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Impact of Globalization on Monetary Policy

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This paper aims to discuss a few core issues in the recent monetary policy and globalization debate.[1] Are global factors becoming important drivers of domestic inflation – or disinflation? To what extent should terms of trade shocks play a larger role in central bank rules for deciding when and for how long to allow inflation to drift above or below target? Even if central banks are reluctant to react to perceived misalignments in asset price levels, how concerned should they be about the fact that thus far, equity, housing and trade-weighted exchange rates have not yet demonstrated the enduring decline in volatility that output and inflation have experienced? I will argue that continuing asset price volatility is at least in part due to heightened asset price sensitivity to risk *changes* as risk *levels* fall, and the increasing ability of financial markets to diversify risk. Therefore, in the context of a long and successful campaign to reduce output and inflation volatility, it would be a mistake for central banks to obsess as much about asset price volatility as asset markets obsess about central bank volatility.

The second section of the paper begins by exploring whether the popular view that "China exports deflation" has any real content, and other issues related to the effect of the global productivity boom on inflation. At some level this view confuses terms of trade gains with deflation. Indeed, over the medium term, it would be more accurate to say that China is exporting *inflation* to the prices of *other* goods in the economy. Nevertheless, there is an important truth to the argument also, in that that central banks may reasonably choose to allow inflation to drift below target in response to favorable terms of trade shifts, just as they may choose to allow inflation to drift temporarily above target in response to adverse oil price shocks. More speculatively, some have argued that

[1] Given that the term "globalization" tends to be a Rorschach test for what ever one thinks about the world, I do not pretend that the issues raised here are exhaustive.

favorable trend terms of trade changes, combined with greater competitiveness and flexibility, allow central banks to target slightly lower trend inflation rates than they might otherwise.

Section II also touches on the intriguing notion that central banks pay more attention to global excess capacity in predicting domestic inflation. Overall, I conclude that whereas global factors certainly help shape monetary decisions, domestic monetary authorities still retain extremely strong control over medium and long-term inflation trends, even in very open economies. This is true despite the fact that, through both goods and asset price arbitrage, globalization is weakening the grip of individual central banks over the trajectory of domestic real interest rates except at relatively short horizons.

The third section revisits the stunning decline in output and inflation volatility that most countries have experienced in recent years, and contrasts this with the continuing volatility in many asset markets, not least including equity prices, housing and exchange rates. Economists have come to term the output volatility decline "The Great Moderation," which in principle has been a great triumph for central banks though there remains a great deal of debate about how to apportion credit. [2] Might the ever-expanding depth and liquidity of global asset markets, which is contributing to the general level of asset price inflation, also be exacerbating their volatility, partially offsetting the reduction that would otherwise come with more stable real economic activity? Why has exchange rate volatility been so slow to decline when, in principle, inflation and output volatility ought to be such major drivers?

[2] See, for example, Stock and Watson (2002, 2003), and Bernanke (2004). As I suggest here, one underlying factor that should perhaps receive greater attention is notable statistical drop in wars and deaths from wars over recent decades.

There are many possible explanations for continuing asset price volatility. First, equities (should) reflect very long horizon returns, and long-run risk does not necessarily diminish in proportion to reductions in short-run volatility. Second, as financial markets deepen, and as riskier parts of the global economy become securitized, aggregate measures of asset price volatility can rise even though the value of the global economy's overall capital stock (including both securitized and non-securitized components) is not necessarily itself becoming more volatile. Deeper markets, of course, also allow greater diversification of risk, lowering its price. Third, investors may still be engaged in a learning process on how to calibrate the effects of today's considerably lower output volatility on asset prices, in which case some significant portion of current volatility may eventually pass. Fourth, I argue that to the extent higher asset prices are fueled by low-risk premia, and therefore low risk adjusted interest rates, asset prices may become proportionately more sensitive to changes in perceived levels of risk. (This is in analogy to fact that a very long lived assets become more sensitive to changes in the levels of interests rates as interest rates fall, which indeed may also be a factor in volatility.) In this case, the continuing volatility of many asset prices, not to mention their continuing sensitivity to monetary pronouncements, may reflect their inflated levels rather than say, major failures in central bank communications policy.

For completeness, in the final section before the conclusions, I briefly survey the burgeoning academic literature on whether, as economies become more open, the case becomes more compelling for including exchange rates or terms of trade shocks into inflation targeting rules. Whereas this relatively narrow issue is not our main focus, it nevertheless concentrates a number of practical questions concerning how central banks

might deal with increasing openness. In principle, exchange rates are naturally-born schizophrenics that are both a relative goods price (for given price levels, the exchange rate is the relative price of two countries' CPI baskets) and an asset price (the relative price of two countries' currencies). Empirically, however, as we see again in section III, exchange rates tend to behave much more like asset prices than goods prices. For countries with well developed financial markets, the thin information content of exchange rates makes of limited use in a monetary policy rule, although of course there can still be important information when movements are extreme and other variables to support the general direction of the signal exchange rates appear to be sending.[3]

A more open question is whether terms of trade shocks (e.g. oil price shocks or an unexpectedly strong and sustained wave of low cost manufactures) should play a larger role in monetary rules as economies become more open, despite the fact they are harder to measure. Although researchers have come up with special cases where central banks should not allow even large terms of trade shocks to cause deviations from a narrowly construed inflation targeting rule, these cases seem to be very much the exception rather than the rule. For more generalized "flexible inflation targeting rules" that include inflation as only one argument, then any role for terms of trade shocks depends on whether its effects are already embodied in other variables such as output.

The final, concluding, section argues that the greatest challenge for central banks ahead is to make sure that their institutional mechanisms for preserving low trend inflation are robust to possible setbacks in the future course of globalization. Whereas central banks should take care to avoid unnecessarily exacerbating asset price volatility

[3] For poor countries or countries with very thinly developed financial markets, speculative volatility is a secondary issue and maintaining stable exchange rates may help anchor inflation and raise growth, see Husain, Mody and Rogoff (2005), and Aghion, Bacchetta, Ranciere and Rogoff (2006).

(and thereby hindering financial deepening), continuing asset price volatility after the Great Moderation can be explained by a number of other factors. Asset price volatility, including exchange rate volatility, should not distract central banks from their core mission of inflation and output stabilization.

II. GLOBALIZATION AND LOW INFLATION

A great deal has already been written about the broad implications of globalization on inflation, interest rates and monetary policy. This includes both the surge of recent interest in policy discussions[4] and, of course, academic analyses dating back at least to Hume's writings in the 18th century.[5] In this section, I attempt to address a few issues that have been of particular concern in the recent policy debate, beginning with the increasingly prominent view that the forces of globalization have become the central drivers in domestic inflation trends.

Is China exporting deflation – or inflation? Perhaps the idea that has gained the most traction is the "China is exporting deflation" theory. At one level, the "China is exporting deflation" paradigm is hopelessly naïve. It is certainly true that as China's low wage workers integrate into the global economy after decades of isolation, (not to mention India, the former Soviet Bloc states, etc.) they place relentless downward pressures on wages and prices elsewhere. But hyper-competitive Chinese exports only affect *relative* prices. As long as the central bank targets inflation in the overall price level, which it can over sufficiently long horizons, cheap goods from China simply imply

[4] For recent discussions of the significance of globalization on monetary policy, see Bank for International Settlements Annual Report 2005-2006, IMF World Economic Outlook (April 2006) or Kohn (2006).
[5] For more recent analyses, see for example, Obstfeld and Rogoff (1995, 2002), Corsetti and Pesenti (2001), Laxton and Pesenti (2003), Rogoff (2004), Devereux and Engel (2002, 2003), Vega and Winkelried (2004), Chen, Imbs and Scott (2004) and Borio and Filardo (2006).

that other goods must become more expensive. From this perspective, one might actually say that China is exporting *inflation* to the other sectors of the global economy.

However, at another level, the "China is exporting deflation" does have an important element of truth. The breathtaking speed and pace of China's integration into the global economy over the past twenty years has been a continuing source of wonder, even for central bank oracles. Setting aside a number of nuances we will return to in section IV, optimal monetary policy in the face of a favorable terms of trade shock will typically involve allowing inflation to temporarily drift below target. Thus, the continuing upside surprises in developing country growth over the past decade has translated into lower than expected inflation. But this is not a permanent effect, and it can run in reverse. If growth rates in the developing world were to sharply slow for a period, presently anticipated trend terms of trade changes might not materialize, and the result might be transitory upward pressure on inflation. In this respect, a crash in China's growth would resemble an oil shock.

Globalization's Deeper and More Durable Impact on Inflation: Rogoff (2004) argues that globalization may help support low inflation, even over the longer term when the developing world's integration into the global economy is no longer a surprise. In particular, globalization creates favorable milieu for maintaining low inflation by steepening the output-inflation (Phillips curve) tradeoff faced by central banks. This steepening, in turn, makes commitments to low inflation more credible and more durable. The core mechanism comes through greater competition that weakens the power of domestic monopolies and labor unions. Greater competition contributes to greater price and wage flexibility, and diminishes the output gains to be reaped from expansionary

monetary policy for any given inflation impulse. (This effect goes in the same direction as does the exchange rate channel emphasized by Romer (1991) and Rogoff (1985).) At the same time as enhanced competition steepens the output-inflation tradeoff, it also closes the gap between the natural rate of output and the efficient rate of output, further strengthening the political economy of maintaining low inflation.[6]

It is important to note that this Phillips curve steepening is a long run effect. As Taylor (2000) observes, during a period of disinflation, nominal price setting and wage contract horizons may extend for some goods, thereby counterbalancing the globalization effect. Since rigid wages and prices are much harder to sustain in a highly competitive environment, one would expect the globalization effect to dominate over the longer run. Even in the shorter run, it still works to make disinflation more credible than it would be absent globalization effects.

Beyond the above positive argument, the Bank of Japan (2006) and the BIS (2006) have advanced the normative argument that globalization can also allow the central bank to target a lower level of inflation, or more easily tolerate mild levels of disinflation. One rationalization for this view follows the analysis of Akerlof, Dickens and Perry (1996), who argue that because wages and prices tend to be more rigid downwards than upwards, it is helpful for central banks to target positive rates of inflation that "grease the wheels" of the economy by helping facilitate relative price adjustments. (With positive inflation, an individual worker's wage can fall in real terms without falling in nominal terms.) To the extent that globalization leads to ongoing improvements in the terms of trade for an economy, imported goods can take more of the brunt of downward nominal price adjustments at any given overall level of inflation.

[6] See also Loungani and Razin (2005).

Although this effect may not be enough to ever make it desirable for central banks to actually target deflation, it probably does imply that there is less to fear from mild deflation when terms of trade gains are the main cause.[7]

Opportunistic Disinflation

The discussion above assumes that the private sector picks up as quickly as central banks on trends shocks to the terms of trade and productivity. If the central bank recognizes a rise in productivity growth ahead of the private sector, it can take advantage of its better forecasting to opportunistically lower inflation while delivering output growth rates that pleasantly surprise the private sector. Arguably, this is exactly what many central banks did in the 1990s, by accident or design, as the unexpected benefits of globalization helped mute the pain of disinflation. During such an adjustment period, the central bank can then give the private sector its cake and eat it, too. [8]

Should Central Banks Be Focusing More on Global Excess Capacity in Forecasting Domestic Inflation Trends? An intriguing elaboration of the view that global factors drive inflation is the argument that global excess capacity has become increasingly more important than domestic excess capacity in forecasting cyclical domestic inflationary pressures (Borio and Filardo, 2006, Vega and Winkelried, 2004 and IMF World Economic Outlook, April 2006). The argument, evidently, is twofold. First, central banks would like to be able to forecast terms of trade changes, and a high level of global excess capacity relative to domestic excess capacity implies that short-run favorable terms of trade gains. Second, to the extent that domestic firms compete with international firms in specific industries, global measures of excess capacity in those

[7] Atkeson and Kehoe (2004) argue that most mild deflationary episodes have in fact been expansionary.
[8] Note everyone has been getting equal portions of cake, though. The fact that globalization has eroded low and middle income workers' share of GDP has probably also helped reduce inflationary pressures.

industries are more relevant in assessing near term price and wage pressures than domestic measures. Given that global shocks are becoming increasingly more important relative to domestic shocks, efforts to forecast global conditions are correspondingly more important so that global excess capacity, to the extent it can be meaningfully measured, may prove useful in forecasting external price pressures. However, these interesting new forecasting concepts in no way overturn the basic proposition that any central bank, no matter how small or open its economy, can always stabilize domestic prices at medium to long-term horizons, should it choose to do so. As Kohn (2006) emphasizes, globalization may affect the parameters of central banks models, but independent central banks still control their own inflation destinies (assuming they are not hamstrung by an exchange rate peg of some form.)

