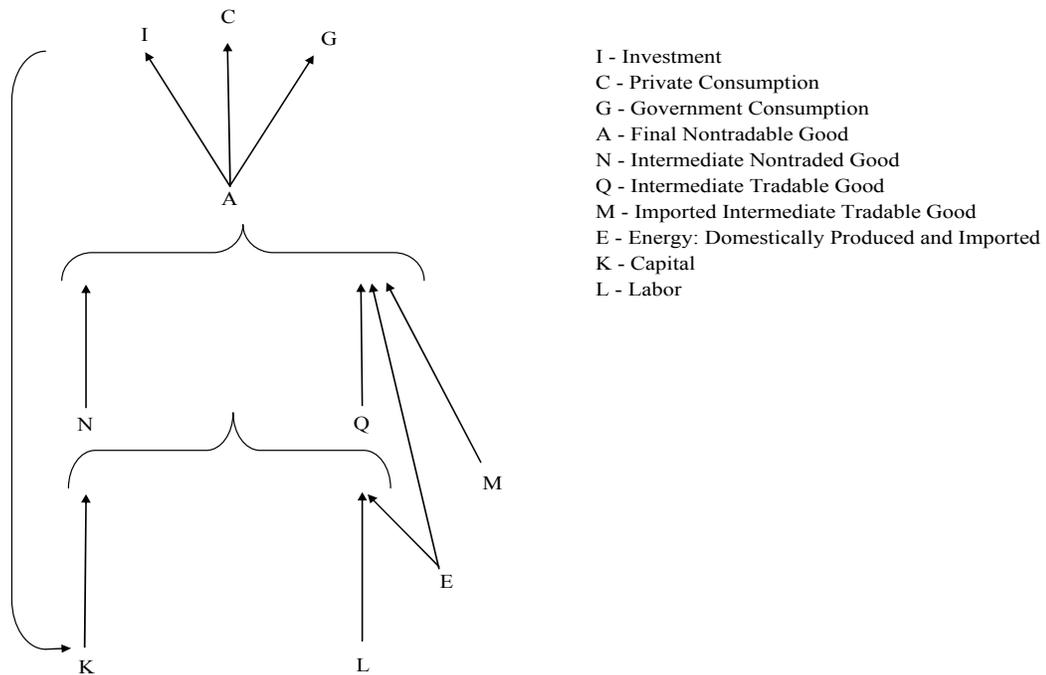
Calibration[2]

12. **The main focus of the calibration has been to achieve two key properties in energy prices:**

- home and foreign energy prices moving together; and
- energy prices that are considerably more volatile over the business cycle than other prices.

13. **The elasticities of substitution play a central role in achieving the desired properties.** The elasticity of substitution between home and foreign produced energy in both consumption and production is calibrated to be high to ensure the that home and foreign energy prices move together. The calibration of three elasticities of substitution and the importance of the fixed factor in energy production contribute to the desired cyclical volatility in oil prices. First, a relatively low elasticity of substitution between energy and non-energy tradable goods in consumption. Second, standard unitary elasticity of substitution among capital, labor and energy in non-energy goods production (Cobb Douglas) combined with costly adjustment. Third, a low elasticity of substitution among the fixed factor (*Land)*,

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[2] A more detailed discussion of the calibration of the energy structure in GEM can be found in Hunt (2005).

labor, and capital in the production of the energy good in industrial countries.[3] Further, the fixed reserve of energy, *Land*, is assumed to be the most significant input into energy production.

14. **The energy intensities, valued at producer prices, of the major industrial countries have been calibrated to match their levels as of end-2003.** The energy intensities that the model has been calibrated to replicate are presented in Table 1. A number of points are worth noting. First, the United Kingdom and Canada are net exporters of energy. Second, for some countries it was necessary to make assumptions about the split between energy as a primary input into production and energy consumed directly by households because of data limitations. Third, the model has not been calibrated to replicate the exact treatment of energy taxes. Value added taxes, however, are important because they affect the transmission of energy price shocks into the CPI. Consequently, for the United Kingdom, a value added tax of 17.5 percent has been included.

Table 1. Eenrgy Intensities of the Major Industrial Countries
Expressed as a share of nominal GDP (oil and natural gas valued at producer prices)

	United Kingdom	Euro Area	United States	Canada	Japan
Production	2.23	0.16	1.50	6.80	0.02
Imports	0.71	1.60	1.26	1.22	1.38
Total available	2.94	1.76	2.76	8.02	1.40
Total use	1.94	1.76	2.72	4.05	1.40
Input	1.15	1.02	1.23	2.23	0.70
Consumption	0.79	0.73	1.49	1.82	0.70
Net Exports	0.29	-1.60	-1.22	2.75	-1.38

Source: OECD, IEA Database; and IMF staff estimates.

C. Energy Price Shocks

15. **Given the complete market for energy in GEM, the price of energy is the result of the interaction of supply and demand factors.** To implement an increase in the price of energy in this paper, factors on the supply side are altered. These factors could be either the markup demanded by the monopolistic suppliers of energy or the available reserve of energy (*Land*). Preliminary work indicates that the macroeconomic implications are independent of the factor altered. Although the shocks are technically generated by altering the supply side, the interpretation of the shock should be broader, recognizing that the outcome reflects the interaction of demand relative to supply. The increases in energy prices in the 1970s are

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[3] Cobb Douglas technology is assumed in energy production in the foreign sector.

generally interpreted to have arisen because of the actions of energy producers restricting the supply. Conversely, the increase in energy prices that has occurred recently is generally interpreted as the outcome of demand for energy increasing faster than available supply and this is how the shocks considered in this paper should be interpreted.[4]

An Illustrative Permanent Increase in the Price of Energy

16.   **To examine the cross-country impact of an increase in energy prices, a 50 percent permanent increase is considered.** The impact on GDP and CPI inflation in the major industrial countries, at several horizons, is presented in Table 2 and the dynamic adjustment path for several key macro variables for the United Kingdom, the Euro Area and the United States are presented in Figure 2. These simulations are done assuming that monetary policy follows a standard inflation-forecast-targeting rule given by:

$$rs_t = \alpha_1 \cdot rs_{t-1} + (1 - \alpha_1) \cdot (r_t^* + \pi_t^4 + \alpha_2 \cdot (\pi_{t+4}^4 - \pi^*) + \alpha_3 \cdot (ygap_t)), \tag{4}$$

where rs_t is the short-term policy rate, r_t^* is the equilibrium real interest rate, π^4 is year-over-year CPI inflation, π^* is the target rate of inflation, $ygap$ is the output gap, and the α_is are response coefficients. For these simulations $\alpha_1 = 0.5$, $\alpha_2 = 0.5$, and $\alpha_3 = 0$.[5]

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[4] A rapid increase in energy demand by emerging Asian economies is cited as key driver of the current rise in energy prices. This increase in energy demand by Asian economies reflects several factors and has an impact on the major industrial countries that is not captured in these simulations. Some preliminary work with GEM generating energy price increases from a variety of factors illustrates that positive spillovers can offset some of the negative impact of higher energy prices. The stronger are the industrial countries'trading links with emerging Asia, the larger are the offsets.

[5] GEM's representative agent structure combined with the assumption that domestic households own all the capital stock has some important implications under energy price shocks that must be considered carefully. Households in energy producing countries receive a positive wealth shock from the increased returns in energy production when real energy prices rise. The structure of the model is such that households consume out of that wealth with their standard propensities. However, the increased returns in the energy sector are probably not widely spread and the propensity to consume out of the increase in wealth is likely much lower than average. To more accurately portray the likely impact on U.K. GDP, an additional temporary shock to household preferences is include so that in the near-term, U.K. consumption behaves similarly to consumption in the Euro Area. Although this is likely a factor in Canada as well, (and could be a factor for the U.S. because of the level of energy production there) no additional shock has been included. Consequently, the near-term positive impact on GDP in Canada is likely to be more subdued than these results suggest. This is an area that will be addressed more carefully in future work.

Table 2. The Impact of a Permanent 50 Percent Increase in Energy Prices

	United Kingdom	Euro Area	United States	Canada	Japan
GDP-percent deviation from baseline					
Year 1	-0.27	-1.20	-1.08	2.36	-1.09
Year 5	-0.37	-0.97	-0.99	1.55	-0.93
Steady state	-0.61	-1.49	-1.76	0.74	-1.43
Year-over-Year CPI Inflation (percentage point deviation from baseline)					
Quarter 1	0.45	0.39	0.77	0.68	0.36
Quarter 4	0.28	0.27	0.43	0.04	0.15
Quarter 8	-0.16	-0.20	-0.37	-0.11	-0.30

17.   **The negative impact on GDP grows over time for most countries, reflecting gradual adjustment of the supply side of these economy.** In Canada, the positive impact that arises because of its large net export position in energy, gradually diminishes over time as aggregate supply in the non-energy sectors adjust. The initial negative impact on GDP reflects lower consumption, lower investment, and lower net exports in net-energy-importing countries (the Euro Area, the United States, and Japan). Consumption declines because of a real decline in households' consumer wage. Lower investment reflects the response of firms to the permanent increase in a factor cost, energy. Firms want to employ fewer of all factors of production. However, because firms face adjustment cost in capital, and energy, the adjustment to the new desired input mix occurs gradually. As the capital stock falls toward itsnew equilibrium level, real wages continue to fall, tracking the decline in the marginal productivity of labor and consumption continues to moderate according.

18.   **Although headline CPI inflation spikes up initially, reflecting the energy intensity of households' consumption bundle, there are no persistent inflation effects.** This benign inflation outcome occurs for two important reasons. First, the response of the monetary authority is implicitly accounting for the negative supply-side implications of the shock. The response is based on an inflation-forecast-based policy rule that incorporates the model-consistent, one-year-ahead rate of inflation. By responding to this measure of inflation, the monetary authority is not attempting to support aggregate demand at the level expected prior to the shock. Rational forward-looking households and firms fully understand the policymaker's reaction function. Second, households accept the permanent change in relative prices and the resulting decline in their real consumption wage, which, along with the policy response, helps to ensure no second round effects.

Figure 2. A Fifty Percent Permanent Increase in Energy Prices
(percent or percentage point deviation from baseline)

Solid - United Kingdom   Dashed - United States   Dotted - Euro area
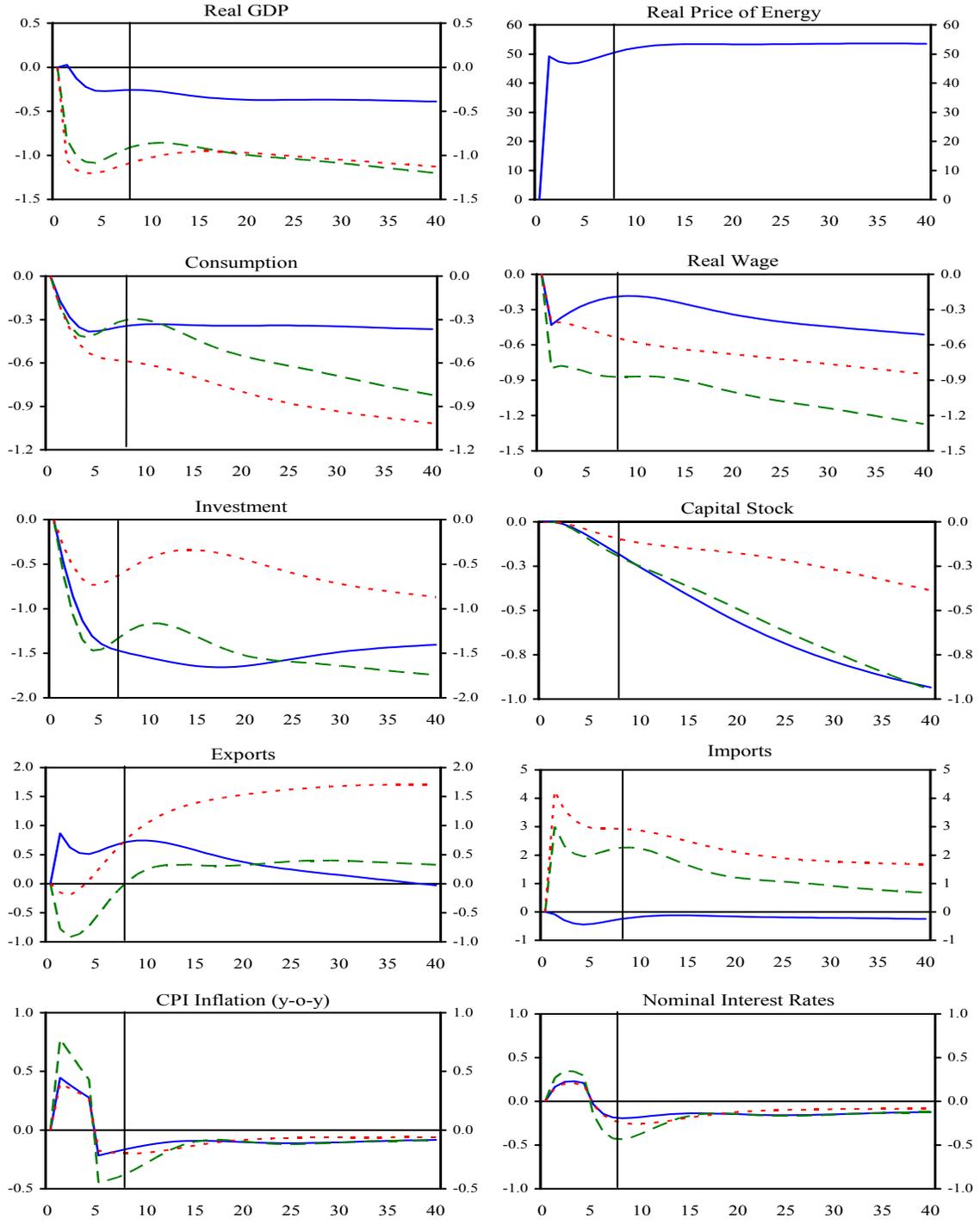
Source: GEM Simulations.

The Actual Increase in Energy Prices Since End-2003

19.   **Since end-2003, oil prices have increased by roughly 100 percent.** To examine the implications for the United Kingdom, an energy price increase that broadly matches that seen in oil prices over the last two years is simulated. One important feature of the recent energy price increase has been the gradual evolution of expectations regarding its persistence. Looking at futures' market prices, it appears that at the beginning of 2004, the increase in the price of oil above the 30 dollars a barrel level was thought to be temporary. As prices accelerated throughout the year and into 2005, it appears that expectations of the price rise's persistence increased. To capture the impact of gradually evolving expectations, the simulations that follow are built up, quarter by quarter, with an energy price shock that matches that seen in the data both in terms of its magnitude and its expected persistence. The left-hand panel in Figure 3 presents the energy price shock considered. The solid line denotes the increase in energy price that occurred over 2004 and 2005 and its expected persistence as of the fourth quarter of 2005.[6] The dashed lines denoted the persistence of the shock in each quarter of the multi-period simulation. In each period in the simulation experiment, agents' expectation of the shock's persistence broadly matches the expected path for oil prices as suggested by futures market prices. The right-hand panel in Figure 3 illustrates the actual increase in oil prices and the futures' market path.

Figure 3. Energy Prices - Simulation and Data

Solid Line - represents actual path and expected path beyond quarter 8.
Dashed Line - represents expected path at each quarter prior to quarter 8.

Source: Bloomberg and GEM Simulations.
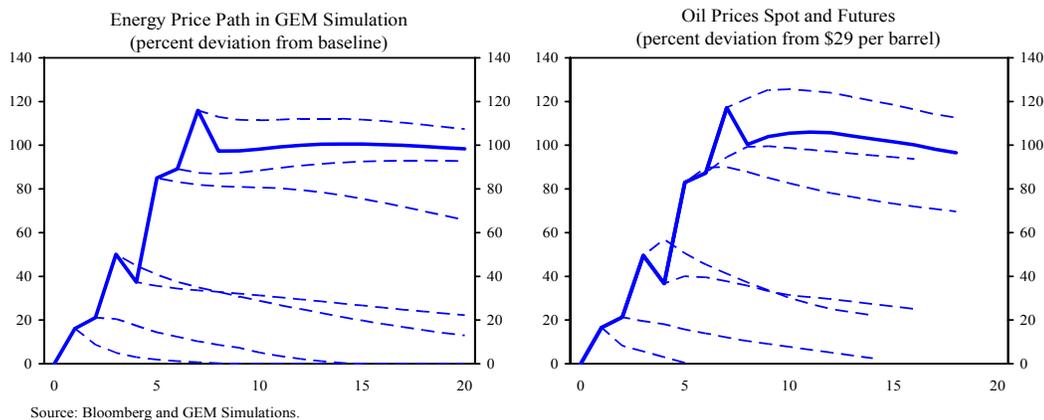
20.   **The simulation is run assuming no change in nominal interest rates in the first eight quarters of the shock.** Since energy prices started to rise in early 2004, there has been little change in the monetary policy rate in the United Kingdom. The tightening cycle in the Bank of England's policy rate, prompted by domestic concerns, was complete by summer-

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[6] For the fourth quarter of 2005, the price and expectations path is matched to that available as of end-October 2005.

2004. Since then, the only move in the policy rate has been a 25 basis point decline in summer-2005. Given that the endogenous policy rule used in the simulations would lead to an increase in the nominal rate as current inflation increases, the interest rate is temporarily fixed at baseline at the start of each of the iterative simulations. The final outcome is that interest rates remain at baseline for the first eight quarters. Beyond that horizon, the endogenous policy rule switches back on.

21.   **The simulated responses of the key macroeconomic variables in the U.K. economy to the multi-period energy price increase are presented in Figure 4.** The peak effect on year-over-year CPI inflation is roughly 0.7 percentage points, which occurs in the fifth quarter. Beyond that horizon , the impact on inflation moderates. Assuming no further increases in oil price beyond the eighth quarter, the impact on year-over-year CPI inflation turns slightly negative before returning toward baseline. Because of the model's structure, the direct impact of energy price changes are reflected immediately in the CPI. In reality, this pass-through is likely slower and, consequently, the precise quarterly dynamics should not be interpreted too literally.[7] The initial impact of the shock on GDP is slightly positive as the increase in the real value of exports more than offsets the negative effects on investment andconsumption that are quite mild due to expectations that the persistent component of the shock is small. As both energy prices and expectations of its persistence continue to rise, the negative impact on both consumption and investment grows, more than offsetting the positive impact on the energy sector and GDP falls below baseline. After eight quarters, GDP is roughly 0.2 percent below baseline. As firms adjust to the higher factor cost by reducing investment and labor demand, GDP continues to fall further below baseline, reaching - 1 percent after 20 quarters and -1.2 percent in the long-run.

22.   **In the simulation experiment, the monetary authority's awareness of the supply-side implications and wage bargainers' acceptance of the required decline in their real consumption wage lead to a very benign inflation outcome.** To illustrate how the energy price increase could lead to more persistent inflationary pressures, alternative responses are considered. First, if policymakers model the evolution of the supply-side of the economy as a determinist or highly persistent process, they may only gradually incorporate the supply-side implications into the policy setting process. As illustrated in Orphanides (2000), during the 1970s the real-time estimates of potential output used by the Federal Reserve appeared to considerably overestimate what is now viewed to have been the level of potential output following the first oil price shock in 1973–74. Hunt (2005) illustrates how responding to an overestimate of potential output incorporated into a standard Taylor (1993) rule could have contributed to the secondary burst of persistent inflation that followed initial spike in CPI inflation in 1974–75.

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[7] Because of the model's complete choice theoretic framework, there is no scope for making ad hoc changes to the dynamic adjustment properties to more closely match the pass-through properties in the data.

Figure 4. An Energy Price Increase Matching Recent History
(percent or percentage point deviation from baseline)
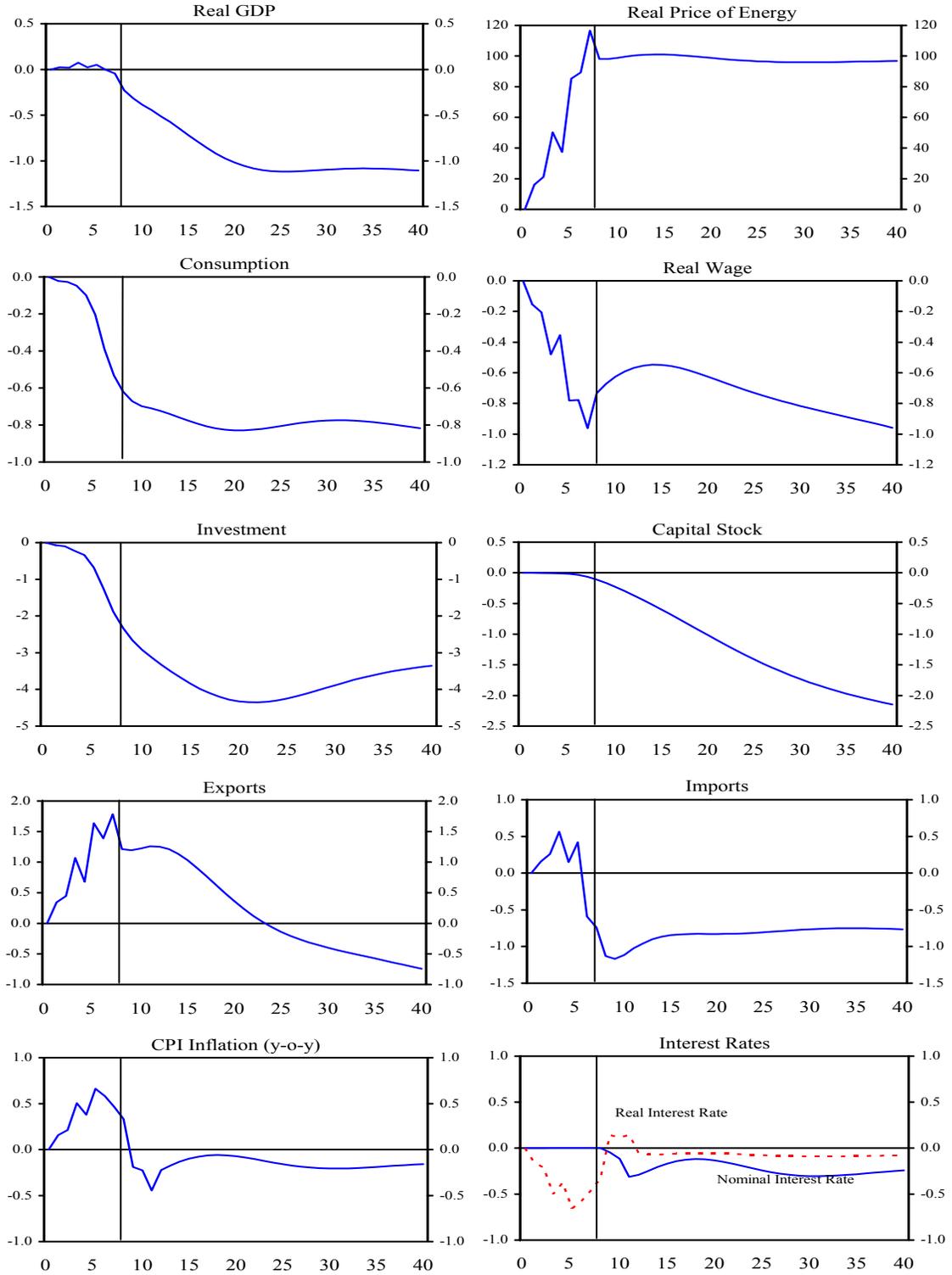
Source: GEM Simulations.

23.   **To illustrate this point, the simulation experiment is re-run putting a coefficient of unity on the policymaker's estimate of the output gap in equation 4 (dotted line in Figure 5).** The policymaker's estimate of potential output only gradually incorporates the negative implications for aggregate supply of the permanent increase in a real factor cost.[8] With monetary policy now aiming to simultaneously stabilize inflation and support aggregate demand at too high a level, a secondary burst of persistent inflation follows the initial spike in CPI inflation generated by the direct effect of higher energy prices. The magnitude and duration of this secondary acceleration in inflation will depend on the speed with which the policymaker learns about the true level of potential output. Faster learning than assumed here would reduce the secondary acceleration. It is interesting to note that nominal interest rates actually rise faster in this scenario than in the base case (solid line in Figure 5) reflecting the important role that expectations can play. Here agents in the model economy understand the policymakers' error and expectations fuel the acceleration in inflation. Policymakers fall behind the curve resulting in real interest rates that are below those in the baseline.

24.   **In addition to the inflationary consequences of misperceptions about the level of potential output, the inflation outcome could deteriorate further if workers resist the required decline in their real consumption wage.** To illustrate this point, a temporary increase in wage bargainers' market power is added to the simulation (dashed line in Figure 5). This has the effect of adding some resistance to the decline in the real consumer wage. To capture the fact that this resistance would take time to materialize as workers gradually realize that the rise in energy prices is permanent, the increase in market power is phased in during the third and fourth years of the simulation. In part, this increased market power could arise because of the easier monetary conditions. In this scenario, the secondary burst of inflation roughly doubles in magnitude even though the relative increase in real wages is small. This reflects the fact that with the same view of the potential output process, the policymaker's error about the output gap increases. This arises because, given the relatively higher real wages, firms adjust the labor input faster, moving more quickly to the long-run equilibrium level of capacity output.

25.   **The important interaction between labor suppliers' response to the shock and the monetary authority's estimate of potential output is highlighted by considering an additional scenario.** In this scenario it is assumed that the monetary authority understands the structure of the economy and can compute the flexible-price solution for output. This is the outcome for GDP that would be achieved if there were no nominal rigidities in the economy. This flexible-price level of GDP is then used by the monetary authority as its estimate of potential output. This estimate is in turn used to compute the output gap

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[8] Initially the policymaker's estimate of potential output is generated putting a weight of 0.95 on the pre-shock level of output and a weight of 0.05 on the post-shock long-run level of output that is achieved once all adjustment has occurred. As the policymaker moves through time the weight on the old level of output gradually declines to zero and the weight on the new long-run level of output gradually increases to unity.

Figure 5. Alternative Responses of Monetary Authority and Labor Suppliers
(percent or percentage point deviation from baseline)

Solid - base case.
Dotted - output gap in reaction function.
Dashed - output gap in policy rule and temporary increase in labor suppliers' market power.
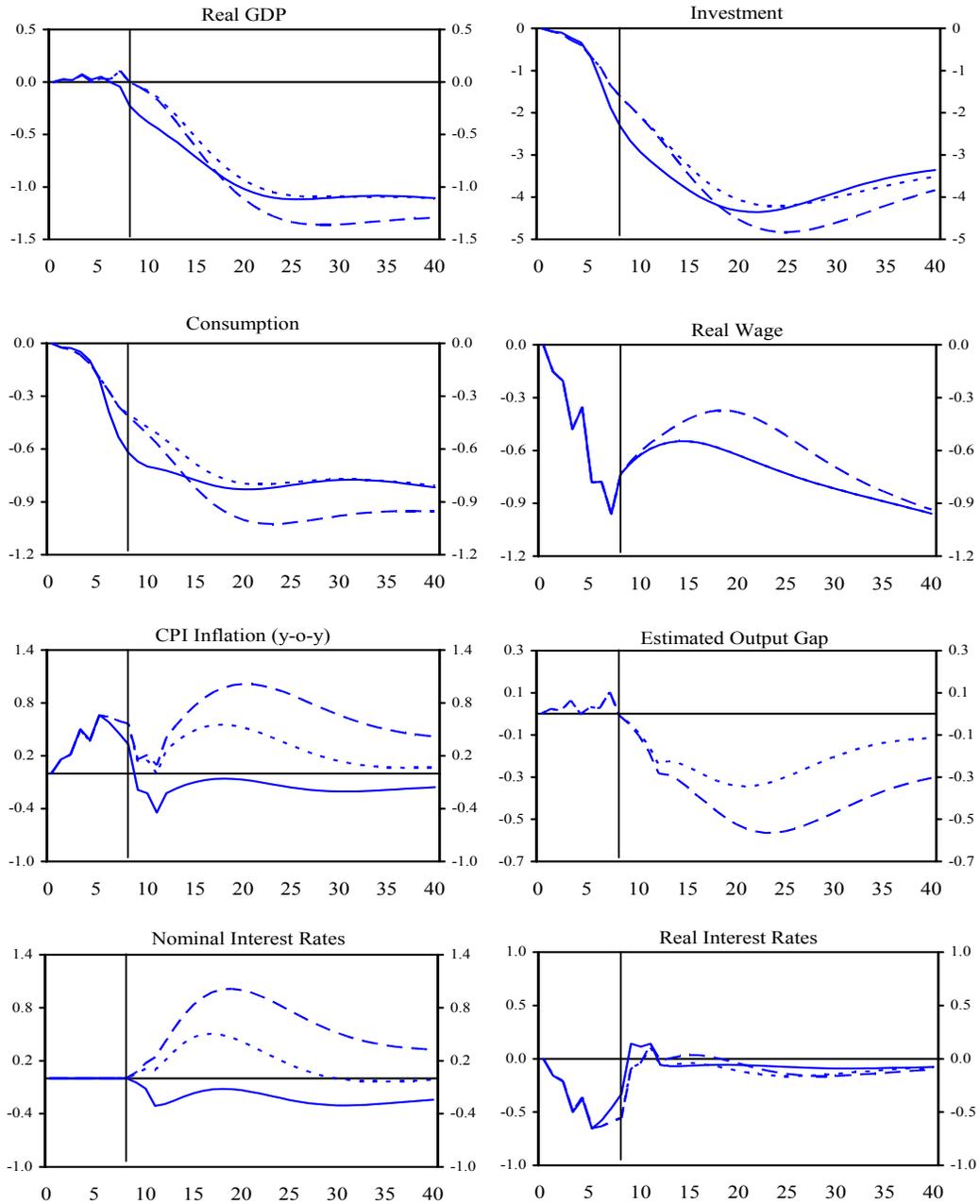
Source: GEM Simulations.

appearing in the reaction function. Further, this scenario also includes the temporary increase in wage bargainers' market power (dotted line in Figure 6). When the monetary authority fully understands the supply side of the economy, there is no secondary burst of persistent inflation even if there is a temporary increase in workers' market power that slows the adjustment in real wages.

D. Conclusions

26.   **Permanent increases in energy prices can be expected to have a negative impact on the level of GDP in most of the major industrial economies.** Underlying the reduction in GDP is a decline in output in the non-energy sectors as firms reduce their production capacity due to the permanent increase in a factor cost, energy. In Canada, however, the positive impact on the energy sector because of Canada's large net export position more than offsets the negative impact on the non-energy sector. While headline inflation spikes up in proportion to the energy intensity of households final consumption bundle in each country, there are no persistent inflation effects. This favorable inflation outcome arises for two reasons. First, under the inflation-forecast-targeting policy rule, the actions of the monetary authority are based on a complete understanding of the supply-side implications of the shock. Second, labor suppliers accept the required real reduction in their final consumption wage.

27.   **Despite the positive impact on the energy sector in the United Kingdom, the increase in energy prices that has occurred over the last two years, if sustained, will permanently reduce the level of GDP.** The simulation results suggest that, once adjustment is complete, GDP in the United Kingdom will be lower by just over 1 percentage point given the current energy intensity of production and consumption. Firms in the non-energy sector facing a permanently higher factor cost (energy) respond by producing less output by employing fewer of all the factors of production.

28.   **The simulation results suggest that, in the United Kingdom, the peak in the direct impact on CPI inflation of the recent run up in energy prices will be in the neighborhood of 0.7 percentage points.** Although the immediate pass-through structure of the model suggests the peak in CPI inflation should have occurred after 5 quarters, which would correspond to the first quarter of 2005, actual pass-through in the U.K economy is likely to be slower. If, as assumed in the simulation, oil price do not rise any further, it may be that the peak direct effect has already occurred in U.K. headline inflation.

29.   **If the resulting reduction in aggregate supply is not fully internalized into the monetary policy setting process, persistent above-target inflation can emerge following the initial direct effects on headline CPI inflation.** To illustrate how such an event might occur, the simulation analysis incorporated a standard Taylor-type monetary policy reaction function that included a response coefficient on the policymaker's estimate of the output gap. If that estimate of the output gap is based on a slowly evolving view of aggregate supply, then policy will be set too loosely, fueling inflation as private agents understand the implications of the policymaker's view.

Figure 6. Responding to the Flexible-Price Output Gap
(percent or percentage point deviation from baseline)

Solid - base case.
Dashed - output gap in policy rule and temporary increase in labor suppliers' market power.
Dotted - flexible-price output gap in policy rule and temporary increase in labor suppliers' market power.
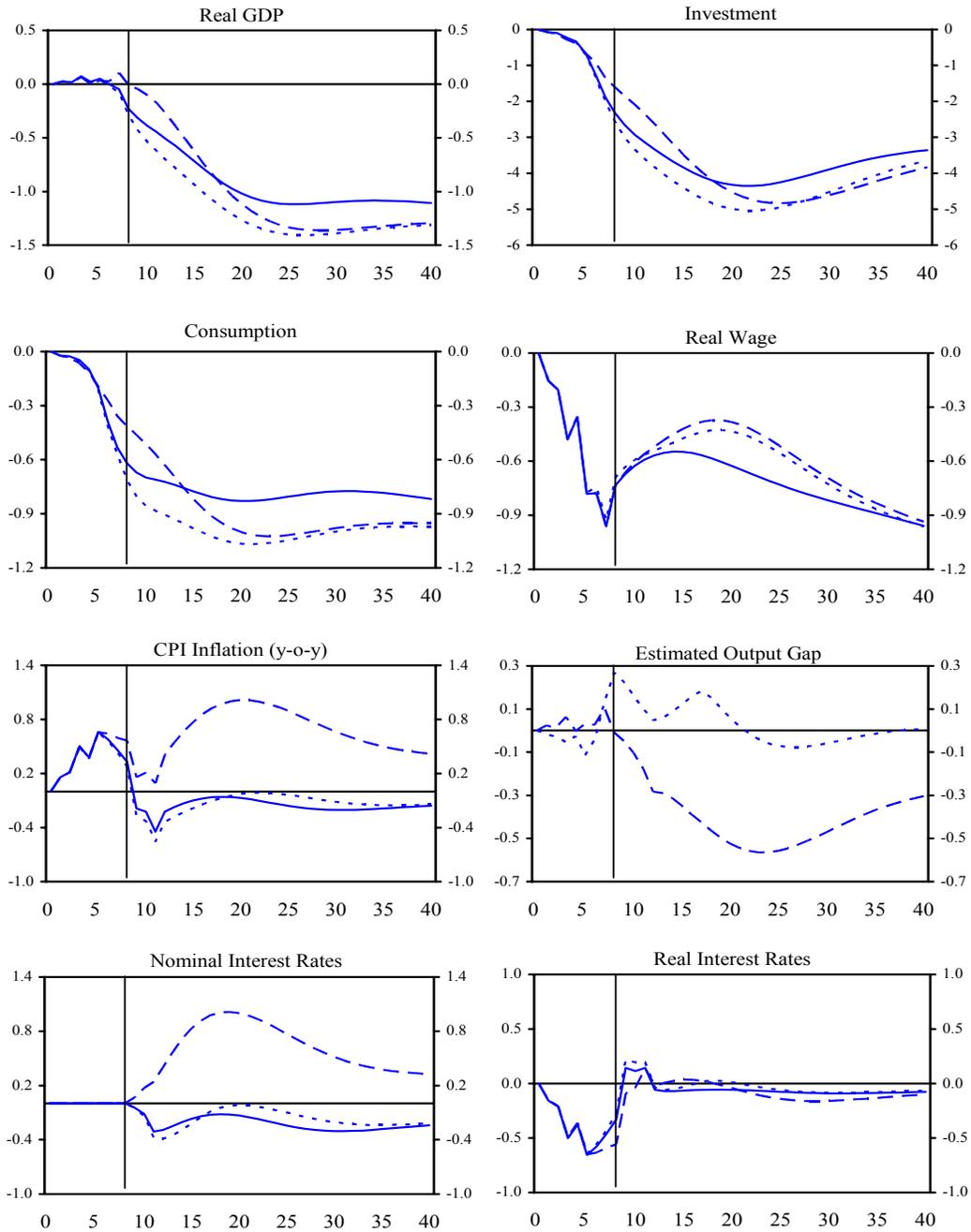
Source: GEM Simulations.

30.   **A temporary increase in labor suppliers' market power, when monetary policy is being guided by a slowly evolving estimate of aggregate supply, can greatly amplify the second round acceleration in inflation.** Once wage bargainers come to believe that the increase in energy prices in permanent, they may attempt to recover a portion of the resulting decline in their real consumption wages. An environment in which monetary policy is perceived to be somewhat accommodative may encourage workers to attempt to do this. Although the resulting wage pressures do directly stimulate inflation somewhat, the largest impact comes through its effect on monetary policy. The response of firms to more quickly reduce labor utilization and its resulting implications for aggregate supply increases the magnitude of the monetary authority's estimate of the extent of excess supply and, consequently, magnifies the excess accommodation in policy settings.

31.   **For policymakers, effectively communicating their assessment of the negative supply-side implications of permanent increases in energy prices is essential to avoid persistent above-target inflation.** The simulations suggest that private agents' expectations about the level of economic activity that the monetary authority views as being sustainable will have important implications for the second-round inflation effects. In addition to the direct effect that this has on inflation via expectations, it could also increase second-round effects coming through the labor market. This could arise if perceptions about the monetary authority's preference for output stabilization encourages labor suppliers to resist the required declines in real wages given permanently higher energy prices. If workers are able to temporarily resist the required real wage declines, it is important that policymakers factor this in to their assessment of sustainable economic growth to avoid further exacerbating second-round effects.