Globalization in reverse. Although the central scenario has to be for continued favorable tailwinds from globalization, central banks must not forget that the process can also run in reverse.[9] The most obvious example is the 1970s oil price shock, which the world is experiencing once again today (albeit in muted form and with the offsetting effects of continuing decline in prices for manufacturing imports.) While early estimates of the effects of supply-related oil shocks were clearly overblown, the income and terms of trade loss due to sustained price rises can still be quite significant,[10] particularly for countries (for example, in Asia) that rely almost exclusively on imported oil. For the same reasons that central banks might want to choose to allow at least temporary disinflation in the face of a favorable terms of trade shock, they might also choose to allow temporarily higher inflation when their economy is hit by an unfavorable shock,

[9] Rogoff (2003) and Fisher (2006) also emphasize that the tailwinds of globalization might reverse.
[10] Rogoff (2006) surveys the range of estimates of the effects of oil shocks on output in the academic and policy literatures.

albeit not necessarily any large deviation from target. (This sensible approach, generally considered best practice by most central banks, has been challenged by some more literal inflation targeting advocates, though as we shall see in section IV, the theoretical case for rigidly stabilizing inflation in the face of large terms of trade shocks rests on some rather strong and empirically implausible assumptions.)

A reversal of globalization will be even more painful if private sector expectations are slow to adjust. Just as globalization and high productivity growth probably lowered the public's resistance to disinflation, the pressure on central banks to inflate after a reversal in globalization will be especially acute if the public is slow to accept the adverse change. This was arguably part of the problem central banks faced after the oil shocks of the 1970s.

Real Interest Rate and Asset Price Convergence Whereas globalization has not substantially diminished individual central banks' long term control over domestic price levels and inflation, the same cannot be said for real interest rates and asset prices. As figure 1 illustrates, cross border financial claims and direct foreign investment have skyrocketed over the past two decades.[11] These closer financial linkages, together with ongoing financial innovation, have led to increasing price arbitrage across similar types of risky investment in different countries. Although it would be a great exaggeration to say that financial markets are already perfectly integrated – indeed they are far from it – the changes are still quite notable, for example in terms of correlations in equity price movements across countries (Ferguson, 2005). Real interest rates on long-term US, German and Japanese government bonds have converged to roughly similar levels,

[11] Figure 1 gives data only for the advanced countries from Kose et al. (2006), employing the Lane and Milesi-Ferretti (2006) database. As they show, the trend is similar for the emerging markets and developing countries, albeit the volume is much smaller as a share of world GDP.

reflecting not only convergence in risk premia, but greater similarities in consumption baskets and a pressures towards global price convergence for similar goods.[12]

As global economic integration inexorably progresses, even the largest central banks, including the Fed, the European Central Bank and the Bank of Japan, have less direct impact on medium and long-term domestic real interest rates than might once have been the case. This important point, of course, was implied in Fed Chairman (then governor) Ben Bernanke's famous "global savings glut" speech (April 2005), where he emphasized that long-term interest rates, especially, are governed largely by global supply and demand factors. Some estimates, for example, suggest that US interest rates might have been over 150 basis points higher in recent years, but for the ability of the United States to borrow from abroad.[13] Of course, assuming that monetary policy is neutral in the long run, a central bank can not affect the long-term trajectory of the riskless real interest rate in any event.

The fact that individual central banks' monetary policies matter less in a globalized world does not imply that central banks have less influence over real interest rates *collectively.* For this reason, the influence of the large central banks, especially the Fed, remains greatly leveraged by their international leadership over other central banks, not least because many countries choose to stabilize their currencies against the dollar. Since, for better or for worse, the central banks of many Asian and oil exporting countries still stabilize their currencies against the dollar, Fed policies can still have an outsized

[12] Real interest rate equalization is far from complete. One need only look at countries in the euro zone, which share the same currency and common market, to see that growth differentials and differing degrees of openness can still lead to substantial interest rate differentials. As Obstfeld and Rogoff (2001) emphasize, large trade costs in goods markets can also produce a wedge in real interest rates across countries, even when their asset markets are otherwise perfectly integrated.

[13] See Warnock and Warnock (2005).

impact on global interest rates even as the US share of global GDP gradually shrinks. The same is true, albeit to a lesser extent, for the ECB.

For those argue that financial globalization leads inevitably to crises and instability, it is hard to escape the observation that despite the financial crises of the 1990s and early 2000's, growth volatility has been declining across much of the world in recent decades.[14] Indeed, we will shortly turn to the evidence on moderation in output volatility, along with the surprising lack thereof in most asset prices, and, in particular, exchange rates.[15] Following Lettau, Ludvigson and Wachter (2006), I will speculate that, at the same time, lower macroeconomic volatility has rationalized sharply higher prices for risky assets. At the same time, however, it may have also contributed to making asset prices more sensitive to perceived changes in risk, substantially offsetting less volatile fundamentals.

Lastly, any discussion of the implications of globalization on monetary policy would be incomplete without noting the risks posed by the global imbalances, a euphemism for the humongous US current account deficit. Financial globalization is clearly an important driver of this process, particularly in inflating asset prices, which have in turn been an important driver of current accounts. Whereas one can argue that the effects until now have been relatively benign, it remains very much an open question of what will happen if the system is stress tested, say by a combination of housing price collapse in the United States combined with a sharp slowdown in growth in China.

III. EXCHANGE RATE AND ASSET PRICE VOLATILITY, AND THE GREAT MODERATION

[14] See Kose, Prasad, Rogoff and Wei (2006).
[15] See S. Campbell (2005).

In the previous section, I have discussed how terms of trade shocks and other international factors become potentially more important considerations for monetary policy as economies globalize. Before turning to theoretical debate on how international variables should, if at all, enter monetary policy rules, it is helpful to review some evidence on how policy has been apparently more successful in stabilizing the real economy as the recent globalization era has progressed. An important feature of the data is the apparent disconnect between the sharp decline in the volatility of real output and the continuing volatility of asset prices, including equities, housing and, as we shall see, real trade-weighted exchange rates.

We begin by reviewing the well-known evidence on output volatility. For some time now, economists have noted that quarterly output volatility seems to be declining across most of the G7 countries, leading to an intense debate on the underlying causes, with leading explanations including improved inventory management (since inventories have historically been a highly volatile component of GDP), financial innovation, improvements in monetary policy, demographics (an aging work force has better job matches, etc.) and plain good luck.[16] Stock and Watson (2002, 2003), in particular, argue that monetary policy can account for only a small fraction of the trend towards stability, and that much of the rest is "good luck." To this list, one should certainly add the end of the cold war and the general decline in conflagrations in recent decades, all of which has provided a benign backdrop for global growth and stability; see Figure 2. Whether this greater geopolitical stability, which has been an important bedrock of

[16] See for example, Kim and Nelson (2001), Kahn, McConnell and Perez-Quiros (2001), Blanchard and Simon (2001), Bernanke (2004), Jaimovich and Siu (2006), Dynan, Elmendorf and Sichel (2006), S. Campbell (2005), and International Monetary Fund World Economic Outlook April 2003. Prasad et al. (2003) show that the moderation has extended to many developing countries and to emerging markets, even factoring in the crises of the 1990s.

institutional development and growth, will persist, is a critical question especially given the more pernicious global terrorism that has begun to develop in the 2000s.

Figure 3 contains measures of quarterly (seasonally adjusted) output growth volatility, by decade, for a number of (mostly OECD) countries. As is apparent from the data, output growth volatility has fallen dramatically since the 1970s. In the United States, for example, quarterly output growth volatility fell by over 50% from the 1970s to the 1990s and 2000s. True, there are some countries like Germany where, thanks to unification, volatility was higher in the 1990s than the 1970s. But it was certainly lower by the 2000s, a broad trend apparent across the world today. Formal statistical tests for structural breaks in volatility (reported in Rogoff, 2006, following the methodology of McConnell and Perez-Quiros, 2000, and Cecchetti et al., 2006) confirm the basic message from the figures. In the United States, for example, there is one statistically significant structural break (1984Q1) whereas for the UK there are two (1981Q1 and then again in 1994Q3).[17]

Although the literature has focused primarily on quarterly data, there are a number of reasons to question the robustness of the quarterly results, ranging from the unreliability of seasonal adjustment techniques to changes over time in reporting and collection methods. For this reason, it is useful to look also at the annual data, which is likely to be more reliable particularly in cross country volatility comparisons. Figure 4 looks at the decade-long standard deviations of output growth for the same set of countries as the quarterly data in figure 3.[18] Interestingly, the annual data tell a slightly different story, one that emphasizes the unusual nature of the high and volatile inflation

[17] For further details on the volatility break tests, see Rogoff (2006).
[18] Figure 4 takes advantage of the fact that one can obtain annual output data back to the 1960s on a consistent basis for a wider range of countries than is possible for seasonally adjusted quarterly data.

era of the 1970s and early 1980s. In particular, there are many countries (including Canada, France, Germany and the UK) for which output growth volatility in the 1960s was not only lower than in the 1970s and 1990s, but it was also lower than in the 1990s.[19] The partial returns for the 2000s decade still show a recent decline in volatility (so far!), but nevertheless, the tranquility of the 1960s shows that explanations such as globalization or deeper financial markets cannot be the whole explanation of the recent declining output volatility pattern.[20] (Notably, referring back to figure 2, we see that the 1960s was a relatively tranquil time for wars and conflicts.)

What about the volatility of asset prices? Figure 5 gives the 36-month rolling volatility of log price changes in the Dow Jones and Standard and Poor's indices. Looking at the Dow Jones graph, there was a notable peak in volatility at the time of the Great Depression, but no obvious trend since.[21] Applying standard volatility break tests to the post 1960 data[22], one obtains volatility breaks for the Dow Jones in 1967m5, 1976m1, and 1990m9 (see table 1). Figure 6 gives the resulting pattern of volatilities. While the data mirror that of output volatility for the US (albeit with different breaks), the decline in volatility from the peak 1967-76 period to the lower post-1990 period is much more modest. Indeed, if one applies a similar methodology to the S&P index, volatility appears to actually rise after 1988m3. So the great moderation has not conspicuously affected the volatility of stock price returns. And, whereas the data are less reliable, and

[19] See also Doyle and Faust, 2006. The annual output data show a volatility pattern more similar to the inflation data, where volatility was relatively low in the 1960s, then began falling in most countries by the 1990s and is extremely low today.
[20] Though not included here, measures of consumption volatility show a similar pattern to output volatility.
[21] The VIX market based measure of expected volatility is available only since 1990. It shows a similar pattern to the rolling volatilities, with expected volatility rising sharply in the mid-1990s and then returning more recently to the levels of the early 1990s. The implied pattern of volatilities shows that at the very least, stock market volatility itself is highly volatile.
[22] Again, I follow Cecchetti et al (2006) in implementing the Bai-Perron test for a structural break(s) of unknown timing, see Appendix.

it is much more complex to properly define returns, housing index prices (figure 7) may have become somewhat less volatile on a very short-term basis, but on any longer horizon basis, remain extremely volatile.

What about the volatility of bond returns? Figure 8 looks at the 36-month rolling volatility of monthly returns on 10-year bonds for the United States and 20-year bonds for the United Kingdom.[23] The basic story for the US is that volatility was low in the 1960s, rose in the 1970s, then spiked very sharply during the disinflation era of the 1980s. Thereafter volatility returned to a level similar to the 1970s, but still above the volatility of the 1960s. For the United Kingdom, the story is similar though the peak volatility period begins somewhat earlier, and the ultimate decline in volatility has brought volatility down close to the 1960s level. The bond return volatility evidence, of course, closely mirrors the timing of disinflation efforts.

Let's return to the question of why there seems to be such a disconnect between volatility in the real economy and asset price volatility? S. Campbell (2005), who also analyzes the impact of the Great Moderation on stock price volatility, argue that this is because that only a small percent of stock price movements can be traced to news about fundamentals, and that most of the movements reflect shifts in perceived rates of return, though this begs the question of why these have not become less volatile, particularly as asset markets have broadened and deepened.

As discussed earlier, there are many other possible (and not necessarily incompatible) explanations of this disconnect, including the fact that equity returns depend on the long-run growth and volatility, and not just short run business cycle

[23] Monthly returns on 10-year Treasury bonds are calculated from yield data using the approximation formula 10.1.19 in Campbell, Lo and MacKinlay, 1997

volatility. Also, some component of the higher volatility may be transitory, as investors digest the Great Moderation, and as asset prices absorb the massive inflation consistent with lower macroeconomic risk (although there is a serious question of overshooting if investors wrongly believe that long-term volatility has fallen proportionately to short-term volatility). An interesting question is whether asset price inflation might provide a counterbalancing effect on (log) asset price volatility that offsets the fundamental driver of lower macroeconomic volatility. If asset prices inflation is partly due to lower global interest rates and risk premia[24] (for housing the evidence is especially compelling), then, it is plausible that relatively small movement in perceived future interest rates or risk premia might cause higher asset price volatility than would be the case at lower prices. (The simplest example is of a consol whose price is the inverse of its yield. Then percentage movements in the price are approximately proportional to percent movements in the interest rate, so a fall in yields from 8% to 4% will have the same price effect on par consoles as will a price fall from 4% to 2%.) While this non-linear effect is not captured in the standard linearizations that are now conventional in asset pricing (for example, the Campbell-Lo-Mack inlay linearization we used to calculate bond returns), it may be quite important in the case of unusually massive price and risk changes such as we have witnessed in the past decade.[25]

[24] Lettau, Ludvigson and Wachter (2005) argue that the general global decline in macroeconomic volatility, combined with gradual learning on the part of investors, can explain a good part of the massive broad-based equity market inflation of the past decade arguably the most spectacular in history. Lower macroeconomic risk implies higher asset prices in any standard consumption capital asset pricing model (loosely speaking, expected future returns are being discounted by a lower risk adjusted interest rate, implying a higher price.) These authors also try to match the timing of the massive asset price inflation of the past ten to fifteen years using a model in which private agents only gradually learn about mid-1980s structural shift in US output and consumption volatility.

[25] As more direct illustration of this point, consider Glassman and Hassett's (2000) analysis of why the Dow Jones should be at 36,000 and 11,000. Glassman and Hassett argue that since stocks always

Having surveyed the domestic evidence, we now turn to the effects of the great moderation on real exchange rate and terms of trade volatility. Figure 9 give estimates of the monthly volatility of the real dollar-euro, dollar-yen and dollar-pound using residuals from simple autoregressions of the real exchange rate on its lagged values; table 2 gives the lags lengths used, and estimated structural breaks using the Bai-Perron algorithm.[26] Visually, all three currencies show a decline in volatility over the most recent period, down especially from the peaks of the first half of the 1980s. In the case of the dollar pound rate, the estimated volatility decline is relatively slight. In the case of the euro and the yen the volatility estimates go up and down over time (they are quite volatile). In the exchange rate literature, many attribute the decline in exchange rate volatility to the September 1985 Plaza accord, but it is notable that decline mirrors the decline in bond market volatility from its spike in the early 1980s. Although the visual evidence seems to support the notion that there is some reduction in exchange rate volatility in recent years (as do volatility measures implied in options), the change is not so decisive as with output and does not yet show up clearly in formal tests.[27]

We next turn to the trade-weighted real exchange rates. Real exchange rates, of course, are schizophrenic in that they are an asset price (which depends on the trajectory of real interest rate differentials across the home and foreign economies) as well as a

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outperform bonds over the long run, they are in effect riskless, so that future dividends should be discounted at the riskless real Treasury bill rate, and not a risky interest rate. Assuming a growth rate of 2.5% for real dividends, they thereby conclude that the price dividend ratio should be 200. Their analysis, of course, contains a fallacy of composition. If the Dow were to rise to 36,000, and then investors decided that there actually does exist a modest amount of uncertainty, there would be a massive price decline, thereby completely negating the original assumption that stock returns are riskless. (I am grateful to John Campbell for suggesting this example.)

[26] Because there has been so much research showing that real exchange rates do not have a unit root, we run the autoregressions under the assumption that there is no unit root. In order to make the results compatible with the volatility break results for other variables we have presented here, we HP filter the data. However, this does not turn out to make any important difference in the results.

[27] The results for volatility breaks are sensitive to whether trends are allowed for in the volatility tests. See again, Rogoff 2006, for further details.

goods market price (the relative price of the home and foreign consumption baskets). As is well known, the asset price side of exchange rates tends to overwhelmingly win this tug of war, with exchange rates having surprisingly little connection to fundamentals over short to medium run periods.[28]

Figure 10 gives 36-month rolling volatility estimates for month to month log exchange rate movements for the real effective exchange rate indices for the euro area, the UK and Japan, and the real effective (major currencies) index for the United States. For Japan and the euro area, there is no obvious fall in volatility. For the UK, there is a slight fall, and for the US, volatility appears to rise and fall in line with the three bilateral dollar rates in the earlier figure. Figure 11 gives the volatility from the residuals of the autoregressions for these exchange rates; the estimated breaks in volatility levels again come from the Bai-Perron algorithm. We see that for the US, the trend breaks fall at the beginning of the 1980s and the beginning of the 1990s. Similarly to bonds, volatility peaked in the 1980s and then declined back to a level somewhat above its 1970 level. All in all, we see some moderation in exchange rate volatility, especially from its 1980 levels, but the decline is less pronounced than with output volatility.

Of course, it should be noted that data on implied volatility from options prices show a continuing decline in exchange rate volatility for the major currency cross-rates, so it is possible that exchange rates are experiencing the Great Moderation but with a long delay. Using this measure, Kos (2006) notes that implied Euro-dollar volatility has fallen from 13 percent in 2000 to 8 percent in 2006, whereas dollar yen volatility has

[28] See Meese and Rogoff (1983), Frankel and Rose (1994) and Obstfeld and Rogoff (2001). There does seem to be some tendency for shocks to real exchange rates to damp out over time, but only over very long periods. The half life of shocks to real exchange rates appears to be between 3 and 5 years (see Rogoff, 1996).

fallen from 16 percent in 1998 to just under 9 percent in 2006. Unfortunately, options volatility data is not available for a long enough period to look at whether this represents a cyclical volatility movement, or a long term break of the type apparently experienced by output and consumption. We note, for example, that implied stock market volatility also fell sharply since the end of the 1990s, but not in comparison to the early 1990s.

The decline in the volatility of the terms of trade (the relative price of exports and imports) comes through much more clearly. Figure 12 gives rolling 36 month volatility estimates for the US, UK and Japan's terms of trade indices. The decline is striking to the naked eye, and volatility break tests show similar results.[29] The relative stability of the terms of trade also reflects the offsetting effects of commodity price shocks and manufactured goods shocks.

Our analysis of volatility results gives a few important messages to add to our earlier broad-brush survey of the effects of globalization on monetary policy. First, globalization has been accompanied by a continuing decline in real output volatility, which has been an additional factor helping support monetary policy. Though there is a considerable debate over the role of monetary policy itself in fueling this decline, it seems clear from the annual output data (as opposed to the quarterly data conventional in volatility break analyses), combined with the bond volatility data, that better monetary policy has played a large role in the "Great Moderation". This is especially the case since, as Bernanke 2004 notes, the deeper financial markets that have also contributed to stability owe their development in part to more stable monetary policy.

[29] . Recent research by Gopinath and Rigobon shows that over the past decade, 97 percent of US exports and 91 percent of US imports is now priced in dollars, with price adjustments in highly disaggregated goods taking place approximately only once every 11 months. They find if anything, a trend increase in price stickiness at the border, consistent with more stable terms of trade, though the data set is not long enough to look at longer term trends.

IV. SHOULD THE EXCAHNGE RATE OR TERMS OF TRADE ENTER DIRECTLY INTO THE MONETARY POLICY RULE?

Many of the most interesting questions arising from globalization involve long-run political economy considerations such as those mentioned earlier in section II. Here, however, for completeness, I will briefly touch on shorter-run tactical questions. In particular, should the central banks' monetary policy rules explicitly take account of international variables such as the exchange rate, the terms of trade or the current account? The reader should recognize that this topic is the subject of an ongoing academic debate. The issues also revolve critically around the exact nature of the rule the central bank implements (e.g., Taylor rule or strict inflation target), as well as the exact price index the central bank focuses its policy rule on.

Exchange Rates in the Monetary Rule: Taylor (2000) argued that adding the exchange rate to a standard "Taylor rule" monetary reaction function was unlikely to produce any significant benefit, especially as "pass-through" from exchange rates to prices has fallen along with inflation rates. Relatedly, Svensson (2000), in his New Open Economy macroeconomics model of monetary rules, finds that it is not necessary to directly include the exchange rate in a monetary feedback rule that already includes output. Using other variations of New Open Economy Macroeconomic Models, Clarida, Galí and Gertler (2001) and Pesenti and Laxton (2003) also find a relatively small independent role for exchange rates, once their indirect effects through output and inflation are taken account of. On the other side of the debate, Smets and Wouters (2004) show that including the exchange rate in the monetary rule can be quite beneficial in some circumstances, particularly as an economy becomes more open.

All of these analyses, however, use models in which the exchange rate can be tied to fundamentals, implying that it contains clear information signals about the underlying state of the economy. But as I have already discussed, exchange rates are so disconnected from fundamentals in practice, that they probably can only be relied on to give off clear signals in the cases of very large shocks to fundamentals. The evidence on volatility presented earlier also supports the view that the exchange rate behaves more like an asset price than a price for trading goods. Obstfeld and Rogoff (1995) argue emphatically that it is a mistake to give large weight to the exchange rate under most circumstances and that to do so, would increase the possibility of debilitating speculative attacks. So the case for not including the exchange rate directly into a country's monetary rule reduces to the same case for not including asset prices more generally.[30] If anything, exchange rates are even harder to explain than, say, housing prices, and the case is stronger. Of course, in cases of very large changes in the exchange rate, and where the signal appears to be corroborated by other variables, greater weight on the exchange rate may be warranted.

Terms of Trade Shocks in the Monetary Rule: What about the terms of trade? Again, there is a theoretical debate. For Taylor type rules which include output (or for "flexible inflation targeting rules" – which include inflation as only one consideration), the issues are fairly similar to those discussed for the exchange rate above. It remains to be shown that there are large gains to separately incorporating the terms of trade, once output and inflation already enter the central banks' rule. The case for taking terms of trade changes into account for departures from strict inflation targeting rules is stronger, although the most radical interpreters of inflation targeting might still argue the point. In

[30] Bernanke and Gertler (1999).

section III, we showed that post 1980s, terms of trade tend to behave much less like asset prices than do exchange rates in that they have shown a marked decline in volatility. This presumably increases the information content of any large changes that are actually observed. Some shocks, such as changes in the price of oil imports, are positively transparent.

Despite the apparently compelling practical case for incorporating the terms of trade in narrow inflation targeting rules, there are certain plausible theoretical cases where it is not necessary to include them. Obstfeld and Rogoff (2002) show that if the distortion between the natural rate and the socially optimal rate of output is fixed, and if there are complete financial markets, then monetary policy rules that stabilize prices are optimal in the face of productivity shocks. Indeed, in this special case, unilateral adoption of inflation targeting rules by national central banks produces just as efficient an outcome as if central banks set their rules cooperatively. This equivalence breaks down when financial markets are incomplete, and when there is only partial pass-through from exchange rates to prices (Corsetti and Pesenti, 2003 illustrate the latter). As Blanchard and Galí (2005) have eloquently demonstrated, the general principle is that when economies contain real rigidities (such as sluggish real wage adjustment) in addition to nominal rigidities, tightly construed inflation targeting is no longer optimal. They argue that an oil shock is likely to be a case where monetary authorities, in general, will want to allow some higher inflation to cushion the shock to output. They show that popular canonical models that do not allow for such real rigidities (e.g., the New Keynesian Model with Calvo Pricing) give a misleading view of the efficacy of overly strict inflation targeting.

There is no resolution yet of this continuing debate, but it appears at this juncture that the case for incorporating terms of trade shocks into stricter inflation targeting rules is fairly compelling, despite the possible communication risks it entails. (This practice is already common among smaller central banks.)[31] For broader Taylor-type rules, it is a more open question.

V. Concluding remarks

Globalization has, by and large, provided an extremely favorable backdrop for monetary policy over the past twenty years, leading to higher productivity, greater gains from trade, and increased competitiveness and flexibility in the global economy. [32] At the same time, output growth volatility – the minimization of which is a central goal for any monetary rule – has been declining steadily. Monetary policy has not only benefited from these trends but helped to contribute thanks to the success of more independent central banks and better monetary policy frameworks. From a narrow tactical perspective, the case for incorporating exchange rates directly into monetary policy or inflation-targeting rules remains dubious outside the case of extreme movements, given the difficulty of extracting any consistently meaningful information content from exchange rates. For central banks that narrowly target inflation, however (without a significant explicit weight on output), there is, however, a stronger case for incorporating terms of trade shocks.

[31] I have neglected the issue of global current account imbalances; there is the question of whether these should also be factored into monetary policy. I am inclined to think that the answer is no. Fiscal policy seems much better suited to the task, especially in that monetary policy will operate by and large through its effects on asset prices.

[32] The favorable winds of globalization for monetary policy were emphasized in my earlier paper for this conference Rogoff (2004).