Technical Presentation of Energy in GEM

Demand for Energy in Final Good

The integral of the Home final goods producing firms output at time (quarter) t is denoted A_t and can be thought of as capturing Home preferences over the range of goods available for consumption.[9] The final good is produced with the following CES technology:

$$
A_t = \left\{ (1-\gamma)^{\frac{1}{\varepsilon}} N_{N,t}^{1-\frac{1}{\varepsilon}} + \gamma^{\frac{1}{\varepsilon}} \left[(1-\gamma_{OA})^{\frac{1}{\varepsilon_{OA}}} \left(v^{\frac{1}{\varepsilon_{QM}}} Q_t^{1-\frac{1}{\varepsilon_{QM}}} + (1-v)^{\frac{1}{\varepsilon_{QM}}} \left[M_t \left(1-\Gamma_{M,t}\right) \right]^{1-\frac{1}{\varepsilon_{QM}}} \right)^{\left(\frac{\varepsilon_{QM}}{\varepsilon_{QM}-1}\right)\left(1-\frac{1}{\varepsilon_{OA}}\right)} \right.\right.
$$

$$
\left.\left. + \gamma_{OA}^{\frac{1}{\varepsilon_{OA}}} \left(v_O^{\frac{1}{\varepsilon_{QMOA}}} Q_{OA,t}^{1-\frac{1}{\varepsilon_{QMOA}}} + (1-v_O)^{\frac{1}{\varepsilon_{QMOA}}} M_{OA,t}^{1-\frac{1}{\varepsilon_{QMOA}}} \right)^{\left(\frac{\varepsilon_{QMOA}}{\varepsilon_{QMOA}-1}\right)\left(1-\frac{1}{\varepsilon_{OA}}\right)} \right]^{\left(\frac{\varepsilon_{OA}}{\varepsilon_{OA}-1}\right)\left(1-\frac{1}{\varepsilon}\right)} \right\}^{\left(\frac{\varepsilon}{\varepsilon-1}\right)}
\tag{1}
$$

Three intermediate goods and two energy goods are used in the production of the final good A: a basket N_N of domestically-produced nontradables, a basket Q of domestically-produced intermediate tradable goods, a basket M of imported intermediate tradable goods, a basket Q_{OA} of domestically-produced energy goods and a basket M_{OA} of foreign-produced energy goods. The elasticity of substitution between tradable and nontradable goods is $\varepsilon > 0$. The elasticity of substitution between the tradable intermediate good and the tradable energy good is $\varepsilon_{OA} > 0$. The elasticity of substitution between the domestic and foreign tradable intermediate good is $\varepsilon_{QM} > 0$ and $\varepsilon_{QMOA} > 0$ is the elasticity of substitution between the domestic and foreign energy good. The parameters γ and $\gamma_{OA} \in (0,1)$ are the weights on tradable goods and energy respectively in the production of the final good. The parameters v and $v_O \in (0,1)$ are the weights on the domestically-produced tradable intermediate good and energy in the final good. These parameters are measures of home bias in consumption. Imports of intermediate goods are subject to adjustment cost $\Gamma_{M,t}$.

---

[9] The convention throughout the model is that variables which are not explicitly indexed (to firms or households) are expressed in per-capita (average) terms. For instance,
$A_t = (1/s)_o^s A_t(x) d_x$

Taking prices as given, cost minimization in Home final good production yields the demands for tradable goods and energy as follows:

$$Q_t^D = \gamma \left(1 - \gamma OA\right)^v \left(\frac{P_{Q,t}}{P_t}\right)^{-\varepsilon_{QM}} \left(\frac{P_{X,t}}{P_t}\right)^{\varepsilon_{QM} - \varepsilon_{OA}} \left(\frac{P_{T,t}}{P_t}\right)^{\varepsilon_{OA} - \varepsilon} A_t \tag{2}$$

$$M_t^D = \gamma \left(1 - \gamma_{OA}\right)\left(1 - v\right)\left(\frac{P_{M,t}}{P_t}\right)^{-\varepsilon_{QM}} \left(\frac{P_{X,t}}{P_t}\right)^{\varepsilon_{QM} - \varepsilon_{OA}} \left(\frac{P_{T,t}}{P_t}\right)^{\varepsilon_{OA} - \varepsilon} A_t$$

$$* \frac{\left[1 - \Gamma_{M,t} - \phi_M \left(\dfrac{\dfrac{M_t}{A_t}}{\dfrac{M_{t-1}}{A_{t-1}}} - 1\right)\left(\dfrac{\dfrac{M_t}{A_t}}{\dfrac{M_{t-1}}{A_{t-1}}}\right)\right]^{\varepsilon_{QM}}}{1 - \Gamma_{M,t}} \tag{3}$$

$$Q_{OA,t}^D = \gamma\gamma OA^{v_O} \left(\frac{P_{QOA,t}}{P_t}\right)^{-\varepsilon_{QMOA}} \left(\frac{P_{OA,t}}{P_t}\right)^{\varepsilon_{QMOA} - \varepsilon_{OA}} \left(\frac{P_{T,t}}{P_t}\right)^{\varepsilon_{OA} - \varepsilon} A_t \text{ , and} \tag{4}$$

$$M_{OA,t}^D = \gamma\gamma OA \left(1 - v_O\right)\left(\frac{P_{MOA,t}}{P_t}\right)^{-\varepsilon_{QMOA}} \left(\frac{P_{OA,t}}{P_t}\right)^{\varepsilon_{QMOA} - \varepsilon_{OA}} \left(\frac{P_{T,t}}{P_t}\right)^{\varepsilon_{OA} - \varepsilon} A_t \tag{5}$$

Relative prices faced by the final goods firms are given by:

$$\frac{P_{OA,t}}{P_t} = \left(v_O \left(\frac{P_{QOA,t}}{P_t}\right)^{1 - \varepsilon_{QMOA}} + \left(1 - v_O\right)\left(\frac{P_{MOA,t}}{P_t}\right)^{1 - \varepsilon_{QMOA}}\right)^{\frac{1}{1 - \varepsilon_{QMOA}}}, \tag{6}$$

$$\frac{P_{QOA,t}}{P_t} = \left(\frac{\bar{P}_{QOA,t}}{P_t} + \eta_{OA} \frac{P_{N,t}}{P_t}\right)\left(1 + tax_{OA}\right), \tag{7}$$

$$\frac{P_{MOA,t}}{P_t} = \left(\frac{\bar{P}_{MOA,t}}{P_t} + \eta_{OA} \frac{P_{N,t}}{P_t}\right)\left(1 + tax_{OA}\right) \text{ , and} \tag{8}$$

$$\frac{P_{T,t}}{P_t} = \left[\left(1 - \gamma_{OA}\right) \left(\frac{P_{X,t}}{P_t}\right)^{1-\varepsilon_{OA}} + \gamma_{OA} \left(\frac{P_{OA,t}}{P_t}\right)^{1-\varepsilon_{OA}} \right]^{\frac{1}{1-\varepsilon_{OA}}}, \tag{9}$$

where the relative prices of the home-produced, $P_{Q,t}$, and foreign-produced, $P_{M,t}$, tradable intermediate goods, and the overall relative price of the tradable intermediate good, $P_{X,t}$ are as given in Laxton and Pesenti (2003). Also, $\overline{P}$ denotes the wholesale or producer price, η_{OA} represents the number of units of the nontradable good required to distribute a unit of the energy good to the final goods producer, and tax_{OA} is the rate at which the government taxes the energy good used in final goods production.

There are several important features of this structure worth noting. First, because energy enters the final good directly, energy price shocks will have an immediate impact on headline inflation. However, the presence of a distribution sector in energy, based on Corsetti and Dedola (2002),[10] mutes the impact of changes in the producer price of energy on the final consumption price. In this application, these distribution services represent things like transportation and refining. The more important are these services in the final energy good, the more muted will be the impact of changes in producer prices on final energy prices. Finally, the structure allows for government to tax energy goods. The specification above implies an ad valorem tax, however, alternative formulations which lead to government tax policy muting the impact of changes in the producer price of energy can be easily implemented.

Demand for Energy in Intermediate Goods Production

The CES production technologies in the tradable, T, and nontradable, N, intermediate goods sectors are given by:

$$T_t = Z_{T,t} \left[\left(1 - \alpha_T - \gamma_T\right)^{\frac{1}{\xi_T}} \ell_{T,t}^{1-\frac{1}{\xi_T}} + \alpha_T^{\frac{1}{\xi_T}} K_{T,t}^{1-\frac{1}{\xi_T}} + \gamma_T^{\frac{1}{\xi_T}} \left[\left(1 - \Gamma_{OT,t}\right) O_{T,t}\right]^{1-\frac{1}{\xi_T}} \right]^{\frac{\xi_T}{\xi_T - 1}}, \text{ and} \tag{10}$$

$$N_t = Z_{N,t} \left[\left(1 - \alpha_N - \gamma_N\right)^{\frac{1}{\xi_N}} \ell_{N,t}^{1-\frac{1}{\xi_N}} + \alpha_N^{\frac{1}{\xi_N}} K_{N,t}^{1-\frac{1}{\xi_N}} + \gamma_N^{\frac{1}{\xi_N}} \left[\left(1 - \Gamma_{ON,t}\right) O_{N,t}\right]^{1-\frac{1}{\xi_N}} \right]^{\frac{\xi_N}{\xi_N - 1}}, \tag{11}$$

---

[10] See also Burstein, Neves, and Rebelo (2000).

where Z denotes the level of productivity, ℓ the labor input, K the capital input, O the energy input, ξ the constant elasticity of input substitution, γ and α are the parameters that determine the shares of energy, and capital respectively and Γ_O is the cost of adjusting the energy input. Taking input prices as given, solving the intermediate goods firms' cost minimization problem yields demands for the energy input given by:

$$Q_{ON,t}^{D} = v_{ON}\left(\frac{P_{QO,t}}{P_{ON,t}}\right)^{-\varepsilon_{ON}} O_{N,t}, \tag{12}$$

$$Q_{OT,t}^{D} = v_{OT}\left(\frac{P_{QO,t}}{P_{OT,t}}\right)^{-\varepsilon_{OT}} O_{T,t}, \tag{13}$$

$$M_{ON,t}^{D} = (1-v_{ON})\left(\frac{P_{MO,t}}{P_{ON,t}}\right)^{-\varepsilon_{ON}} O_{N,t}, \tag{14}$$

$$M_{OT,t}^{D} = (1-v_{OT})\left(\frac{P_{MO,t}}{P_{OT,t}}\right)^{-\varepsilon_{OT}} O_{T,t}, \tag{15}$$

$$O_{N,t} = \gamma_N \left(\frac{P_{ON,t}/P_t}{Z_{N,t}MC_{N,t}/P_t}\right)^{-\xi_N} \frac{N_t}{Z_{N,t}}$$

$$\tag{16}$$

$$* \frac{\left[1-\Gamma_{OT,t}-\phi_{OT}\left(\frac{O_{T,t}}{T_t}/\frac{O_{T,t-1}}{T_{t-1}}-1\right)\left(\frac{O_{T,t}}{T_t}/\frac{O_{T,t-1}}{T_{t-1}}\right)\right]^{\xi_T}}{1-\Gamma_{OT,t}}, \text{ and}$$

$$O_{T,t} = \gamma_T \left(\frac{P_{OT,t}/P_t}{Z_{T,t}MC_{T,t}/P_t}\right)^{-\xi} \frac{T_t}{Z_{T,t}}$$

$$\tag{17}$$

$$* \frac{\left[1-\Gamma_{OT,t}-\phi_{OT}\left(\frac{O_{T,t}}{T_t}/\frac{O_{T,t-1}}{T_{t-1}}-1\right)\left(\frac{O_{T,t}}{T_t}/\frac{O_{T,t-1}}{T_{t-1}}\right)\right]^{\xi_T}}{1-\Gamma_{OT,t}},$$

where the parameters v_{ON} and v_{OT} denote the degree of home bias in energy demand in the nontradable and tradable intermediate good sectors and the parameters ε_{ON} and ε_{OT} denote the elasticities of substitution between domestic and foreign energy in nontradable and tradable intermediate good sectors respectively.

The relative prices faced by the intermediate goods producers are given by:

$$\frac{P_{ON,t}}{P_t} = \left(v_{ON} \left(\frac{P_{QO,t}}{P_t} \right)^{1-\varepsilon_{ON}} + \left(1-v_{ON}\right) \left(\frac{P_{MO,t}}{P_t} \right)^{1-\varepsilon_{ON}} \right)^{\frac{1}{1-\varepsilon_{ON}}}, \tag{18}$$

$$\frac{P_{OT,t}}{P_t} = \left(v_{OT} \left(\frac{P_{QO,t}}{P_t} \right)^{1-\varepsilon_{OT}} + \left(1-v_{OT}\right) \left(\frac{P_{MO,t}}{P_t} \right)^{1-\varepsilon_{OT}} \right)^{\frac{1}{1-\varepsilon_{OT}}}, \tag{19}$$

$$\frac{P_{QO,t}}{P_t} = \left(\frac{\overline{P}_{QO,t}}{P_t} + \eta_O \frac{P_{N,t}}{P_t} \right) \left(1+tax_O\right), \text{ and} \tag{20}$$

$$\frac{P_{MO,t}}{P_t} = \left(\frac{\overline{P}_{MO,t}}{P_t} + \eta_O \frac{P_{N,t}}{P_t} \right) \left(1+tax_O\right), \tag{21}$$

where tax_O is the rate at which the government taxes energy used as an intermediate input, and η_O represents the number of units of the nontradable good required to distribute a unit of the energy good to the intermediate goods firms.

As was the case with the final consumption price of energy, the existence of distribution services in energy used in the production of intermediate goods will mute the impact of changes in the producer price of energy on the prices paid by intermediate goods producers. There is also a role for government tax policy. The level of distribution services and government tax policy can be different in energy used in the production of intermediate goods and energy used directly in the final good. Unlike the case of energy price effects in the final good, the existence of adjustment costs in intermediate goods price setting implies that changes in the price of energy inputs will only be passed slowly into intermediate goods prices. Further, because it is costly for intermediate goods producers to adjust the quantity of energy used in production, the short-run elasticity of substitution between energy and the other two inputs, can be significantly below ξ_N and ξ_T.

Energy Production

The CES production technology for energy is given by:

$$
T_{O,t} = Z_{O,t} \left[(1 - \alpha_O - \gamma_O)^{\frac{1}{\xi_O}} \ell_{O,t}^{1 - \frac{1}{\xi_O}} + \alpha_O^{\frac{1}{\xi_O}} K_{O,t}^{1 - \frac{1}{\xi_O}} + \gamma_O^{\frac{1}{\xi_O}} LAND_t^{1 - \frac{1}{\xi_O}} \right]^{\frac{\xi_O}{\xi_O - 1}},
\tag{22}
$$

where $Z_{O,t}$ denotes the level of productivity, $\ell_{O,t}$ denotes the labor input, $K_{O,t}$ denotes the capital input, $LAND_t$ denotes the fixed factor land, $\gamma_O and \alpha_O$ are the parameters that determine the shares of land and capital respectively, and ξ_O is the elasticity of input substitution.

Taking input prices as given, the solution to the energy producer's cost minimization problem yields real marginal cost in energy production as:

$$
\frac{MC_{QO}}{P_t} = \frac{\left[\varphi_O (W_t / P_t)^{1-\xi_O} + \alpha_O (R_t / P_t)^{1-\xi_O} + \gamma_O (P_{L,t} / P_t)^{1-\xi_O} \right]^{\frac{1}{1-\xi_O}}}{Z_{O,t}},
\tag{23}
$$

where $\varphi_O = (1 - \alpha_O - \gamma_O), W_t / P_t$ is the real wage, R_t / P_t is the real user cost of capital, and $P_{L,t} / P_t$ is the real price of land.

In the presence of a distribution sector in energy and monopolistic competition, the producer or wholesale prices of the energy good are given by the following markups over marginal cost:

$$
\frac{\overline{P}_{QOA,t}}{P_t} = \left(\frac{1}{\theta_O - 1} \right) \eta_{OA} \frac{P_{N,t}}{P_t} + \left(\frac{\theta_O}{\theta_O - 1} \right) \frac{MC_{QO}}{P_t}
\tag{24}
$$

$$
\frac{\overline{P}_{MOA,t}}{P_t} = \left(\frac{1}{\theta_O^* - 1} \right) \eta_{OA} \frac{P_{N,t}}{P_t} + \left(\frac{\theta_O^*}{\theta_O^* - 1} \right) \frac{MC_{QO}^*}{P_t} \left(\frac{\varepsilon_t P_t^*}{P_t} \right),
\tag{25}
$$

$$
\frac{\overline{P}_{QO,t}}{P_t} = \left(\frac{1}{\theta_O - 1} \right) \eta_O \frac{P_{N,t}}{P_t} + \left(\frac{\theta_O}{\theta_O - 1} \right) \frac{MC_{QO}}{P_t}, \text{ and}
\tag{26}
$$

$$
\frac{\overline{P}_{MO,t}}{P_t} = \left(\frac{1}{\theta_O^* - 1} \right) \eta_O \frac{P_{N,t}}{P_t} + \left(\frac{\theta_O^*}{\theta_O^* - 1} \right) \frac{MC_{QO}^*}{P_t} \left(\frac{\varepsilon_t P_t^*}{P_t} \right),
\tag{27}
$$

where ε_t is the nominal exchange rate and θ_O is the elasticity of input substitution (the lower is the elasticity of input substitution, the greater is the energy producers' market power and the larger is the markup over marginal cost in energy prices).

Given this structure, the producer price of energy is endogenously determined in GEM. The structure can be calibrated so that the supply of energy is very inelastic and small changes in demand yield large changes in prices. Alternatively, changes on the supply side to either the quantity of land available for energy production or energy producers' markup over marginal cost can also lead to sharp changes in energy prices.

Nontradable Good Resource Constraint

The resource constraint in the nontradable intermediate good N_t is given by:

$$N_t = N_{N,t} + \eta(Q_t + M_t) + \eta_O(Q_{ON,t} + Q_{P,t} + M_{ON,t} + M_{OT,t}) + \eta_{O4}(Q_{O4,t} + M_{O4,t})$$ (28)

In addition, with imports of the intermediate input now going into the production of the final nontraded good, the equations for imports, exports, the trade balance, the current account and the exchange rate must all be modified slightly to account for this. There is also a symmetric set of equations added or modified as outlined above for the foreign sector.

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II. THE LINK BETWEEN PRIVATE CONSUMPTION AND THE HOUSING MARKET [11]

In the U.K., the cooling of the housing market was accompanied by a sharp slowdown in consumption growth. This paper finds that the main determinants of consumption growth are changes in income and wealth. Changes in housing wealth have an effect on consumer spending on impact, while changes in financial wealth affect consumption only gradually. The results suggest that, between 2001–04, the positive effect of housing wealth growth on consumption was offset by the negative effect of the equity market correction. Looking forward, strong income growth should underpin a sustained pick-up in consumption, in the absence of further negative shocks from the housing market.

A. Introduction

1. **The cooling of the housing market in 2004-05 coincided with a sharp slowdown in private consumption growth** (Figure 1). This has raised concerns regarding the resilience of consumption in the event of persistent weakness in the housing market. Among industrial countries with significant cumulative house price appreciation since the mid-1990s, the Netherlands was the first to experience an extended period of low house price growth. This was accompanied by a period of very weak consumption growth (see Figure 2 and De Nederlandsche Bank (2004)). More recently, Australia also saw a sharp slowing of both residential asset prices and consumption growth, although domestic activity has been supported by strong commodity export prices.

2. **The degree of sensitivity of consumption to house price developments is a subject of on-going debate in the U.K.** Historically there has been a strong correlation between consumption and house price growth. However, the apparent breakdown of the correlation since the early 2000s could be interpreted as diminished sensitivity of expenditure to housing market developments (Figure 1, second panel). A possible alternative explanation is that the sharp equity market correction offset the positive effect of house price appreciation on consumption. In the second half of the 1990s, both housing and financial wealth increased rapidly, while the household savings ratio declined from above ten percent to 4–5 percent of disposable income (Figure 3). The stock market drop in the early 2000s reduced the households' net financial wealth by an amount equivalent to one year's disposable income. The decline in total wealth was attenuated by the steady rise in house prices. If household spending is affected by changes in both types of wealth, the puzzle of the weak correlation between housing price growth and consumption growth in recent years could potentially be resolved.

3. **This chapter re-examines the determinants of private consumption expenditure suggested by the literature on consumer behavior.** The first section reviews the theoretical case for possible effects of changes in household wealth on consumption. The following

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[11] Prepared by Dora Iakova.

Figure 1. Real Private Consumption and Real House Price Growth 1/
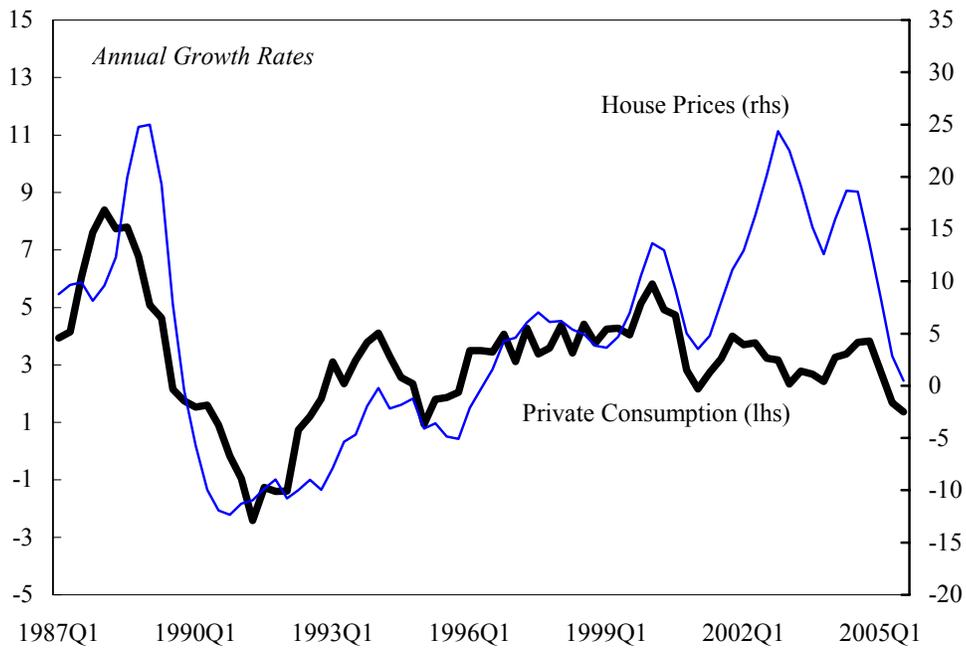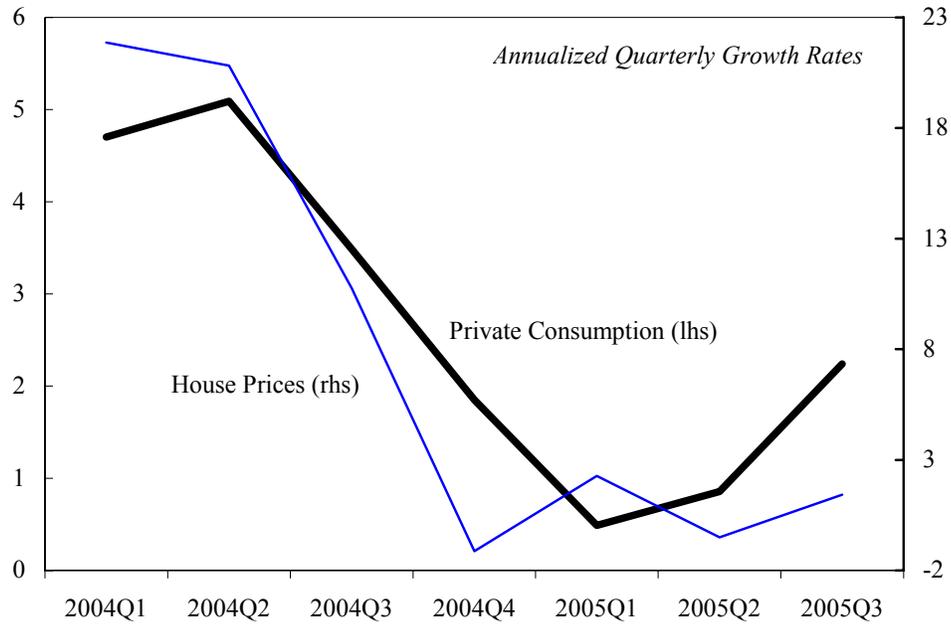
Source: UK Office of National Statistics, Nationwide, Halifax, and staff calculations.
1/ The house price index is the average of Halifax and Nationwide, deflated by the
private consumption deflator.

Figure 2. Global House Price Developments
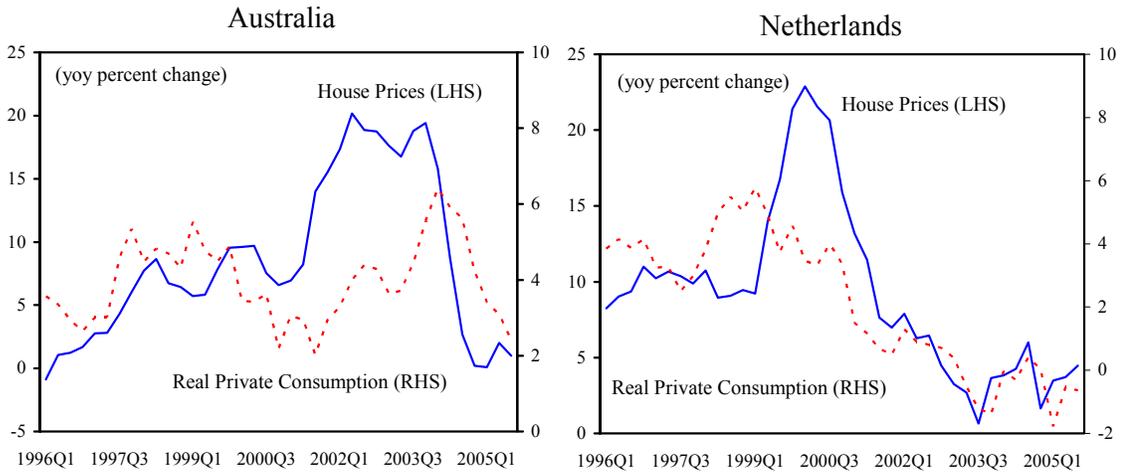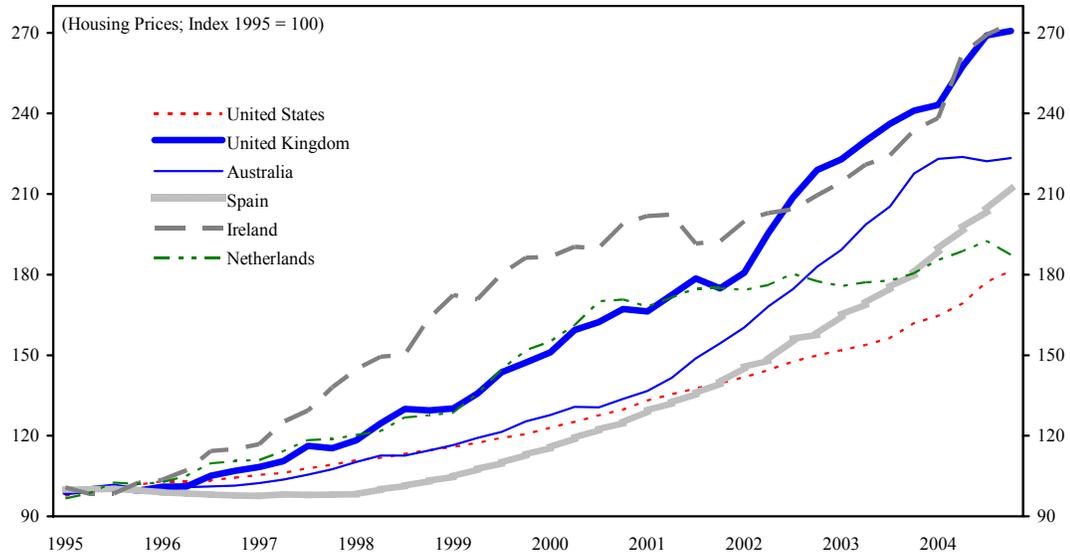
Sources: Haver Analytics; *IMF*, International Financial Statistics; national sources; OECD, Bank for International Settlements; and IMF staff calculations.

Figure 3. Net Household Wealth and Savings, 1987-2005
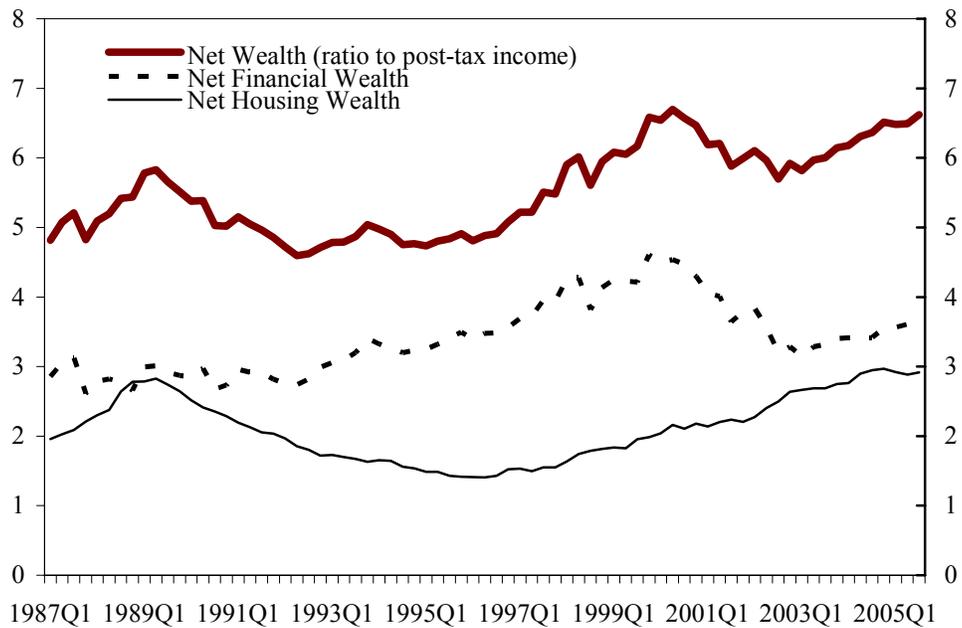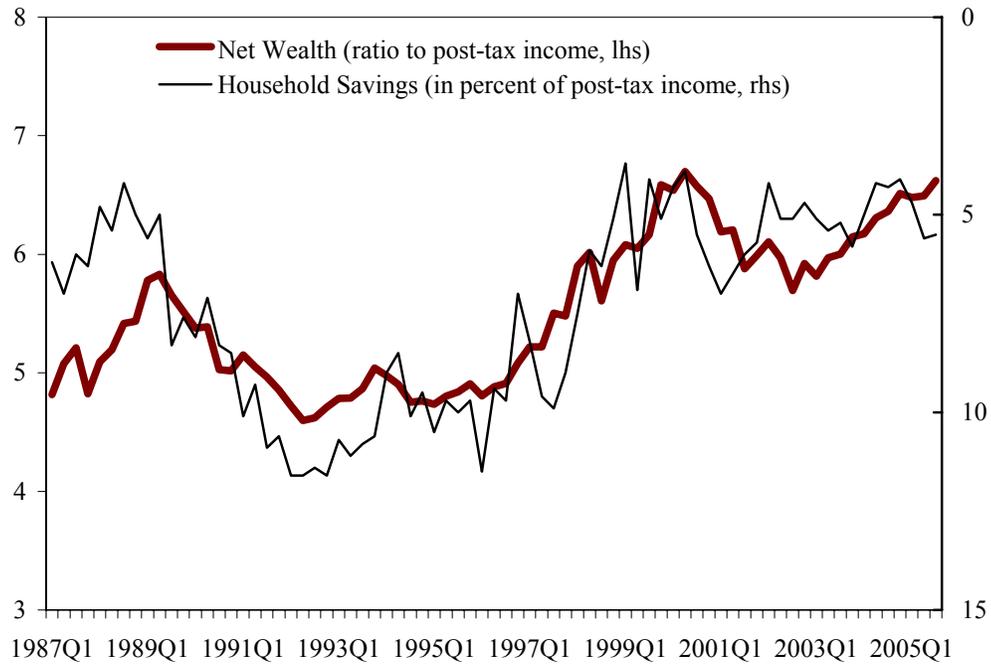
Source: UK Office of National Statistics and staff calculations.

sections presents the empirical results from a standard error-correction model of consumption, estimated over the period 1987–2005. The estimation results suggest that consumption growth follows closely movements in income, with wealth also playing a role. Changes in housing wealth have a significant effect on consumption both in the short and in the long run, while changes in financial wealth affect consumer spending only gradually.

B. Theoretical Background

4.   **Most of the literature on consumption behavior is based on the permanent income hypothesis (PIH).** The PIH implies that the flow of consumption is chosen via intertemporal optimization given expectations of permanent income, defined as the annuity value of human and non-human wealth. The recent resurgence of empirical interest in that literature is related to importance of assessing the effect of asset prices on the real economy in the context of active monetary policy. Below we review the theoretical case for a possible effect of wealth changes on consumption, and discuss if the impact depends on the type of wealth.[12]

5.   **The first channel through which asset prices may affect consumption is the traditional wealth channel.** It follows directly from the permanent income hypothesis – an unexpected rise in asset prices increases the wealth of households and their current spending. While this effect is unambiguous in the case of financial asset prices, for housing the case is less clear, since a rise in prices also increases the cost of future housing services (assuming rents move in tandem with house prices). The positive wealth effect for most homeowners could be at least partially offset by negative wealth effects for those that are "short" the housing asset - renters and people intending to buy a larger house. The net effect would depend, among other things, on the share of owner-occupied housing, the age of the population, and the extent to which actual rents move in line with house prices.

6.   **Second, increases in asset prices expand the collateral available to liquidity constrained households.** Mortgage equity withdrawal is a relatively inexpensive source of funds that can be used to boost consumption. The growth of uncollateralized lending also tends to be correlated with asset price cycles. There is strong evidence for the existence of a collateral effect both theoretically and empirically.[13] Generally, changes in house prices are expected to have greater influence on consumption than changes in financial assets through this channel. Housing is a widely held asset, while the distribution of financial wealth is heavily skewed toward households in the upper tail of the income distribution, which are less likely to be liquidity constrained. In addition, financial asset prices are more volatile than

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[12] The focus of this paper is on consumption, even though investment can be influenced by changes in asset prices as well.

[13] See, for example, Aoki et al. (2001) and references therein; and the financial accelerator literature pioneered by Bernanke and Gertler.

house prices, therefore shocks to financial wealth are more likely to be perceived as temporary and may not affect borrowing and consumption in the short run. With continuing financial innovation, however, the number of liquidity constrained households may be declining, which could have reduced the strength of the collateral effect over time.

7.   **Indeed, credit-financed consumption tends to be correlated with asset prices** (Figure 4). Aggregate durable goods expenditure, housing prices, and credit growth are highly correlated. The comovement between non-durables consumption and housing prices is much less pronounced, since non-durable goods purchases are less frequently financed by borrowing.

Figure 4. Real Consumption and House Price Annual Growth, 1983-2005
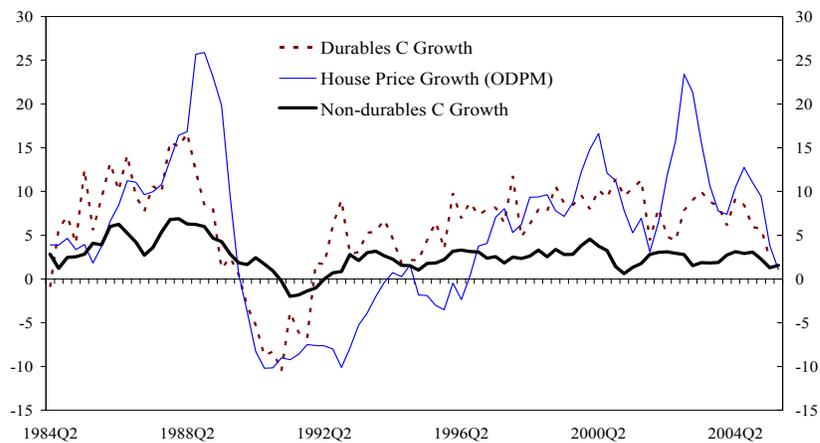
8.   **Third, changes in asset prices have an impact on consumer confidence.** A sharp slowdown in asset price appreciation may create uncertainty and lead to a decline in investment and consumption. There might be additional channels – for example, Benito and Wood (2005) show that the number of housing transactions affects durables spending. Since transactions tend to be positively correlated with house price movements, the transactions effect will complement any asset price effects on consumption.