One important issue that monetary authorities have had to confront during the globalization period is the continuing volatility of asset prices, even as real output volatility has come down. Part of the volatility in asset prices is likely transitory, as investors react to higher trend productivity and begin to absorb the implications of sustained lower macroeconomic risk. This learning process in itself may produce considerable volatility since risky asset prices depend critically not only on expected future returns, but assessments of volatility as well. Regardless, a good portion of sustained asset price volatility, including exchange rate volatility, seems likely to endure. One possible explanation is that as long-term interest rates and risk premia fall, thereby inflating the prices of long-lived assets such as housing and equity, they simultaneously become more sensitive to perceived changes to risk and the trajectory of interest rates, offsetting the volatility reduction that would otherwise come from lower macroeconomic volatility. Even as risk *levels* have fallen, they remain volatile. As a corollary, asset prices also may become more sensitive not only to central bank interest rate policy but to central bank communications on macroeconomic risk.

I have argued that to some extent, this conundrum is a byproduct of central banks' success in helping stabilize economic activity, and thereby inflating the prices of risky assets. A number of interesting questions arise, including the extent to which central banks should worry about asset price volatility and the extent to which, in a more interconnected world, coordination of central bank communications might help stabilize risk assessments, reducing the volatility of volatility as it were.

But the larger concern for central bank policy has to be to insure that frameworks and institutions are robust to the risk of an eventual slowing down or reversal of some of

the factors that have been so favorable for so long, including global peace and Indo-Chinese growth. And even if these favorable trends continue, there are the massive budget problems that most of the developed world is going to face as its populations age. Improving central bank's communication will perhaps help reduce asset price volatility, and thereby help foster further financial development and growth. But given that some part of the continuing volatility may simply be a result of higher general levels of asset prices, and given a strong presumption that the central bank's main focus should be on maintaining growth and price stability, the core challenge has to be to look ahead to when times might not be so favorable.

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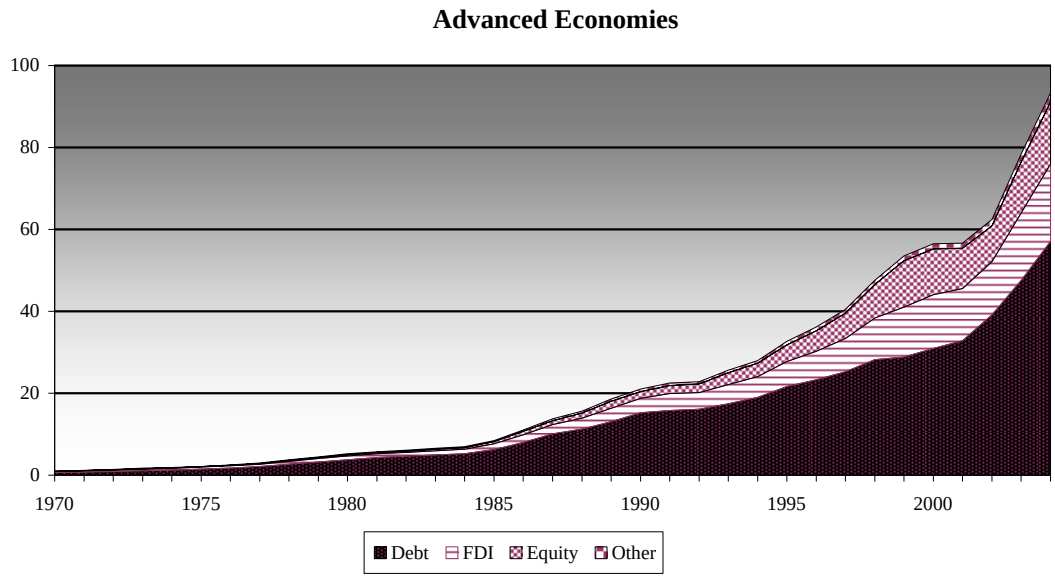
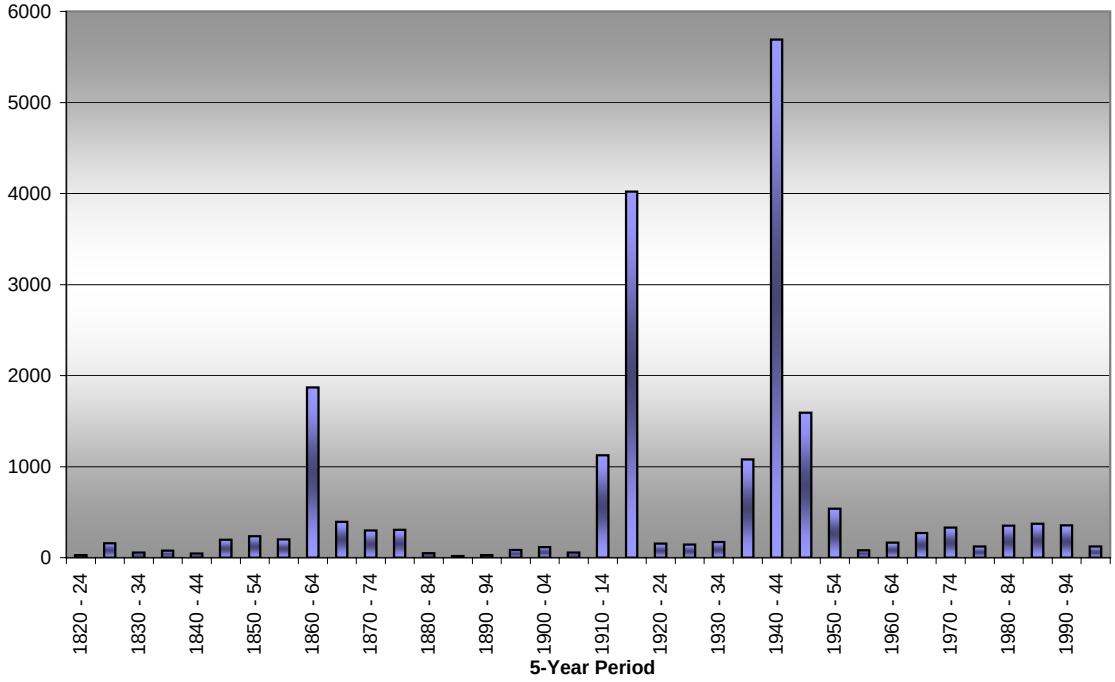
Figure 1. Gross International Financial Assets and Liabilities: 1970-2004
(trillions of U.S. dollars)



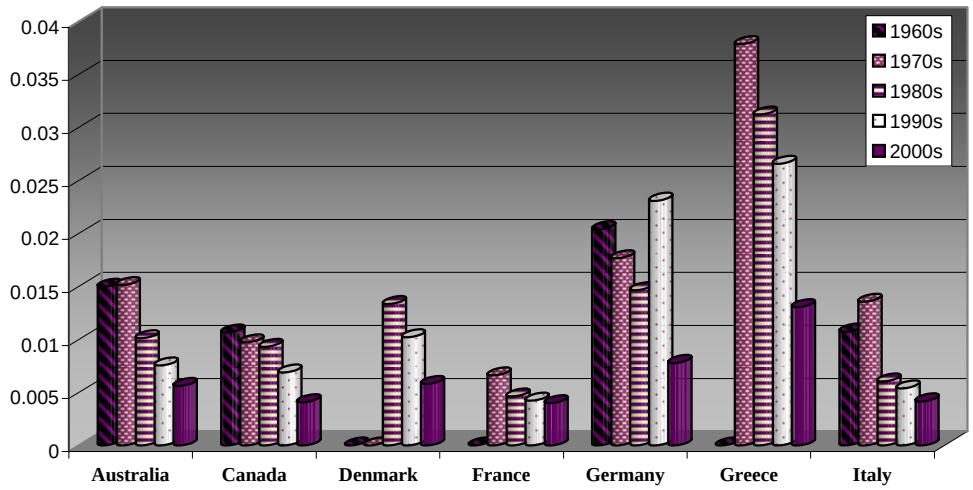
Notes: The financial integration data are based on a dataset constructed by Lane and Milesi-Ferretti (2006). The charts show how the components add up to the total integration measure in each period. Debt includes both official and unofficial debt. The category "Other" includes financial derivatives and total reserves minus gold.
Source: Kose, Ayhan; Prasad, Eswar; Rogoff, Kenneth and Shang-Jin Wei (2006).

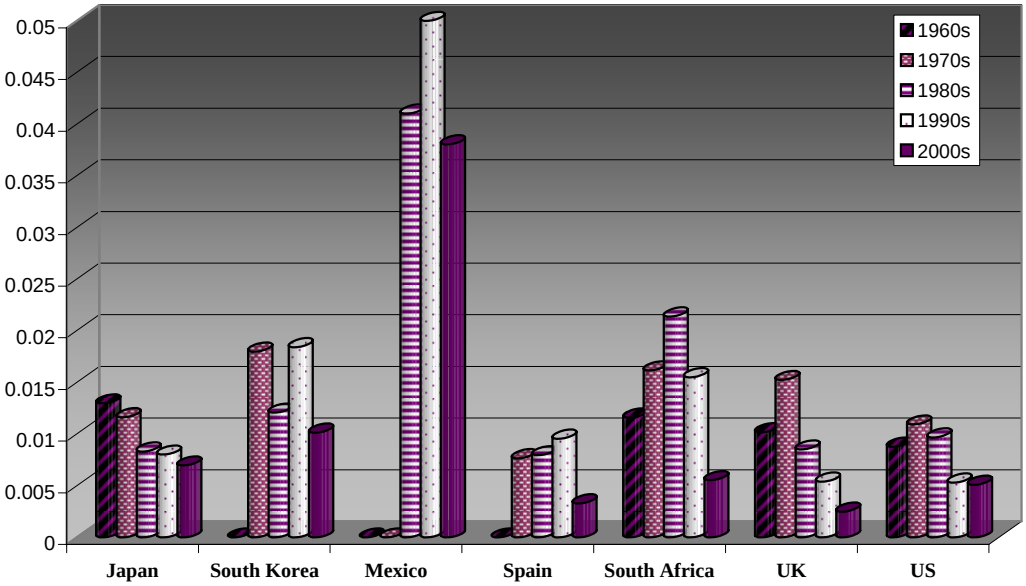
Figure 2. War Deaths per Million Population



Note: Bars indicate total number of deaths from intra-, inter-, and extra-state war for a given five-year period, divided by world population mid-period. Wars are defined as interstate, intra-state and extra-state violent armed conflicts in which there are more than 1,000 battle deaths.
Sources: Gleditsch (2004) for war dates and deaths and United Nations Population Division (1999) for population.

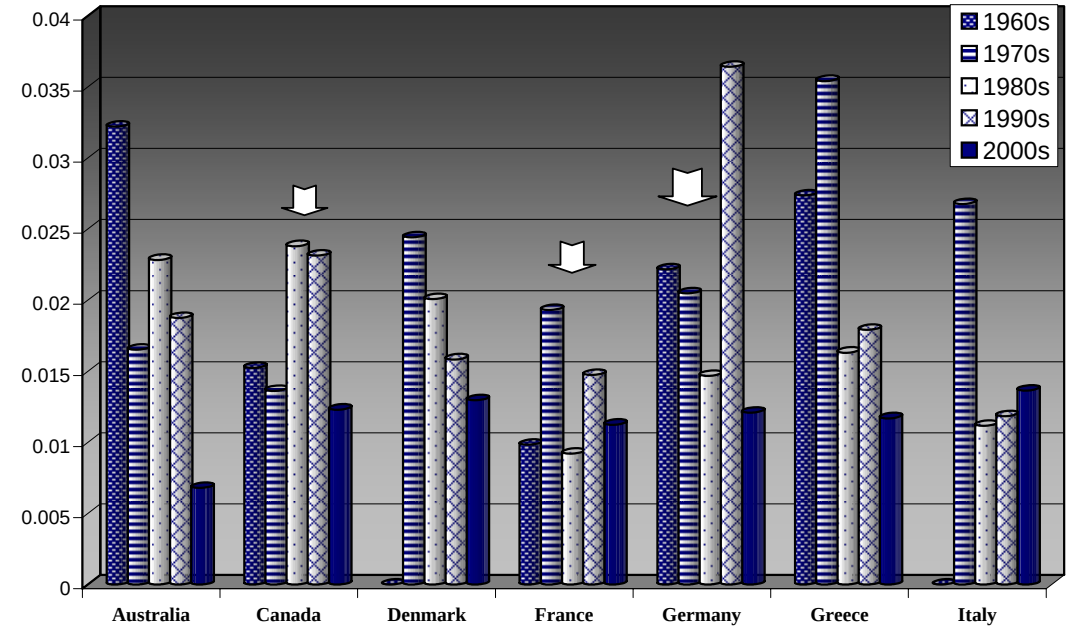
Figure 3. Decadal Output Volatility (quarterly data)