9.   **Finally, asset prices and consumption are affected by common shocks.** The above discussion focuses on channels through which changes in asset values can affect consumption. However, asset prices and consumption are jointly determined by individual decisions and their movements will be influenced by common shocks, such as interest rate shocks or changing expectations for future income growth. While it is difficult to estimate separately the liquidity effect, the "pure wealth" effect, and the "common shocks" effect using aggregate data, one could, in principle, distinguish between them using micro data. The evidence from the micro literature is sometimes conflicting, but on balance, research tends to

support the hypothesis that asset price movements affect consumption, even after accounting for common shocks.[14]

10.   **The analysis in this paper is based on the life-cycle version of the permanent income theory.** Gali (1990) has extended the PIH to allow for finite individual life horizons. His model implies a linear long-run relationship between aggregate consumption (C), labor income as a proxy for human wealth (Y), and non-human wealth (see Appendix I for a sketch of the model). Since different types of wealth may have different effects on consumption, in the estimation non-human wealth has been separated into two main components – housing wealth (HW) and financial wealth (FW):

$$C_t = \alpha + \beta Y_t + \delta HW_t + \gamma FW_t + u_t$$

11.   **A standard error correction model is used in the empirical estimation.**[15] The above long-run relationship is estimated first, and the short-run movements in consumption growth are estimated in the second step. To keep the analysis manageable, some important temporary factors that can affect real consumption, like oil prices, are not included in the model.

C. Data Issues

12.   **The permanent income hypothesis applies to the flow of consumption services, which could be different from the measured total consumption expenditure.** Consumption expenditure includes spending on non-durable goods, services, and durable goods. The consumption services provided by durable goods and spending on these goods are typically separate events in time. Aggregation over individual durable purchases removes part of this difference, but durables spending remains much more volatile over time than the flow of durables goods services.[16] For that reason, in empirical analysis total consumption is frequently proxied by the consumption non-durables and services. That is appropriate, however, only if the share of durables in total expenditure is not changing systematically. This has not been the case in practice – since the mid-1990s, there has been a trend increase in the share of durables in real consumption, reflecting their falling relative price.

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[14] See Campbell and Cocco (2005) for evidence for the U.K. and Bostic et al. (2005) for evidence for the U.S. Attanasio et al. (2005) support only the common causality hypothesis.

[15] The model is similar to that used by the HM Treasury (2003), Tzanninis (2002), and the Bank of England (2000).

[16] See Hamilton and Morris (2002) for empirical evidence for the UK, and Caballero (1994) for a theoretical discussion.

13.   **This study presents estimates of the consumption function using both actual consumption expenditure and a constructed flow of consumption services measure.** Hamilton and Morris (2002) have constructed a flow of durable goods services measure for the U.K. by assuming a fixed life for the various categories of durable goods. The results using this measure are comparable to studies for the U.S. that typically use non-durables consumption. However, the model for the flow of consumption services can not be used for short-term growth forecasting since the actual consumer expenditure is much more procyclical and sensitive to asset movements than the smoothed flow of consumption. Therefore, estimates using total consumption expenditure are also presented and used for simulation analysis – the results from this exercise are comparable with most of the earlier consumption studies for the U.K.

14.   **Statistical analysis of the data is presented in Appendix II.** Unit root tests for all series used in the estimation suggest that they are first difference stationary. Next, consumption, income, housing wealth, and financial wealth are tested for cointegration. The maximum eigenvalue and the trace statistics suggest the presence of one cointegrating vector for both total consumption and the flow of consumption services measure.

D. Empirical Estimation

15.   **A long-run cointegrating relationship between consumption and its fundamental determinants is estimated using three different methods** – the dynamic least squares estimator of Stock and Watson (1993), the Johansen cointegration procedure (Johansen, 1998), and the fully modified OLS estimator (Phillips and Hansen, 1990).[17] The alternative estimates produce similar long-run coefficients (Appendix II, Table A3). The cointegrating vectors based on the Johansen procedure are presented in Table 1.

Table 1. Estimation Results for the Cointegrating Vector

	Consumption Flow	Total Consumption
Income	0.66	0.85
	(0.03)	(0.04)
Net housing wealth	0.048	0.072
	(0.008)	(0.010)
Net financial wealth	0.072	0.075
	(0.015)	(0.019)

Note: Standard errors are in parenthesis.

---

[17] All three procedures provide consistent and asymptotically efficient estimates of the long-run coefficients, accounting for the endogeneity of variables and for the serial correlation of the residuals (see Hamilton (1994)).

16.   **The main determinant of household consumption in the long run is income, with wealth also playing an important role.** The long-run income elasticity and the housing wealth elasticity are both higher for consumption expenditure than for the measure of consumption flow, reflecting the strong pro-cyclical behavior of durable goods expenditure and their high sensitivity to housing market developments. All coefficients are statistically significant and similar in magnitude to the results from earlier studies for the U.K. using the same methodology (Table 2). Various test for constancy of the coefficients show no evidence of instability in the estimated cointegrating relationships (see Appendix II, C).

Table 2. Estimates of Total Consumption Elasticities for the U.K. from Recent Published Studies

Y	0.89	0.85	0.81	0.85
HW	0.05	0.10	0.08	0.07
FW	0.07	0.04	0.05	0.07
Short run coefficient:				
d(HW)	0.12	0.14	0.30	0.14
	BOE(2000)	Tzanninis (2002)	Treasury (2003)	Iakova (2006)

Note: The exact variable definitions and model specifications may differ somewhat across these studies.

17.   **The estimates suggest that the strength of the housing market has supported consumption growth in the early 2000s, despite the sharp adjustment of the equity market** (Figure 5). In fact, actual consumption expenditure has exceeded the estimated long-run equilibrium level during most of the 2001-2004 period (rather than being below it as a simple comparison of house price growth and consumption growth may suggest). Currently, consumption expenditure is marginally below the estimated equilibrium consumption level.

Figure 5. Actual and Estimated Long Run Equilibrium Consumption
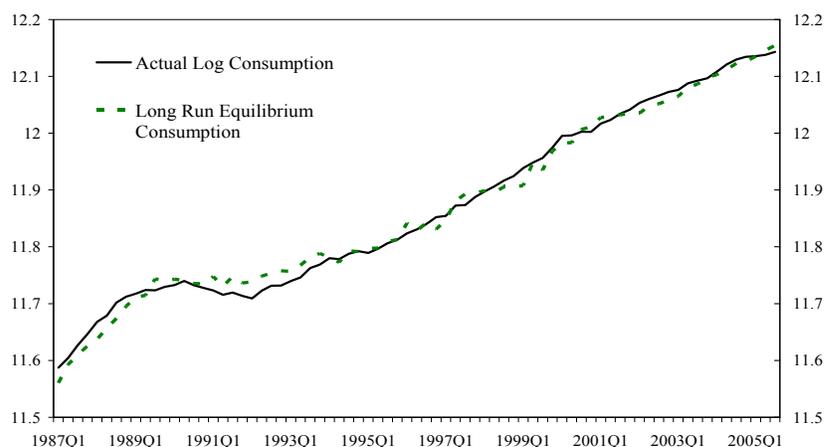
18.   **In the short run, there may be persistent deviations from the estimated long-run equilibrium due to slow adjustment or various temporary shocks that affect consumption.** For example, consumers may not respond immediately to wealth shocks if they are not sure whether the shocks are temporary or permanent.[18] There could be particular uncertainty in the case of financial shocks since financial asset prices tend to be very volatile.

19.   **The short-run dynamics of consumption are modeled in an error-correction form.** The change in consumption is estimated as a function of changes in income, wealth, and the lagged residual from the long-run relationship (ECT). The change in the nominal interest rate and the lagged change in unemployment are also added to the equation.[19] An increase in unemployment creates income uncertainty that can raise precautionary savings (see Benito, 2004). The nominal interest rate captures cash-flow effects and is expected to have a negative effect on consumption.[20] The equation was first estimated using instrumental variables techniques (generalized method of moments) to account for the possible endogeneity of changes in consumption, income, and wealth. The set of instruments consisted of lagged changes of income and wealth and all explanatory variables, except for the contemporaneous changes of income and wealth. The Durbin-Wu-Hausman test for endogeneity was applied to compare the estimated coefficients to those from an OLS regression using the same specification.[21] Since the coefficients are not statistically different and OLS is more efficient, the results from the OLS estimation are presented (Table 3).

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[18] An interesting recent strand of the wealth literature, following Lettau and Ludvigson (2004), decomposes the unobservable shocks to the consumption system into their permanent and transitory components (see Blake et al. (2003), for the UK). A typical finding is that consumption responds only to permanent shocks, and transitory shocks account for a significant share of the variations in total wealth (especially financial wealth). Unfortunately, the framework is not suitable for forecasting purposes due to the unobservable nature of the constructed shocks. In addition, Koop et al. (2005) shed doubt on the results from this literature with their finding that the magnitude of the role of permanent shocks is difficult to estimate precisely.

[19] These two variables were first regressed on all the other explanatory variables to test for orthogonality. This preliminary analysis confirmed that the nominal interest rate is unrelated to the original regressors. For changes in the unemployment rate, the regression had some explanatory power. Including the residual from this first stage regression in the consumption equation instead of the actual unemployment change did not affect the results significantly, so the latter results are presented.

[20] The Bank of England short-run equation also includes the nominal interest rate in the consumption growth equation.

[21] See Baum et al. (2002) for a description of the test.

Table 3. Estimation results for Consumption Growth

	Consumption Flow	Total Consumption
d(Net housing wealth)	0.066	0.144
	(0.020)	(0.030)
d(Income)	0.070	0.181
	(0.033)	(0.062)
d(Unemployment rate(-1))	-0.008	-0.010
	(0.002)	(0.003)
d(Nominal Interest Rate)	-0.003	-0.004
	(0.001)	(0.002)
ECT (-1)	-0.170	-0.207
	(0.069)	(0.075)
Constant	0.004	0.003
	(0.001)	(0.001)
Sample	1987:3 2005:3	1987:3 2005:3
R2-adj	0.40	0.43
Standard Error	0.004	0.005

Note: Standard errors are in parenthesis.

20. **The main results are the following:**

- The short-run income elasticity is relatively small, suggesting substantial consumption smoothing. About 85 percent of the adjustment to income shocks is completed after two years.

- Consumption does not respond contemporaneously to changes in financial wealth. That probably reflects uncertainty about the temporary versus the permanent components of shocks to equity wealth.

- The short-run sensitivity of consumption to changes in net housing wealth is fairly high – one percent increase in housing wealth can boost private consumption expenditure by about 0.15 percent. The housing wealth elasticity of the consumption flow measure is lower, reflecting the subdued cyclicality of the service flows relative to expenditure. The fact that the estimated short-run elasticities exceed the long-run elasticities could be interpreted as evidence of a strong liquidity channel. Relaxation of liquidity constraints allows more borrowing and stimulates current consumption. However, higher debt payments reduce future consumption.

- Changes in unemployment and the nominal interest rate both have the expected negative sign. A quarter percentage point increase in unemployment is associated with a reduction of about ¼ percent in quarterly consumption growth. A twenty five basis point increase in the interest rate will reduce consumption growth by about

0.1 ercentage points. However, this coefficient does not capture the full effect of changes in the interest rates. Both wealth and income respond to interest rates and, in turn, affect consumption growth.

21.   **Sensitivity analysis suggests that the model is reasonably robust.** Estimates of the model in per capita terms, using an interpolated measure of population growth, do not affect the results significantly. Recursive estimates of the parameter coefficients (Appendix II C, Figure A1) show that the coefficients are relatively stable when the sample increases. There is a slight decline in the coefficient on housing wealth over time, which could be consistent with the hypothesis that the strength of the collateral channel has diminished over time. To examine this further, another variable was added to the original consumption growth equation – an interaction of housing wealth growth with a dummy variable, taking a value of one until the end of 1996 and zero after that. The coefficient on that variable was positive, but not statistically significant; while the coefficient on the housing wealth variable declined to 0.11. This suggests that the housing wealth effect has remained significant throughout the period. Finally, non-linearities in the response of consumption to housing wealth growth were added to the model, but these also turned to be insignificant.

E.   Dynamic Simulations

22.   **Dynamic simulations of the model capture well the decline in consumption expenditure over the past year**. The equation for total consumption was estimated with data through the first quarter of 2004,[22] and consumption growth for the following five quarters was projected out-of-sample. The forecasted growth for the first half of 2005 (solid thin line) is slightly stronger than the actual outcome, but the slowdown relative to early 2004 is evident. Based on the model, the slowdown was driven by weaker income and house price growth.

23.   **A counterfactual simulation was done to assess the importance of the weakening house price growth.** The quarterly growth of net housing wealth over the last year was set at about 2 percent (its average value in 2003). The actual average real housing wealth growth was close to zero in that period.[23] The other variables were kept at their actual values. Under this scenario, quarterly consumption growth over 2004Q4-2005Q2 would have been higher by about ¼ percentage points relative to the baseline (dotted line in the text chart above).

24.   **Finally, consumption growth is projected for a scenario of steady income growth and moderate housing wealth growth for the next five quarters.** Real post-tax

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[22] The coefficient estimates are practically the same as for the whole sample.

[23] Note that flat net real housing wealth is not equivalent to zero growth in housing prices, since consumer inflation is positive and secured debt is rising.

income is assumed to increase at its average quarterly growth rate over the last two years. Real net housing wealth and real net financial wealth are assumed to grow in line with income, while unemployment and the nominal interest rates are left unchanged. Under these assumptions, quarterly consumption growth is projected to be around 0.6 to 0.7 percent.

25.   **The simulations and the forecast should be interpreted with caution.** They assume a fixed path for the explanatory variables and do not capture any feedback among the variables, which is likely to be important in practice. In addition, the forecast errors of the equation can be fairly high in the short run. This could be due to a number of factors: (i) the model does not capture various one-off shocks that can influence consumption in the short run, (ii) large movements in wealth that are perceived as unsustainable may not affect consumption significantly, and (iii) the estimated elasticities may change over time.

Actual, Forecasted, and Simulated Real Consumption Growth
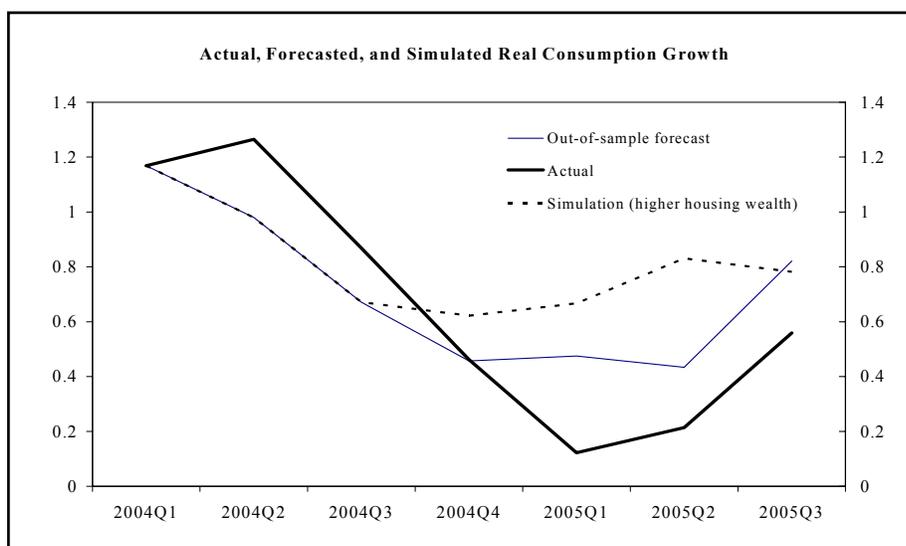
F. Concluding Remarks

26.   **The empirical results from this chapter suggest that the main determinants of consumption growth are disposable income and wealth.** Changes in housing wealth have a significant effect on consumption both on impact and over the following quarter, while changes in financial wealth affect consumer spending only gradually. Short-term movements in consumption also depend on interest rate changes and labor market developments. As the forecast errors at any particular juncture can be large, predictions from the model should be interpreted with caution. Looking forward, stable income growth should support a sustained pick-up in private consumption expenditure, in the absence of further negative shocks from the housing market and oil prices.

The Standard Life-Cycle Consumption Model

The representative agent in the model (born at time s) maximizes the expected present discounted value of utility at time t:

$$\max E_t \sum_{j=0}^{\infty} \beta^{j} U(C_{s,t+j})$$

subject to

$$W_{s,t+1+j} = W_{s,t+j}(1+r) + YL_{s,t+j} - C_{s,t+j}$$

$$\lim_{j \to \infty}(1+r)^{-j} W_{s,t+j} = 0,$$

where the first equation is the budget constraint and the second is the transversality condition; C is consumption, W is non-human wealth, and YL is labor income, β is the discount rate, and r is the rate of return on wealth.

Assuming quadratic utility and a constant interest rate equal to the discount rate, Gali (1990) shows that the solution to the optimization problem of the individual consumer, aggregated over all consumers alive at time t, gives the following expression for total consumption:

$$C_t = \alpha + \beta YL_t + \delta W_t + u_t,$$

where the error term is the present discounted value of expected future increases in disposable income (in deviations from the mean expected growth rate). For a more detailed exposition of the model, see Gali (1990).

A. Data

The following data (in log levels) were used in the analysis:

Consumption (C): Final consumption of households and non-profit institutions serving households (NPISH) in 2002 prices, seasonally adjusted.

Consumption Flow (C_FS): The estimated flow of consumption services from durable and semi-durable goods plus consumption of non-durable goods and services (households only). Deflated by the household consumption deflator, seasonally adjusted.

Income (Y): Total post-tax household income, deflated by the respective consumption deflator, seasonally adjusted.

Net housing wealth (HW): Residential, commercial, industrial and other buildings assets of households and NPISH minus household debt secured on dwellings by banks, building societies and others; deflated by the respective consumption deflator and seasonally adjusted. Residential assets data are available only at an annual frequency – the quarterly figures have been obtained by interpolating the annual data using the ODPM house price index data to revalue the existing stock, and flow data on private sector new dwellings investment. The data on quarterly housing wealth through the end of 2004 has been kindly proved by NIESR and extended by staff for the first three quarters of 2005.

Net financial wealth (FW): The difference between the total financial assets of households and household unsecured debt; deflated by the respective consumption deflator and seasonally adjusted.

Interest Rate (IR): The implied nominal interest rate on total household debt (in percent).

Unemployment Rate (U): Unemployment rate (in percent), International Labor Organization, seasonally adjusted.

House price indexes from Halifax, Nationwide and the Office of the Deputy Prime Minister (ODPM).

B. Unit Root Test and Cointegration Analysis

Augmented Dickey-Fuller tests for non-stationarity of the variables (in log levels) were carried out to determine the order of integration. All variables are found to be stationary in first differences.

Table A1. Unit Root Tests, 1987:1-2005:3

Variable	Test Specification	Additional Regressors	ADF t-stat	
Real Consumption Expenditure	Levels	Constant and trend	-1.049	
	First Differences	Constant	-3.708	**
Real Consumption Flow	Levels	Constant and trend	-1.871	
	First Differences	Constant	-3.918	**
Real Income	Levels	Constant and trend	-2.647	
	First Differences	Constant	-12.902	**
Real Housing Wealth	Levels	Constant and trend	-1.202	
	First Differences	Constant	-2.427	
Real Financial Wealth	Levels	Constant and trend	-1.741	
	First Differences	Constant	-8.659	**
Unemployment	Levels	Constant	-1.933	
	First Differences	Constant	-2.736	*
Nominal Interest Rate	Levels	Constant and trend	-2.982	
	First Differences	Constant	-4.258	**

Null hypothesis: Series has a unit root.
**(*) Denotes rejection of null hypothesis at 1% (5%) significance level.
For the first difference of real housing wealth, the null hypothesis is rejected at 13% level.
The appropriate lag length is chosen based on the Schwartz Information Criterion.

The Johansen procedure was used to test for cointegration of consumption, income, housing wealth, and financial wealth. The lag length of the VAR system used to perform cointegration analysis was selected based on the following criteria:

Table A2. Lag Order Selection Criteria

Lag	FPE		AIC		SC		LR	
0	1.3E-09		-9.1		-9.0		NA	
1	3.1E-15		-22.0		-21.4	*	857.9	
2	2.8E-15	*	-22.2	*	-21.0		34.9	*
3	3.2E-15		-22.1		-20.4		19.4	

* indicates lag order selected by the criterion
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
LR: Sequential modified likelihood ratio test statistic

The trace and the maximum eigenvalue statistic suggest one cointegrating relationship for both total consumption expenditure and the estimated flow of consumption services. T

Cointegration Rank Test (Total Private Consumption)

Hypothesized Number of Cointegrating Vectors	Maximum Eigenvalue		Trace Statistic	
None	25.6	*	44.41	*
At most 1	12.2		18.79	

* denotes rejection of the hypothesis at 10% level.

Cointegration Rank Test (Consumption Flow)

Hypothesized Number of Cointegrating Vectors	Maximum Eigenvalue		Trace Statistic	
None	26.6	*	44.96	*
At most 1	11.9		18.39	

* denotes rejection of the hypothesis at 10% level.

Normalizing the coefficients on consumption to one, the estimated long-run coefficients, based on three different estimators are presented in Table A3.[24] The number of lags for the Johansen estimator are set at 2 based on the criteria in Table A2. The Stock and Watson dynamic OLS regression includes the levels of income and wealth, and leads and lags of their first differences. The number of leads and lags is chosen based on the Akaike Information Criterion (which indicates two lags).

Table A3. Estimates of the Coefficients of the Cointegrating Vector

Total Private Consumption Expenditure			
	Income	Housing Wealth	Financial Wealth
Johansen (1988)	0.85	0.07	0.07
Stock and Watson (1993) DOLS	0.80	0.09	0.09
Philips and Hansen (1990) FMLS	0.80	0.09	0.09

Private Consumption Flow			
	Income	Housing Wealth	Financial Wealth
Johansen	0.66	0.05	0.07
Stock and Watson DOLS	0.67	0.04	0.06
Philips and Hansen FMLS	0.72	0.03	0.05

Note: All coefficients are statistically significant, the standard errors are

not shown.

The number of leads and lags for the DOLS estimator is chosen based on
the Schartz Inormation Criterion.

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[24] The theoretically appropriate measure of income that should be used is labor income. Several measures of labor income were constructed and the results were very sensitive to the measure used and the period of estimation, so total disposable income was used instead, in line with most existing studies.

C. Model Stability

Examining the stability of cointegrating vectors is a difficult issue. The longest sample available should be used to estimate a truly "long run relationship," and the sample that we use is already fairly short. Nonetheless, the results from Hansen (1992) tests for parameter instability show no indication of structural break in the estimated relationships (Table A4).

These three tests have been developed specifically for regressions with I(1) processes and all share the null hypothesis of no parameter instability. They differ in the choice of an alternative hypothesis. The first test tries to identify a structural break with unknown timing (typically used to indicate a possible shift in the regime). The second and third tests model the cointegrating vector as a martingale process and are typically used to check whether the specification captures a stable relationship, or one that is slowly changing over time. Hansen notes

Table A4. Tests for Parameter Stability		
	Cointegrating Vector	
Test	c, y, hw, fw	c_fs, y, hw, fw
SupF	10.75	8.23
	(>0.20)	(>0.20)
MeanF	4.12	2.71
	(>0.20)	(>0.20)
Lc	0.14	0.13
	(>0.20)	(>0.20)
Note: p-values are in parenthesis.		

that the lack of cointegration is a special case of the alternative hypothesis considered, so these tests can also be viewed as testing the hypothesis of cointegration (the null) versus to cointegration. All test statistics (shown above) suggest that it is not possible to reject the null of a stable relationship against a number of alternatives that represent various forms of instability.

The recursive residuals from the second stage equation for consumption growth are shown to the right (these correspond to the one-period ahead forecast errors from the equation estimated over increasing subsamples of the data). Points outside the standard error bands are either outliers or indicate possible coefficient changes. Ignoring the beginning of the sample (where only a few observations are used for the estimation), the equation performs least well in the years around 2000, when the peak and burst of the equity price bubble occurred. It is worth noting that the forecast error can be fairly high at times (compared to the average consumption growth rate), so forecasts based on the equation should be treated with caution. Diagnostic tests of the residuals show that the hypotheses of no serial correlation, homoscedasticity, and normal distribution can not be rejected.
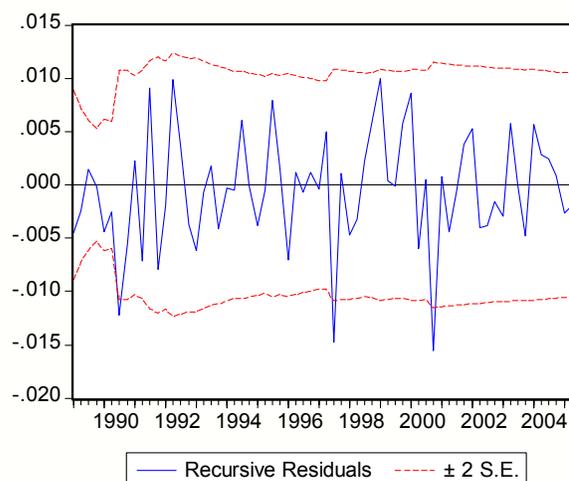
Finally, the estimated coefficients from the short-run model for increasing subsamples of the data are shown below.

Figure A1. Recursive Paramenter Estimates

Coefficient on the Constant +/- 2 S.E.

Coefficient on Income +/- 2 S.E.

Coefficient on Housing Wealth +/- 2 S.E.

Coefficient on the ECM Term +/- 2 S.E.

Coefficient on Interest Rates +/- 2 S.E.

Coefficient on Unemployment +/- 2 S.E.
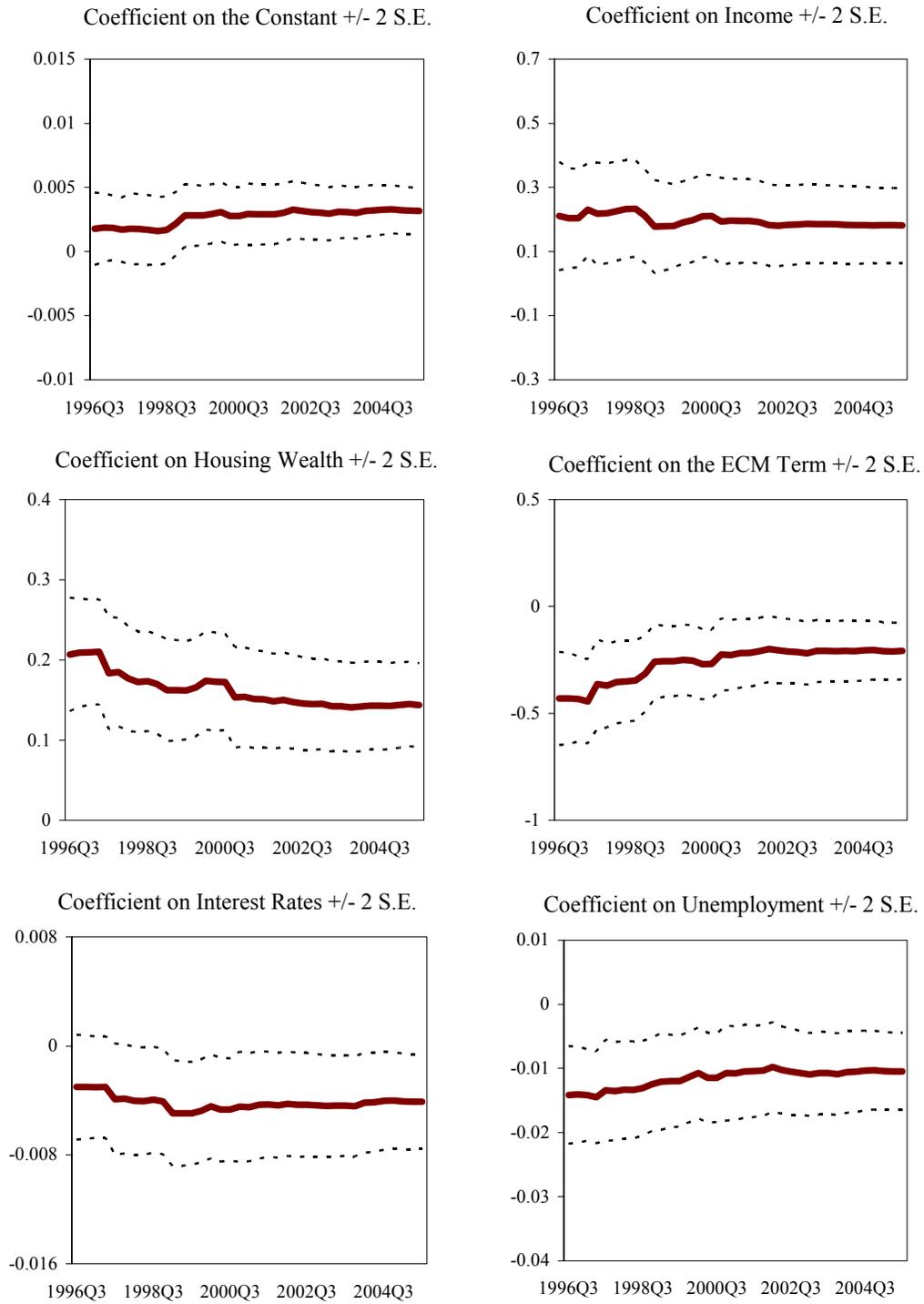
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III. OPTIONS FOR FISCAL CONSOLIDATION IN THE UNITED KINGDOM [25]

This paper examines the impact on GDP of differences in the timing and composition of fiscal consolidation, using the IMF's Global Fiscal Model calibrated to match the UK economy. Early consolidation dampens aggregate demand in the short term, but increases output in the long term as the size of adjustment is reduced by lower interest payments. Early consolidation becomes even more favorable if global interest rates rise. Reducing transfers or government spending is better than tax increases because of the adverse effects of higher taxes on labor supply and capital accumulation.

A. Introduction

1.   **Fiscal rules introduced in 1997—a Golden rule and a Sustainable Investment rule—are a central part of the U.K. fiscal policy framework to ensure sound public finances over the medium-term**. The Golden rule requires that the public sector's current balance be non-negative on average over the economic cycle and the Sustainable Investment rule requires net public sector debt to be kept at a stable and prudent level (which the Treasury regards as below 40 percent of GDP). These fiscal rules, aimed at assuring fiscal solvency and avoiding procyclical fiscal stimulus while providing scope for automatic stabilizers to operate fully, have contributed to enhancing the credibility of the fiscal framework by anchoring expectations and improving transparency.

2.   **However, the fiscal deficit has remained large during the recent period of strong economic growth and now poses an increasing challenge to the fiscal rules.** The past five years have seen a sizable deterioration in the fiscal position owing to a rise in current spending that outstripped the improvement in revenue. With the overall deficit stuck at about 3 percent of GDP in recent years, net public debt has edged up to about 35 percent of GDP in FY2004/05 from a low of 30 percent of GDP in FY2001/02.[26] While the level of public debt remains relatively low, going forward, a reduction in the overall deficit will be needed to continue to meet the fiscal rules. Against this backdrop, the paper aims at exploring the macroeconomic consequences of the timing and composition of fiscal consolidation.

Fiscal Balance and Net Public Debt

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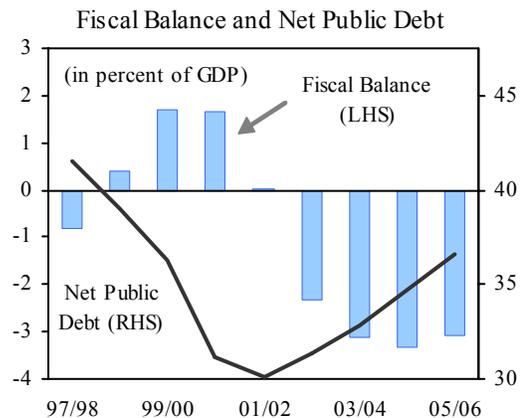
[25] Prepared by Dennis Botman (FAD) and Keiko Honjo.

[26] The fiscal year runs from April to March.

3.   **This paper investigates the macroeconomic effects of the various options for fiscal consolidation.** For this purpose, the paper uses a two-country version of the IMF's Global Fiscal Model (GFM), calibrated to the U.K. economy. GFM is a theory-based annual simulation model developed specifically to examine a range of fiscal issues (see Botman and others 2006 for details on GFM).[27] The paper poses the following questions:

- **What is the trade-off between early versus delayed fiscal adjustment?** The paper will contrast the macroeconomic effects of a delayed fiscal consolidation with higher government debt versus an early fiscal adjustment to contain the debt ratio at about 37 percent of GDP.

- **How does the type of fiscal adjustment matter?** The study will compare the impact of fiscal consolidation on the economy when it takes place through increases in taxes (on either labor income, corporate income, or personal income), or through a reduction in government transfers or lower current government spending.

- **To what extent are the effects robust when taking into account uncertainty about the behavioral response of consumers and producers to changes in fiscal policy?** The paper examines some of the key components that may affect the impact of fiscal consolidation, including the sensitivity of labor supply to changes in the real wage, and the substitutability between capital and labor. Furthermore, the paper analyses the impact of a reduction in global savings on the U.K. economy, and how this affects the timing and instrument of fiscal adjustment.

B. The Model and Calibration

4.   **GFM is a dynamic general equilibrium macro model suitable for the evaluation of alternative fiscal policies when Ricardian equivalence does not hold.** In the presence of Ricardian equivalence, the timing of fiscal adjustment does not matter for the real economy. However, for the two-country version of GFM used in this paper, there are three reasons why Ricardian equivalence does not hold:

- **The private sector is assumed to be more "impatient" than implied by the government budget constraint.** This is because of the overlapping-generations structure of the model—consumers have finite lives as they face a constant probability of death. Because the private sector uses a discount factor that is higher than the real interest rate, the effects of future policy actions are discounted more rapidly than is implied by the government budget constraint (consumers discount

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[27] For applications of the model in the context of fiscal reform in respectively Canada and the United States see Bayoumi and Botman (2005), Bayoumi, Botman and Kumar (2005), Kumhof, Laxton, and Muir (2005), and Botman and Laxton (2004).

future tax liabilities because there is a chance they will no longer be alive to pay them). As a result, fiscal policy changes influence national saving.

- **Markets are not fully competitive**. Firms and workers have some monopolistic power, so that prices and wages are above their perfectly competitive levels. In addition, profits reflect both returns to capital and economic rents extracted by firms. Compared with the case of perfect competition, these rents reduce the distortionary impact of corporate and personal income taxes.

- **Some consumers have no access to financial markets.** Consumers that are liquidity-constrained, consume their entire disposable income. As a result, the pattern of taxes matters, with higher taxes causing their consumption to fall one-for-one.

5.   **The model involves a stylized representation of the U.K. tax and expenditure system.** The analysis incorporates four taxes: a labor income tax levied on wage compensation paid by workers or employers (payroll tax); a corporate income tax levied on accounting profits of firms; and a personal income tax levied on labor income, accounting profits, government transfers, and interest income (on government bonds and net foreign assets). Since liquidity constrained consumers have no wealth and do not save, they are not directly affected by corporate income taxes. It is assumed that for all three taxes, there is a single (although different) marginal rate, which coincides with the average tax rate. Revenues raised by taxation are spent on lump-sum transfers to consumers, government consumption of both traded and nontraded goods, and servicing government debt. At present, GFM does not incorporate a sales tax or VAT.

6.   **Other main aspects of the model can be briefly summarized as follows:**

- Consumption and production are characterized by constant elasticity of substitution utility and production functions, respectively.

- There are two factors of production—capital and labor—which are used to produce either traded or nontraded goods. Labor and capital can move freely between the traded and nontraded sectors, but are not mobile internationally.

- Investment is driven by a Tobin's Q relationship, with firms responding sluggishly to differences between the future discounted value of profits and the market value of the capital stock.

- Wages and prices are fully flexible. The central bank implements money targeting.

- The model's financial market block is highly stylized. There are two kinds of assets, namely government debt (which can be traded internationally) and equity (which is held domestically). International trade in government debt implies the equalization of real interest rates across countries over time.

7.   **The model has been parameterized to reflect key macroeconomic features of the United Kingdom.** In particular, key parameters—the ratios of consumption, investment, government spending, wage income, and income from capital relative to GDP—are calibrated to the U.K. economy. Similarly, fiscal variables—taxes rates on capital, labor, and personal income, and government debt—have been calibrated to correspond to the U.K. fiscal structure. The size of the U.K. economy is assumed to be around 5 percent of the world economy, which implies U.K. policies have only a minimal impact on the global rate of interest.

8.   **Behavioral parameters are based on microeconomic estimates and set equal across the United Kingdom and the RoW.** These include parameters characterizing real rigidities in investment, markups for firms and workers, the elasticity of labor supply, the elasticity of substitution between labor and capital, the elasticity of intertemporal substitution, and the rate of time preference.[28] The Appendix discusses the values of the key parameters in more detail.

9.   **The impact of fiscal policy on real activity combines responses from aggregate supply and demand.** Aggregate supply changes are triggered through the "distortion channel." Fiscal policy influences include the impact of wage taxes on the incentive to work and the effect of corporate income tax rates on the incentive to invest in productive capital. Aggregate demand changes largely depend on fiscal policy's effects on wealth and interest rates. The strength of the wealth channel is influenced by the level of consumer "impatience."

C.   Macroeconomic Effects of Alternative Forms of Fiscal Consolidation

10.   **The baseline features delayed consolidation.** In the baseline, government debt increases to about 43 percent of GDP by FY2009/10. This is consistent with a scenario in which no fiscal consolidation is forthcoming in the near future. The financing gap—the difference between revenue and expenditure—is assumed to close after FY2009/10 by gradually increasing labor income taxes on workers. The consolidation generates the primary surpluses required to stabilize the debt ratio at 45 percent of GDP.

11.   **Delaying fiscal consolidation implies modest short-term output gains** (Figure 1). The initial financing gap stemming from higher government transfers stimulates aggregate demand in the short term, especially by liquidity-constrained consumers. The initial increase in domestic demand is supported by real exchange rate appreciation—following higher interest rates in the United Kingdom than the rest of the world. As government debt rises, however, labor income taxes on workers need to be increased—by about 2 percentage

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[28] See Laxton and Pesenti (2003) for a more detailed discussion of evidence on parameter values.

Figure 1. Baseline: Macroeconomic Effects of Delayed Consolidation
(Deviation from initial steady state in percent of GDP unless otherwise noted)

Government Accounts

Labor income tax (percentage points)

Revenue

Financing gap
(Revenue-Expenditure)

Government Debt and Net Foreign Assets

Government debt

Net foreign assets

Real GDP and Consumption

Real GDP (percent)

Consumption (percent)

Investment, Capital Stock, and Labor Effort

Investment (percent)

Capital stock (percent)

Labor effort (percent)

Real Interest Rate and Real Exchange Rate

Real interest rate
(percentage points)

Real exchange rate (percent)

Current Account Balance, Government
Balance, and Trade Balance

Current account balance

Government balance

Trade balance

Source: IMF staff estimates.

points—to stabilize the government debt-to-GDP ratio taking into account the need to finance higher interest expenses. The long-run increase in the real interest rate is muted by the fact that the UNITED KINGDOM is a relatively small open economy. Labor effort, investment, and consumption all decline in the medium-term, implying a permanent output loss of about 0.3–0.4 percent.

12.   **In contrast, early consolidation that prevents the increase in government debt yields considerable long-term output gains**. Under this scenario, a gradual consolidation from FY2006/07 onwards stabilizes the debt-to-GDP ratio at 37 percent. Early consolidation dampens aggregate demand in the short term but increases output in the long term because the government's interest payments and, consequently tax rates are lower compared to delayed consolidation.[29] The consolidation—either early or delayed—can take place through (i) lower government transfers; (ii) lower government consumption of traded and nontraded goods; (iii) higher labor income taxes levied on workers; (iv) higher labor income taxes levied on employers; (v) higher personal income taxes; or (vi) higher corporate income taxes. Regarding these different options for raising revenue (see text figures and Figure 2).
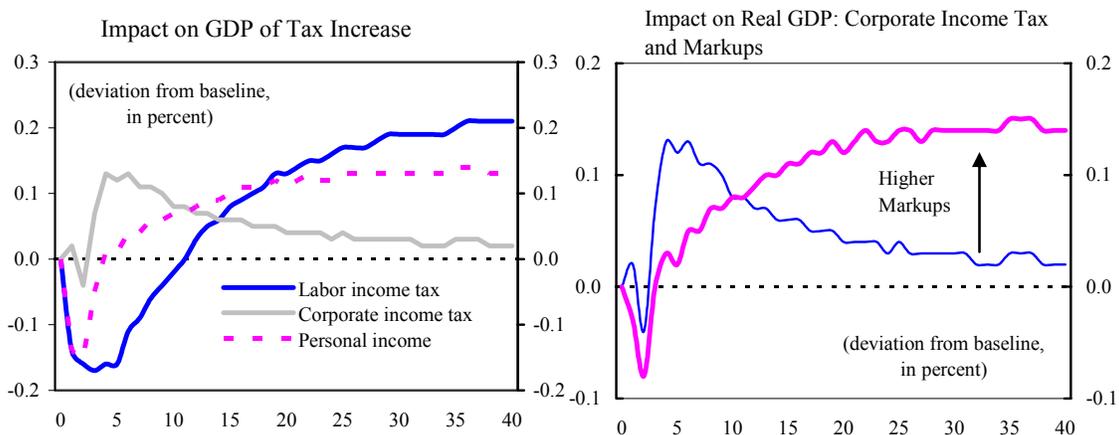
- **An increase in labor taxes has larger long-term benefits than increasing corporate income taxes.** Capital is more responsive to changes in tax rates while labor supply is more inelastic. In this context, it should be noted that corporate income taxation becomes less distortionary if profit margins increase as a larger share of the tax burden falls on rents rather than the required return to capital (i.e., goods price markups are high). Also, despite being less favorable than raising taxes on labor income, an early adjustment through higher corporate income taxation is still beneficial to delaying fiscal adjustment.

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[29] In case trade in financial assets is imperfect between the U.K. and the rest of the world, the benefits of an early rather than a delayed consolidation would be larger as higher government debt in the U.K. would imply a larger increase in the real interest rate.

Figure 2. Effect on Real GDP of Alternative Types and Timing of Consolidation
(Deviation from baseline in percent of GDP)
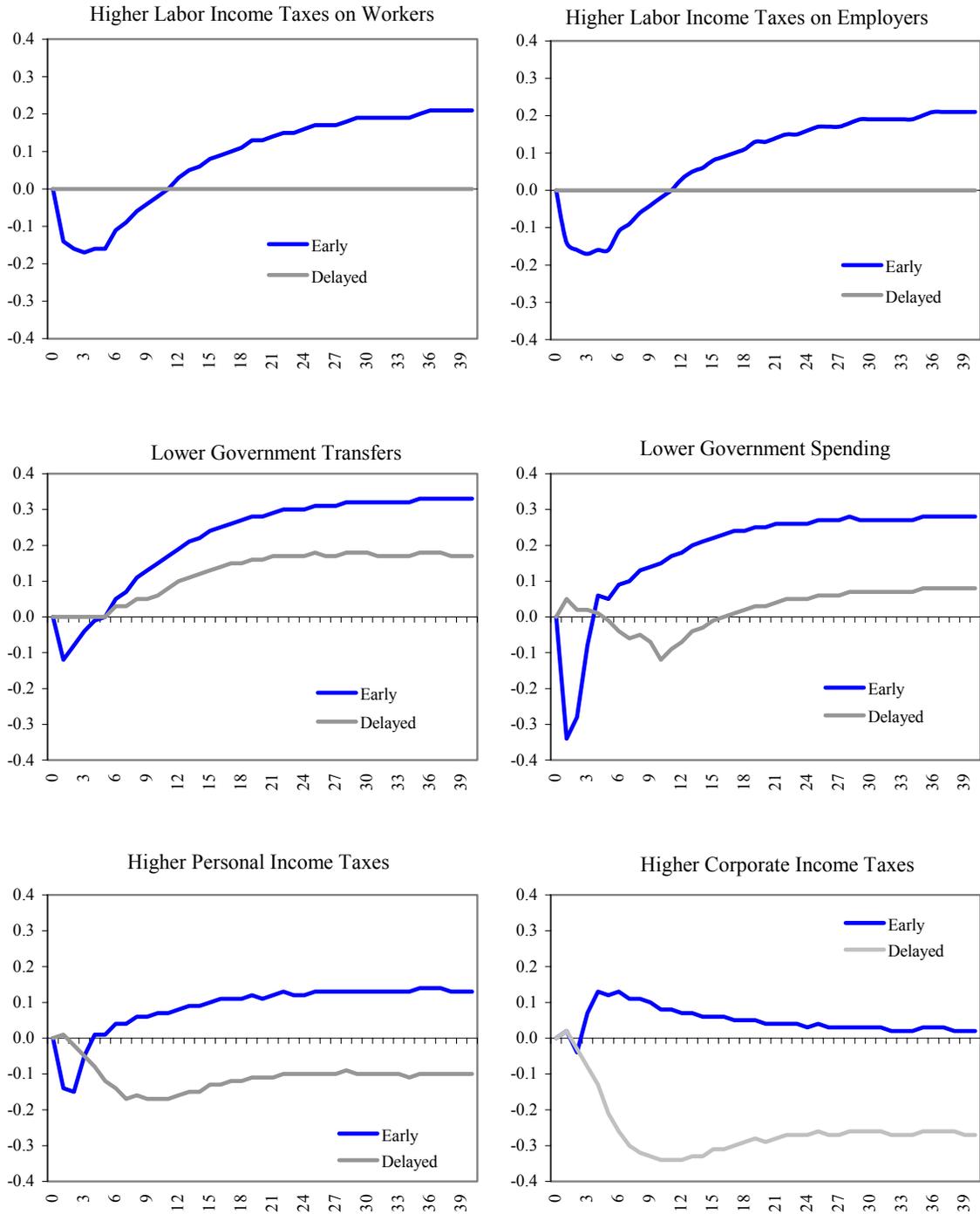
Source: IMF staff estimates.

- **On the other hand, the short-term loss in output is reduced if the early consolidation takes place through higher corporate or personal income taxes.** This result stems from the sluggish response of investment to changes in after-tax returns in light of the assumed adjustments costs on capital accumulation. Also, raising corporate income taxes affects optimizing, forward-looking consumers, while higher transfers increase disposable income of liquidity-constrained consumers. The latter individuals smooth their consumption over time implying a more subdued response of aggregate demand in the short-term.

- **The gains are largest, and occur more rapidly, if consolidation takes place through lowering government expenditure.** This owes much to the fact that regardless of the timing of the consolidation, reducing transfers or government spending has the advantage of preventing further tax distortions.

Impact on GDP of Spending Restraint vs. Tax Increase
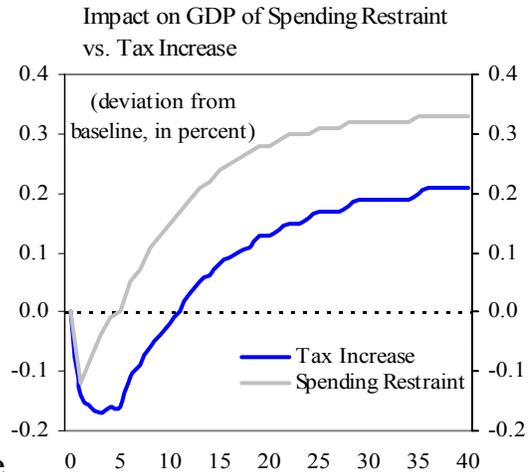
- **The trade-off between short-term costs and longer-term benefits of an early consolidation occurs regardless of the type of consolidation** (Figure 2)*.* The exception is corporate income taxes for which it is preferable to raise them earlier regardless of the planning horizon of policymakers (panel 6) as the protracted increase in corporate taxes discourages forward-looking investors at an early stage. In GFM, efficiency losses occur regardless of which side of the market is taxed, as evidenced by the fact that raising labor income taxes on workers has the same effect as increasing the payroll tax on employers.[30]

13.   **Weighing the short and long-term macroeconomic effects through a net present value calculation confirms the significant benefits of early consolidation**. The gains of early consolidation compared to delayed adjustment through higher labor income taxes is between 1½ and 7½ percent of GDP depending on the type of instrument. When adjustment is delayed, the benefits of lowering transfers or government spending compared to higher personal or corporate income taxes are even more pronounced than for an early

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[30] Total after-tax wage income accruing to workers changes the same whether payroll taxes levied on workers or on employers are increased. However, in the former case hours worked declines through a drop in labor supply—increasing the real wage. While in the latter case, hours worked declines (although by less) through a reduction in labor demand causing the real wage to fall as well.

Net Present Value of Alternative Forms of Fiscal Consolidation
(Deviation from baseline (delayed consolidation via higher labor income taxes) in percent of GDP)
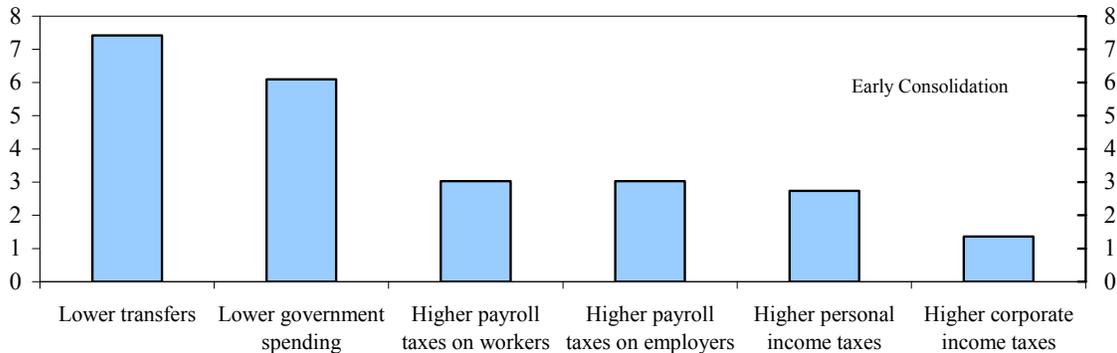
Source: IMF staff estimates.

consolidation. This is because the higher level of government debt and associated interest payment creating further distortions in case taxes are increased.

14.   **Sensitivity analysis indicates that the results are broadly robust to changes in behavioral parameters** (Appendix).[31]

- **The key factors affecting the timing of consolidation** are the planning horizon of consumers and the sensitivity of consumers to changes in the real interest rate. The benefits of early consolidation decline if consumers have a longer planning horizon, but increase if consumption is less sensitive to changes in the interest rate. These behavioral assumptions affect the crowding out effects of government debt and therefore the costs of delaying fiscal adjustment. Furthermore, tax reform aimed at increasing incentives to save could provide support to fiscal consolidation measures. This applies in particular to the long-term benefits of early fiscal adjustment.

- **The key factor affecting the type of consolidation** is the sensitivity of workers to a change in their real wages. Consolidating through reducing transfers or lowering government spending become more attractive if workers are more sensitive to changes in the after-tax real wage. This factor increases the distortions created by raising labor income taxes, also making consolidation through raising other types of taxation relatively less harmful.

15.   **The choice between early and delayed consolidation in the United Kingdom is also likely to be affected by changes in global interest rates.** In particular, changes in global savings and investment have implications for the real interest rate in the United Kingdom and changes in consumption in the rest of the world affect the demand for imports from the U.K. Furthermore, foreign fiscal policies affect the real exchange rate implying

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[31] The Appendix also analyses the impact of fiscal adjustment when it is combined with tax reform.

potential wealth effects on U.K. consumers. In order to illustrate these channels of interaction we consider a gradual, but permanent increase in government debt by ten percentage points in the rest of the world because of a temporary reduction in labor income taxes.

16.   **A reduction in global savings would have a significant impact on the U.K. economy by pushing up real interest rates** (Figure 3). A less benign global financing environment, simulated here as an increase in government debt in the rest of the world, increases real interest rates by about 70 basis points in the long run. This results in crowding out of investment in the United Kingdom as well as higher (labor income) taxes because of higher financing costs of government debt. These two channels are magnified by the negative wealth effect of real exchange rate depreciation in the short-term and—despite higher exports of the United Kingdom to the rest of the world—imply a permanent decline in output.

17.   **In such a scenario, delaying fiscal consolidation in the United Kingdom becomes more costly.** From a cyclical perspective, fiscal adjustment before a reduction in global saving reduces output in the United Kingdom would be preferable. In addition, early consolidation becomes more beneficial from a longer-term perspective. Higher world real interest rates imply that any increase in government debt in the United Kingdom requires a further increase in taxes. As a result, early consolidation preventing higher debt becomes more beneficial and consolidating through lowering transfers or reducing government spending becomes more attractive as well. Raising corporate income taxes becomes more harmful as the incentive to save for domestic capital accumulation would decline at the same time as there is a higher world demand for U.K. saving.

The Effects of Early Consolidation in the U.K. When Global Savings Decline
(Deviation from baseline (delayed consolidation via higher labor income taxes) in percent of GDP)
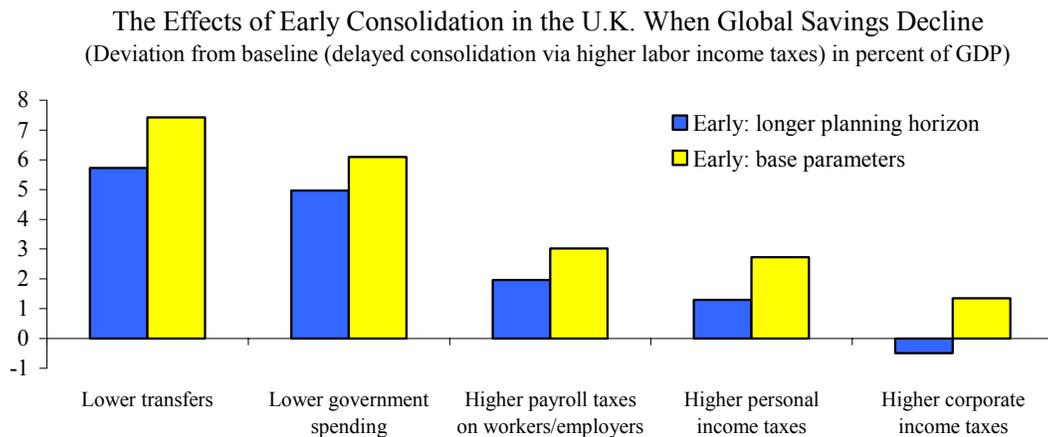
Source: IMF staff estimates.
1/ Effect on real GDP in net present value terms.

Figure 3. Effects on the U.K. of a Reduction in Global Saving
(Deviation from initial steady state in percent of GDP unless otherwise noted)

Government Accounts

Government Debt and Net Foreign Assets

Real GDP and Consumption

Investment, Capital Stock, and Labor Effort

Real Interest Rate and Real Exchange Rate

Current Account Balance, Government Balance, and Trade Balance
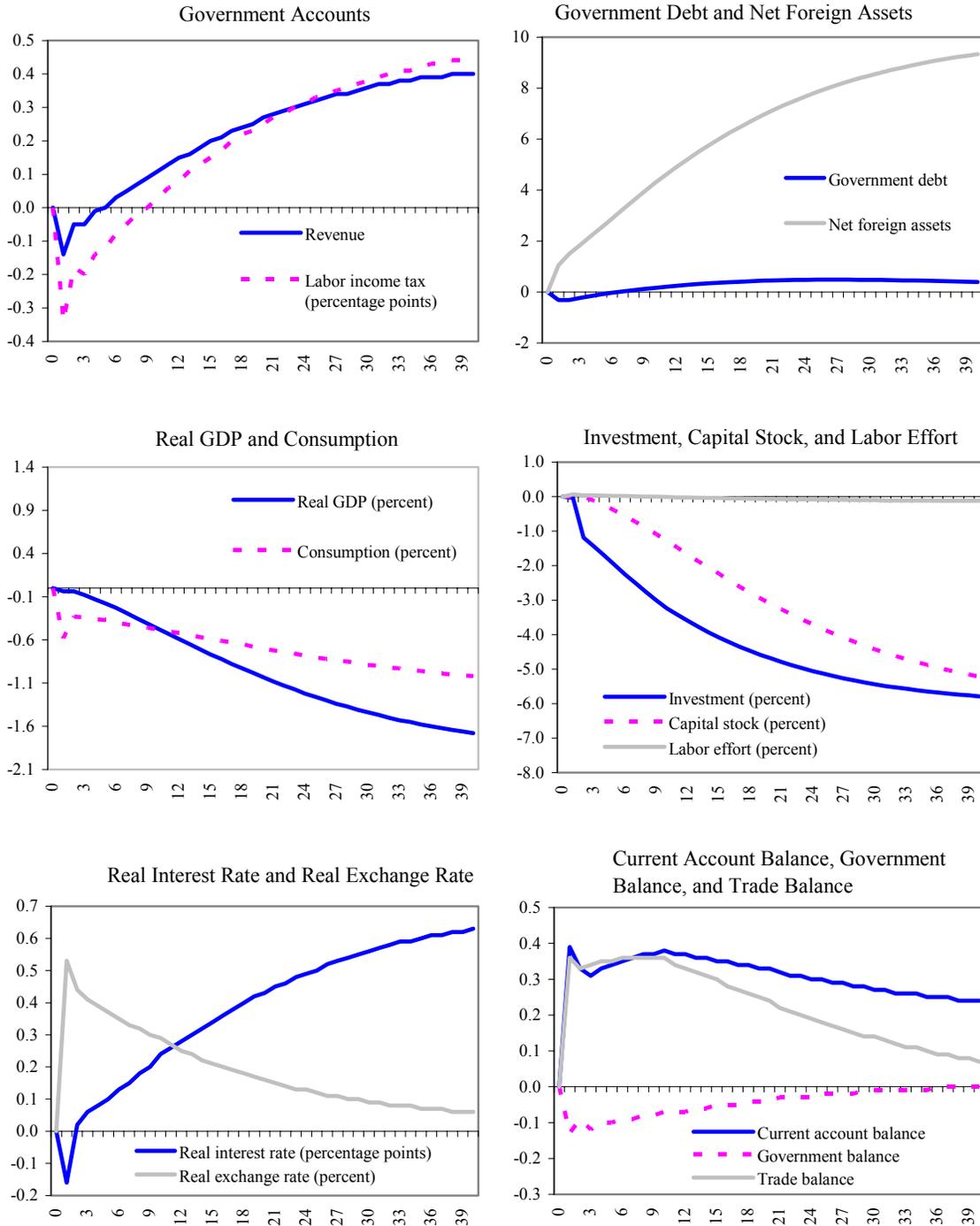
Source: IMF staff estimates.

D. Conclusions

18.   **The conclusions of this analysis can be summarized as follows:**

- **There are significant potential benefits from early fiscal adjustment.** The long-term gains of preventing a rise in government debt more than outweigh the short-term costs of fiscal adjustment.

- **Reducing transfers or government spending on goods provides larger gains than raising taxes.** In particular, raising corporate or personal income taxes creates larger distortions by reducing capital accumulation.

- **These results remain valid after taking into account uncertainty about the behavioral response of consumers and producers to changes in fiscal policy.** In addition, a reduction in global saving would make early consolidation more urgent from both cyclical and long-term perspectives.

19.   **The 2005 Pre-Budget Report (PBR) contained measures aiming at a modest reduction in the overall deficit over the medium-term broadly consistent with the findings above**. On staff projections, with the measures—an increase in the tax rate on oil company profits and current spending restraint—the overall deficit would come down to about 2 percent of GDP by FY2009/10, stabilizing net public debt to about 40 percent of GDP. Although specifics have not yet been provided, the envisaged fiscal consolidation through spending restraint is a good example of an early and gradual consolidation discussed in this paper, which would prevent the steady increase in government debt.
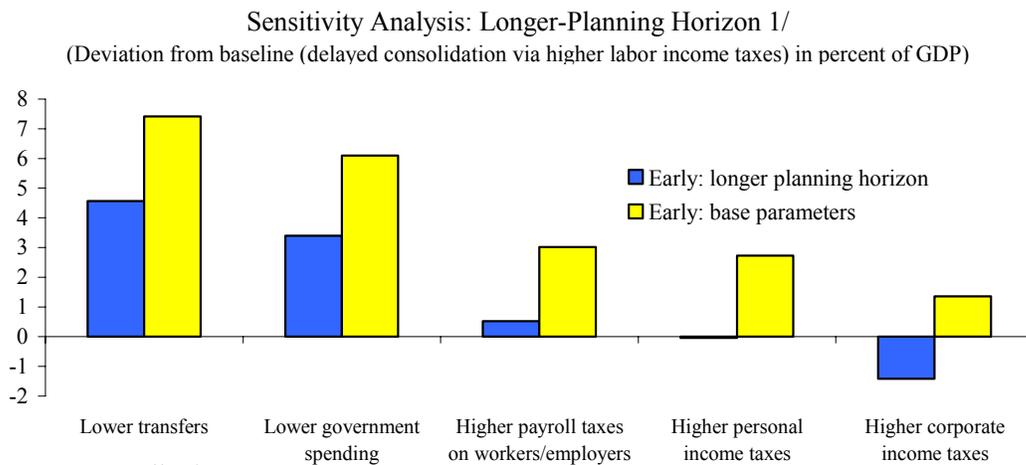
The macroeconomic effects of fiscal consolidation are likely to be sensitive to the uncertainty about the behavioral response of consumers and producers to changes in tax policy and government spending. In GFM, these behavioral responses follow from a number of key parameters:

- **The sensitivity of labor supply to the real wage:** The baseline value (0.04) is at the mid-range of values found by micro-economic studies. An alternative simulation assumes a value close to the lower limits of these estimates representing the case of inelastic labor supply.

- **The elasticity of substitution between labor and capital in the production function:** The baseline value is 0.8, with an alternative simulation using a value of 1 (the Cobb-Douglas case).

- **The elasticity of intertemporal substitution:** The baseline value for this parameter that describes the sensitivity of consumption to changes in the real interest rate is 0.33. The parameter value in the alternative simulation (0.2) is consistent with the lower end of microeconomic estimates.

- **The wedge between the rate of time preference and the yield on government bonds:** This parameter—which determines consumers' degree of impatience—has not been subject to extensive microeconomic analysis. The baseline value of the wedge is set to 10 percent, with an alternative simulation using 1 percent. The baseline value implies an effective planning horizon of ten years, which is obviously much lower than the probability of survival for most of the population, but it is a simple way of introducing a form of myopia into the model.

- **The fraction of consumers that does not have access to financial markets:** In the baseline, 20 percent of the population is assumed to be liquidity constrained and consumes its entire disposable income every period. This fraction is consistent with empirical evidence for the U.K. reported in Al-Eyd and Barrel (2005). To investigate the importance of this assumption, an alternative simulation assumes that all consumers can use financial markets to smooth their consumption over time.

The key factors affecting the *timing* of consolidation are the planning horizon of consumers and the sensitivity of consumers to change in the real interest rate. The key factor affecting the *type* of consolidation is the sensitivity of workers to change in the real wages.

- **A longer planning horizon of consumers reduces the cost of delayed consolidation**. If consumers discount the future less—a planning horizon of 100 years instead of 10 years in the scenarios discussed thus far—their intertemporal choices become similar to those in a representative agent model. The crowding out effect of higher government debt is smaller as consumers anticipate that higher government

transfers will be followed by higher labor income taxes in the future, leading them to save a higher fraction of the short-term increase in disposable income. Nevertheless, significant benefits of early consolidation through lower transfers or lower government spending remain although consolidating early via higher corporate income taxes now becomes more costly than delaying and adjusting via higher labor income taxes. The reason is that optimizing agents are now more forward-looking and incorporate the fact that the after-tax rate of return will be lower in the future, leading them to substitute towards higher consumption and lower capital accumulation.

Sensitivity Analysis: Longer-Planning Horizon 1/
(Deviation from baseline (delayed consolidation via higher labor income taxes) in percent of GDP)

Source: IMF staff estimates.
1/ Effect on real GDP in net present value terms.

- **Reducing the sensitivity of consumption to changes in the real interest rate increases the benefits of early consolidation.** As can be seen from Figure 4 (third panel), a lower intertemporal elasticity of substitution increases the benefits of all early consolidation measures compared to the baseline of delayed consolidation. Delaying consolidation increases net foreign liabilities, alongside the increase in government debt. As a result, the U.K. needs to run trade balance surpluses to service the interest cost on these liabilities. For the trade balance to be in surplus, saving in the U.K. needs to increase. As consumption becomes less responsive, interest rates need to increase by more to provide the incentive to save more. As a result, capital accumulation will decline by more implying that delayed consolidation becomes more costly.

- **Increasing the sensitivity of workers to changes in the after-tax real wage increases the benefits of consolidating through lower transfers and government spending** (Figure 4). As labor supply becomes more elastic, labor income taxation becomes more distortionary as workers reduce labor effort more. In fact, corporate income taxes become less distortionary than labor income taxes in the alternative scenario. By contrast, completely inelastic labor supply would make labor income taxation lump sum, reducing the benefits of alternative types of consolidation measures.

Figure 4. Sensitivity Analysis of Alternative Forms of Early Consolidation 1/
(Deviation from baseline (delayed consolidation via higher labor income taxes) in percent of GDP)
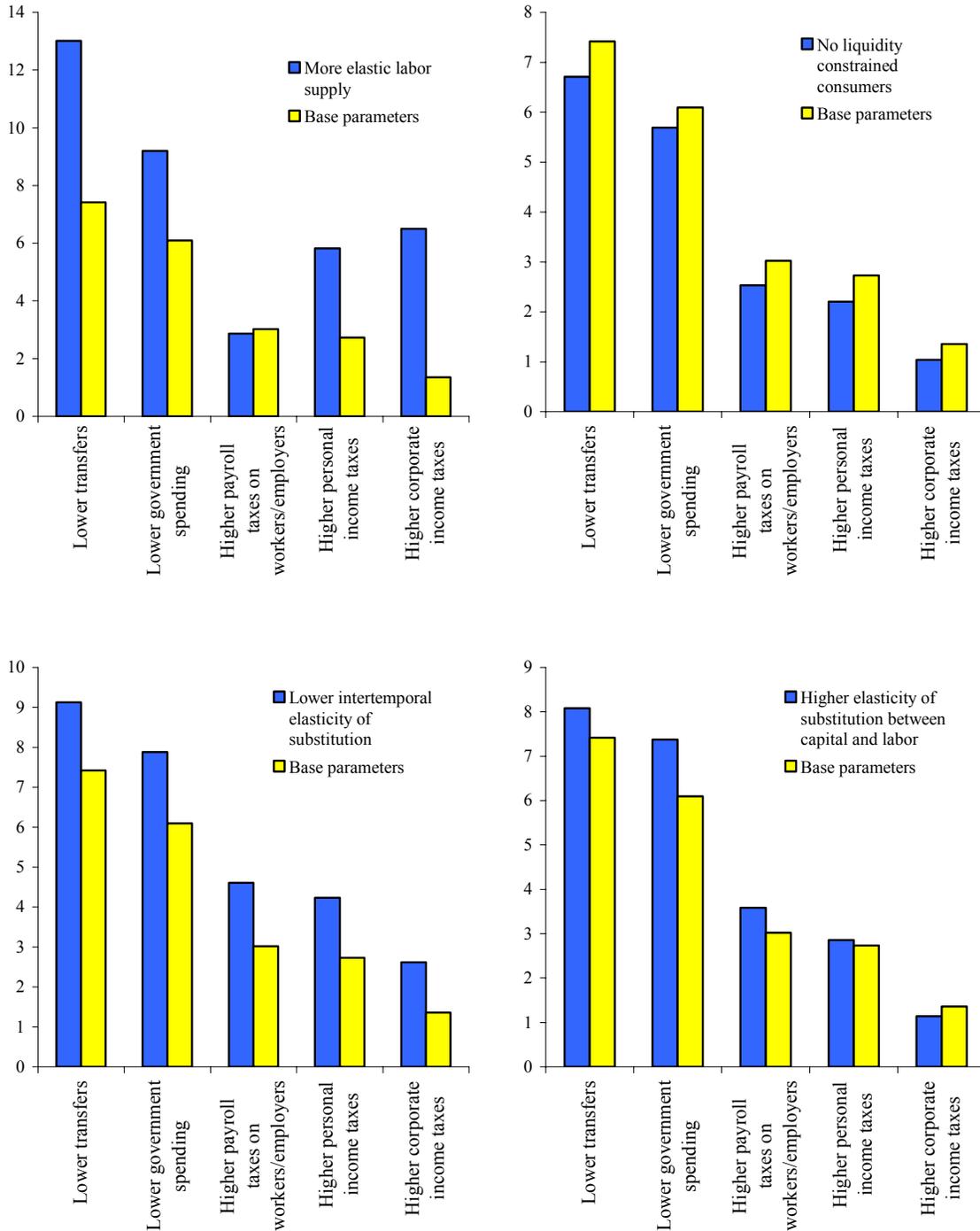
Source: IMF staff estimates
1/ Effect on real GDP in net present value terms.

- **Increasing the access of consumers to financial markets or increasing the substitutability between factors of production has only a marginal effect on the results.** Essentially, if all consumers have access to financial markets and are able to smooth their consumption over time, aggregate consumption is determined in a more forward-looking manner. This reduces the crowding out effects of government debt, but not substantially. Conversely, a higher substitutability between capital and labor generally increases the costs of delaying consolidation, while making consolidation through higher corporate income taxation less harmful as it is easier for firms to substitute towards labor.

- **Tax reform aimed at increasing incentives to save could provide support to fiscal consolidation measures.** Specifically, there are potential benefits from revenue neutral tax reform given that taxation of corporate income is more distortionary. To investigate the potential benefits of such tax reform, the paper assumes that corporate income taxes are permanently reduced by 3 percentage points in the context of early consolidation, which is offset by either increasing labor income taxes, or through reducing transfers or government expenditure. Lower taxation of savings produces significant long-term output gains (Figure 5). A reduction in corporate income taxes increases the after-tax marginal product of capital. This in turn stimulates saving and investment in the economy, which, in the long-term increases output. This reflects a move to a more efficient tax system—although less egalitarian. Introducing tax reform alongside fiscal consolidation produces somewhat earlier output gains and makes especially consolidation through lower transfers more effective. Compared to early consolidation without reform, the short-term output losses are somewhat larger as the benefits of lower corporate income taxation accrue over time via higher capital accumulation supported by increased national saving. In net present value terms, tax reform could provide a substantial boost to consolidation efforts.

Figure 5. The Effects of Combining Early Fiscal Consolidation and Tax Reform 1/
(Deviation from baseline (delayed consolidation via higher labor income taxes) in percent of GDP)

Early Consolidation through Higher Labor Income Taxes

Early Consolidation through Lower Transfers

Early Consolidation through Lower Government Spending

Impact of Tax Reform: Net Present Value of Alternative Types of Consolidation
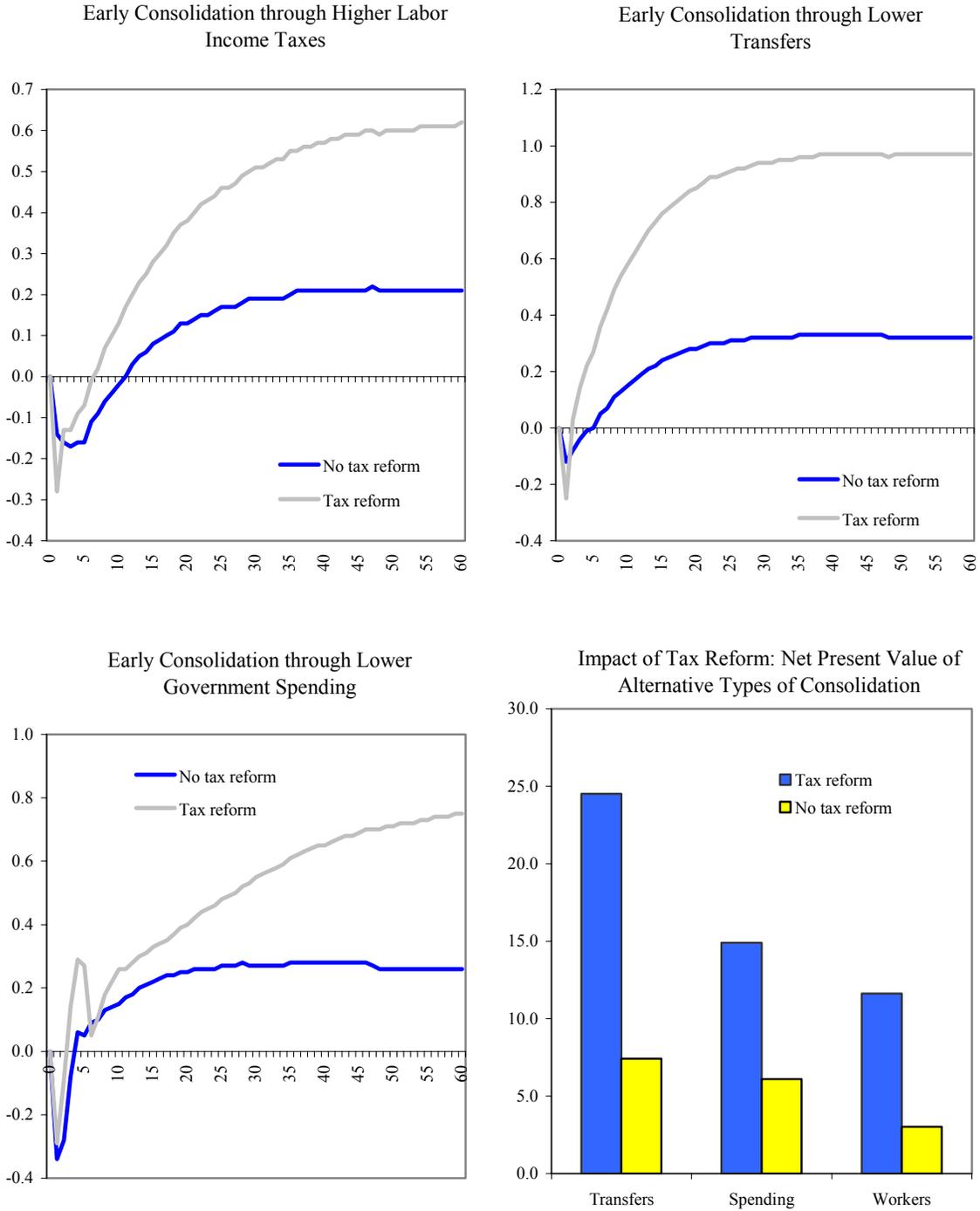
Source: IMF staff estimates
1/ Effects on real GDP.

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IV. LONG-TERM HEALTH CARE COSTS: WILL THEY MAKE THE BUDGET SICK? [32]

The U.K. government projections, which factor in only demographics and changes in health status, suggest that health care spending will rise by just 1½ percent of GDP between 2007–50. Using the government's estimates as a baseline, this paper shows that, taking account of both demographic and non-demographic factors, health spending could rise by nearly 6 percent of GDP. While the U.K. is among the few countries that regularly provide comprehensive long-term scenarios to assess the impact of population aging on fiscal sustainability, there is scope for improving these exercises by disclosing full extent of risk and uncertainty surrounding health care spending projections.