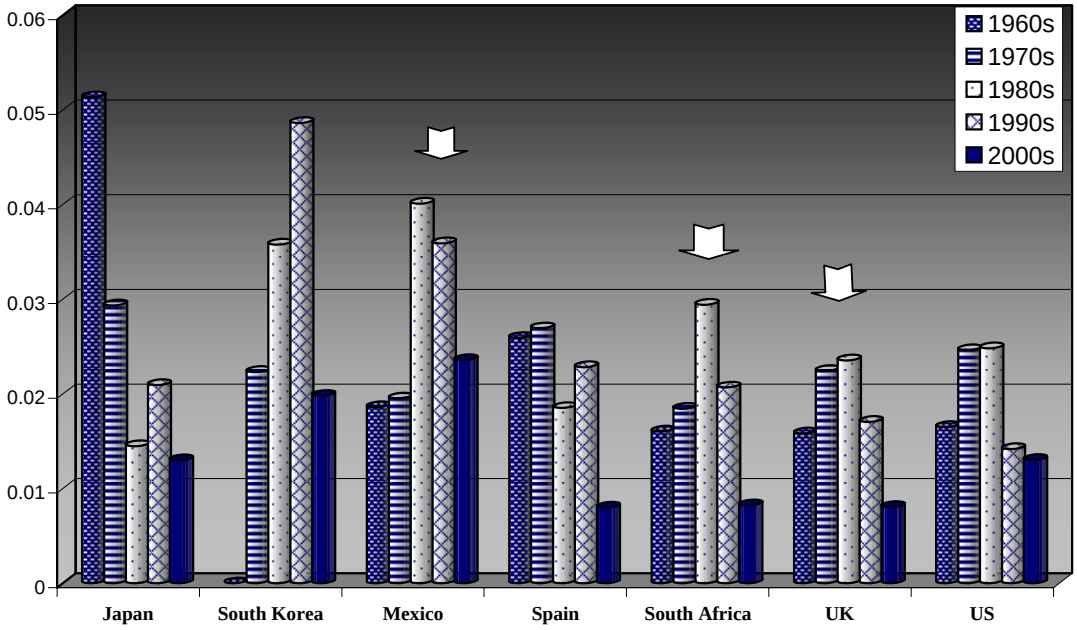




Output Volatility is measured as the st. dev. of the change in natural log of real GDP for the given decade. All of the time series begin in 1960 or 1970 and end in 2005Q4 or 2006Q1, with the exception of Denmark (begins in 1980).
Source of data: OECD except for Germany and South Africa (IMF-IFS); quarterly data

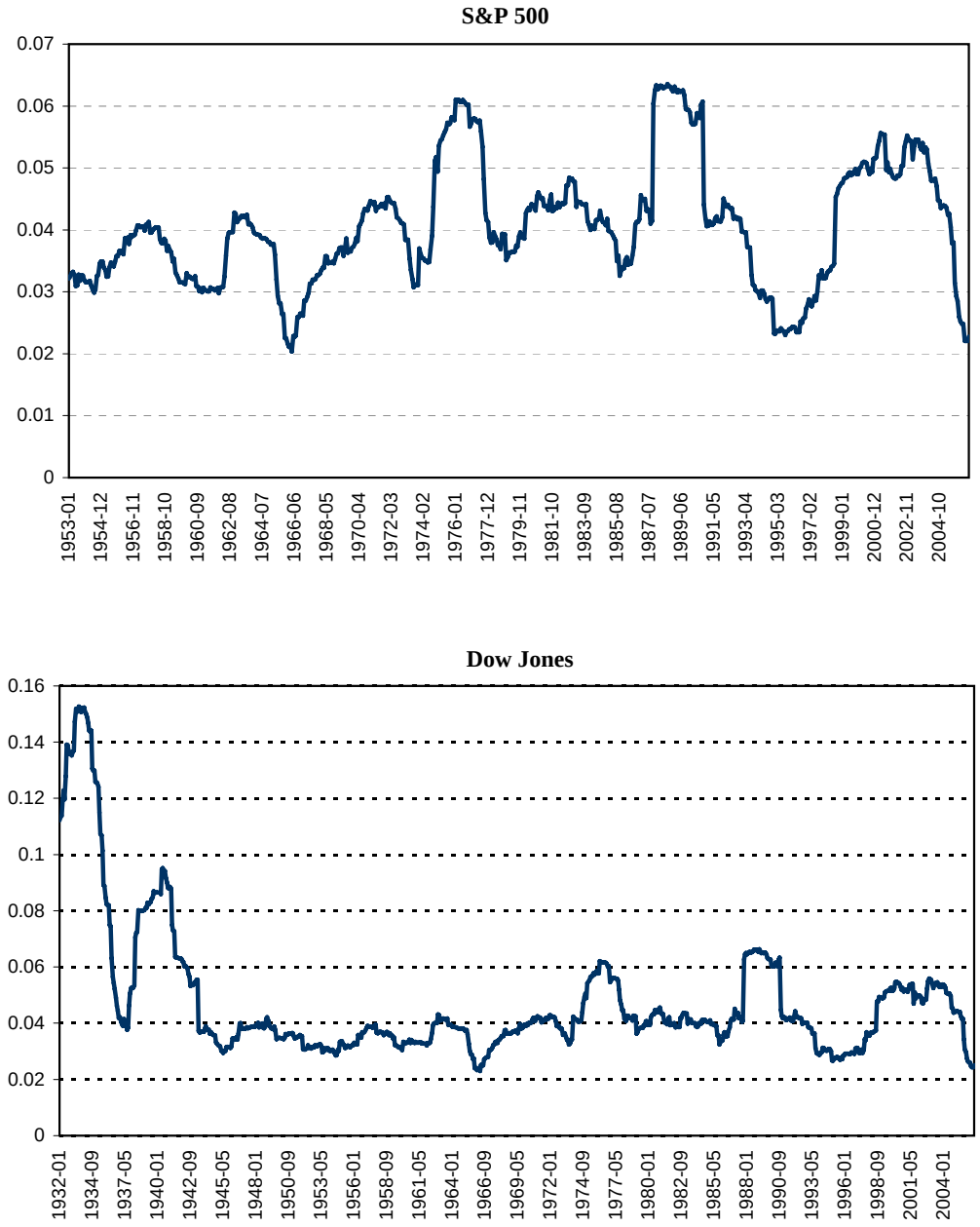
Figure 4. Decadal Output Volatility (annual data)





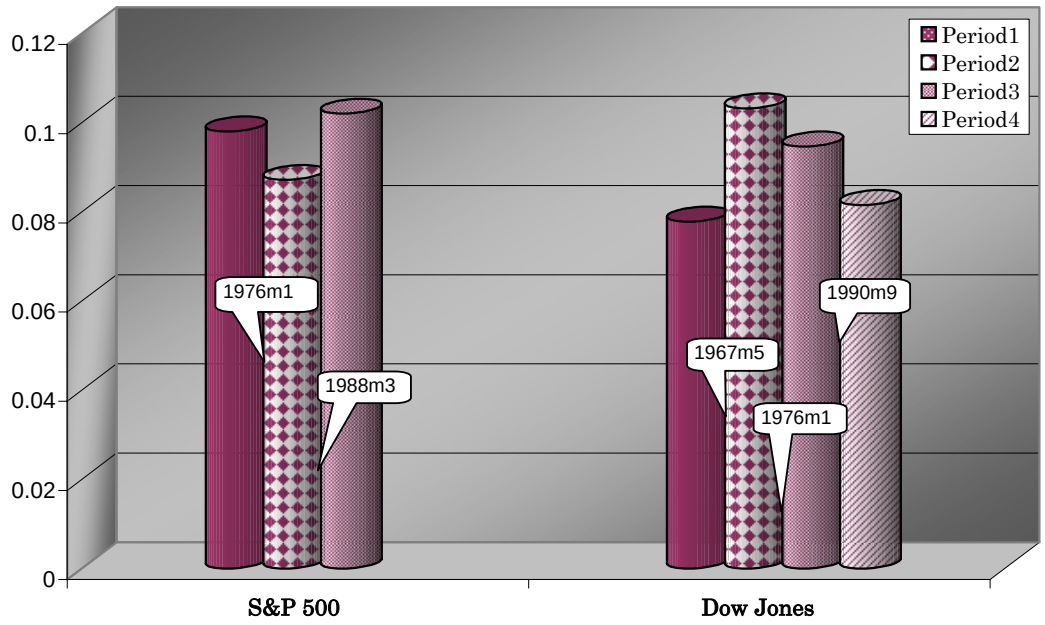
Note: Output volatility is measured as the st. dev. of the change in natural log of real GDP for the given decade. Data ranges from 1960 to 2005 except S. Korea (1970), Italy (1970) and Denmark (1970). Arrows indicate countries with lower output volatility in the 60s compared to the 90s.
Source of data: IMF-IFS; annual data

Figure 5. Stock Market Volatility



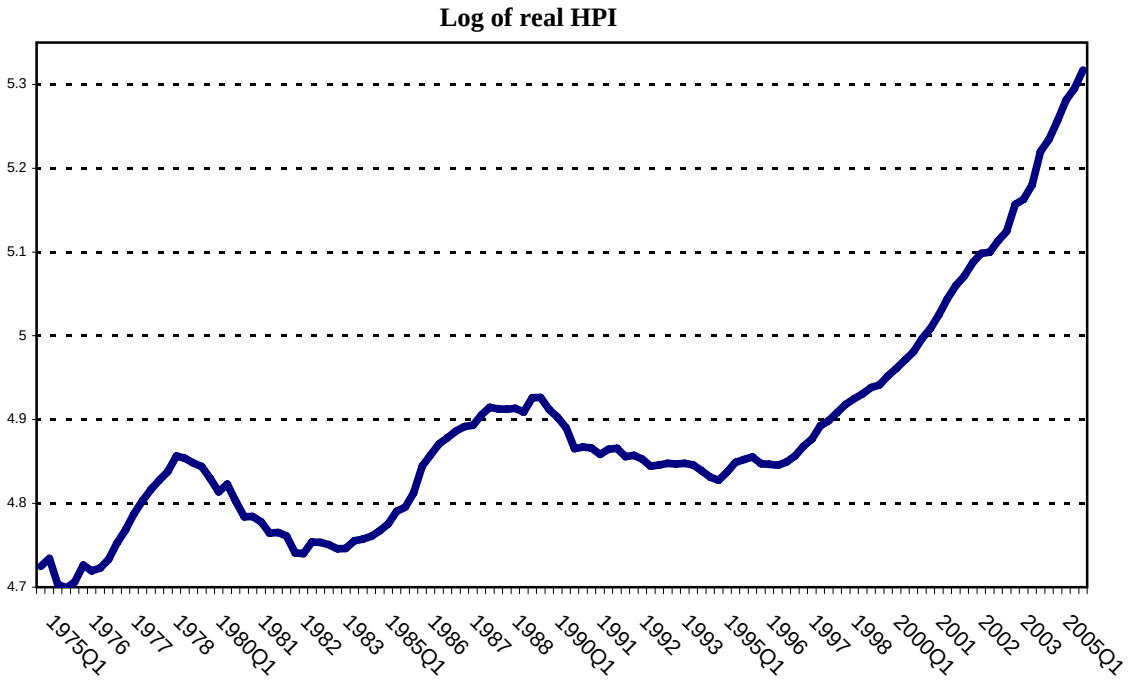
Note: Volatility is measured as the 36-month rolling st. dev. of the change in natural logs of the S&P 500 and Dow Jones.

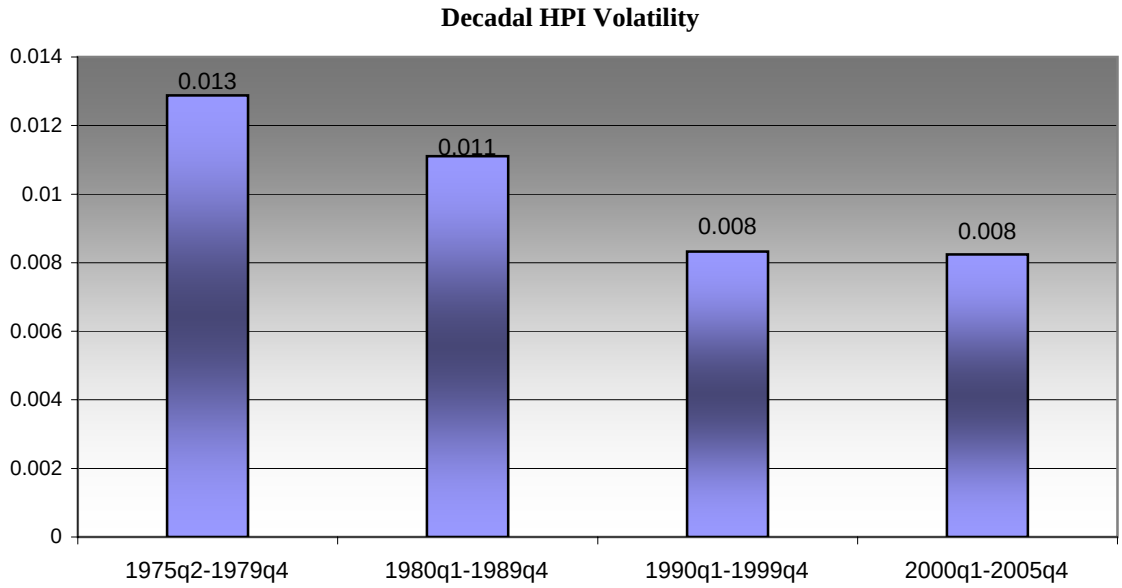
Figure 6. Stock Market Volatility Before and After the Structural Break



Note: Volatility is measured as the st. dev. of the deviation of the natural log of the stock market index from its HP-filtered trend.