A. Introduction

1.   **The United Kingdom, like most industrialized countries, faces significant challenges associated with the aging of the population**. While cross-country comparison shows that the U.K. population is projected to age less rapidly than in many developed countries, demographic pressures from higher life expectancy and the impact of post-war baby boom remain substantial. The number of people over the age of 65 is projected to increase by 90 percent by 2050, from 16 percent of the population to 25 percent. As a result, the old-age dependency ratio is set to rise to about 40 percent over the next five decades.

UK Population by Age Group
(2004=100)
65 +
Total
16-64
0-16
2004 2011 2018 2025 2032 2039 2046 2053
Source: UK GAD

Old-age Dependency Ratio
■ 2005   ▨ 2050
US UK NZL AUS CAN FRA DEU ITA JPN
Source: UN
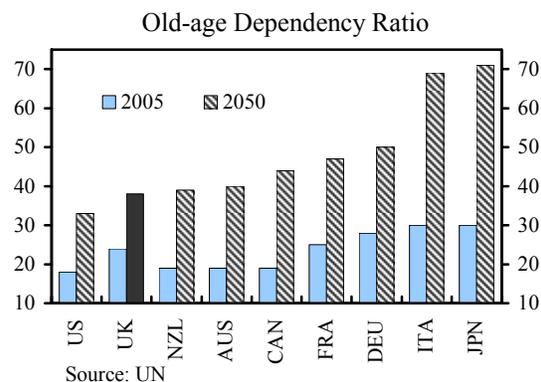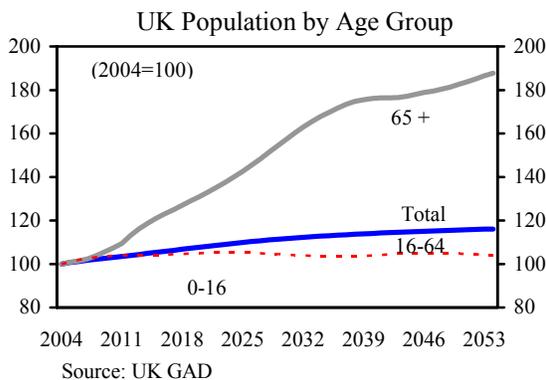
2.   **Population aging will have significant budgetary implications, especially on health care expenditure.** The average person aged 65 or over costs the U.K. health system about 5 times more than the average person under 65, excluding costs associated with birth. However, demographic factors will not be the only important driver of future heath care expenditures. In fact, a wide literature has stressed the crucial role that will be played by non-demographic factors—such as technological advance, productivity, health status, and changes in the coverage of the public health system—in driving health care spending over the long run.

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[32] Prepared by Keiko Honjo.

3.   **The U.K. government's long-term fiscal projections do not factor in the potential impact of demand and technology advances on health costs.** Since 2002, the government has published a *Long-Term Public Finance Report* (LTPF Report) at the time of the *Pre-Budget Report*. The report provides detailed scenarios and sensitivity analysis to evaluate the long-term risks in meeting the Sustainable Investment Rule—40 percent of GDP debt ceiling.[33] In the *2005 LTPF Report*, health care spending rises by one percentage point of GDP by FY2007/08, consistent with the 2004 Spending Review, and then is projected to increase by another 1½ percentage points of GDP by 2050, reflecting only the effects of demographic changes and health status. In contrast, studies done for some other countries project more dramatic increases in health care spending, on the order of 5 percentage points of GDP or higher, when both demographic and other major non-demographic factors are considered. These studies also stress the substantial uncertainties involved in long-term projections of health care expenditures. They point to the need to look at all cost drivers and to consider uncertainties in assessing long-term fiscal sustainability.

4.   **This paper focuses on the magnitude and uncertainties surrounding the impact of non-demographic factors on future health care spending in the United Kingdom.** The basic conclusion is that, taking account of both demographic and non-demographic factors, health care spending could rise by about 6 percentage points of GDP between 2007 and 2050, significantly higher than the government's projections of 1½ percentage points of GDP. Large uncertainty, however, surrounds these projections, especially associated with non-demographic factors. While the United Kingdom is among the few countries that regularly provide comprehensive long-term scenarios to assess the impact of population aging on fiscal sustainability, there is scope for improving these exercises. To enhance fiscal transparency, and potentially enhance the credibility of policy decisions to tackle these long-term issues, especially with regard to health care spending, the government could disclose the full extent of risk and uncertainty surrounding its long-term projections.

5.   **The paper is organized as follows.** Section B describes the key characteristics of the U.K. population and the main features of the U.K. health system. Section C provides a brief survey of approaches used in projecting health care spending. Section D discusses the government's projections of long-term health care costs presented in the December 2005 *Long-Term Public Finance Report*. Section E presents illustrative alternative scenarios to quantify the magnitude of uncertainties in the U.K. projections. Section F provides some concluding remarks.

B. Some Characteristics of the U.K. Population and the Health System

6.   **The U.K. population is aging.** The proportion of the population over 65 has increased from about 11 percent to 16 percent over the past five decades. The pace of aging

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[33] In addition, Budgets provide "Illustrative long-term fiscal projections" over the period of 30 years.

is expected to intensify in the coming decades, as the post-war baby-boom generation reaches retirement age, fertility rates remain subdued, and life expectancy continues to increase steadily. The U.K. Government Actuary's Department (GAD) projects that the number of people in the United Kingdom aged 65 or over will increase by 90 percent over the next fifty years. The pace of aging is projected to accelerate from 2007 to 2030, reaching nearly a quarter of the total population by 2050. The number of very elderly people (aged 85 or over) will rise even more rapidly, with its proportion of the population more than tripling from today. The prospect of an aging population in future decades will clearly have implications for the costs of providing healthcare, as the need for health care is greatest among very elderly people. In FY2002/03, health care spending on those aged 65 and over accounted for about a half of total health expenditure.

The Share of the aged 65+

Health Spending Per Capita 2002/03
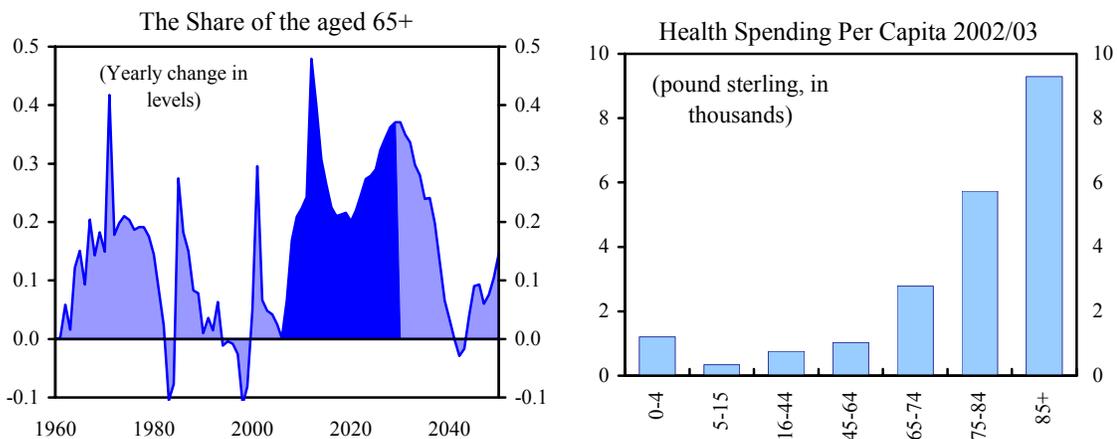
7.   **The pace of aging will be relatively less rapid in the United Kingdom than in many other countries.** Unlike many countries, the U.K. population has already undergone much of its aging. Cross-country comparison of long-term population projections show that the projected increase in the old-age dependency ratio over the next five decades is relatively mild for the United Kingdom, rising to about 40 percent. By 2050, the U.K.'s old-age dependency ratio is projected to be roughly the same level as in the United States, Canada, New Zealand, and Australia, but far below that of the continental European countries.

Projected Old-age Dependency Ratio

8.   **The United Kingdom spends a relatively small share of its national income on health care.** Total U.K. health care spending (both public and private) was 7.7 percent of GDP in 2003, compared to a 10 percent average for G7 countries. Indicators of life expectancy and infant mortality in the U.K are less favorable than the G7 average. Measures of service
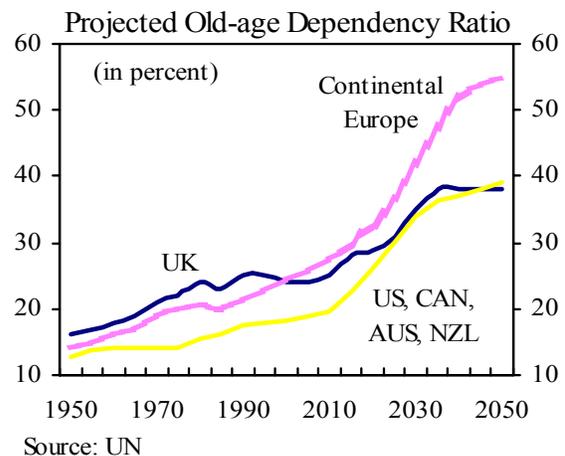
Source: UN

quality, including hospital waiting lists and waiting times (which may be inversely related to "quality of life") are also worse for the United Kingdom. Available cross-country information about waiting times suggest that all patients in the United Kingdom had to wait more than a month for non-emergency surgery, compared with only one in three patients in Australia, Canada, and New Zealand and just one in ten in the United States.

Increase in Health Care Spending
(in percentage point of GDP)

	1960-69	1970-79	1980-89	1990 ~
U.K.	0.6	1.1	0.4	1.7
G7 average	1.5	1.6	1.0	1.8

Source: OECD Health Data 2005.

Income and Health Spending per Capita

Health Outcome 2003
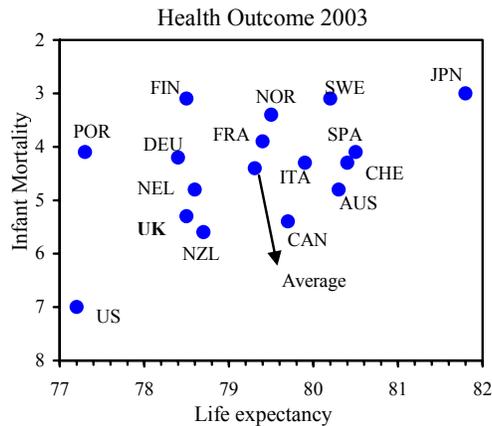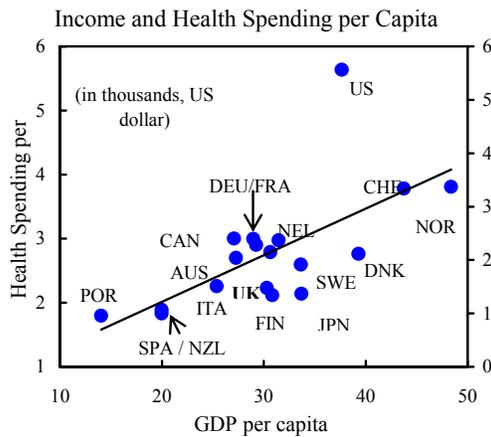
9.   **The U.K. health system is characterized by a high degree of public sector involvement.** Of total health care spending, over 80 percent is provided by the public sector. The U.K. National Health Service (NHS) since its establishment in 1948 has been one of the most centrally managed and financed health care system in the world. The U.K.'s large public sector involvement in health care is similar to New Zealand. In contrast, the private sector plays a larger role the countries like United States and Switzerland.

Total Health Spending (Public and Private)

Public Health Spending
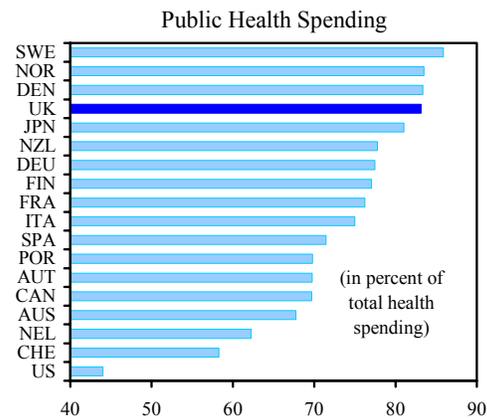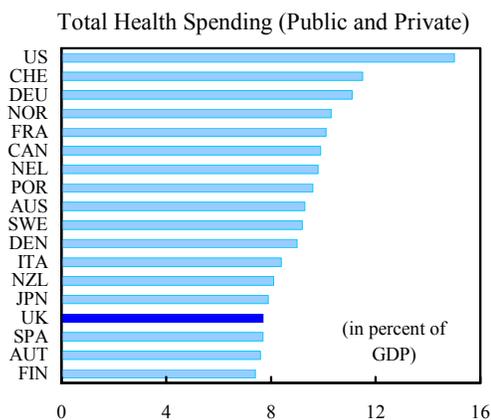
10.   **U.K. health care expenditure has risen less quickly than other G7 countries.** The pace of increase accelerated in the early-1970s and again in the late 1990s. Since 1999, health care spending has grown on average by 7½ percent in real terms, compared to a historical average of 4½ percent. As a result, health care spending as a share of GDP

increased by nearly 1¾ percentage points to about 7½ percent in 2004. Most of the other industrialized countries have experienced similar or even stronger pick-ups in health care spending during this period.

GDP and NHS Spending per capita 1/

NHS Spending 1/

1/ In real terms, adjusted by GDP deflator.

1/ In real terms, adjusted by GDP deflator.
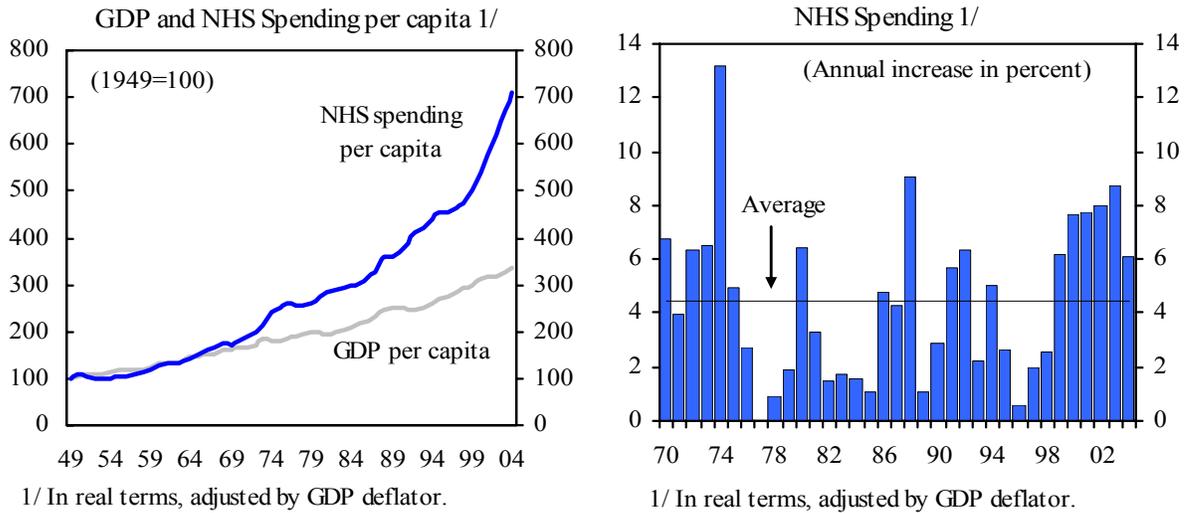
C. Survey of Health Care Cost Projections

11.   **Traditionally, long-term health care projections have been derived by multiplying the last actual observation on health care cost per age group by projections for population by age group.** In this way, projected changes in real health care spending reflect only changes in demographics. A cross-country comparison of age-related health care spending projections taking into account only the impact of demographic changes shows that the increase in the United Kingdom is moderate in relation to other European countries. This is consistent with the U.K.'s relatively slower pace of aging and lower per capita health care spending.

12.   **Recent literature suggests, however, that demographic changes may not be the key driver of future health care expenditure.** Bjornerud and others (2005) show that demographic change accounts for only about 10 percent of the average growth in health care expenditure across the OECD over the past 30 years. Seshamani and Gray also find that the effect of aging has accounted for only a small share of the observed increases in health care spending between 1985 and 1999, especially in

Projected Increase in Health Care Spending

1/ European Commission, Stability Report.
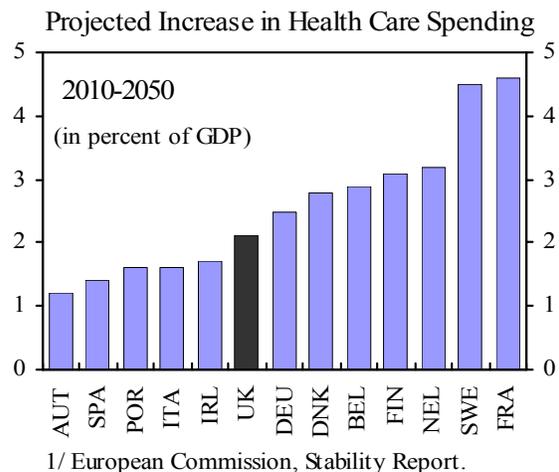
England and Wales with 2 percent—compared to 6 percent in Australia, 14 percent in Canada, and 56 percent in Japan.

13.   **Non-demographic factors play a major role in determining health care costs.** The European Commission's Aging Working Group identifies five key non-demographic factors driving health care spending: (i) health status; (ii) economic growth; (iii) technological and medical progress; (iv) the organization and financing of the health care system; and (v) health care resource inputs.[34] Among these non-demographic factors, technological advances have been identified as the major factor affecting the level and rate of change in health care spending. OECD (1998) indicates that continued advances in technology has accounted for between 50 and 75 percent of increases in health care costs in the recent past. Other studies that examined specific medical procedures in the United States show that the rapid health care cost increases have been associated with the diffusion of existing technologies, rather than the emergence and implementation of new technologies (Fuchs (1998) and Okunade and Murthy (2002)). Similarly, in the case of the United Kingdom, Wanless (2002) shows that while medical innovations and more advanced procedures have reduced unit costs, increased demand by a greater segment of the population due to lower prices resulted in higher total health care spending.

14.   **More recent studies have attempted to incorporate the effects of both demographic and non-demographic factors in projecting long-term health care spending.** To better characterize the impact of non-demographic factors (i) a life expectancy adjustment has been introduced to capture the health status of the population, reflecting different assumptions regarding whether the projected gains in life expectancy are spent in good or bad health; (ii) alternative assumptions regarding proximity to death have been included; and (iii) projections made regarding unit costs in the health care sector to reflect the influence of technology and other factors affecting costs. Recent health care projections for Australia (Productivity Commission (2005)) and New Zealand (Bryant et al. (2004)) incorporate all three of these elements.

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[34] The Aging Group has not yet reached a consensus on how to incorporate such factors; however, it has identified that the health care projections are highly sensitive to the assumptions on unit costs.

D. The U.K. Government's Projections

15.   **The 2005 Long-Term Public Finance Report projects that U.K. health care spending will rise only slightly over the**
coming decades. Initially, health care spending is projected to increase by one percentage point of GDP by FY2007/08 consistent with the government spending plan envisaged in the 2004 Spending Review. Then, based on the Government Actuary's Department (GAD) principal population projections and assumed improvements in the health status of the elderly as life expectancy increases, the government projects that age-related health care spending will increase by about 1½ percentage points of GDP by 2050.

Spending Projections 1/
(in percent of GDP)

Legend: Health/Long-term care, State Pensions, Education, Public pensions

1/ 2005 Long-term Public Finance Report.
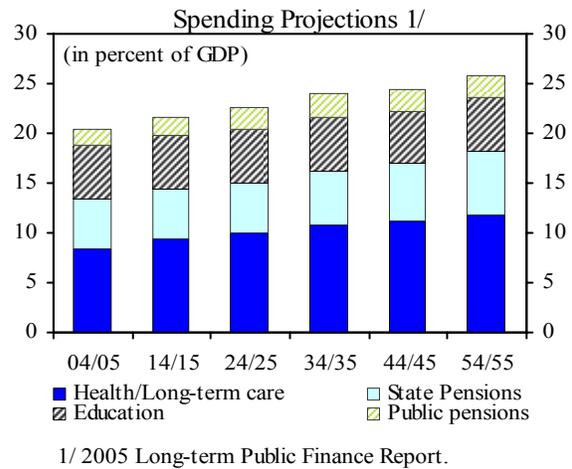
16.   **The small projected increase in health care spending from the impact of aging leads to only limited fiscal pressures in the medium-term.** The government's projections show that under the central assumptions, the U.K. public finances will satisfy the Sustainable Investment rule over the long term.[35] The required improvement in the primary balance, the so-called fiscal gaps, to meet the 40 percent of GDP net debt ceiling is small and manageable. While substantial uncertainties surround these estimates, alternative scenarios in the Report suggest that the fiscal adjustments required to meet the debt rule would not be large, in the range of ¼ to ½ percentage point of GDP per decade starting in the 2040s.

17.   **The relatively favorable outlook owes much to the fact that it is based only on demographic changes and assumed improvements in health status.** The latter assumption serves to reduce the potential impact of aging. At present, there is no clear evidence that there is a significant positive relationship between increases in life expectancy and the health status of the population. The government's projections do not factor in the potential impact of demand and technology advances on per capita health costs, which is one of the key non-demographic drivers in projecting health care spending.

18.   **In contrast, projections of health care spending that incorporate these likely per capita cost effects suggest more substantial increases.**

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[35] Sustained Investment rule—the government's fiscal rule aimed at assuring fiscal solvency—requires net public sector debt to be kept at a stable and prudent level, which the Treasury regards as below 40 percent of GDP.

- The 2002 Wanless report assessed the required health care spending to secure high-quality health services in the United Kingdom over the next two decades taking into account both demographic and non-demographic factors. The report concludes that the United Kingdom will face significant increases in health care spending to first catch up and then keep pace with the level of health care provided in other developed countries. In three different scenarios, Wanless projects that real health care spending would need to rise by 3-5 percentage points of GDP over the next 20 years.

Health Care Cost Projections

(in percent of GDP)

Wanless 2/

Auth. 1/

2007/08   2012/13   2017/18   2022/23

1/ 2005 Long-term Public Finance Report.
2/ Based on the "Solid" scenario.
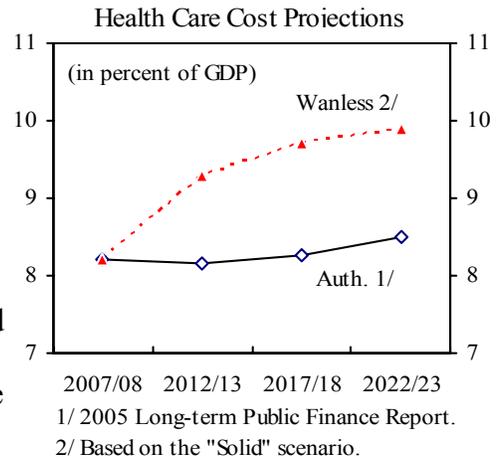
- **Australia**: the Productivity Commission (2005) projects that the government health care expenditure will increase from nearly 6 percent of GDP in FY2002/03 to about 10½ percent of GDP by FY2044/45, with population aging accounting for a little less than half of the projected increase. The Commission emphasizes that its projections are particularly sensitive to assumptions about the growth in prices of health services. With different assumptions regarding the rate of inflation in these prices, projected health expenditure in FY2044-45 are found to possibly range from 9 percent to close to 12 percent of GDP.

- **New Zealand**: Bryant et al. (2004) explores the relationship between population aging, health, and health care prices to estimate future fiscal pressures for New Zealand. Their results suggest that non-demographic factors will have greater effects on long-term health care spending than demographic factors. Assuming a modest annual increase of 2.1 percent in prices of health services, which is slightly higher than the assumed overall inflation rate and significantly lower than the 3-4 percent annual increase in recent years, government health care expenditure would rise from 6 percent to about 12 percent of GDP in FY2050/51.

E. Illustrative Alternative Scenarios

19.   **To illustrate the possible effects of non-demographic factors as embodied in the prices of health services, alternative projections can be derived based on the 2005 Long-Term Public Finance Report's estimates.** As constructed, the government long-term health care projections can be seen as implicitly assuming that the health care prices will rise at the same rate as overall inflation. Alternatively, based in part on historical experience, illustrative scenarios can be constructed

Real NHS Pay and Price Index 1/

Average

(Annual changes in percent)

1981/2   1986/7   1991/2   1996/7   2001/2

1/Adjusted by the GDP deflator.
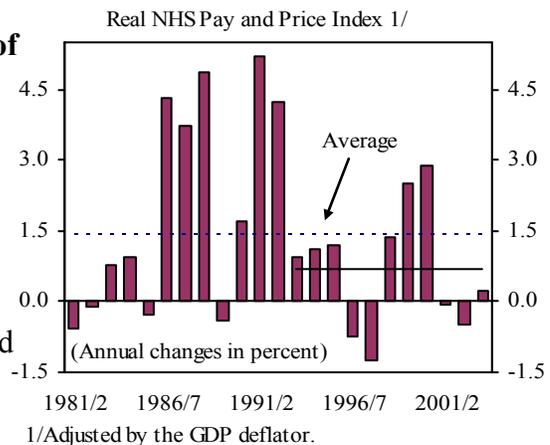
based on different assumptions regarding the differential between the average annual rate of increase in health services prices and the economy's overall inflation rate. This differential effectively embodies some of the key non-demographic factors effecting health care spending.
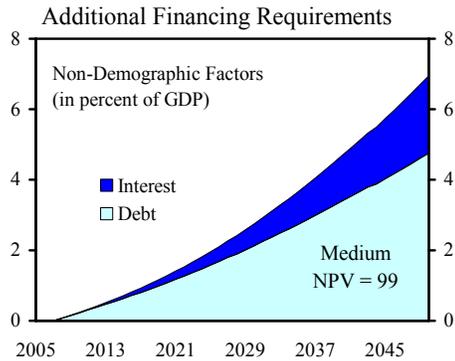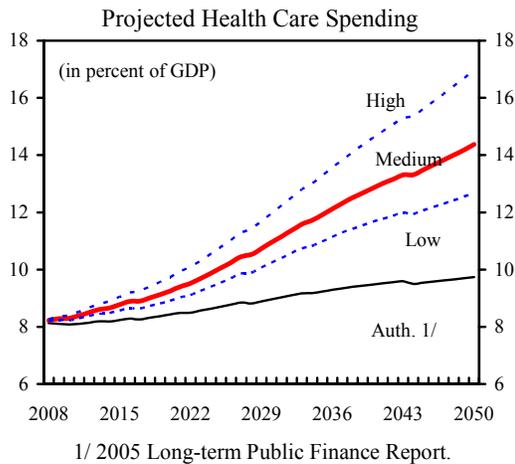
20.   **NHS per capita spending has increased significantly over the past 25 years across all health services.** To a large extent, the steady increase in NHS per capita spending was attributable to increases in the prices of health services. The NHS measure of pay and price inflation (a weighted average of the annual changes in the pay cost index and the health service cost index in hospital and community health services (HCHS)) has exceeded the annual rise in the GDP deflator by 1.4 percentage points on average over the past 25 years.[36] This differential in the inflation rate of health services has been more subdued in recent years, amounting to 0.7 percentage points on average since FY1993/94. Comparable price indexes are not available for the other major components of health care spending. Most notably, there is no index for pharmaceuticals, which is a large and rapidly growing component. Data for other countries (2005 OECD Health Data) suggest that pharmaceutical prices are increasing significantly faster than other health care services. For illustrative purposes here, three scenarios are constructed assuming that the annual differential in health service inflation and overall inflation in per capita terms is 0.7 percentage point in a low case, 1 percentage point in a medium case, and 1.4 percentage point in a high case.

21.   **In all three of the illustrative alternative scenarios, health care spending relative to GDP rises substantially more than in the government's long-term health care projections.** From 2008 to 2050, the increases range from 4½ to nearly 9 percentage points of GDP, compared to 1½ percentage points in the government projections. In the absence of appropriate fiscal adjustment these higher estimates of health care spending, in turn, suggest that—when interest costs are also factored in—government debt will exceed the 40 percent debt to GDP target in the Sustainable Investment Rule over a large part of this period Consequently, in contrast to the government's long-term projections, these scenarios would suggest that significant policy adjustments would be needed. Without fiscal adjustment, the net present value of the additional debt that would be accumulated over the period would range from about 60 percent of GDP in the low case scenario to 140 percent of GDP in the high case scenario.

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[36] The HCHS accounts for about 60 percent of total NHS expenditure. The pay cost index (PCI) is a weighted average of increases in unit staff costs for each of the staff groups within the HCHS. The Health service cost index (HSCI) is calculated to measure the price change for each of 40 sub-indices of goods and services purchased by the HCHS.

Projected Health Care Spending

1/ 2005 Long-term Public Finance Report.

Additional Financing Requirements

Projected Increase in Health Spending 2008-2050
(in percent of GDP)

	Differential inflation		
	0.7	1.0	1.4
Projected increase	4.6	6.3	8.9
ow. Non-demographic factor	3.1	4.8	7.4
Additional debt (NPV) 1/	61	93	140

1/ Includes additional debt stock reflecting non-demographic
   factor and compounded interest payments.

F.   Concluding Remarks

22.   **The alternative scenarios presented here illustrate that long-term health care spending in the United Kingdom could rise significantly over the next five decades.** In particular, they emphasize the importance of non-demographic factors in projecting health care spending. When factoring in the full effect of non-demographic drivers, U.K. public finances may face considerable challenges in meeting the net debt ceiling, which suggests that significant policy adjustments could be needed. To assess the possible magnitude of such fiscal costs adequately, more complete projections for health care expenditures are essential.

23.   **However, significant uncertainty surrounds health care projections.** In addition to risks associated with non-demographic factors, population projections are subject to significant uncertainty. There are also uncertainties regarding how health status will change as life expectancy increases. It is not clear, a priori, whether an aging population with a longer life expectancy will enjoy more or less ill health. Even in an optimistic case where the aging population lives longer in better health, Pellikaan and Westerhout (2005) suggest it will not alleviate the fiscal problems, as it may just shift the composition of public expenditure from health to either longer-term care or pension expenditure.

24.   **The United Kingdom is among the few countries that regularly provide comprehensive long-term scenarios to assess the impact of population aging on fiscal sustainability; however, there is scope for improving these exercises.** To draw implications for fiscal policy from such projections, it is essential to incorporate the

uncertainty, particularly with regard to non-demographic factors such as the future prices of health care services. Such analysis would facilitate the policy responses over the medium term. In addition, in forming an appropriate policy response, consideration has to be given to the question of intergenerational equity. Doing the analysis now will help ensure those reaping the benefits of the spending have born an appropriate share of the cost. This will enhance fiscal transparency, raise the level of public debate on these issues, and potentially enhance the credibility of policy decisions to tackle these problems.

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V. THE CREDIT RISK TRANSFER MARKET AND IMPLICATIONS FOR FINANCIAL SECTOR STABILITY[37]

The increasing ability to trade credit risk has facilitated the dispersion of risk and enhanced the stability and efficiency of the financial system. However, the still-limited liquidity of the credit risk transfer (CRT) market could heighten specific risks attached to CRT instruments, such as modeling risk, legal risk, counterparty risk, among others. These risks are potentially compounded by the increasing inter-linkages across the financial sector. A direct assessment of U.K. financial institutions' exposures to CRT instruments is not possible, given the lack of available information in this area. Thus, this paper proxies such exposures by the extent to which the variability of a financial institution's equity returns is explained by the variability of actively-traded collateralized debt obligation (CDO) tranches. The empirical results suggest that the large U.K. insurance companies are relatively conservative in their investment strategies, with greater exposures to volatility in the more senior (i.e. less risky) CDO tranches. Further, the exposures of large U.K. financial institutions as a group are sufficiently diversified across tranches to limit any impact from a negative shock.

A. Introduction

1.   **The increasing ability to trade credit risk in financial markets has facilitated the dispersion of risk across the financial and other sectors.** Credit risk transfer (CRT) instruments—such as credit derivatives and structured credit products—enable institutions to reduce their concentration of risks by passing on the "unwanted" risks. In other words, they provide a stabilization mechanism similar to that of reinsurance for the insurance sector (IAIS, 2003). Banks, in particular, can diversify their credit risk exposure by transferring it to other banks, or more importantly, achieve much larger diversification gains by shifting the risk outside the banking sector itself.[38] Theoretically, the net outcome of CRTs should be one of benefit, with a positive impact for overall financial stability and efficiency.[39]

2.   **However, there are specific risks attached to CRT instruments which could be heightened, in a relatively "new" market, by the still-limited liquidity and lack of transparency in some segments.** Notably, the complexity of quantitative techniques required to value and hedge these instruments is not yet completely understood, exposing market participants to potentially large losses. The situation is compounded by problems associated with, among others, the creditworthiness of transaction counterparties, and the adequacy of existing market and legal infrastructure. Increasing inter-linkages between financial institutions raises the question of whether institutions fully understand their risk

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[37] Prepared by Jorge A. Chan-Lau and Li Lian Ong (both MFD).

[38] See Rule (2001) for a discussion on the motivations for credit risk transfers.

[39] See Clementi (2001), Cousseran and Rahmouni (2005), Wagner and Marsh (2004).

exposures. For instance, while banks are shedding credit risk to insurance companies, life insurers are using capital markets and banks to hedge some of their portfolio risks (Rule, 2001). Substantial losses in credit markets experienced by German Landesbanks in 2002−03 suggest that some active participants in the market might not have the capacity to adequately manage the risks associated with CRT instruments.[40]

3.   **Thus, a key concern among regulators is that the rapid expansion of CRT markets may actually *pose* problems for financial sector stability, if a significant market event were to occur.** In their increasing search for yield in recent years, a wide variety of investors—some with little experience managing credit risk—have become active sellers of protection. Justifiably, regulators worry whether a major shock in credit markets could cause substantial and widespread losses among these investors, forcing a disorderly unwinding of credit risk positions. The general lack of accurate data on open positions in credit derivatives and structured credit instruments further increases the risks for financial stability by masking the extent of institutions' involvement with these products. Such risks arise from the ability of investors to leverage their positions substantially compared to similar positions in cash instruments such as loans or bonds.

4.   **This paper examines the financial stability issues related to CRT markets, focusing, in particular, on the use of CRT instruments in the banking and insurance sectors in the United Kingdom.**[41] Within the financial sector in the United Kingdom, globally active banks such as Barclays, Hongkong and Shanghai Banking Corporation and Royal Bank of Scotland are believed to be more exposed to credit derivatives than insurers. That said, other financial institutions have increasingly become more active in the credit derivatives market.

5.   **The paper is structured as follows.** Section II examines the growth of credit derivatives instruments and the proliferation of structured credit products in the global market. Section III considers the risks inherent in the CRT market, and the increasing inter-linkages among financial institutions. Section IV presents the empirical evidence on the exposure of financial institutions in the United Kingdom to credit derivatives products. Issues of market regulation and supervision are covered in Section V, while Section VI provides with specific recommendations in these areas for the United Kingdom market. Section VII concludes.

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[40] See *Risk* (2003).

[41] London is the main center of the global credit derivatives market, ahead of even New York. The size of the London market is estimated to have reached $2.2 trillion in 2004, of the total global size of about $5 trillion—about 44 percent, compared to the New York market at 40 percent.

B. Credit Risk Transfer Instruments—Structured Credit Products and Credit Derivatives

6.   **The exponential growth of the global credit derivatives market—since the instrument was first traded in 1996—has played a key role in the development of the CRT market.** A credit derivative is a contract (derivative security) that is used to transfer the risk that the total return on a credit asset would fall below an agreed level to another party. This is usually achieved by transferring the risk on a credit reference asset. It does not require the transfer of the underlying asset, although the cash flow of the credit derivative instrument is determined by the credit quality of the underlying asset. [42] According to the British Bankers' Association, the value of credit derivatives products, which exceeded even the total volume of outstanding U.S. Treasury bonds at the end of 2004, is projected to surpass $8 trillion by 2006 (Figure 1).

Figure 1. Growth of the Global Credit Derivatives Market
(In billions of U.S. dollars)

Source: British Bankers Association.
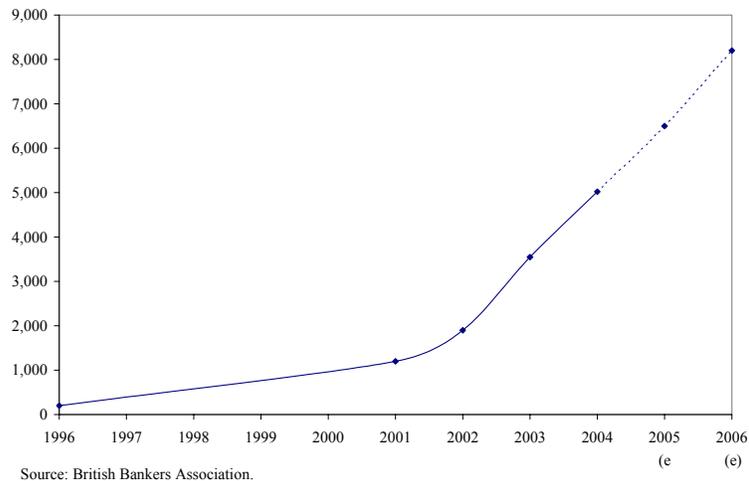
7.   **Among the most popular structured credit products are collateralized debt obligations (CDOs).** [43] CDOs are constructed by "pooling" the credit risk of different financial instruments, and dividing the pooled credit risk into tranches with different risk and

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[42] Examples of credit derivatives include credit default swaps (CDSs), credit-linked notes (CLNs), credit spread options (CSOs) and total return swaps (TRSs).

[43] Rule, Garratt and Rummel (2004) define a structured credit product as *"a bond combined with one or more options or forwards linked to market prices or indices"* which can *"take a variety of contractual forms depending largely on the nature of the target investors."*

return characteristics (Box 1).[44] CDOs generally combine three mechanisms common to all securitization structures (Cousseran and Rahmouni, 2005):

(i)   the construction of a reference portfolio comprising a pool of bank loans and/or negotiable financial instruments and/or credit derivatives;

(ii)   the de-linking of the credit risk of the portfolio from that of the originator of the portfolio via the use of a Special Purpose Vehicle (SPV) that issues the CDO and holds the underlying assets; and

(iii)   the tranching of CDOs backed by this portfolio, with specific seniority rank in terms of rights to cash flows generated by the underlying assets.

8.   **Motivations to issue CDOs are varied.** They include arbitrage opportunities (from attractive excess spreads coupled with low default rates); balance sheet management (reduced cost of funding and meeting regulatory capital requirements); providing fund managers with the opportunity to earn a stable fee income and to increase their assets under management; providing investment banks the opportunity to earn underwriting fees and cross-sell collateral into CDOs (Memani, 2005). In other words, legal, regulatory and economic incentives have typically been the key drivers of growth in the CDO market. In addition, the underlying bond and loan secondary markets are relatively illiquid. Thus, CDOs help to improve liquidity raising the total valuation to the issuer of the CDO structure (Duffie and Garleanu, 2001).

9.   **Participants in the CRT market have also become increasingly diverse.** According to the Fitch (2005), the main participants in the CDO market are lending institutions, who are usually net buyers of protection or net sellers of CDOs and insurance companies, who are net sellers of protection and net buyers of CDOs. A 2004 survey by the British Bankers' Association (BBA) suggests that while banks, securities houses and insurance companies still constitute the majority of market participants, hedge funds have emerged as key players, both as protection buyers and sellers (see Figure 2). According to data from Credit Suisse First Boston (CSFB), the investor base (sellers of protection) has broadened more recently, to include hedge funds, proprietary traders and the more traditional asset management industry, who participate in both the protection buyers' and sellers' markets (see Figure 3). Even some pension funds, which had followed conservative investment strategies, are said to have started taking on the role of protection sellers.

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[44] A tranche is defined as a certain loss range.

Box 1. How Collateralized Debt Obligations (CDOs) Work

In a CDO transaction, investors have the choice of purchasing different tranches of the instrument, commensurate with their risk-return preferences. An investor could purchase the riskiest tranche, which offers the highest return by far, but which also bears the initial losses that the pool suffers from any default among all its bonds. In other words, the risk-taking investor is taking a bet that any such loss would not occur, in return for the opportunity to earn double-digit returns. Alternatively, the investor could purchase a more conservative tranche, which pays a lower return, but is insulated from initial defaults in the bond pool. The super-senior, senior, mezzanine and equity tranches bear increasing risks of defaults. Specifically, holders of mezzanine, senior and super-senior tranches of a CDO have some protection from the risk of loss from their respective more junior tranches.[1]

In order to estimate the rates of return at which to offer each tranche of the instrument, the originator (usually an investment bank) first has to estimate distribution of losses in the pool. The distribution of losses depends largely on the correlation of default among the names referenced in the CDO. In general, the lower the default correlation, the higher the compensation paid to the equity tranche investor and vice-versa. This is because lower default correlations suggest that the probability of observing a limited number of defaults is higher. The limited number of defaults is sufficient to wipe out the equity tranche investor's capital. The opposite is true for the senior tranche investor—higher default correlations imply that the senior tranche is more likely to suffer losses, and thus the senior tranche investor would expect to be paid a higher compensation.[2] The dependence of the compensation paid to mezzanine tranches investors on correlation lies between the equity and senior tranche extremes (Gibson, 2003).

The *synthetic* CDO is one of the most popular products derived from the regular CDO instruments.[3] This instrument has the potential to intensify both the risks and returns of the regular CDO, by replacing the pool of bonds with credit derivatives, specifically, credit default swaps (CDS). The synthetic CDO is classified as a credit derivative. In a synthetic CDO transaction, the credit risk on the reference portfolio is transferred using CDS instruments:

(i)   the special purpose vehicle (SPV) sells protection to the originator of the deal in return for agreed fees;

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[1] These tranches may also be protected by credit enhancements such as the overcollaterization of assets, reserve accounts or trapping excess spread, which would allow them to achieve a higher credit rating than the average rating of the underlying portfolio.

[2] From the equity tranche investor's perspective, the higher chance of a large number of defaults (fatter tails in the distribution of the number of defaults) due to high correlation is inconsequential since the investor's position is no longer affected beyond the first losses.

[3] Cousseran and Rahmouni (2005) provide details on the types of CDOs available in the market, including the criteria for issuing these instruments, the nature of credit risk transfers being effected and the CDO instruments available.

[4] A credit default swap is essentially an insurance policy, which insures against a bond default. Holders of bonds could purchase credit default swaps on their bonds as protection—if the bond defaults, the seller of the CDS (seller of protection) acts as an insurer and pays the buyer. In return, the seller of the CDS receives an immediate payment up front without investing any funds, just in return for pledging to play if a default occurs. The price of protection naturally increases with the perceived likely of default. Investors who do not own bonds may also purchase credit default swaps, in order to benefit from any rise in value.

Box 1. How Collateralized Debt Obligations (CDOs) Work (Continued)

(ii) the risk is then transferred from the SPV to investors through the issuance of tranches of fully-funded synthetic CDOs, credit default swaps (which are unfunded), or a combination of both (that is, partially funded CDOs).[5]

The demand for synthetic CDOs has grown exponentially, and is displacing cash CDOs. The introduction of single-tranche CDOs (also known as "bespoke tranches") has been an important innovation in synthetic CDO structures. This instrument was created in 2003 as a more flexible alternative to traditional CDOs. With single-tranche CDOs, only one tranche of the structure—usually a mezzanine tranche—is sold to the investor, while the arranger becomes the direct counterparty of the investor since there is no SPV in the structure. This specialized structure allows the seller to meet specific needs of the investor, and in a more timely and cost effective manner compared to traditional CDOs, which require that all the different classes of tranches (equity, mezzanine, senior)—usually to different investors—be sold to do the deal.[6]

Since synthetic CDOs could be created without holding any actual bonds as an underlying asset, the supply of these instruments appears limitless. However, this causes problems in the event of a default if contracts specify physical settlement since there may not be enough bonds available for settlement. Markets have started to address this situation. For instance, in the default incidents involving Collins & Aikman, and Delphi, auction mechanisms were introduced to cash settle index trades.

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[5] Synthetic CDO tranches could be either "funded" or "unfunded". If a tranche is funded, the CDO investor pays the notional amount of the tranche at the beginning of the transaction—the funds are put into a collateral account and invested in low-risk securities—and any default would result in a write-down of the principal. In return, the investor receives LIBOR plus a spread which reflects the riskiness of the investment. If a tranche is unfunded, no money changes hands at the initiation of the transaction. Rather, the investor (protection seller) receives a spread and pays out in the event that a default in the reference portfolio affects the investor's particular tranche. Since unfunded tranches depend on the investor's future ability and willingness to pay, they create counterparty credit risk for the protection buyer. A credit default swap is an unfunded credit derivative.

[6] See Cousseran and Rahmouni (2005) for a detailed description of the structure of a single-tranche CDO, and the risks attached to this instrument.

Figure 2. CDOs: Protection Buyers and Sellers

Protection Buyers

Government /export credit agencies, 1%
Insurance companies, 7%
Hedge funds, 16%
Corporates, 3%
Securities firms, 16%
Mutual funds, 3%
Banks, 51%

Protection Sellers

Government /export credit agencies, 1%
Hedge funds, 15%
Corporates, 2%
Securities firms, 16%
Pension funds, 4%
Insurance companies, 20%
Mutual funds, 4%
Banks, 38%
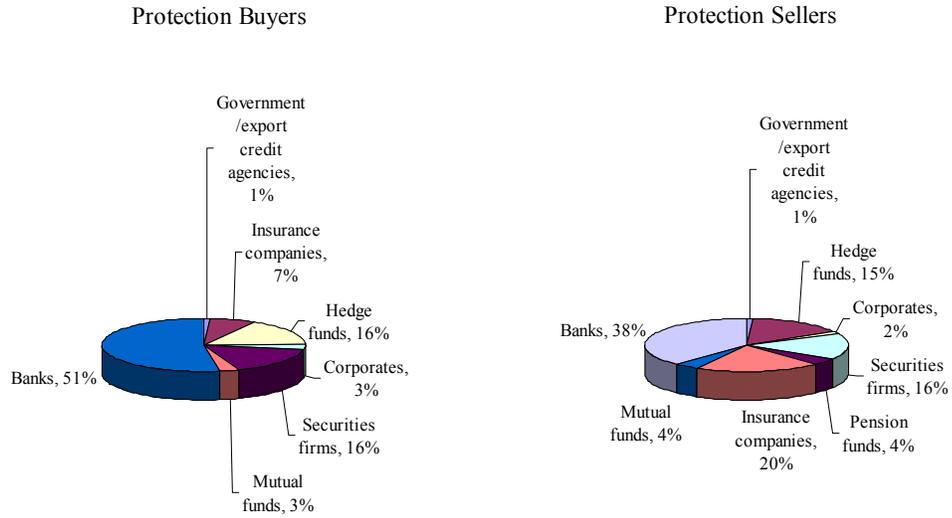
Source: British Bankers' Association.

Figure 3. Composition of Protection Sellers (Buyers of CDOs)

Mezzanine Tranches

Asian Banks, 1.3%
US Banks, 2.3%
High Net Worth, 5.7%
European Banks, 12.3%
Structured Funds, 12.4%
Insurance Companies, 28.6%
Money Managers, 37.4%

Senior Tranches

Structured Funds, 0.3%
Money Managers, 3.9%
US Banks, 10.0%
Insurance Companies, 20.4%
Foreign Banks, 25.5%
Conduits, 39.9%
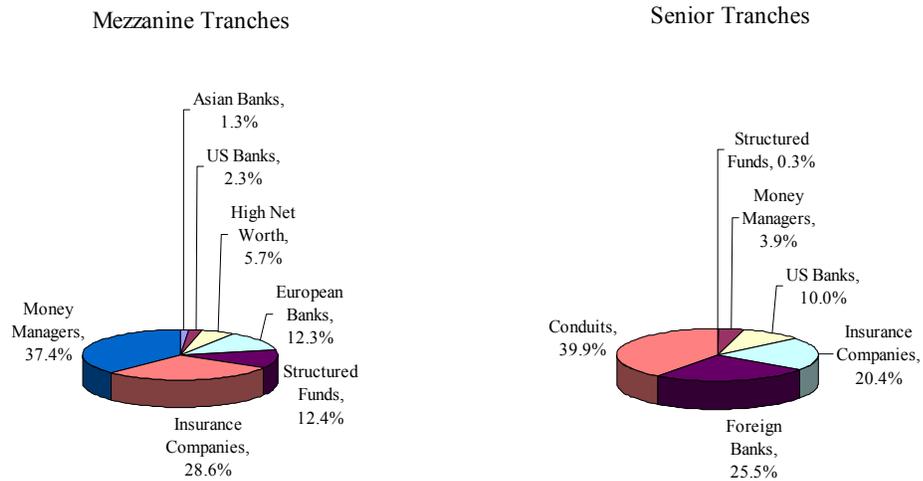
Source: CSFB.

10.   **The growth of credit derivatives has provided the impetus for the sharp growth in *synthetic* CDOs** since the latter are easier to assemble and disperse than their cash counterparts (Figure 4).[45] According to the BBA (2004), synthetic CDOs make up about 16 percent of the credit derivatives market, behind CDSs, which have a 51 percent market share. Indeed, synthetic CDOs, which insured less than $400 billion of the face amount of U.S. corporate bonds in 2001, are estimated to cover some $2 trillion by the end of 2005, according to JPMorgan. As a benchmark comparison, this would represent about 40 percent of the entire U.S. corporate bond market of almost $5 trillion.[46] The demand for these instruments has been particularly strong in Europe, driven by the existing legal and taxation barriers to securitization transactions involving the true sale of underlying assets, and the limited interest in these transactions for refinancing purposes (Cousseran and Rahmouni, 2005). Further, the outstanding volume of corporate bonds in Europe is much smaller than in the US, making it more difficult to source assets for cash CDOs.

Figure 4. Growth of the Global Synthetic CDOs Market
(In billions of U.S. dollars)

Source: JPMorgan.

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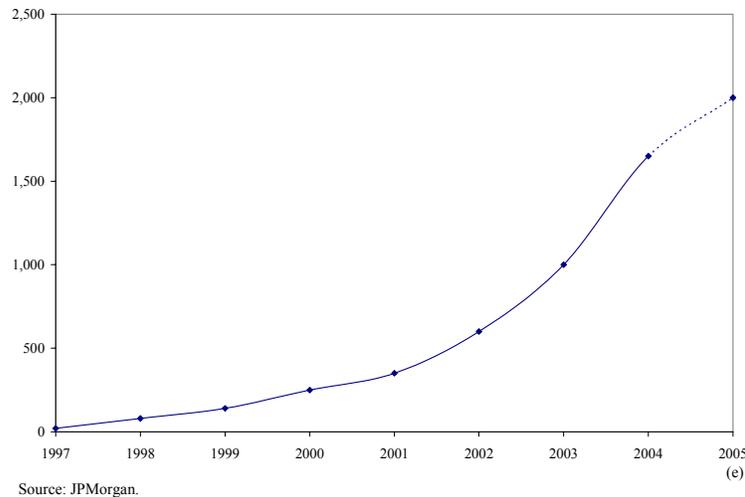
[45] See Box 1.

[46] CDOs issued in Europe targeted at European investors may also include U.S. underlying assets.

C. Inter-Linkages across Financial Institutions

11.   **Within the financial system, there are increasing linkages across different financial sectors, especially between banks and insurers.**[47] Insurance companies are major investors in banks' equity and debt instruments, which exposes them to risks taken by banks. Insurers also cover banks and their customers for the usual insurable risks; they provide companies with trade credit insurance, while banks often finance these "receivables", supported by insurance. Meanwhile, banks provide insurers with liquidity facilities to enable them to pay current claims, and with letters of credit as evidence of their ability to pay future claims.

12.   **The formation of bancassurance groups through the merger of banks with insurers represents another example of cross-sector linkages.** In the United Kingdom, for example, ownership interests of U.K. banks in insurance companies have been significant, with six of the 10 largest U.K.-owned banks having equity shares in life insurance subsidiaries as at end-2003. This is in contrast to the direct credit exposure of U.K. banks to the life insurance sector, with loans to insurers and pension funds amounting to just over 6 percent of the major banks' Tier 1 capital. Existing empirical evidence shows that the equity prices of individual bancassurers in the U.K. were adversely affected by disruptions in the United Kingdom life insurance sector over the 2001–03 period, suggesting a spillover effect though ownership links (Monks and Stringa, 2005).[48]

13.   **Meanwhile, the development of techniques to repackage credit risk into "slices" has facilitated the increasing shift of credit risk away from the banking sector.**[49] Credit risk has been transferred to insurance companies, and to other capital market participants such as hedge funds, mutual funds, and pension funds.[50] Banks account for the major share

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[47] See Rule (2001).

[48] See Monks and Stringa (2005).

[49] These techniques, to a large extent, have been borrowed from mortgage backed securities (MBS). Lessons learned in this market have been transferred to the credit derivatives market.

[50] As an example, credit risk in the banking sector spiked up in early May 2005 on rumors that hedge funds active in credit derivative markets might have incurred large losses following the ratings downgrade of automobile companies General Motors (GM) and Ford. The influence of hedge funds on the banking industry is largely due to the substantial contribution of hedge funds to investment banks' fee income. The banks generate these fees by providing trading ideas, financing positions, and executing trades on behalf of hedge funds. Hence, factors affecting hedge funds' performance affect banks' profitability. For instance, idiosyncratic shocks that reduce hedge funds creditworthiness increase counterparty risk to banks involved in financing these funds' positions. It was not entirely surprising, then,

of CRT market activity—they use CRT instruments for diversifying or hedging risks in their banking books (portfolio management). Banks also provide investor services by devising and intermediating CRT products, and make markets for credit derivatives (ECB, 2004). Individual banks could be involved in both portfolio management and intermediation activities. In the United Kingdom, the larger banks (by assets) participate in the CRT market.

14.   **Within the European Union, insurance companies are the largest buyers of credit risk outside the banking system** (ECB, 2004). Different types of insurers have been using CDOs and CDSs to take on credit risk at varying levels of seniority and forms, commensurate with their balance sheet needs and regulatory restrictions (see Rule, 2001). In countries such as Denmark, German, Japan, the Netherlands and the United Kingdom, life insurers are reportedly seeking more credit risk in order to increase the yield on their assets. Ironically, these investors may then have to seek recourse from their respective banks by drawing on their credit lines if losses crystallize during a credit event, in order to meet their obligations under these CRT instruments.

15.   **The transference of credit risk between institutions also gives rise to several other risk factors.**[51] **Market risk** is associated with changes in the credit spreads of names in the underlying portfolio of a CDO tranche. The seller is often exposed to **liquidity risk** as well, as it may be difficult to sell an asset quickly in an insufficiently liquid secondary market. That said, investors such as life insurers and hedge funds with less liquid liabilities than banks may benefit from the liquidity premium. The use of standardized tranches on credit derivatives indices to hedge exposures to single-tranches gives rise to **basis risk**, since the instruments are not perfectly matched. **Counterparty risk** arises from the possibility that the risk buyer may default in settling a claim, while **legal risk** refers to the lack of complete and timely documentation, in the event of a dispute over a particular transaction. **Ratings risk** arises from the fact that ratings tend to reflect the average risk of a security, without factoring in the dispersion of risk around its mean (Cousseran and Rahmouni, 2005). This may limit the usefulness of ratings given the structured nature CDOs.[52] There is also the possibility of "ratings arbitrage", wherein CDO issuers may be tempted to choose rating agencies based on the best rating that is assigned to their particular issue or tranche, to minimize funding costs. **Model risk arises** in the valuation of CDOs using a myriad of complex models that continue to evolve.

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that banks' equity prices fell and credit spreads widened when hedge funds investment strategies underperformed following the automobile companies' downgrades.

[51] See Appendix I for a detailed discussion on the individual risk factors. It should be noted that these risks are not unique to CRT instruments.

[52] It should be noted that rating agencies are constantly refining the rating criteria applied to structured products.

D. Exposure of U.K. Financial Institutions to Credit Derivatives Market

16.   **A *direct* assessment of the exposures of financial institutions in the United Kingdom to credit derivatives—and their implications for financial stability—is not possible, given the lack of available information in this area.** To overcome this limitation, we estimate the exposure of a firm to the credit derivatives market by examining the extent to which developments in the credit derivatives market explain the variability of the firm's equity returns in the longer-run. The assumption that such a relationship exists is reasonable, given that gains/losses on holdings of CRT instruments are eventually manifest in a company's financial data.[53] We assess this exposure indirectly by using the vector autoregression (VAR) approach first suggested by Hasbrouck (1991a, b). In this case, we estimate the model using daily data for the period August 28, 2003 – September 15, 2005 (see Appendix II).

17.   **The major financial services groups analyzed here represent either the largest life insurers or major banking groups**, which list their shares locally in the United Kingdom: Aviva, Barclays, Halifax Bank of Scotland (HBOS), Hongkong and Shanghai Banking Corporation (HSBC), Lloyds, Legal and General, Royal and Sun Alliance and Royal Bank of Scotland (RBS).

18.   **Our empirical results suggest that U.K. insurance companies tend to be more conservative in their investment strategies.** Table 1 shows the longer-term impact of volatility in the credit derivatives market on the stock price returns of our sample companies.[54] The major insurance companies tend to be more exposed to volatility in the more senior mezzanine tranches, with attachment points of 9–12 percent and 12–22 percent.[55] In contrast, the bancassurance businesses tend to be more exposed to the junior

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[53] See, for instance, Tett (2005).

[54] In this model, the shocks are not orthogonalized. This means that the variance decomposition ranks the importance of every shock, but does not represent the actual percentage that each shock contributes to a particular share price, since the shocks may be correlated. In other words, the sum of the individual variances would not be equal to the total variance because of the covariance terms, but the rankings hold since it is equivalent to a renormalization.

[55] The risk levels of a synthetic CDO are determined by the total accumulated loss of the reference pool of assets. In a CDO, the default losses borne by a tranche range between the attachment point and detachment point. The lower bound of the range is called an attachment point and the upper bound a detachment point. For example, a 3−6 percent tranche has an attachment point of 3 percent and a detachment point of 6 percent. When the accumulated loss of the reference pool is no more than 3 percent of the total initial notional of the pool, the tranche will not be affected. However, when the loss has exceeded 3 percent, any further

(continued…)

mezzanine tranches, with attachment points of 3–6 percent and 6–9 percent, with the exception of HBOS. The apparent conservatism of HBOS, which is substantially exposed to the senior mezzanine tranche, with attachment points 12–22 percent, could possibly be explained by the fact that it is also the biggest life insurer in the United Kingdom market, in addition to being one of the five biggest banks in the country. Barclays also appears to be most exposed to the senior mezzanine tranche.

Table 1. Impact of Volatility in Credit Derivatives Market on Major U.K. Financial Groups, 28 August 2003-15 September 2005
(In percent)

	Bank	Bancassurance				Insurance		
	Barclays	HBOS	HSBC	Lloyds	RBS	AVIVA	Legal &	RSA
Dependent variable	0.2	3.6	9.3	0.4	0.9	1.8	26.0	0.3
iTRAXX tranches								
Equity tranche								
0-3 percent	8.6	0.3	17.9	0.2	2.4	7.3	0.7	3.3
Mezzanine tranches								
3-6 percent	2.1	10.4	51.6	32.7	38.9	12.5	13.2	0.7
6-9 percent	24.1	0.4	0.9	35.3	14.9	27.4	4.7	33.9
9-12 percent	17.3	12.3	5.2	6.6	13.9	35.8	5.0	53.7
12-22 percent	47.6	72.9	15.0	24.6	28.9	15.2	50.4	8.0
10 less 2 year govt yield	0.1	0.0	0.1	0.2	0.0	0.0	0.0	0.0

Sources: Bloomberg L.L.P. and IMF staff calculations.

19.   **The empirical evidence suggests that the CRT market does not pose a substantial threat to financial sector stability in the United Kingdom, at this point.** While our sample of financial institutions is admittedly rather small, thus making it difficult to generalize this finding, the results suggest that: (i) there are sufficiently diverse holdings across major institutions in the United Kingdom market, which are potentially active in the CRT market, to limit the extent of the impact if markets were to experience a negative shock; and (ii) insurance companies—at least the major ones—which are risk-buyers, appear to prefer the tranches that better insulate them from first losses.[56]

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loss will be deducted from the tranche's notional until the detachment point 6 percent is reached. At this point, the tranche is wiped out.

[56] The data are subsequently divided into two sub-periods—August 28, 2003 to September 6, 2004, September 7, 2004 to September 15, 2005—and the VAR approach is applied to each sub-sample. The results suggest that the major U.K. financial institutions have become more conservative in their involvement in credit derivatives over time. These institutions became more exposed to volatility in the more senior mezzanine tranches over the two sub-periods, with the exception of RBS. The holdings across institutions remained diverse over time.

20.   **In our view, the main threat posed by a credit event in the credit derivatives market is that of reputation risk, which could result in contagion.** In other words, the failure of one financial institution could have the knock-on effect of denting public confidence in the financial sector in general, especially given the increasing inter-linkages between different segments of the financial sector. In the United Kingdom, inter-relationships between the banking and insurance sectors are especially significant, as discussed earlier. In the current environment, where the market is rapidly evolving, and credit yields remain relatively low, institutional investors may be tempted to take riskier bets and move down the credit spectrum to increase the returns on their investments. It is thus important for authorities to continue monitoring developments in these markets, and to obtain more detailed information on the exposure of institutions—identified by supervisors as being potentially systemic—to CRT products.

E. Supervision Initiatives and Disclosure Requirements

21.   **In the United States, the advent of securitization exposed major deficiencies in its regulatory and supervisory practices.**[57] The U.S. authorities realized that while regulatory and accounting reforms were important, proper supervision of the market would require adequate resources and relevant experience on the part of supervisors.[58] As a result, the Office of the Comptroller of Currency (OCC) implemented supervisory reforms related to securitization exercises by banks. These include:

- developing a cadre of specialized experts to examine securitization programs;
- recognizing that these examinations require extraordinarily high person-hour expenditure;
- developing independent valuation capabilities for the residual risk component;[59] and,
- obtaining information on every securitization vehicle for every bank.

In terms of banking practice, the OCC has recommended that banks should:

- encourage an independent legal and accounting review of every vehicle;
- perform "stress to breakage" risk analysis to complement their residual risk valuation; and,
- put in place contingency liquidity and reserve planning.

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[57] See Carhill (2005).

[58] In the United States, the regulation and supervision of banks are undertaken by the Federal Reserve and the Office of the Comptroller of Currency, as well as by individual state regulators and supervisors.

[59] This refers to the issuing bank's equity piece of a securitized instrument.

22.   **In the United Kingdom, the Financial Services Authority (FSA) posits that understanding the extent to which real risk is transferred is key when monitoring the CRT market.**[60] To this end, the FSA has engaged in surveys—in particular, through the Joint Forum—to understand who the end investors are, and how well the risks are managed.[61] The FSA maintains a conservative approach with respect to data collection on a regular basis given its view that such exercises incur high costs and provide limited benefits, under its existing cost-benefit framework for regulation. The supervisor is also prioritizing the issue of model risk by initiating the *hypothetical portfolio exercise* to better understand how firms are modeling CRT instruments and to discover the challenges across firms. In the meantime, the FSA and the New York Federal Reserve are currently working with major participants in the CRT market to resolve the issue of backlogs in trade confirmations and assignments.

23.   **Meanwhile, the strengthening of reporting standards will likely improve disclosure in the financial sector.** Notably, the promulgation of International Financial Reporting Standards (IFRS) points to the likelihood of more accurate valuations of structured credit and credit derivatives instruments in the financial statements.[62] IAS 39, which is still undergoing revisions, introduces the use of fair value accounting for financial assets and liabilities of *listed* companies. Essentially, credit derivatives held in the trading book of a bank would have to be recorded at fair value, under this standard. Within the banking book, the *purpose* of the instrument is key to determining its valuation in the financial statements. Credit derivatives used to hedge underlying transactions in the banking book would have to be recorded at fair value, while the same instruments may be recorded at cost if the objective is to hold them to maturity.[63]

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[60] The approach to supervision and regulation taken by the authorities in the United States and the FSA in the United Kingdom is different, reflecting the differences in the structure and history of the banking system in each country.

[61] International initiatives on surveillance of the credit derivatives market include the Joint Forum and the Financial Stability Forum (see Joint Forum, 2004)

[62] The United Kingdom adopted IFRS on 1 January 2005. The European Commission brought in fair value accounting for derivatives on 16 November 2005. The Commission initially accepted most of the proposals presented by the International Accounting Standards Board in 2004, but opted out of its recommendations on fair value accounting and on hedge accounting. It then drew up a restricted fair value option, which was approved in July 2005, and came into force on 16 November 2005, retroactive to 1 January 2005.

[63] The financial institution is required to fully disclose the criteria for which the instrument is used, and to detail how the instrument supports its investment or hedging strategy. Disclosures of details on credit derivatives is covered by IFRS 7, *Financial Instruments Disclosure*s.

F. Policy Recommendations

24.   **Credit derivatives markets allow for a better distribution of risks across different segments of the financial sector.** As such, the development of the credit derivatives market should be encouraged. The challenge for regulators is to implement regulatory measures and provide adequate supervision and surveillance to prevent the misuse of these instruments, while providing an environment that encourages further development of this market.

- **Ensure that all paperwork relating to CRT transactions are timely and kept up-to-date.** U.K. institutions involved in the huge backlogs in trade processing, as mentioned in section V above, should be encouraged to address these problems as quickly as possible.[64]

- **Ensure risk management systems are adequate to cope with stresses in the credit derivatives market.** Given the opacity of some CRT products, it may be difficult to determine the existence of any significant credit risk exposures through investment portfolios, from mainstream regulatory reports. Onsite examinations could be performed during periods when authorities foresee greater risks in the market, for example, when markets appear one-sided (crowded trades).

- **Ensure that supervisory staff are always up-to-date with the latest techniques and tools** in order to adequately assess the risk management systems and controls of institutions participating in the structured credit products market. In the United States, for instance, regulators have recognized that specific specialist skills and high levels of resources are necessary to supervise this highly innovative market in an effective manner.

- **Require financial institutions to regularly stress test the open positions in CRT instruments, notably in structured credit exposures**. Current models for pricing CRT instruments are very sensitive to changes in parameter values, such as the correlation of defaults. It is thus important to stress test existing portfolios for extreme changes in parameter values arising from the strategic and herd (or endogenous) behavior of other investors. In addition, supervisors should ensure that adequate counterparty risk management procedures, including collateral arrangements, are in place.

- **Provide leadership in encouraging market participants to consider richer and more consistent measures of risk, in addition to formal ratings of CRT instruments**. With regards to ratings provided by rating agencies for CRT

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[64] Also see Appendix I.

instruments, the authorities should encourage investors to become fully familiar with the nature and scope of such ratings. Some form of involvement by supervisory authorities in the mapping of different agencies' ratings onto a common scale—a potentially complex and complicated exercise—may also be useful. That said, explicit regulation against the practice of ratings arbitrage may not necessarily be appropriate. Another possible option may be to require that all the capital charges of a particular bank or insurance company be based on the ratings of one rating agency at any one time.

- **Consider the need for greater disclosure by financial institutions, of their holdings in CRT instruments.** For example, obtaining information on holdings in first-loss tranches would enable supervisory authorities to determine the concentration of risks in the CRT market. However, an appropriate balance would need to be struck between the increased cost of greater disclosure by financial institutions, and its marginal benefits for financial stability.

G. Conclusion

25.   **The increasing ability to trade credit risk in financial markets has facilitated the dispersion of risk across the financial and other sectors.** Theoretically, the net outcome of CRTs should have a positive impact on overall financial stability and efficiency. However, there are specific risks--such as modeling risk, legal risk, counterparty risk, among others--attached to CRT instruments which could be heightened by the still-limited liquidity in the market. Thus, a key concern is that the rapid expansion of CRT markets may actually pose problems for financial sector stability in the event of a major negative shock in credit markets.

26.   **This paper focuses on the use of structured credit products in the banking and insurance sectors, and its implications for financial sector stability in the U.K.** Given the lack of publicly available information on the portfolio holdings of financial institutions, an indirect method using vector autoregression (VAR) is applied instead. Our results indicate that the structured credit market may not pose a substantial threat to financial sector stability in the United Kingdom, at this point. The apparent diverse holdings across major financial institutions potentially active in the structured credit market may have limit the impact of any negative shock to the market. Further, insurance companies, at least the major publicly listed ones, appear to prefer the "safer" senior tranches. Overall, the challenge for regulators is to ensure adequate regulation, supervision and surveillance of this rapidly growing market, while encouraging the development of this market.

Key Risk Factors in CRT Markets

Market risk **largely affects sellers of single tranche CDOs (buyers of protection).**
Hedging the short credit risk positions requires selling protection periodically on the names
referred in the CDO in credit markets. The originator/seller of the CDO is exposed to risk
associated with changes in the credit spreads of names in the underlying portfolio of the
tranche. However, any dynamic hedging techniques entered into by the seller would only be
effective if the instruments used (CDSs, corporate bonds, CDS indices) are sufficiently
liquid. Thus, the seller is often exposed to **liquidity risk** as well, which could exacerbate
losses in the event of market stress.

Liquidity risk **arises from the difficulty of selling an asset quickly in an insufficiently
liquid secondary market.** This risk tends to be higher for new or rapidly growing markets,
compared to well-established, mature ones. The secondary market for customized CDOs is
non-existent. One potential concern is that some participants in credit derivatives markets
may overestimate the liquidity of these products in constructing and hedging their
correlation-based portfolios. The issue is not whether occasional losses are sustained by well-
diversified large investors, but rather that one of the key player's portfolios may be too
highly concentrated in these instruments. While CDS indices have a certain level of liquidity
due to their standard nature, they are not perfect hedges, and thus give rise to **basis risk**.

Basis risk **arises when the hedging instruments available are not perfectly matched to
the risks that are to be transferred.** Indeed, most hedges are imperfect. For example,
standardized tranches on credit derivatives indices are increasingly being used by arrangers
to hedge their exposure to single- (or "bespoke") tranches.[65] Given that the attachment points
of the tranches of a substantial number of CDO structures, which determine the potential
losses faced by CDO investors and arrangers, are different from the attachment points of
standardized tranches, these market participants would be exposed to **basis risk**. This risk is
particularly high at the more subordinated end of the capital structure, namely, equity and
lower-rated mezzanine tranches, where idiosyncratic factors tend to be important.[66]
Furthermore, arrangers may not be able to hedge unanticipated event risk arising from a
sudden default as experienced in the Delphi and Collins & Aikman bankruptcies.

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[65] As an example, the Dow Jones iTraxx index was created from the merger between two
existing CDS indices (TRAC-X and iBoxx) in June 2004. Standardized tranches of CDOs
based on the iTraxx—which replicate the behavior of unfunded synthetic CDO tranches
whose reference portfolio comprises names in the basket of the CDS index—were issued.
These tranche prices are continuously quoted, and have contributed to improving the
transparency and liquidity, and lowering the trading costs of the CDO market. Box 1 briefly
discusses single-tranche CDO structures.

[66] See IMF (2006).

Counterparty risk **arises from the possibility that the risk buyer (seller of protection) may default in settling a claim.** A fully-funded CDO structure incurs higher costs but is less-exposed to counterparty risk.[67] The concentration of counterparty risk may be unavoidable during periods of rising credit risk; in some large CDO transactions, it may become prohibitively expensive to fund the credit risk transfer beyond a certain point (Rule, 2001). Thus, buyers of unfunded protection must assess whether the protection seller would be able to pay up during an extreme credit event, that is, determine the correlation between the realization of credit events and the creditworthiness of the protection seller.

Market imperfections also work against fully realizing the benefits from credit risk transfer. In particular, the lack of comprehensive legal and supervisory frameworks, the still-developing trading infrastructure, and rating arbitrage could contribute to financial instability in the event of an adverse shock in the credit markets.

Legal risk **in the relatively new CRT market has largely arisen from imperfect documentation**, although the maturing of the market has resulted in the setting of precedents over time. Legal risk is fundamentally important since legal and documentary issues are key considerations in defining the roles of the different parties involved in a CDO structure, and ensuring the efficiency and validity of the risk transfer itself (Cousseran and Rahmouni, 2005). Unsound market practices such as incomplete documentation of trades in the credit derivatives market are key examples of **legal risk**. In the United Kingdom, the FSA recently asked banks for an update on delays and errors that are occurring in processing credit derivatives trades. The authorities have expressed concern about the apparent high levels of unsigned trade confirmations between credit derivatives counterparties in transactions conducted outside of exchanges.[68]

The inadequacy of the trading infrastructure is evident by the substantial backlog for processing trades. However, a number of private sector initiatives have been advanced to deal with this problem. Recently, 14 leading investment banks pledged to U.S. and European regulators to address the issue backlogs in trade processing, and to improve operational practices. These initiatives include commitments to (i) reduce backlogs, (ii) provide regulators with information on the progress, (iii) use a new procedure for or transferring

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[67] Counterparty exposure is usually greater for *synthetic* CDOs, where the risk transfer is usually unfunded. Further, these exposures could potentially increase very sharply if the creditworthiness of the counterparty deteriorates quickly.

[68] When assignments of trades are effected without the correct notifications and/or consents, this could result in institutions having out-of-date or inaccurate information on their exposures to individual counterparties. Tracking down these assignments has contributed to the existing confirmations backlog.

trades according to the ISDA protocol produced in September, which requires consent before trading. Additionally, there are plans to increase automation of trade processing via the Depository Trust and Clearing Corporation, and a proposal that cash settlement become the standard and that offsetting trades between the same parties are cancelled.

Ratings risk **arises from the fact that the structured nature of CDOs limits the usefulness of their ratings, since ratings only reflect certain aspects of their credit risk.** Ratings reflect the average risk of a security, and merely represent an opinion on the probability of default and expected loss. They do not factor in the dispersion of risk around its mean (Cousseran and Rahmouni, 2005), nor can they convey the complexity of a structure or its sensitivity to embedded assumptions, for example, default correlations and recoveries post-default (Miles, 2005). In cases where investors rely on ratings for their CDO investments, **model risk** is also related to the specific model the rating agency uses to size the credit enhancement for a given tranche and rating (Fender and Kiff, 2004).[69]

Different methodological approaches used by to rate CDOs could result in "ratings shopping" activity. For instance, Moody's ratings are based on the concept of expected loss, while Standard and Poor's and Fitch base their ratings on probabilities of default, which could result in clear differences in the ratings assigned by the agencies to certain tranche structures (Peretyatkin and Perraudin, 2002). Thus, CDO issuers may be tempted to choose rating agencies based on which one assigns the highest rating to their particular issue or tranche, in order to minimize funding costs.[70] One possible solution is to encourage investors to require more than one rating as part of their internal control procedures.