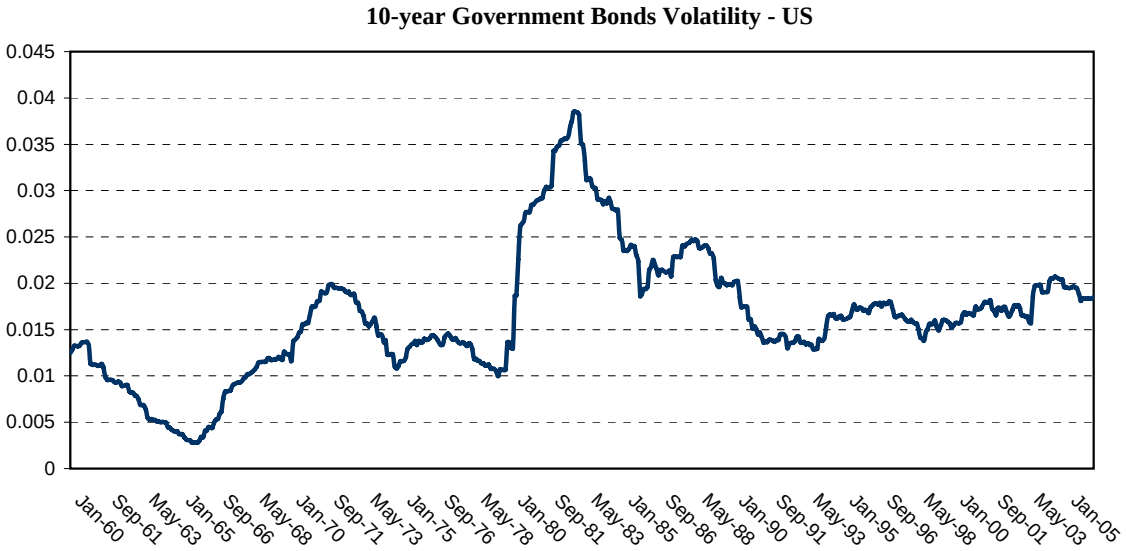
Figure 7. Housing Price Volatility

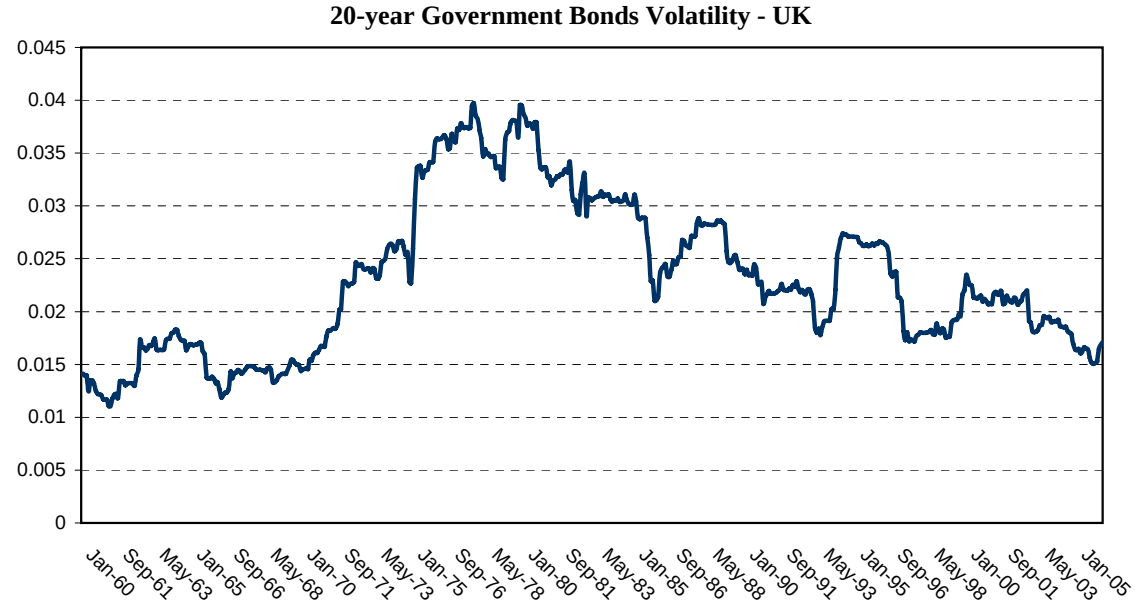




Volatility is measured as the 10 year st. dev. of the change in natural log of the real HPI index.
Source of data: OFEHO (HPI series) and BLS (CPI less shelter series); quarterly data (not SA).

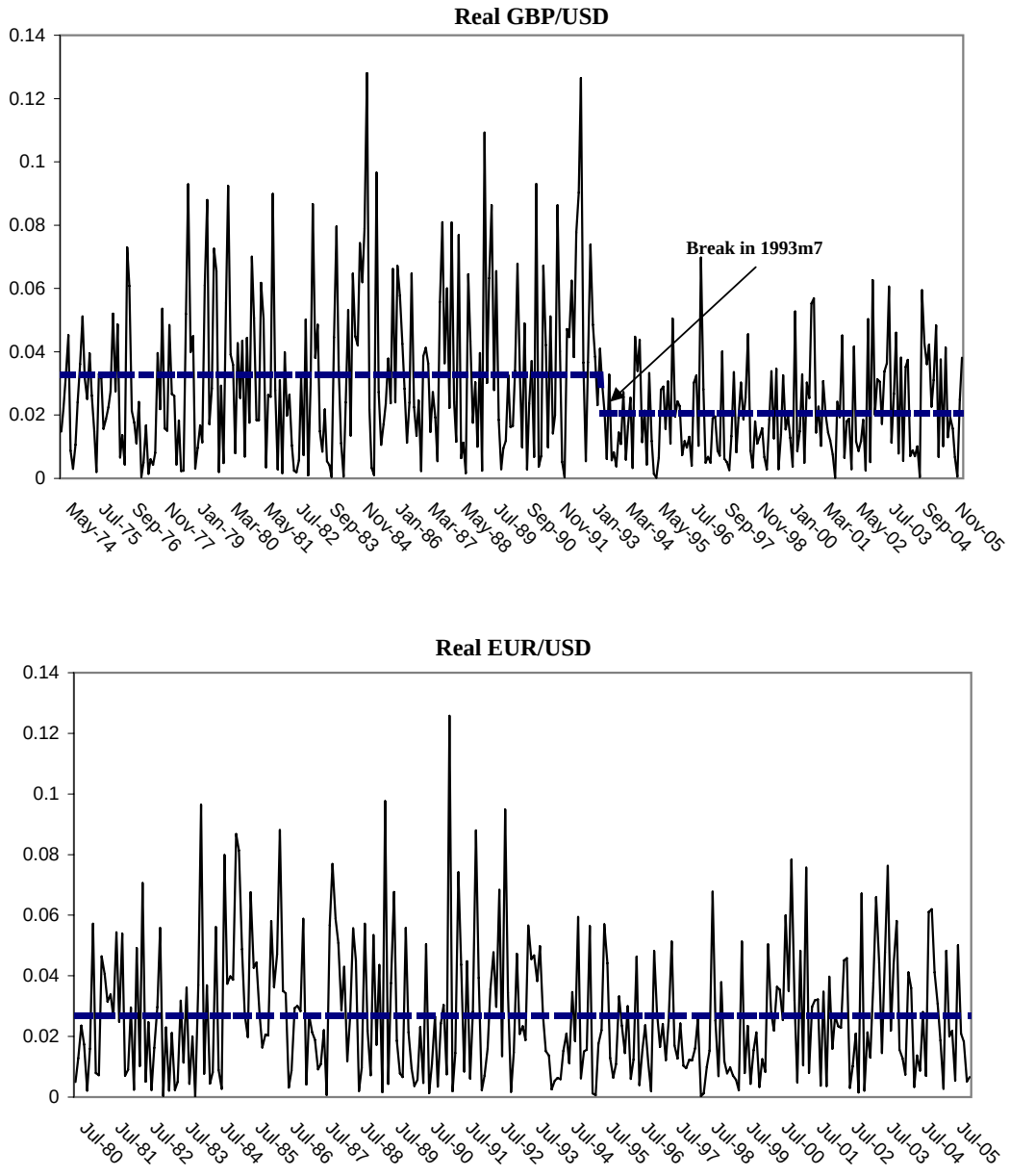
Figure 8. Long-Term Government Bonds Volatility

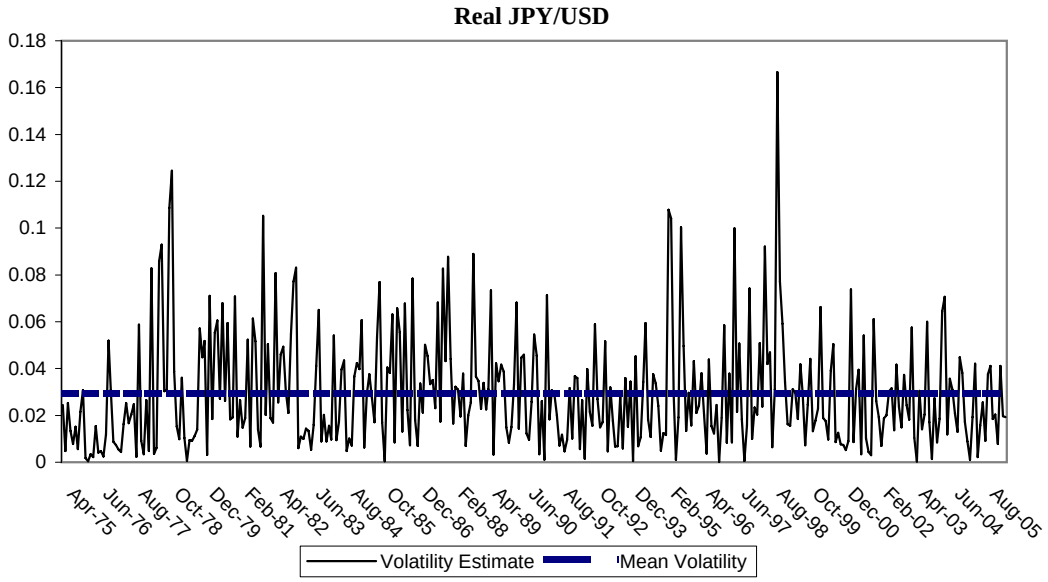




Note: Volatility is measured as the 36-month rolling st. dev. of the log of bond returns calculated using formula 10.1.19 from Campbell, Lo and MacKinley (1997).
Source of data: IMF-IFS; monthly data