Model risk **arises in the valuation of CDOs using myriad complex models that continue to evolve.** A major shortcoming of existing models is that they do not adequately capture the co-movements of credit spreads and default correlations, leading to some simplifications in

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[69] The asset pool for a CDO may sometimes need to be enhanced by one or more types of credit in order to attain the desired credit risk profile for the security being issued. Such enhancements are usually derived from internal sources, that is, they may be generated from the assets themselves or supplied by a third party.

[70] See Fender and Kiff (2004) for a detailed discussion on the practice of ratings arbitrage.

modeling the correlation structure. These simplifications, however, may be incorrect (see Box 1). Essentially, model-based prices cannot replicate observed market prices and the associated correlation skew, and hence, may be misleading for assessing risks. Moreover, since market prices are only available for tranches of CDS indices, these cannot be used for valuing synthetic CDOs with non-standard underlying portfolios.

Estimating the Exposure of U.K. Financial Institutions to the
Credit Derivatives Market

The choice of factors in our model is guided by the requirement that the econometric model captures both systemic risk in the financial system and the specific risk associated with credit derivatives products. Market prices are used in our analysis, since they are readily available on a daily basis (as opposed to accounting data), and quickly transmit financial information about individual companies.[71] Equity prices for the major financial groups are obtained from Bloomberg L.L.P. The slope of the yield curve, measured as the difference between the yields on the 10-year and 2-year U.K. government bonds, is included as a measure of contemporaneous economic conditions that would lead to simultaneous movements in equity returns and structured credit product prices. The yield data are obtained from the generic 2-year and 10-year yield series constructed by Bloomberg L.L.P.

While there has been a rapid proliferation of CRT products, credit derivatives are among the most widely used products. The introduction and rapid acceptance of benchmark credit derivatives indices, specifically iTRAXX in Europe, has helped develop a two-way market for standardized CDOs. Given that the tranche seniority of a CDO affects its riskiness, we include as factors the prices of the equity tranche and a number of mezzanine tranches with varying degrees of seniority.[72] The super-senior tranche is not included in the analysis since its time-series just started in mid-2004. Price data for the different tranches are obtained from JPMorgan.

Given the vector of n endogenous variables, $Y_t = (y_{1t}, y_{2t}, ..., y_{nt})'$, the corresponding unrestricted VAR system of order p is given by:

$$Y_t = c + \Phi_1 Y_{t-1} + \ldots + \Phi_p Y_{t-p} + \varepsilon_t, \tag{1}$$

where c is a n-vector of constant terms, Φ_i ($i=1,...,p$) are n-by-n coefficient matrices and ε_t is a vector of uncorrelated, independent and identically distributed error terms. The error terms are also serially uncorrelated. Under certain technical conditions, described in detail in econometrics texts like Hamilton (1994), the vector autoregression system in equation (1) admits the following vector moving average representation (VMA):

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[71] See Monks and Stringa (2005).

[72] The equity tranche has attachment points of 0-3 percent, and the mezzanine tranches has the following attachment points: 3-6 percent, 6-9 percent, 9-12 percent, and 12-22 percent.

$$
\begin{bmatrix} y_{1t} \\ \vdots \\ y_{it} \\ \vdots \\ y_{nt} \end{bmatrix} = \begin{bmatrix} \psi_{11}(L) & \cdots & \psi_{1i}(L) & \cdots & \psi_{1n}(L) \\ \vdots & & \vdots & & \vdots \\ \psi_{i1}(L) & \cdots & \psi_{ii}(L) & \cdots & \psi_{in}(L) \\ \vdots & & \vdots & & \vdots \\ \psi_{n1}(L) & \cdots & \psi_{ni}(L) & \cdots & \psi_{nn}(L) \end{bmatrix} \begin{bmatrix} \varepsilon_{1t} \\ \vdots \\ \varepsilon_{it} \\ \vdots \\ \varepsilon_{nt} \end{bmatrix}, \tag{2}
$$

where $\psi_{ij} = \sum_{k=1}^{\infty} \psi_{ij}^{k} L^{k}$, $i,j=1,...,n$ are lag operators.

The coefficient ψ_{ij}^{k} measures the effect k periods ahead of a unit shock or innovation to variable y_j on variable y_i. Therefore, the long-term cumulative impact of variable y_j on variable y_i can be measured by adding up the coefficients associated with the lag operator $\psi_{ij}(L)$:

$$
\sum_{k=0}^{\infty} \psi_{ij}^{k} = \text{information content of } y_j \text{ on } y_i. \tag{3}
$$

Equation (3) suggests that variance decomposition can be used to quantify the overall importance of innovations to variable y_j for explaining subsequent realizations of variable y_i vis-à-vis the other endogenous variables. Specifically, the overall importance of variable y_j is captured by the relative share of the variance of variable y_i it explains:

$$
\frac{\left(\sum_{k=0}^{\infty} \psi_{ij}^{k} \right)^{2} \sigma_{\varepsilon_j}^{2}}{\sum_{m=1}^{n} \left(\sum_{k=0}^{\infty} \psi_{im}^{k} \right)^{2} \sigma_{\varepsilon_m}^{2}}, \tag{4}
$$

where $\sigma_{\varepsilon_j}^{2}$ is the variance of the innovation to variable y_j. Note that our VAR framework does not choose a particular ordering of the variables entering equation (1), and hence it is a statistical description of the dynamic interrelations between the variables analyzed. While a structural VAR may offer some advantages for interpreting the data, it requires specifying *a priori* a causal ordering of the variables, which we do not deem appropriate for this study.

In interpreting the results, we do not make any assumption as to whether a particular institution is long or short the credit exposure. We assume that losses fall within the attachment points in case of defaults. Therefore, the higher the fraction of equity return volatiliy explained by a senior tranche, the lower the credit exposure of the firm and the potential impact on financial stability.

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VI. FSAP FOLLOW-UP REPORT[73]

A. INTRODUCTION

1.   **The outlook for the U.K. banking system is favorable, while the health of the insurance industry has improved substantially over the past 3 years.** Banks are well-capitalized, highly profitable and highly cost efficient. In the insurance sector, progress has been made in risk-reduction within investment portfolios, underpinned by regulatory reforms and supported by higher equity prices. Payment and settlements systems have been further strengthened, and measures to reduce the level of intraday interbank exposures, as well as the settlement risk in money market instruments and retail payments, have been implemented.

2.   **That said, medium-term risks exist, shaped by apparent expectations that benign credit conditions will continue indefinitely, and the intensifying inter-linkages across different segments of the financial sector.** There is some concern that risk may currently be underpriced, as investors leverage-up in their search for returns in a low-yield environment, while banks come under increasing competitive pressures in the lending market. Meanwhile, rapid financial innovation has allowed banks to transfer credit risk outside the banking sector to other financial institutions. While the development of the credit risk transfer market is clearly positive in enabling the diversification of existing risk concentrations, any major shock to the financial system could potentially be magnified by the increased linkages among these institutions.

3.   **These risks are particularly pertinent for the United Kingdom, given its position as one of the biggest—and most open—financial centers in the world.** Its banking sector is the third-largest by total assets, after the United States and Japan, and U.K. banks have increasingly expanded their operations internationally. Its insurance industry is the largest in Europe and the third largest in the world, and accounts for 17 percent of investment in the U.K. stock market, the world's third largest by capitalization. London is also the main center of the global credit derivatives market—with a 44 percent share—ahead of even New York. As such, the stability of the financial sector in the United Kingdom has potentially far-reaching implications beyond its borders.

4.   **The 2002 Financial Sector Assessment Program (FSAP) mission made several recommendations to augment the United Kingdom's already-strong financial stability framework.**[74] Key recommendations of the FSAP include: (i) rectifying the shortcomings in the insurance supervision framework via the implementation of the Tiner Report;[75]

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[73] Prepared by Li Lian Ong (MFD) and Martin Anderssön (MFD technical expert, Sveriges Riksbank).

[74] See IMF (2003).

[75] See FSA (2002).

(ii) pursuing the remaining steps needed to strengthen the payment and securities settlement infrastructure; (iii) strengthening surveillance and monitoring of inter-institutional linkages—notably in the interbank market and credit risk transfer market—including greater use of quantitative techniques to assess its vulnerabilities; (iv) continuing to promote improved disclosure and governance by financial institutions, ahead of international initiatives, if necessary; and (v) pursuing improvements to further strengthen the assessment and verification of financial institutions' systems and controls.

5.   **This paper provides an update on developments in key areas identified in the 2002 FSAP, and assesses current risks to the U.K. financial sector outlook.** The key risks to the banking sector, and its capacity to absorb and manage these risks are covered in Section II. The non-banking sector is discussed in Section III, while section IV analyses the credit risk transfer market in the United Kingdom. The progress made in improving the payment and settlements system is presented in Section V, followed by an assessment of the supervision and regulation issues faced by U.K. regulators in Section VI. Section VII concludes with recommendations to further strengthen the financial stability framework.

B.   The Banking Sector

Structure of the Banking Sector

6.   **The banking sector in the United Kingdom had previously undergone significant domestic consolidation via the "big five"**, namely, the Hongkong and Shanghai Banking Corporation Bank Group ("HSBC"), The Royal Bank of Scotland Group ("RBS"), Barclays Group ("Barclays"), Halifax Bank of Scotland Group ("HBOS") and Lloyds TSB Group ("Lloyds"). Other major British banking groups (MBBGs) include Abbey Group, Alliance & Leicester Group, Bradford & Bingley plc and Northern Rock plc. Altogether, domestically-owned banks account for 81 percent of total national banking sector assets.

7.   **Many of the largest mortgage lenders in the United Kingdom are part of the MBBGs.**[76] According to the British Bankers' Association, they account for about two-thirds of all outstanding mortgage loans and around 70 percent of gross lending. They also account for more than half of all outstanding consumer credit, including 70 percent of all credit card loans.

8.   **Some of the "big five" banks have expanded their operations overseas to diversify their sources of earnings, and invest in markets with higher growth prospects.** In September 2005, RBS acquired a 5 percent share in the Bank of China, as part of a consortium, as well as continuing its expansion in Europe and the United States; Barclays acquired 56.1 percent in Absa Group, one of the largest South African banks, in July 2005, following an acquisition in Spain in 2003; HSBC expanded its Asian operations in 2004 with

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[76] The mortgage lenders within the MBBGs comprise 12 of the 15 largest in the country.

the purchase of a 20 percent stake in China's Bank of Communications, following the acquisition of Republic National Bank (2000) and *Grupo Financiero Bital* (2003), in Mexico. In contrast, Lloyds has divested its international activities in New Zealand and Latin America to concentrate on its U.K. business.

9.   **The banking sector is also well-populated with other participants outside of the major institutions.** Many of these are affiliated to the major banks and insurance groups, ranging from retailers' financial services offerings to internet and telephone banking operations. There are relatively few foreign players in the purely domestic market to date. The purchase of Abbey National Bank—the sixth largest in the United Kingdom—by Banco Santander (Spain's largest bank) in 2004, was a major development in this area.

Risk Assessment

Credit Risk

10.   **The personal lending (housing and consumer) market is considered an important source of risk for the banking sector.** Total lending to households accounts for 43 percent of banking sector loans to the non-banking sector. The growth rate for total lending to individuals decelerated to a seasonally-adjusted 10.2 percent in November 2005, compared to 13.4 percent as at November 2004, as both consumer credit and secured lending slowed over this period. The deceleration in the latter started earlier and has been much sharper (Figure 1). Nonetheless, total household debt rose further, to 146 percent of aggregate disposable household income as at end-2005, from 140 percent a year ago.

Figure 1. Growth in Total Lending to Individuals, November 2003−November 2005
(12-monthly, in percent)
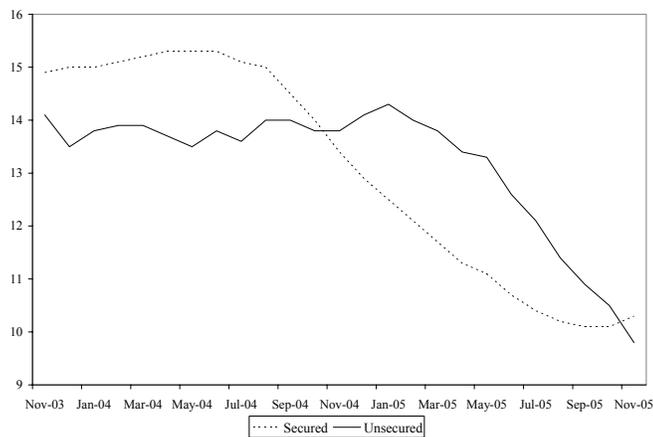
Source: Bank of England.

11.   **Risks have become most evident in the unsecured household lending segment.** Banks are reporting higher impairment charges with respect to their unsecured retail books—

albeit from historically low levels—and are expected to increase loan loss provisioning.[77] In December 2005, an estimated 99 percent of write-offs of household lending by U.K. banks was in unsecured loans, with 48 percent of this amount comprising credit card borrowings and the remainder to other unsecured loans.[78] To put this in perspective, however, unsecured lending to households only makes up 5 percent of total banking assets, compared to mortgage lending, which makes up around 20 percent of banks' total assets. Further, the recent deterioration, which is partly a manifestation of the effects of previous interest rate rises, is also partly attributable to changes in the bankruptcy legislation.

12.   **The secured lending market appears to be recovering, following the slowdown between mid-2004 and the first quarter of 2005** (Figure 2). Gross mortgage lending by banks in November 2005 amounted to a seasonally-adjusted £18.5 billion ($32.9 billion)— one of the highest on record, and up 23 percent from a year ago. Seasonally-adjusted net mortgage lending by banks in November 2005, amounting to £6.6 billion ($11.7 billion), was the strongest monthly increase since June 2004, and was well above the £2.5 billion ($4.4 billion) average over the first 10 months of 2005.[79]

13.   **Sub-prime mortgage lending in the United Kingdom is reportedly increasing.**[80] This category of lending comprises products which are more flexible relative to the mainstream products. While this activity has largely been the preserve of specialist lenders in the past, more mainstream lenders are reportedly entering the market, albeit at the less-risky end of the sub-prime range initially.

14.   **There are indications of some easing in corporate lending standards**. Banks are willing to lend more freely to corporates, as they compete with each other and with capital markets to provide funding in a low-yield environment. According to the Bank of England (BoE) loan covenants have also weakened. Banks have increased their exposure to higher-risk corporates through the underwriting of lower-rated debt issues and the provision of

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[77] See also Croft (2005).

[78] The total write-off of unsecured household loans represented 75 percent of all write-offs by banks in December 2005.

[79] Some analysts attribute the firming demand for mortgages in the months leading up to December 2005 to speculation about the new pension regime.

[80] Sub-prime lending is a flexible approach for lending to borrowers with little or poor credit experience. This credit history serves as a barrier to traditional or conforming credit markets. Sub-prime loans are priced according to risk, although pricing is only one characteristic of such loans. Sub-prime lending also includes structuring payments, offering credit enhancements, and providing otherwise non-traditional loan terms to allow customers to best meet their financial needs (Bartlett, 2000).

financing for increased private equity activity, such as leveraged buyouts. Some of the increased lending is attributable to mergers and acquisitions activity.[81] Overall, non-financial corporates represent almost a quarter of total bank lending to the non-bank segment.

Figure 2. Bank Lending Secured on Dwellings, November 2003−November 2005
(In millions of British pounds)
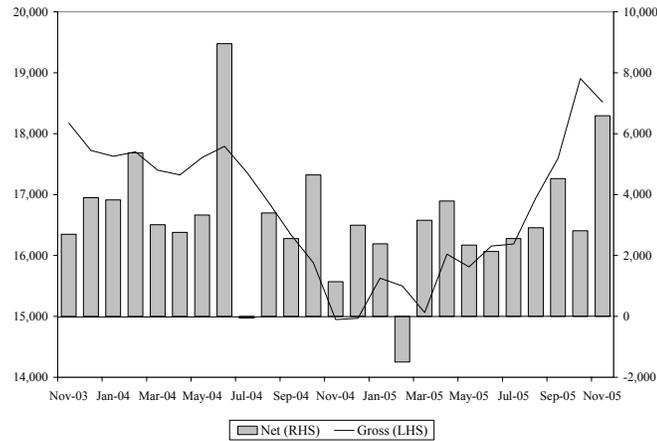
Source: Bank of England.

15.   **Banks' commercial real estate exposures have risen sharply, and concerns about overvaluations in this sector are growing.** The commercial property sector currently accounts for more than a third of the major banks' outstanding loans to non-financial companies in the United Kingdom, or about 8 percent of total outstanding loans. Indeed, bank lending to U.K. resident commercial property has recorded growth rates that are twice as high as other forms of corporate lending.[82] Banks are also susceptible to indirect risks from this market, with loans to small- and medium-sized enterprises—which represent 20 percent of corporate lending—usually collateralized by commercial property. The government's approval of real estate investment trusts (REITS) as an investment vehicle could further inflate the prices of commercial property, which is expected to be a key segment of investment under this initiative.[83]

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[81] See BoE (2005a).

[82] According to a recent survey, 75 percent of total debt secured by commercial property was held by 12 organizations at the end of 2004 (see Maxted and Porter, 2005). The average loan-to-value (LTV) ratios increased for all commercial sectors in 2004, with those for prime office and prime retail property reaching their highest levels since 1999.

[83] It should be noted that the introduction of REITS is widely expected to provide benefits such as improving the liquidity of the property market, and increasing diversification opportunities for investors.

16.   **Concern over the buy-to-let market has also been rising.** This market is very speculative and, according to analysts, is very difficult to model as it is a new market and little data are available. Lending to this segment has been growing faster than the rest of the mortgage market, with *unregulated* property investment clubs encouraging members to purchase off-the-plan flats. The growth in this particular market had been facilitated by the sharp increase in the number of flats from 21 percent to 46 percent of the new-build market, since 2000, following encouragement by the government to build on brownfield land (Figure 3).[84]

Figure 3. Buy-to-Let Lending and New Flats, H2 1999−H1 2005
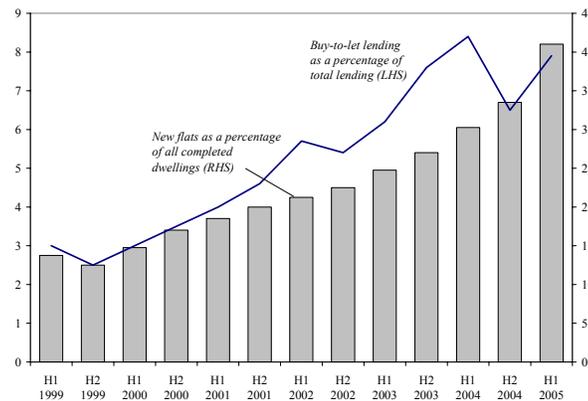
Source: Financial Times.

Liquidity Risk

17.   **The banking system is largely funded by stable, highly diversified retail deposits from the domestic customer base.** However, banks have been increasingly experiencing a funding gap since 2002 as credit growth outstripped deposit growth. As a result, greater use of **wholesale funding** by banks has been observed. This strategy has somewhat increased the liquidity risk for some banks, as wholesale funding may be difficult and costly to roll over during times of company-specific or market-wide stress. That said, with the rate of growth in bank lending and deposits from customers converging over the past year, the rate of growth in the funding gap has slowed.

18.   **From a longer-term perspective, banks in the United Kingdom are continually challenged to attract relatively inexpensive, stable deposit base.** The competition for funds against other sources of savings, such as mutual funds, life insurance and pension

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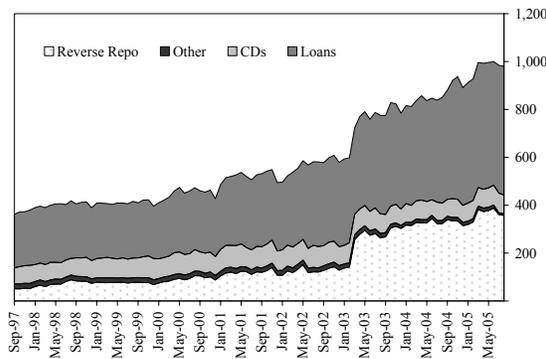[84] "Brownfield" is the term generally used to describe previously developed land, which may or may not be contaminated from previous industrial uses. Recent government objectives have initiated a move towards redevelopment of brownfield land instead of greenfield sites, to relieve the pressure on the countryside and green belt areas. The Government has targeted the development of 60 percent of new housing on brownfield sites.

funds, among other alternative investment vehicles, is likely to remain an important challenge for the banking sector.

19.   **The large interbank segment of the money market could potentially become the conduit for contagion during periods of extreme stress.** On a day-to-day basis, the money market functions well in distributing liquidity within the financial system. However, the increasing links between financial institutions means that a shock to one financial institution could be quickly transmitted across the financial system, giving rise to systemic liquidity problems. Interbank lending is the single largest form of counterparty exposure among the major U.K. banks, in addition to exposures the major global large complex financial institutions (LCFIs). U.K. banks had large exposures to more than 50 different counterparties, as at end-September 2005.[85]

20.   **The balance between secured and unsecured lending in the interbank market has largely remained stable since 2003.** Unsecured lending accounts for around 65 percent of the total, with the balance consisting of repo lending, which has grown by around 40 percent since early-2003 (Figures 4 and 5). The CD market has become increasingly concentrated in recent years, to fewer than 10 financial institutions, and is now dominated by large U.K. banks, which issue and purchase CDs from each other.

Figure 4. Components of U.K. Interbank Lending (In billions of British pounds)   Figure 5. Composition of U.K. Interbank Lending

Source: Bank of England.

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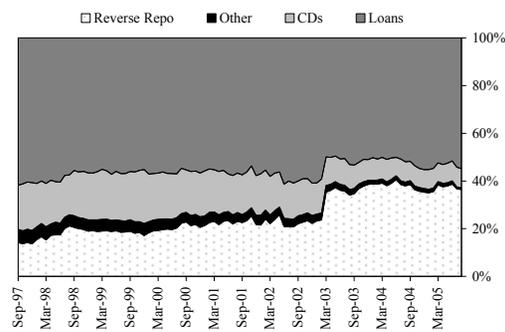
[85] See BoE (2005b).

Market Risk

21.   **Traditionally, U.K. banks have not taken aggressive positions with respect to trading and taking on market risks.** Banks tend to use derivative products—such as exchange rate forwards, interest rate swaps and forward-rate agreements (FRAs)—for asset-liability management and in their trading activities.

22.   **Some of the major banks are important long-term investors in capital markets through their holdings in the insurance sector.** Given that insurers are exposed to market risk through their investments in equity markets, these banks are similarly exposed.

23.   **The larger banks also participate in the credit derivatives market**, which has experienced exponential growth in recent years.[86] According to supervisors, they continually monitor the extent of banks' involvement with these products to ensure adequacy of risk management systems and infrastructure development.

24.   **The underpricing of risk could pose problems for banks' exposures, if a sudden, and sustained, reversal in the current benign credit environment occurs** (Figure 6). Thus, general expectations that the low-yield environment—underpinned by ongoing macroeconomic stability—will continue in the foreseeable future, could result in the underestimation of risks being accumulated in banking books.

Figure 6. U.K. 10-Year Treasury Yields, April 2004 −January 2006
(In percent)
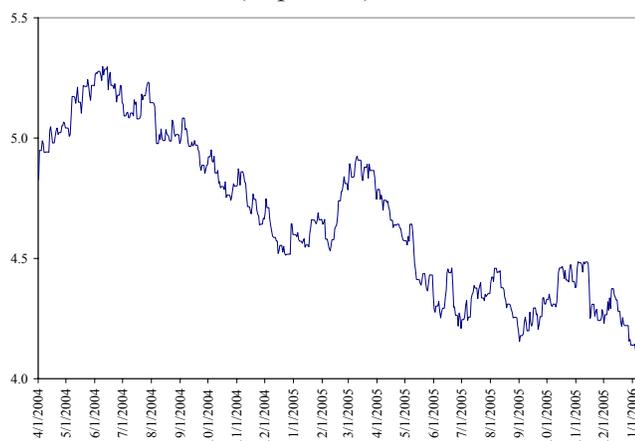
Source: Bloomberg LLP.

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[86] See Selected Issues Paper, "United Kingdom—The Credit Risk Transfer Market and Implications for Financial Sector Stability."

Capacity to Absorb and Manage Risks

25.   **The profitability of U.K. banks is among the highest in advanced economies** (Figure 7)**,** with relatively large margins. Strong profitability has allowed these institutions to generate—and where necessary raise—additional capital and grow their balance sheets. The interim results of the "big five" banks for the first-half of 2005 indicate that their solid performance has continued, with returns on equity ranging from 15−25 percent.[87] Further, increased diversification of earnings sources will help banks maintain greater stability in their profits. Banks, such as HSBC, Barclays and RBS, have diversified geographically (see discussion in Section II above), as well as into other business lines, such as investment banking.

Figure 7. Cross-Country Comparison of Banks' Returns on Equity, 2004
(In percent)
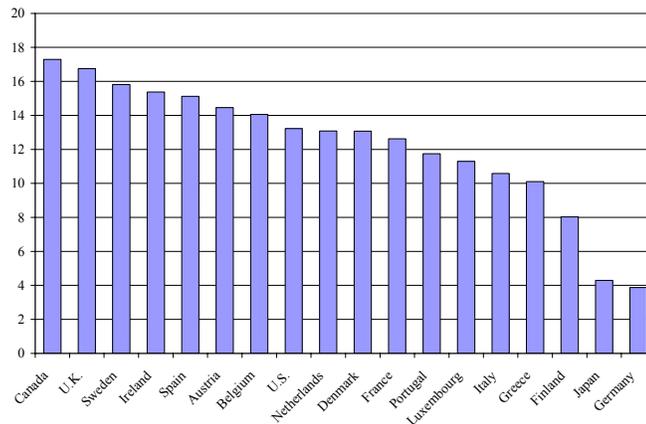
Sources: Bank of Japan, European Central Bank, Federal
    Deposit Insurance Corporation, Office of the
    Superintendent of Financial Institutions Canada.

26.   **U.K. banks' efficiency in controlling costs have enhanced their profitability.** Indeed, U.K. banks are among the most cost-efficient in advanced economies (Figure 8). This suggests that banks should be able to absorb higher provisioning charges comfortably, as and when they occur. The cost-to-income ratios of all the "big five" banks remained below 55 percent in the first-half of 2005. For some banks, such as Barclays and HSBC, costs had been rising as a result of the expansion in their investment banking operations. That said, Barclays has been able to meet its rising expansion costs with increased income and profitability, while HSBC's major investment phase is reportedly almost completed, at least for the time-being.

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[87] See Longsdon and Scott (2005).

Figure 8. Cross-Country Comparison of Banks' Cost-to-Income Ratios, 2004
(In percent)
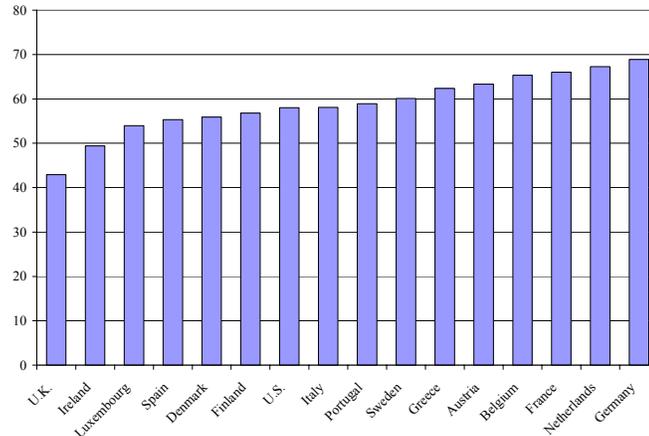
Sources: European Central Bank, Federal Deposit Insurance
Corporation.

27.   **Other indicators of asset quality and solvency for the banking sector remain
healthy** (Table 1). Non-performing loans (NPLs) were stable at around 1.9 percent of total
loans, as at end-2004, while loan-loss reserves coverage remains strong, especially among
the MBBGs. The capital adequacy ratio was a healthy 12.7 percent as at the end of 2004.
Among the "big five" banks, retail asset quality deteriorated, particularly in the unsecured
segment, but this was offset by the reduced levels of delinquency in the corporate segment.
Impaired loans fell as a percentage of gross loans, with the exception of HBOS and Lloyds,
which have relatively greater weight in U.K. retail loans. The Tier 1 capital ratios for these
"big five" banks remained strong in the first-half of 2005, ranging from 6.6−8.7 percent,
despite some "distortions" as a result of International Financial Reporting Standards (IFRS)
implementation.

Table 1. United Kingdom: Financial Stability Indicators
(As at end of period, unless indicated)

	2000	2001	2002	2003	2004	2005 Sept
External Indicators						
Foreign assets of banking institutions (in billions of U.S. dollars)	2,106	2,209	2,500	3,074	3,764	4,096
Foreign liabilities of banking institutions (in billions of U.S. dollars)	2,094	2,237	2,591	3,162	3,896	4,161
Credit indicators						
Lending to Construction sector (as a percentage of GDP)	1.2	1.4	1.4	1.4	1.5	1.7
Lending to Real estate sector (as a percentage of GDP)	6.0	7.2	8.3	9.1	10.0	11.4
Financial sector risk indicators						
Total loans to assets (percent)	82.0	82.1	83.1	83.4	83.1	83.1
Total loans to deposits percent)	92.9	92.2	93.8	93.6	83.1	92.2
Foreign exchange loans (in billions of U.S. dollars)	1,699	1,789	2,059	2,599	3,165	3,413
Net foreign exchange loans (in billions of U.S. dollars)[1]	-297	-368	-640	-797	-959	-983
Share of foreign exchange loans in total lending (percent)[2]	41.4	41.8	41.3	42.7	43.0	44.7
Deposits in foreign exchange (in billions of U.S. dollars)	1,995	2,157	2,700	3,396	4,125	4,396
Share of foreign deposits in total deposits (percent)[3]	57.3	57.8	57.9	56.1	57.3	58.6
Share of foreign denominated liabilities in total liabilities (percent)[4]	52.4	52.5	52.8	54.3	54.7	56.2
Share of real estate sector in private credit (percent)[5]	46.9	47.5	48.8	49.4	48.7	48.1
Share of real estate sector in loans to non financial private corporations (percent)	27.9	32.1	35.4	39.4	43.1	39.6
* Share of non-performing loans in total loans [6] (percent)	2.5	2.6	2.6	2.5	1.9	*n.a.*
* Share of non-performing loans in total assets sector (percent)	1.7	1.7	1.7	1.8	1.3	*n.a.*
* Regulatory capital to risk-weighted capital (percent)	13.0	13.2	13.1	13.0	12.7	*n.a.*
* Return on equity (percent)[7]	13.5	7.7	6.1	8.6	10.9	*n.a.*
* Return on assets (before taxes, percent)	0.9	0.5	0.4	0.6	0.7	*n.a.*

Sources: Bank of England (BoE) and Financial Services Authority (FSA).

Note: Whereas data sourced from the BoE relate to the U.K. resident banks, data from the FSA (as denoted by "*") relate to U.K.-owned banks. Compilation methods for some indicators included here differ from the proposed treatment for the FSI CCE. Throughout, "deposits" includes currency, deposits and money market instruments, and "loans" excludes investments. All BoE data sourced from BankStats publication, Tables A5.3, B2.1, B2.1.1 and C1.2.

[1] FX loans less FX deposits.

[2] FX loans/total loans and security.

[3] Non-resident deposits/total deposits.

[4] FX liabilities/total liabilities.

[5] Excludes investments.

[6] The figures for non-performing loans represent the gross value of loans against which specific provisions have been made.

[7] Includes mortgage banks and building societies. This ratio is different from that presented in Figure 7 for the United Kingdom due to differences in definitions applied to the computations.

28.   **Banks' mortgage books do not appear to be a significant direct source of vulnerability.** Although the proportion of new mortgages with higher loan-to-value (LTV) ratios have increased, the average LTV ratio remains extremely favorable, at 40−50 percent. Analysts estimate that that property prices would have to fall by 30-40 percent before stresses are manifest in the banking sector. This scenario is considered highly unlikely—the housing market has been more resilient than expected (Figure 9), while the economy, particularly the low rate of unemployment, remains supportive overall.[88] Further, the concentration is largely in fixed-rate mortgages, which should mitigate the interest burden for households, in the event of a sustained rise in interest rates.[89]

Figure 9. Nominal House Price Indices
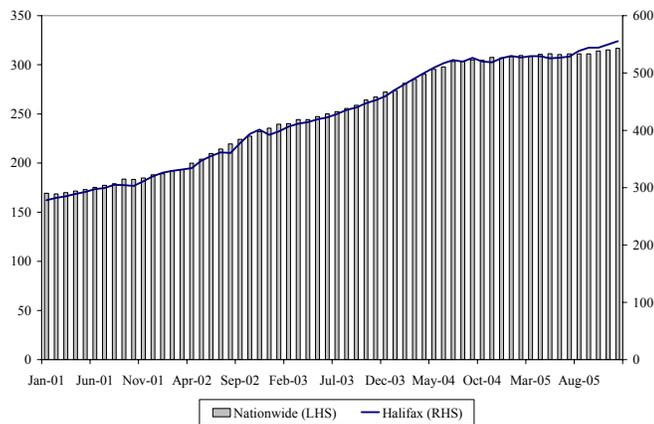
29.   **The biggest vulnerability for banks lies in the "second round" effects of any sharp downturn in the property sector, given that the sector appears well-cushioned against any initial, direct impact.** In the event of a spillover into the broader economy, consumer confidence would fall and jeopardize business confidence, and credit quality would deteriorate. That said, previous interest rate rises have had the effect of dampening demand for property, thus decreasing the probability of a significant drop in prices from this point.

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[88] Discussions with supervisors reveal that the unemployment rate is a closely-watched statistic, as it is considered a key flag of potential problems in the housing market and banks' credit quality.

[89] The split of fixed/floating rate loans to households was 30 percent at floating rate and 70 percent at fixed rate, for 2005, compared to 32 percent floating and 68 percent fixed for 2004.

30.   **In the buy-to-let market, private sector initiatives are being taken against speculative pressures.**[90] The property industry has lobbied the Financial Services Authority (FSA) to call for investor protection against property investment clubs, citing the inexperience of investors in this market and the potential fallout for property funds in general.[91] Meanwhile, the reversal of a tax break proposal, which would have allowed investors to put residential property in their self-invested personal pensions, is also expected to remove some of the upward pressure on property values.

31.   **Banks' corporate sector loans do not appear vulnerable at this point.** The corporate insolvency rate has fallen to 25-year lows. Corporate sector credit quality remains very strong, with three major banks, Barclays, HSBC and RBS having reported a decline in impaired to gross loan ratios as at end-June 2005, compared with the start of the year.

32.   **U.K. banks' exposure to commercial property merits close scrutiny moving forward.** In the short-term, banks appear less vulnerable to speculative lending in the current environment. The commercial property sector is considered relatively solid, with low tenant-default rates. Additionally, the risks from commercial property lending activities are now reflected in banks' improved risk management practices. That said, strong investor demand for commercial property has placed upward pressure on valuations. According to an assessment by the BoE, this demand appears to be based on expectations that rental growth would pick up from current levels; a key risk is that these expectations will not be met, especially given the increase in supply.[92]

33.   **The growth in investor interest in the commercial mortgage-backed securities (CMBS) in the United Kingdom could provide further support for lending to this market segment.** The transfer of credit risk across a broad investor base helps to disperse its concentration from banks' balance sheets, and removes the dependence of the commercial property market solely on banks, which may withdraw their credit at short-notice.

34.   **Banks appear to be managing their funding well.** Despite the wider retail funding gap experienced by U.K. banks, the funding position (loan-to-deposit ratio) of the largest banks remains sound by global standards (Figure 10). Other funding sources have become increasingly diversified in terms of sources and maturities, and appear to be well-balanced. Large lenders are issuing more covered bonds and securitizing their books to enhance and vary their funding sources, while the smaller and more specialized lenders are increasing

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[90] In December 2005, Portman Building Society, the third largest buy-to-let lender in the United Kingdom, became the first lender to refuse approval of buy-to-let mortgages on new flats (Pickard, 2005a).

[91] See also Pickard (2005b, 2005c).

[92] See BoE (2005a).

their use of residential mortgage-backed securities (RMBS) to transfer credit risk from their books.[93]

Figure 10. Cross-Country Comparison of Banks' Loans-to-Deposits Ratios, 2002-04 Average
(Based on the largest banks in each country, in percent)
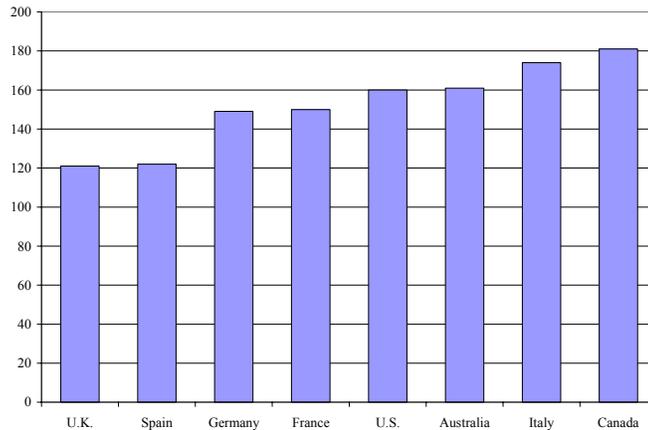
Source: Standard & Poor's.