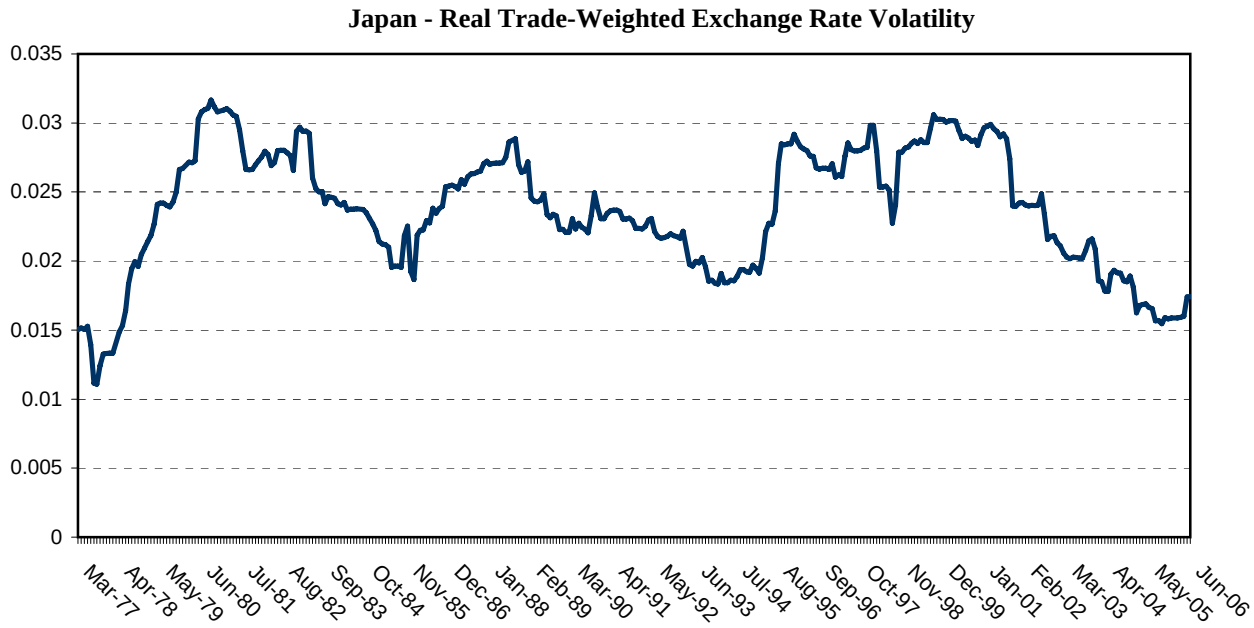
Figure 9. Real Exchange Rate Volatility Before and After the Structural Break

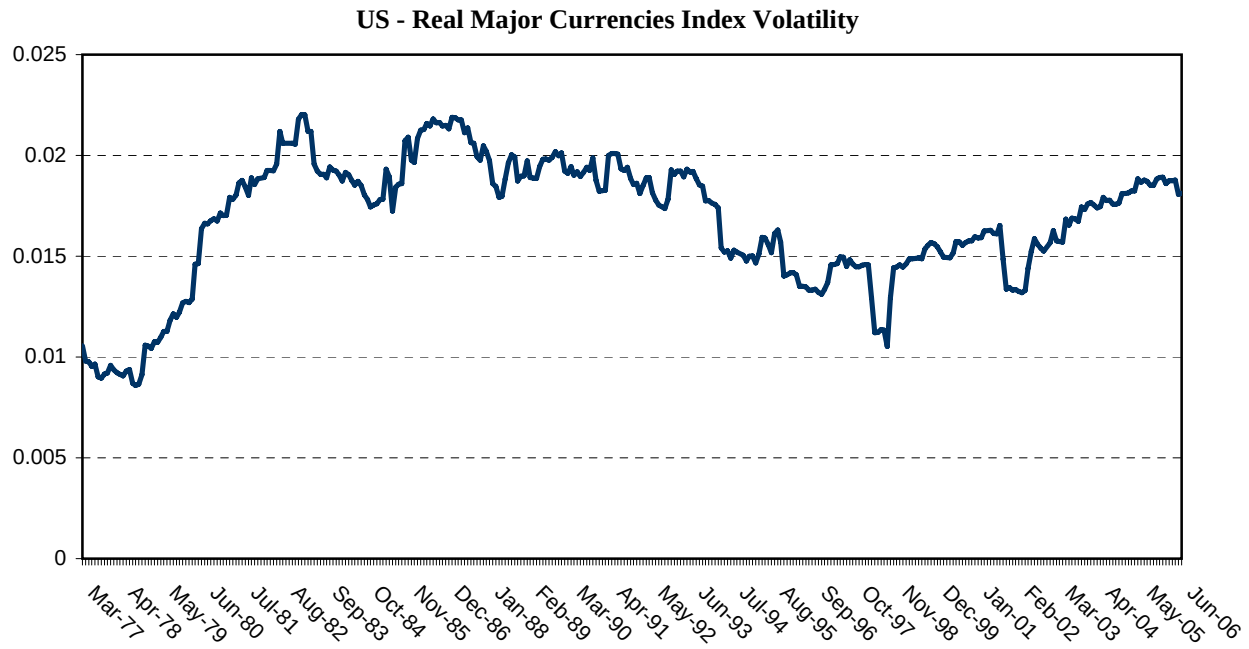




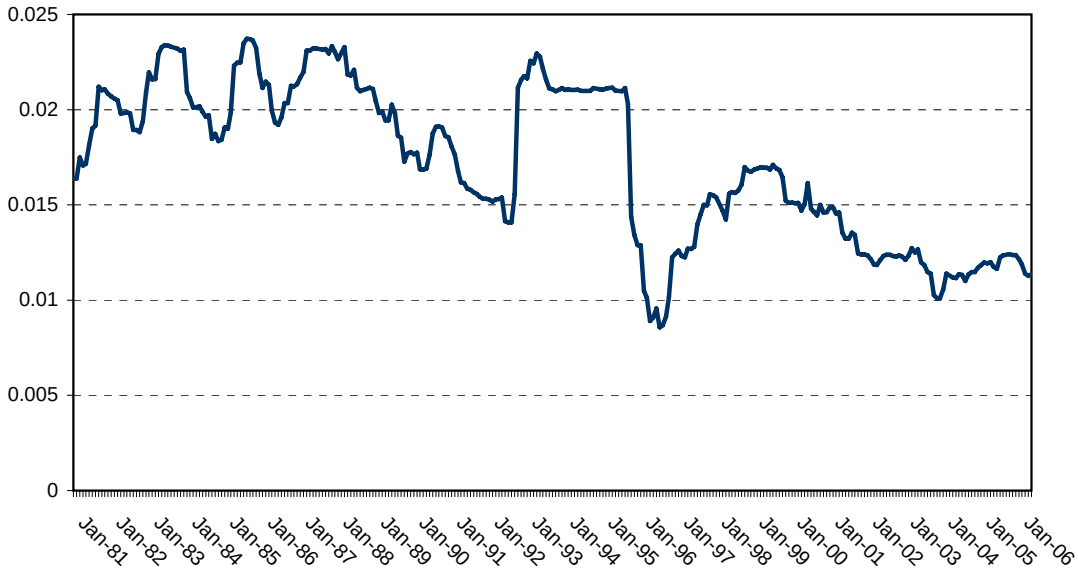
Note: Volatility is measured as the st. dev. of the error terms estimated from an AR process using the deviation of the log real exchange rate from its HP-filtered trend. Mean volatility is the average st. dev. of the error terms before and after the break(s), which is(are) estimated using Bai-Perron's Gauss program. The test for structural breaks in mean volatility indicates no significant breaks for EUR/USD and JPY/USD.
Source of data: IMF-IFS; monthly data

Figure 10. Real Trade-Weighted Exchange Rate Volatility

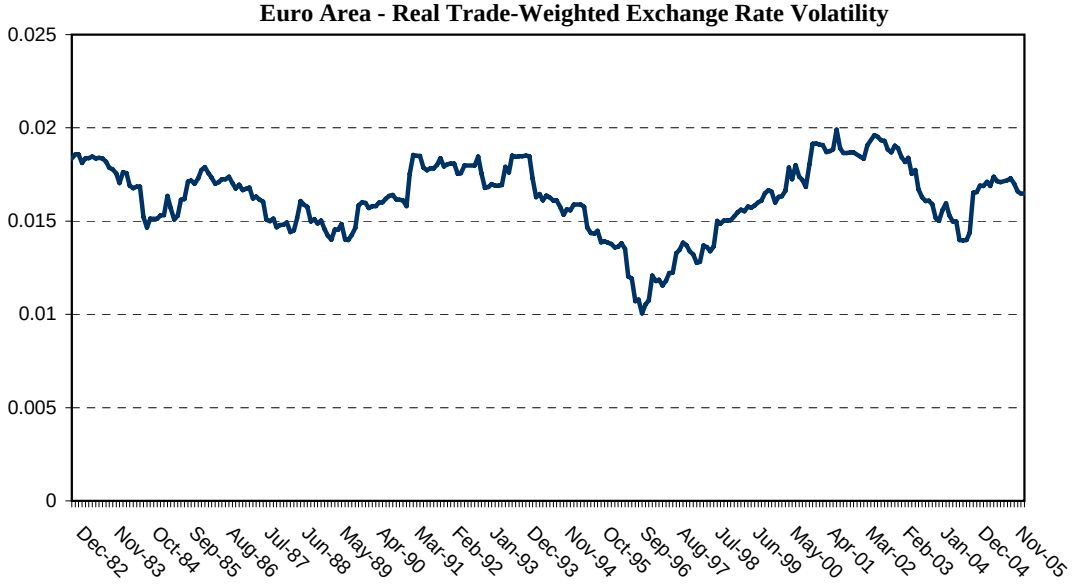




UK - Real Trade-Weighted Exchange Rate Volatility



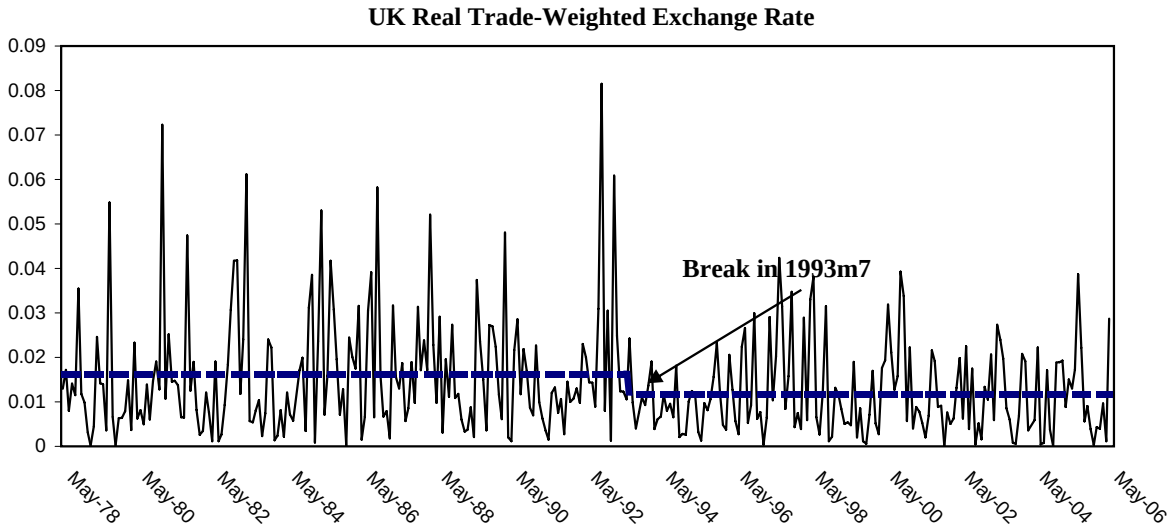
Euro Area - Real Trade-Weighted Exchange Rate Volatility

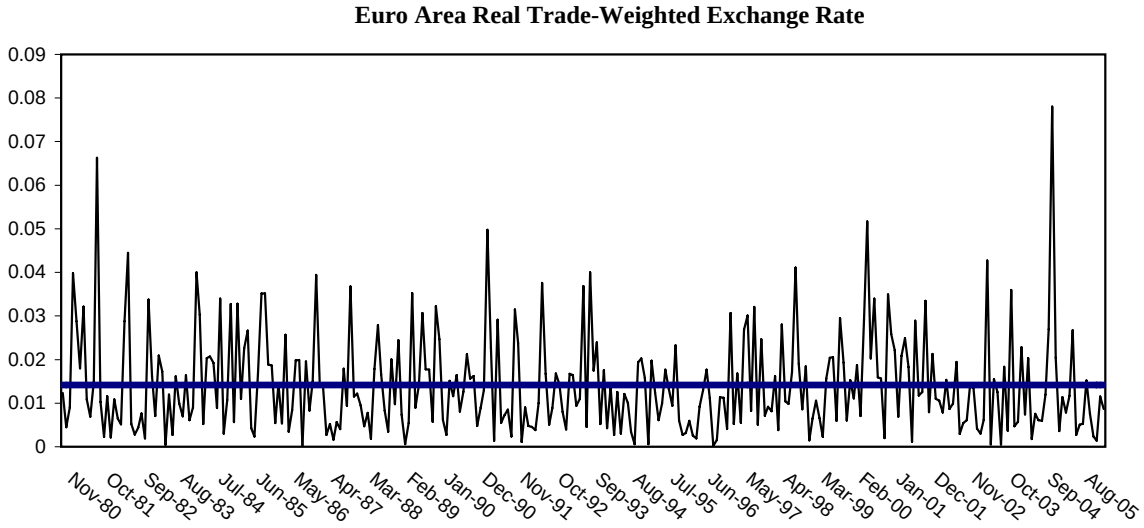


Note: Volatility is measured as the 36-month rolling st. dev. of the month to month log change of the REER.