35.   **Interbank money market exposures, including those of major foreign institutions, have come under intensified surveillance by the authorities.** Steps taken by the authorities to mitigate this risk include more frequent analyses and monitoring of regulatory large exposures data (which discloses counterparty details), and comparing these data to aggregate interbank lending. The analysis results have also been published to highlight the extent of large exposures to U.K. counterparts and major foreign institutions.[94]

36.   **The money market has moved to a repo structure for the majority of short-dated funds, thus offering greater security for interbank transactions.** There has also

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[93] A covered bond is an instrument directly issued by a bank and guaranteed by the collateral that the bank puts aside, by selling it to a special purpose vehicle. Covered bonds offer favorable funding costs relative to RMBS, as well as the ability to lengthen liability profiles and access new investors. The FSA recently clarified the guideline relating to banks' issuance of covered bonds. Essentially, banks are expected to inform the FSA if their total covered bond issuance exceeds 4 percent of total assets, to enable a case-by-case assessment of additional risk to depositors beyond this threshold. The issuance of covered bonds beyond 20 percent of total assets is likely to be considered sufficiently material to require an increase in a bank's individual capital ratio (ICR), the minimum capital ratio that a bank should maintain.

[94] Within Europe, the advent of Basel II, which would require banks to carry more capital to cover unsecured loans, is yet another factor influencing interbank market participants to prefer secured over unsecured lending.

been a reduction in aggregate bank exposure to the CD market, as well as in the size of the CD market. The authorities attribute these developments to: (i) bank mergers (banks have kept the same counterparty limit post-merger as that of one of the merging banks pre-merger); (ii) the withdrawal by German banks from the CD market in 2000, when their capital charges for CDs were altered; (iii) the contraction in bid-offer margins and cheaper settlement costs in the derivatives market, which has reduced the attractiveness of using CDs to express interest rate trading views; and (iv) the reform of open-market-operations by the BoE, which includes the introduction of a long-term repo facility in January 2005.

37.   **Risk management by banks has continued to become more professionalized, ahead of the proposed introduction of a capital charge for operational risk under Basel II.** Banks are focusing their resources on further developing their risk management expertise, with the majority of banks said to be collecting and analyzing loss data and implementing risk profiling of their main activities, in line with other developed banking systems. The bigger banks have the necessary expertise and sophistication to perform more complicated risk management tasks, but this may not necessarily be the case for the smaller banks.

38.   **There is currently wider use of stress-testing by banks.** The BoE and the FSA have worked towards convincing the private sector to undertake the exercise regularly, and to continually enhance existing models.[95] Nowadays, banks regularly stress-test their assets and liabilities to determine the potential outcomes under extreme economic and market scenarios. Banks are also recognizing that their risk functions have increased, and are increasingly aware of the need to integrate their credit, operation and market risks into their stress tests. Another area where banks' modeling of risks could be improved is in taking the *systemic* implications of risks into account.

39.   **The impact of the shift to IFRS has been modest to date.** Banks' capital adequacy levels have remained stable, following the adoption of IFRS from 1 January 2005 (Table 1). Tier 1 capital ratios have decreased, while Tier 2 capital ratios have increased. The fall in Tier 1 capital ratios is mainly attributable to the difference in the treatment of capital instruments between IFRS and U.K. GAAP. This outcome poses little concern for supervisors as the drop is not substantial, and supervisors have been able to identify the key areas where changes have occurred.

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[95] See FSA (2005a). The BoE's own stress-test model has also changed significantly since the 2002 FSAP (see Bunn, Cunningham and Drehmann, 2005; Goodhart and Zicchino, 2005). The new model is built from micro foundations, with core (theoretical) and non-core (set of equations which fit data better and pick up correlations) components, whereas the old model was more data driven.

C. The Non-Banking Sector

Insurance Sector

40.   **The outlook for the life insurance industry has improved significantly over the past three years.** Private sector participants have credited the FSA with regulating the insurance industry back to health.[96] The timing had also been fortuitous, as reform was effected during a buoyant period for capital markets, notably, rising equity prices. In that instance, the cost of regulation, while expensive, was deemed necessary. Overall, the cost of regulation in this sector is anticipated to decline, with the weeding out of weaker companies. There are few short-term risks at present.[97]

41.   **That said, the solvency coverage in *some* life insurance companies remains weak.** Specifically, the quality of capital is suspect where implicit items, financial reinsurance and subordinated debt are used to boost capital coverage of the required minimum margin (RMM).[98] As it is, the RMM for the industry is currently at historically low levels, at around 270 percent.[99] Further, the use of implicit items in capital means that while the Tier I capital ratio is quite healthy, it does not necessarily reflect the strength of core capital, which comprises tangible equity.

42.   **Meanwhile, debt issuance by insurers has also increased, driven by the low cost of capital.** However, the relative quality of debt has not been as good as in the past. Under current U.K. regulations, insurers are allowed to issue hybrid instruments up to 75 percent of total capital; however, rating agencies place a 15−25 percent limit on these instruments in assessing the quality of capital. Regulators attribute this marked difference in weightings to

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[96] See also FSA (2002) and FSA (2005b).

[97] Currently, Standard & Poor's has assigned a stable outlook to 85 percent of ratings in the life sector (Button and Harrison, 2005).

[98] Implicit items are intangible assets, which under certain conditions are admissible to cover an insurance company's required minimum margin of solvency. Future profits are implicit items. Intangible items will be phased out over the next two years under the enhanced Solvency I requirements. (Solvency I comprises various EU directives, which make only modest changes to existing regulations. They were adopted in March 2002, and became effective in member countries on January 1, 2004.)

[99] The RMM is effectively a weighted average of provisions (life insurance) or premiums/claims (non-life insurance). It is the minimum level that a regulated insurance company needs to cover with solvency capital to operate under normal conditions. The solvency capital requirement reflects a level of capital that enables an insurer to absorb significant unforeseen losses, thus providing reasonable assurance to policyholders.

the cross-border nature of ratings exercises—ratings agencies tend to take a more stringent measure in order to promote credible cross-country comparisons of financial institutions that may be regulated under either principles-based or rules-based regimes or both.

43. **The non-life insurance sector may have to absorb significantly higher exposures in the coming year.** Following the catastrophic hurricane season of 2005, reinsurance rates are expected to rise sharply, notably in the property, marine and offshore energy segments, and may thus become too expensive for some primary insurers. As a result, some insurers may withdraw from covering catastrophe risks, while others may reinsure a smaller proportion of their exposures in 2006. However, given the relatively low barriers to entry, new participants in the reinsurance industry are expected to provide greater competition, thus reducing the higher costs eventually.

44. **Progress has been made in risk-reduction within investment portfolios.** The asset mix for insurers has shifted, from large equity holdings into bonds, and there is generally a much better matching of assets to liabilities currently. The quantification and management of risks within the insurance sector has also strengthened, albeit still variable across firms in terms of expertise.

45. **The insurance sector is currently transitioning to the FSA's risk-based approach to determining capital adequacy.**[100] The underlying principle of the new risk assessment framework is that insurers should consider all relevant risks, such as market risk and operation risk, but also insurance and other risks. The Individual Capital Adequacy Standard (ICAS)—which became effective from January 2005—encourages each insurance company to improve its understanding of existing risks.[101] Further, it is anticipated that the Individual Capital Assessment exercise will enable the FSA to quickly build a database on the different ways in which insurers model their risk exposures.

46. **It is unclear at this stage if the advances promulgated in the ICAS will eventually be incorporated into the EU's Solvency II regulations.** While the vast majority of EU countries reportedly favor the risk-based approach, U.K. regulators acknowledge that some aspects of Solvency II may differ from the ICAS. In this case, U.K. rules that are

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[100] See FSA (2005c).

[101] The insurers initially provide the FSA with an assessment of its own risk exposures and potential losses. Upon the FSA's receipt of the insurer's assessment, an actuarial team would review the assessment and then issue an Individual Capital Guideline (ICG) to the insurance company. The eventual determination of an insurer's capital adequacy would be the result of an interactive process between the insurer and the FSA, with stress-testing required in the modeling to justify the insurer's capital assessment. The first cycle of assessments is expected to be completed by the first quarter of 2006. The second iteration, which is expected to include broader risk assessments, will likely take another two years.

incompatible with Solvency II would need to be reworked, and U.K. regulators may reconsider the justification for any element of the local regime that is super-equivalent to EU requirements.

47.   **The Treating Customers Fairly (life) and Contract Certainty (non-life) initiatives, which are being pushed aggressively by the FSA, are considered crucial for the credibility of the industry.** The FSA's objective is to increase transparency, so that customers fully informed. On the life side, the TCF initiative emphasizes policyholder communications over the life of the contract, while the focus of contract certainty is on the documentation available at the inception of the contract.[102]

48.   **The new method for product distribution is aimed at providing consumers with improved choices, and, it is anticipated, eventually reducing costs for consumers.** The concept of depolarization—which came into force on 1 December 2004—no longer requires life-insurance salespeople to be either fully independent or tied to a single provider. Rather, they may also choose to be "multi-tied" to several product providers. The new regime is expected to eventually increase competition for insurance products, likely leading to further consolidation among insurance providers.

49.   **The financial statements of insurance companies globally are largely considered opaque and difficult to understand**, even by insurance sector analysts. Currently, EU insurance companies that are listed are required to comply with IFRS 4, which is considered a "stopgap". This will be replaced in due course by a comprehensive standard that is often referred to as "Phase II" of the IFRS. The insurance industry in the United Kingdom has expressed disappointment at the lack of progress made by the EU on Phase II, and is looking for quicker implementation. It has the full support of the FSA towards this objective.

Building Societies

50.   **Building societies had previously come under some pressure with the slowdown in the mortgage market.** These institutions have had to weather margin compression through increased competition in this market segment. Additionally, building societies tend to have higher cost bases due to smaller economies of scale; they also have little scope to diversify their operations to enhance profitability.

51.   **However, there is generally little concern about the health of the building societies at this point, given the resilience of the housing market.** Credit risk is not considered significant for building societies, especially with the stabilization of the housing market. Further, unlike banks, building societies are established to serve the membership

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[102] The common practice with documentation has been for insurers to issue policies way after their cover had run out ("deal now, detail later"), resulting in uncertainty on the part of both parties as to the details of the coverage.

rather than to focus on achieving high profitability, which means that the squeeze on margins are of lesser significance from a perception perspective. The implementation of Basel II is expected to benefit building societies, in terms of reduced capital requirements.

D. The Credit Risk Transfer Market

52.   **Financial innovation has changed the landscape of risk—credit risk transfer (CRT) instruments are providing important diversification benefits, but their rapid growth is also creating some risks**. A key concern is that the pace of innovation may have exceeded the development of market infrastructure and the risk management systems of financial institutions participating in this market. Consequently, any shock to the financial system may be exacerbated by the financial sector's increased exposures to these instruments.

53.   **At the global level, the Delphi situation has focused regulators on the issue of credit exposures.** Presently, there is little information on where the credit exposures lie, because data do not exist *outside* of the institutions that are involved these transactions. Fortunately, the market is not very fragmented, since these transactions are generally effected by large institutions. That said, the concentration of select corporate names in the majority of CDO deals could cause significant stress for the credit derivative market in the event of a default.[103]

54.   **The stresses induced by the Ford-GM and Delphi incidents are generally seen as a timely "reality check" for participants in the CRT market.** The rapidity with which the market overcame the respective stresses is seen as a very positive indicator of its increasing maturity and liquidity. That said, policymakers and analysts acknowledge that these events have occurred during a period when credit conditions have remained benign. The resilience of the CRT market has not, as yet, been tested in a less accommodative credit environment.

55.   **The extent of U.K. banks' and insurers' exposures to the CRT market appears to be limited.** [104] CRT activity by U.K. institutions is seen to be largely focused on

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[103] According to South (2005), the top 3 corporate names are each referenced in more than 80 percent of transactions in European synthetic CDOs, and each of the top 40 corporate names appear in more than half the of the transactions. In the case of the former, South estimates that any default by any one of the three corporates could lead to ratings downgrades for 47 percent of synthetic CDOs, by an average 2.5 notches.

[104] Empirical evidence using publicly available market data suggests that any exposure of major U.K. financial institutions to the different tranches of credit derivatives instruments appear to be well diversified across institutions; there appears to be little cause for concern at this stage (see Selected Issues Paper, "The United Kingdom—The Credit Risk Transfer Market and Implications for Financial Sector Stability.")

residential mortgage-backed securities (RMBS) and credit card securitization between local banks and a more general investor base, with commercial mortgage-backed securities (CMBS) having grown rapidly over the past year. Meanwhile, synthetic CDO transactions undertaken by U.K. banks such as Barclays, HSBC and RBS are said to be largely for trading arbitrage purposes. Within the U.K. insurance sector, there is less urgency to seek yield pick-up through alternative investments, such as structured products and credit derivatives, given that there are few insurance products left with guaranteed returns following the phasing out of with-profits policies.

56.   **This view is supported by key players in the origination segment of the market, who observe that U.K. financial institutions are not major participants in the structured credit products market.** Rather, the biggest investors tend to be international institutions *based* in the United Kingdom, such as continental European insurance companies, as well as hedge funds. These observations are also supported by the lack of any significant impact from recent credit events in the corporate sector (for example, Ford, GM, Delphi) on U.K. banks and insurers.

57.   **Supervisors and private sector analysts acknowledge that it is very difficult to track transactions in the CRT market.** The publicly available financial statements of financial institutions reveal little information on positions taken in these instruments. As a result, financial sector analysts are omitting the pricing of risk from CRT transactions in their analysis of individual financial institutions.

58.   **From a surveillance perspective, the FSA posits that understanding the extent to which real risk is transferred is a key element in monitoring the CRT market.** To this end, the FSA has engaged in surveys—in particular, through the Joint Forum—to understand who the end investors are, and how well the risks are managed.[105] The supervisor is also prioritizing the issue of **model risk** by initiating the *hypothetical portfolio exercise* to better understand how firms are modeling CRT instruments and to discover the challenges across firms.

59.   **From a risk management perspective, market participants argue that understanding counterparty risk is crucial for managing credit risk from CRT instruments.** Professional investors perform significant amounts of due diligence on counterparties, in terms of their counterparts' risk management capacity, trading strategies and viability. Meanwhile, stress testing by market participants has also become very important following the Ford-GM incident.

60.   **The FSA maintains a conservative approach with respect to data collection on a regular basis under its existing cost-benefit framework for regulatio**n. The regulator

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[105] International initiatives on surveillance of the credit derivatives market include the Joint Forum and the Financial Stability Forum (see Joint Forum, 2004)

holds the view that such exercises incur high costs and may be of limited benefit. As a method of surveillance of the CRT market, the BoE and the FSA regularly publicize the risks associated with these instruments, along with more general evidence about the existing financial environment. Both the BoE and FSA also rely on "market intelligence" as one of their key surveillance tools.

61.   **The FSA and the New York Federal Reserve are currently working with major participants in the CRT market to resolve the issue of backlogs in trade confirmations and assignments.** Both regulators and market participants anticipate that significant inroads will be made towards resolving the problem over the next 12 months; improved automation and increased use of standard contracts are expected to help reduce the problem in the future.[106] This particular focus by the authorities has been generally well-received by market participants—those who had under-invested in the necessary technology and operational infrastructure are increasing their investment in this area.[107]

E. Payment and Settlements Systems

62.   **The authorities have, in recent years, collaborated closely with payment and settlements systems operators to mitigate key risks identified in the 2002 FSAP.** Some of the key areas of improvement include:

- Major advances in the disclosure of goals and the process of conducting oversight of payment and settlements systems. In January 2005, the BoE published its first annual Payment System Oversight Report (PSOR), which sets out clearly the role of the BoE in payment systems, the process for oversight, and the BoE's assessment of the payment systems it oversees against the Core Principles.[108] Moreover, publication of the PSOR has also acted as a disciplining device to the payment systems

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[106] The implementation of the ISDA Master Agreement is expected to help mitigate risks (although hedge funds, which are major players in this market, have not signed up).The ISDA Master Agreement is a standardized contract that two parties sign before they trade derivatives with each other. This Master Agreement is a bilateral agreement. It contains general terms and conditions that apply to all the individual derivative contracts that the two parties may enter into later.

[107] See also Simensen and Beales (2005).

[108] See BoE (2005c). The BoE is in the process of finalizing the second PSOR, which will also include a section on the new risk framework for oversight that the BoE developed in 2005, and will be implementing in 2006. These developments represent a significant step by the BoE towards best practice in being transparent and accountable to the public about its oversight function.

themselves—such a device is particularly important given that the BoE currently lacks power in carrying out its oversight responsibilities (see below).

- Increased awareness by both the BoE and the FSA towards the intraday interbank exposures stemming from, for instance, tiering in major systems and U.S. dollar settlements in CREST and LCH.Clearnet. [109]

- The reduction in the level of intraday exposures, for example, broadening the first tier of banks in CHAPS, and the BoE taking over the role as concentration bank for LCH.Clearnet, in both sterling and euro. [110]

- The mitigation of settlement risk from settling money market instruments by introducing these instruments in CREST, which was made possible through legislative changes making dematerialization of money market instruments possible.

- The significant reduction in the settlement risk of BACS, although there is still room for shortening the settlement cycle in BACS further.

63. **Three additional issues are assessed in this update:**[111]

- **The first deals with the mergers between CREST and Euroclear, and between LCH and Clearnet.** The effects so far have been very small, and have not changed the risk assessments of these systems. There are some concrete plans for future changes, especially in the CREST-Euroclear case, in which the U.K. authorities are already involved, working with their counterparties in the other affected countries.

- **The second is that the BoE has made the decision not to join the TARGET 2 system for euro payments.**[112] This decision will have an insignificant effect on the

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[109] In a tiered system, a few member banks (first-tier banks) settle directly with the central bank, while a larger number of customer banks (second-tier banks) processes their payments through the direct members.

[110] The concentration bank holds the accounts where all net funds from LCH.Clearnet are accumulated.

[111] See Appendix, "An Update on the Payment and Settlements System," for further details.

[112] The BoE concluded that it was not essential, from either a financial or a monetary stability perspective, for there to be a high-value euro payment system in London. The BoE was prepared to provide such a service, but only on a full cost-recovery basis. Since there was insufficient information on the costs it would incur, and the ability to recover those costs, the BoE concluded it should not participate in TARGET 2.

current settlement banks in CHAPS Euro. The important issue is to find solid settlement facilities for other systems cash settlement, notably CREST and LCH.Clearnet. From a settlement risk perspective, the preferred solution is to find a way to settle these transactions through a central bank.

- **The third is that the distinction between the services provided by payment and settlements systems and banks is less clear than might be supposed.** As highlighted in the discussions about tiering, there is substantial clearing activity being undertaken within financial institutions. There is, however, some concern over banks' handling of credit derivatives and other complex instruments. There is a risk that the authorities may focus overly on the *systems* aspect, and overlook some of the important issues relating to the *banks* themselves.

64.   **The 2002 FSAP mission recommended that the authorities consider laying out the BoE's oversight responsibility more formally and fully in the statute.** Little has happened in this area, although few problems have arisen to this point. In light of recent merger activities within the infrastructure sector and the planned integration of these systems in coming years, it seems appropriate for the authorities to revisit this issue. In a national environment, tradition and moral suasion is often quite strong. However, this is not necessarily the case in a more international context, when formal powers for information gathering and sharing may be necessary.

F. Regulation and Supervision

The Cost-Benefit Framework

65.   **Overall, the financial sector is well-regulated.** The FSA is generally perceived to be even-handed and professional in its approach to regulation and supervision. The FSA operates under a strict **cost-benefit analysis (CBA) framework.**[113] The regulator is obliged to be cost-effective, in order to ensure the "proportionality" of any regulation it imposes. The cost of regulation is quantified, while benefits are assessed on a qualitative basis. In order to improve the efficiency and cost-effectiveness of regulation, the FSA has begun to employ CBA much earlier in its internal policy-making processes, and often seeks information from firms, consumers and other stakeholders on the impact of regulation in areas where market failure may exist.

66.   **Opinions are mixed on the** *focus* **of financial sector regulation.** Some market participants observe that regulation in recent years has largely been driven by a consumerist agenda, and has incurred high business costs. In contrast, others posit that consumer regulation is only just "catching up" in the United Kingdom. The FSA argues that the use of

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[113] See FSA (2000) and FSA (2004).

the CBA mitigates any push by more politically-sensitive policymakers towards consumer-oriented regulation.

67.   **Supervisors and market participants have expressed their concerns about the costs of over-regulation.** Notably, the weight of regulatory pressure on U.K. firms from the implementation of domestic initiatives and the EU Financial Services Action Plan, IFRS, IOSCO, Basel II and IFRS, and eventually, Solvency II, have become increasingly burdensome. As an example, anecdotal evidence suggests that corporate boards meetings are largely spent discussing regulatory issues, rather than business matters. It is unclear at this stage if financial institutions have the ability to absorb all the requisite regulatory changes, what the risks of unintended consequences are, or what the market's reaction to these changes will be. The full impact of these developments is likely to unfold over the next 2−3 years.

68.   **To mitigate the problem, the FSA plans to move to a hybrid of principles- and rules-based supervision, with greater weight put on principles than rules.** However, it is not certain that such a move will reduce the cost of regulation, at least in the short-term, since corporate management may need to spend more time understanding the principles, rather than applying mechanistic rules. The supervisor would still be legally obliged to perform CBA on EU proposals, to provide a more balanced view on their impact on financial institutions. Any issue arising from CBA findings would then be taken up at more senior levels of representation in the European Commission. Market participants expect the "deluge" of new regulations to slow following the implementation of the Markets in Financial Instruments Directive (MiFID, expected to be adopted during 2006), Basel II (in late-2006) and eventually, Solvency II.

The Home/Host Supervision Debate

69.   **Financial institutions are very concerned about the costs arising out of duplicative supervision at the international level, and have emphasized the need to streamline regulation.** The FSA agrees with this view, but also recognizes the need for effective supervision, in addition to being efficient from the viewpoint of market participants.

70.   **The FSA is keen to see more efficient, risk-based collaboration among supervisors**, which both improves the quality of supervision and reduces the burden on firms. This approach is supported by the FSA's European regulatory counterparts and the European Commission.[114] The FSA also supports the judicious delegation of tasks among supervisors, where appropriate, without changing the respective responsibilities (for example, reliance on work done by other supervisors, conduct of joint-visits to financial

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[114] Within the EU, there is already a particular set of arrangements prescribed by directives.

institutions). The nature of the relationship between international financial institutions and regulators in each country would also need to be clarified upfront.[115]

71.   **The FSA recognises the need for performing crisis simulation exercises at the EU level for crisis management purposes.** Indeed, the United Kingdom has signed the EU Memorandum of Understanding for crisis management. However, while the FSA acknowledges that it would be helpful to establish memoranda of understanding and more formalized arrangements between regulators, it holds the view that it would be more important to know whom the individual counterparts are, in order to communicate efficiently in the event of a crisis.[116]

G. Conclusion

72.   **The U.K. banking system is one of the strongest among advanced economies, and the health of the insurance sector has improved substantially in recent years.** That said, retail asset quality has deteriorated somewhat, with the uptick in personal insolvency rates, and banks' rapidly increasing exposure to commercial property. There has also been some easing in corporate lending standards within an intensely competitive, low-yield environment. Further, the rapid growth of the CRT market—while providing important diversification benefits—is also creating risks. For instance, the speed of innovation may have outstripped the development of market infrastructure and risk management systems of financial institutions. The authorities are well aware of the medium-term risks to outlook for the financial system, and continue to publicize these concerns, as well as the more general evidence that risk may be underpriced.

73.   **The authorities are also continuing to enhance an already-strong financial stability framework.** In the insurance sector, the FSA's risk-based approach to determining capital adequacy is aimed at improving risk assessment within the industry. The authorities have also taken concerted actions to reduce the level of intraday interbank exposures and reduce settlement risk in money market instruments and retail payments. On an international level, much progress is being made in developing home/host supervision arrangements, both within Europe and with non-EEA regulators, and the FSA is keen to build on this.

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[115] The most fully-developed example of home/host collaboration at present is the tripartite of Switzerland, the United Kingdom and the United States.

[116] The Cross-Market Business Continuity Group (CMBCG) is an explicit and formal arrangement between the authorities (BoE and FSA) and key financial institutions operating in the United Kingdom, irrespective of their U.K. or non-U.K. status. It has been set-up to establish contacts in advance of a crisis, and can be called upon whether the event is an operational disruption or a financial crisis.

74.   **Moving forward, the authorities have identified several priority risks to the financial sector outlook, against which a business plan is set.**[117] On the wholesale side, issues such as extreme risk scenarios, terrorism, valuation of illiquid financial instruments, outstanding credit derivatives trade confirmations, financial fraud and volume of regulation are considered key. Concerns in the retail segment include the high levels of borrowing by households, an increasingly uncertain financial environment and complex retirement decisions. Three alternative economic scenarios and their implications for financial sector stability are also being considered, namely, an oil price shock, a slowdown in global consumption and a disorderly unwinding of U.S. imbalances.

75.   **The two main recommendations of this report are that:**

- **The FSA should continually enhance its surveillance of the CRT market—in co-operation with their overseas counterparts—given the rapid evolution of the market.** While the financial sector in the United Kingdom is well-regulated and well-supervised, the transaction counterparties to U.K. institutions may be domiciled in financial systems that are less well regulated and supervised, potentially giving rise to systemic risks. The authorities should also encourage private sector initiatives to increase disclosure of exposures to these instruments, to alleviate the burden on the FSA's limited resources.

- **Risk mitigation in clearing arrangements *within* banks needs to be improved further, on the back of strengthened payment and settlements systems.** To date, measures have been taken to reduce the level of intraday interbank exposures and the settlement risk in money market instruments and retail payments. However, as greater clearing activities are undertaken within banks, for example in the processing of transactions related to credit risk transfer instruments, these activities are becoming more important for financial sector stability.

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[117] See the FSA's 2006 Financial Risk Outlook (FSA, 2006a) and 2006/07 Business Plan (FSA, 2006b).

An Update on the Payment and Settlements System

During the 2002 Financial Stability Assessment Program (FSAP) for the United Kingdom, a detailed assessment was made of the payment and settlement systems. The systems, CHAPS Sterling and CHAPS Euro, were assessed against the *Core Principles for Systemically Important Payment Systems*, and CREST, was assessed against the *Recommendations for Securities Settlement Systems*. In addition, less detailed assessments were made on CMO, BACS and LCH. This report follows up on the issues raised in the FSAP, and examines several other issues which have evolved since then.

A.   The Main Issues Raised in the 2002 FSAP

The mission noted that the U.K. financial infrastructure had undergone considerable improvements in mitigating key risks since the late 1990s. Priority had been given to the large value payment system (CHAPS) and the main securities settlement system (CREST), in order to safeguard the most critical functions from a financial stability perspective. Consequently, most of the issues raised by the mission were outside these central systems, even though there were some areas where additional improvements could still be effected.

The main issues raised were connected to intraday risk exposures—which according to the IMF mission was not given appropriate attention—**and various types of settlement risks still remaining in the systems:**

(i)   Intraday risk exposures of significant values had originated from several sources within the infrastructure.

- **First, a high degree of tiering existed in payment and settlement systems**, between the direct settlement members on the one hand, and indirect members and end-users on the other. The intraday risks stemming from tiering was highly concentrated in a few large settlement members, who act as first tier banks in CHAPS, CREST and LCH. The concern raised was that the U.K. authorities did not pay enough attention to the risks associated to tiering, and the fact that those potentially large intraday exposures could have a systemic impact.

- **Second, risks existed *within* the payment mechanism of the LCH.** Large potential intraday exposures were building up in settlement banks participating in the "Protected Payment System" (PPS), and exposures were concentrated on one bank— the "concentration bank"—during the settlement process. In contrast to what its name implied, the PPS was not a protected scheme. However, little information was provided to participating banks of their financial risk exposures from participating in PPS.

(ii)   Of the identified settlement risks, the most important were the significant shortcomings in the CMO system for money market instruments, which, among other things,

did not provide delivery versus payment (DvP) in settling these instruments. Other settlement risks identified were:

- **The risks in the U.S. dollar settlement of CREST and LCH**, which took place via correspondent banks and therefore not settled on a DvP-basis. It was noted that although the value involved was rather small at the time, this could easily change in future years, partly due to of London's role as an international financial center.

- **The shortcomings in the risk management procedures of the BACS system for electronic retail payments.** The system could not ensure timely completion of settlement if the largest net debtor were to fail. In addition, there were rather long settlement cycles (3 days), with the effect of increasing participants' settlement exposures.

B. Major Achievements

Intraday Risk Exposures

Since the 2002 FSAP, progress has been made in terms of raising the authorities' awareness of the exposures and the actions taken to reduce the level of tiering.

(i)   Several exercises have been undertaken to improve the authorities' understanding of existing exposures:

- In 2004, a study by the Bank of England (BoE) quantified the credit risk arising due to intraday settlement-related exposures between first and second tier banks in CHAPS Sterling. In 2005, the BoE also analyzed the impact of tiering in CREST Sterling. The credit lines extended by first- to second-tier banks were larger in CREST than in CHAPS, and to a greater extent, collateralized. The finding is that under stressful scenarios, the combination of credit in CHAPS and CREST could pose a considerable risk to settlement banks.[118] However, the scenarios that could threaten the credit standing of settlement banks are very low probability events. Moreover, even under these extreme scenarios, the BoE's analysis indicates that the solvency of settlement banks would not be threatened. Indeed, the analysis suggests that the risks from tiering are more likely to apply to second-tier banks rather than to settlement banks.[119] Further, the analysis suggests that further work needs to be done to assess whether second-tier banks have contingency plans, in the event of a significant operational disruption to their settlement bank.

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[118] See BoE (2005d).

[119] For example, during periods of general market stress, a settlement bank may delay making payments on behalf of the customers of second-tier banks in favor of making its own payments and/or cut intraday credit lines extended to the customers of its second-tier banks thereby exacerbating any liquidity pressures faced by the second-tier banks.

- The effects of tiering on LCH.Clearnet and CLS have also been analyzed.[120] While the numbers in LCH.Clearnet are fairly small, they are very substantial in the case of CLS. The total value of trades settled through CLS on behalf of third-party users was estimated at $220 billon per day in April 2005.

- During 2005, the Market Infrastructure Division within the Financial Services Authority (FSA) conducted an educational exercise for bank supervisors on risk stemming from tiering, in order to increase the latter's awareness of these risks. In addition, a survey of risk management practices of first- and second-tier banks was performed.

(ii) Actions have also been taken to reduce the identified exposures:

- A new Settlement Account Policy was implemented by the BoE in 2003, which enabled more banks to participate in the first tier. In addition, a new Money Market Reform will be implemented in 2006, aimed at encouraging wider membership in CHAPS, among other things.

- On the risk surrounding the payment mechanism of LCH.Clearnet, the Bank of England took over the role as concentration bank in 2005, and thereby effectively eliminated that risk. In addition, LCH.Clearnet introduced a new agreement for PPS banks in 2005, which sets out more clearly the risks incurred by participating in the scheme and specifies when payments to the concentration bank should be done and the penalties for breaking these rules.

Settlement Risks

The settlement risk from settling money market instruments was mitigated, when the CMO system was closed and the settlement of money market instruments transferred to CREST in October 2003. U.S. dollar settlement has risen significantly since the 2002 FSAP, although values are still small compared to sterling activities. The most important achievement in this area has been the closer attention paid to this settlement risk exposure. For example, CREST and the settlement banks are investigating the possibility of jointly developing a multilateral net settlement arrangement, via U.S. Federal Reserve facilities. As long as the value remains small, mitigating this risk is not a key concern; however, it is important for U.K. authorities to actively monitor this development, as well as how banks are managing this exposure.

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[120] In 2003 LCH merged with Clearnet and the name was changed to LCH.Clearnet.

The settlement risk in BACS was significantly reduced during 2005, with the implementation of the Liquidity Funding and Collateralization Agreement (LFCA). Under the LFCA, settlement for a failing member would be completed through committed liquidity from surviving members. This liquidity injection would then be reimbursed to the extent possible by selling the collateral pledged by the failing member. There is no guarantee, however, that the net debit position of a failing member is not larger than the liquidity committed by surviving members, since there is currently no debit cap in the system. Further development to eliminate settlement risk in the BACS system is encouraged.

There is an initiative to introduce retail payments with a shorter settlement cycle. This is positive from an efficiency perspective. There is also still room for shortening the settlement cycle in BACS so that settlement risks can be reduced, as is being encouraged by the BoE.

Improved Oversight

The publication by the BoE of an Annual Payment System Oversight Report (PSOR) represents a significant step towards best practice in terms of transparency and accountability:

- The 2004 PSOR was published in January 2005, and sets out in Chapters 1 and 2 the role of the BoE in payment systems, with Chapter 2 describing the oversight process in the United Kingdom. Chapter 3 assesses the systems overseen by the BoE against the Core Principles, and Chapter 4 concludes with future policy priorities. The first PSOR also sets out in a box (pages 38−41) the BoE's response to the 2002 FSAP recommendations.

- The BoE is currently in the process of finalizing the 2005 PSOR, which will set out its assessment of the systems, as well as the BoE's oversight priorities for 2006. Moreover, the report contains a section on the new risk framework for oversight, which the BoE developed in 2005, and which it plans to roll out during 2006.

C. Current Issues

New Ownership Structures

Thus far, the changes in CREST have been minor, and do not materially change the assessment made during the 2002 FSAP. The operations in CREST are run as a separate company, with only a few centralized functions.[121] That said, the new company aims to migrate CREST's transaction processing onto Euroclear's "Single Settlement Engine" (SSE)

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[121] In 2002, CRESTCo and Euroclear merged. The merger was announced during the FSAP mission, but since there were no significant changes in CREST operations at that stage, the assessment was performed on CREST as an individual system.

in July 2006, while the money settlement will migrate to the single platform in 2009. These changes will have an impact on operational as well as settlement risks in CREST. The BoE and the FSA are currently working closely with CREST on these matters. Although it is too early to say what the impact will be for the settlement of U.K. securities, the fact that the U.K. authorities are closely involved in the process is a positive development. LCH.Clearnet is also run as separate companies, and in reality, the merger has not effected the assessment of the clearing scheme.

As a direct consequence of these mergers, the FSA and the BoE have been involved in colleges with authorities in the other countries where the companies operate. These colleges are set up based on Memoranda of Understanding, and facilitate collaboration on technical work, as well as more high-level decision-making.

Euro Settlement Post-Target

In November 2005, the Bank of England decided not to join the TARGET 2 system for euro payments. Since the decision is still relatively recent, there is currently no clear solution on how euro settlements, currently done through CHAPS Euro, will be handled in the future. CREST, LCH.Clearnet and BACS all currently settle euro payments through the books of the BoE. From a settlement risk perspective, the preliminary assessment by the BoE that a preferred solution is to find a way to settle these transactions through a central bank, is a sound one. The potentially large intraday balances on the BoE's euro account, in acting as a concentration bank for LCH.Clearnet, provides support for this argument.

By and large, settlement banks in CHAPS Euro appear to be operating smoothly. Most of them already have a presence within the monetary union. However, the rest may decide to use other banks as settlement banks, thereby increasing the tiering problem discussed above. The share of these banks' payments in CHAPS Euro is, however, less than 1.5 percent, so they should only have a marginal impact.

A Statutory Base for Payment Systems Oversight?

The 2002 FSAP mission recommended that the authorities consider laying out the BoE's oversight responsibility more formally and fully in the statute. It was noted that the BoE plays a crucial role in payment and settlements systems oversight, arising from its inherent central banking functions related to monetary policy and financial system stability. However, the existing statute at the time did not fully reflect this responsibility; and this work has not yet proceeded.

The oversight role is even more important in the current environment, given that major infrastructure providers are part of international groups. In a national environment, tradition and moral suasion is often quite effective; this may not necessarily be true in an international context, when formal powers for, say, information gathering and sharing may be necessary. In light of the recent merger activities within the infrastructure providers, it is appropriate for the authorities to revisit this issue. Currently, the BoE likely does not have

the right to disclose information for oversight purposes to third parties—such as the FSA and other central banks—without the consent of the relevant payment system, since information is provided voluntarily by these system operators.

Systems versus Institutions

The distinction between the services provided by payment and settlements systems and banks is less clear than might be supposed. As highlighted in the discussions about tiering, there are substantial clearing activities being performed *within* institutions. This is true for settlement banks in different systems, as well as correspondent banking activities and banks acting as custodians. These activities entail many of the risk characteristics that are normally attributed to payment and settlements systems. Given the increased attention to risks stemming from financial market activities, it is important that these issues are not overlooked. For example, except for the FSA's valuable work on reducing confirmation backlogs in credit derivatives transactions, there has been relatively little attention paid to this area.

There is a risk that the authorities may overly focus on the *systems* and potentially overlook more important issues relating to the *banks* themselves. As an example, it may be more important for the BoE, given its financial stability focus, to use its market intelligence to increase the awareness of clearing arrangements for credit derivatives, rather than going in-depth into pure retail systems like the ATM network (LINK) and the debit card scheme (U.K. Maestro), as is currently the case.

Banks' clearing arrangements are not always very well-known to banking supervisors. Although initiatives have been taken within the FSA, from the market infrastructure perspective, to educate their bank supervisors in clearing and settlement risks, anecdotal evidence suggests that there is still room for considerable improvement. Using the information gathered on market infrastructure to increase awareness of these risks would be an important first step in making sure these risks are carefully managed.

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