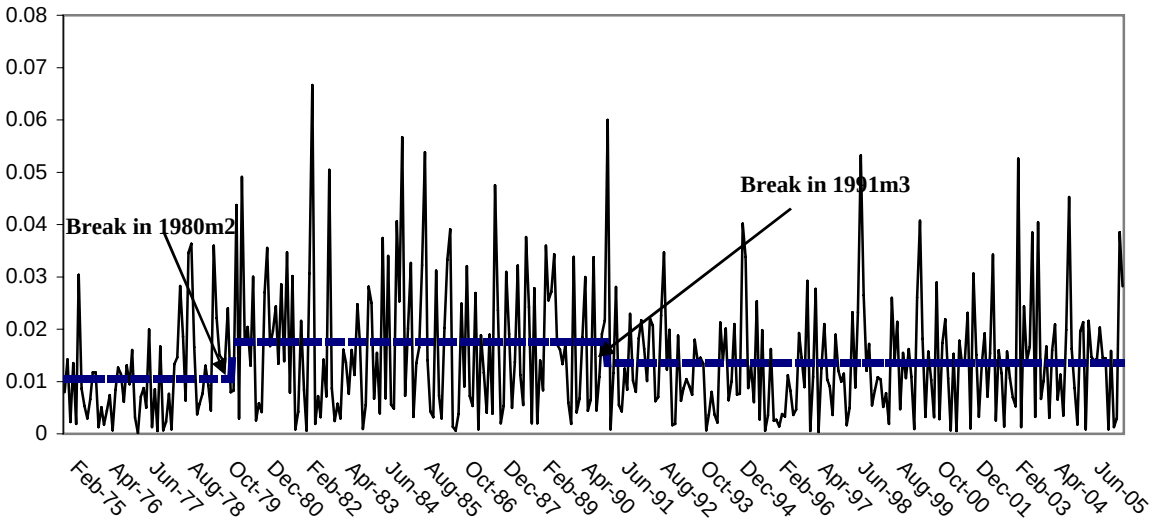
Source of data: The Bank of Japan (Japanese REER), The Fed (US major currencies index), IMF-IFS(Euro Area REER and UK REER); monthly data

Figure 11. Real Trade-Weighted Exchange Rate Volatility Before and After the Structural Break

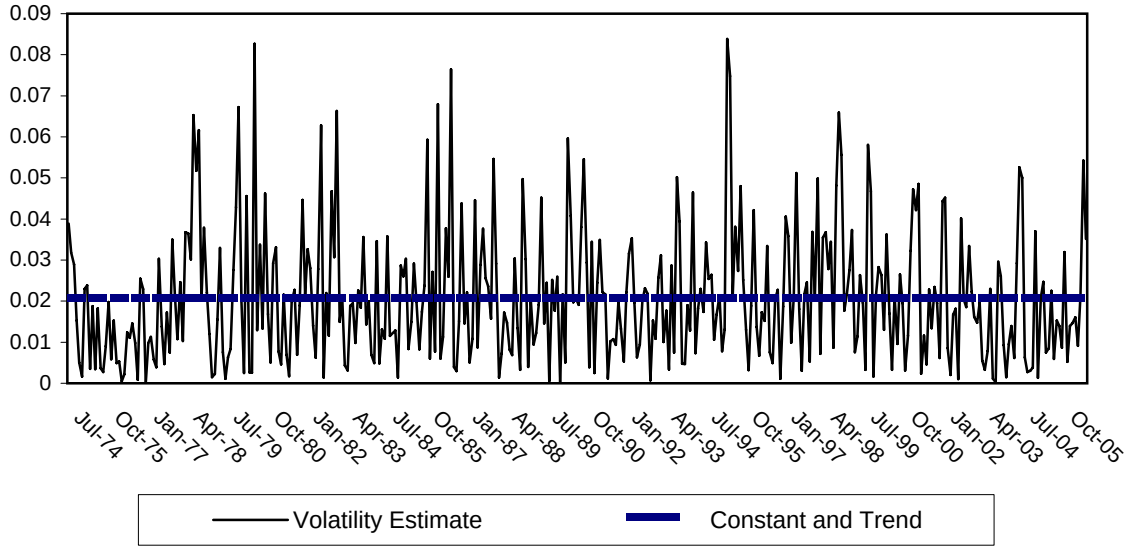




US Real Trade-Weighted Exchange Rate

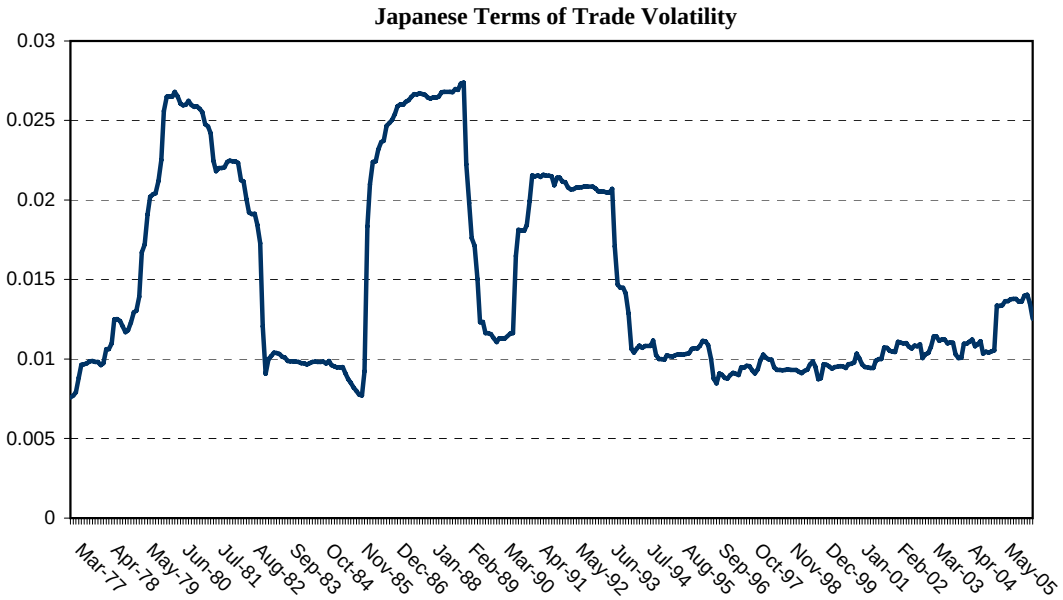


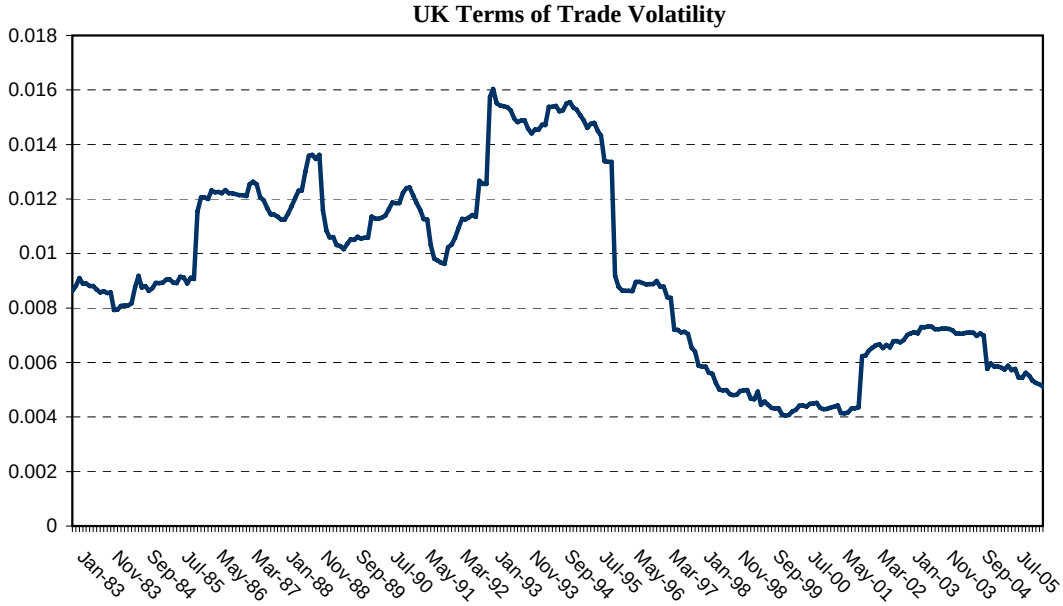
Japan Real Weight-Traded Exchange Rate



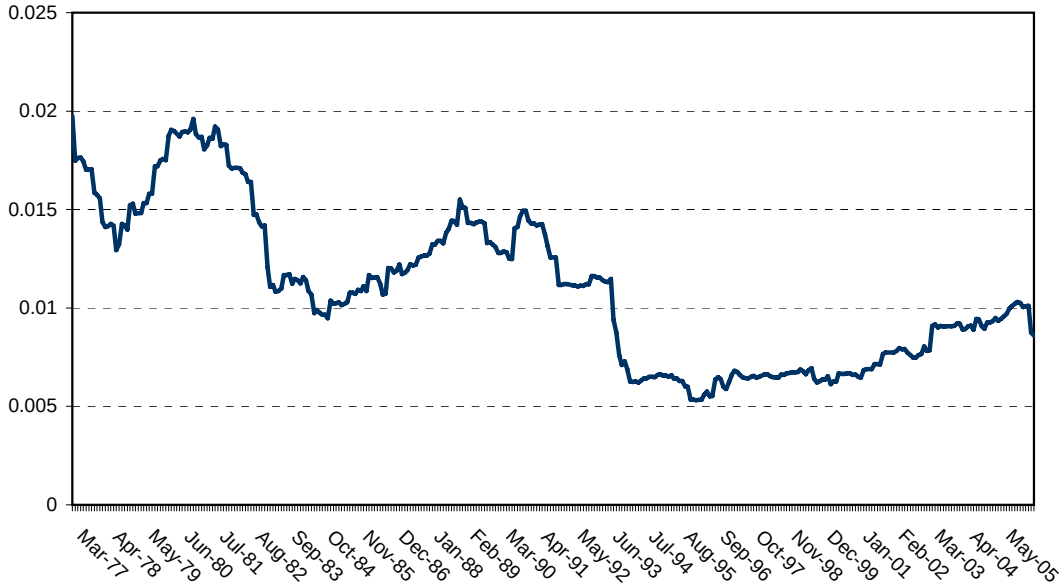
Note: Volatility is measured as the st. dev. of the error terms estimated from AR process using the deviation of the log REER from its HP-filtered ternd. Mean volatility is the average of the st. dev. of the error terms before and after the break(s), which is(are) calculated using Bai-Perron's Gauss program. The test for structural breaks in mean volatility indicates no significant breaks for Japan and the Euro Area.
Source of data: The Bank of Japan (Japanese REER), The Fed (US major currencies index), IMF-IFS(Euro Area REER and UK REER); monthly data

Figure 12. Terms of Trade Volatility





US Terms of Trade Volatility



Note: Volatility is measured as the 36-month rolling st. dev. of the month to month log change of the terms of trade.
Source of data:IMF-IFS; monthly data

Table 1. Volatility Breaks of the US stock market

				Data Range	
Stock Index	**1st Break**	**2nd Break**	**3rd Break**	**From**	**To**
S&P500	1976m1* (1975m8-1978m1)	1988m3* (1987m9-1990m7)		1960m3	2006m7
Dow Jones	1967m5*** (1966m8-1971m6)	1976m1* (1975m8-1977m6)	1990m9* (1989m12-1993m10)	1960m3	2006m7

* significant at 1% ** significant at 2.5% *** significant at 5% **** significant at 10%
The range in brackets represents 90% CI
The statistical method used is similar to the one employed by Cecchetti et. al. (2006), using Bai and Perron (2003)'s Gauss program for the estimation of the structural breaks.

Table 2. Volatility Breaks of Real Exchange Rates and Real Trade-Weighted Exchange Rates (REERs)

			Number of Lags	Data Range	
Exchange Rate	**1st Break**	**2nd Break**		**From**	**To**
Real GBP/USD	1993m7* (1992m11-1998m4)		2	1974m3	2006m4
Real EUR/USD	none		12	1979m7	2006m1
Real JPY/USD	none		13	1974m3	2006m4
UK REER	1993m7*** (1989m1 - 2001m2)		4	1978m1	2006m5
US Real Major Currencies	1980m2* (1977m7 - 1981m5)	1991m3* (1987m9 - 1998m1)	11	1974m3	2006m6
Japanese REER	none		4	1974m03	2006m06
Euro Area REER	none		11	1979m12	2006m03

* significant at 1% ** significant at 2.5% *** significant at 5% **** significant at 10%
The range in brackets represents 90% CI
Source of Data: IMF(IFS) with the exception of US Real Major Currencies (the Fed) and Japanese REER (Bank of Japan)