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Spillovers of Domestic Shocks: Will They Counteract the "Great Moderation"?

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Prepared by Alina Carare and Ashoka Mody[1]

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Abstract

Even prior to the extreme volatility just observed, output growth volatility—following protracted decline—was flattening or mildly rising in some countries. More widespread was an increasing tendency from the mid-1990s for shocks in one country to transmit rapidly to other countries, creating the potential for heightened global volatility. The higher sensitivity to foreign shocks, in turn, appears related to stepped-up vertical specialization associated with the integration of emerging markets in international trade. Increased international spillovers call for stronger *ex post* coordination mechanisms when shocks are large but the best *ex ante* prevention strategy probably is sensible national policies.

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I. INTRODUCTION

The world has just experienced unprecedented levels of volatility. While the gyrations were most evident in financial markets, global production and trade were also severely buffeted. For the first ten months following the start of the crisis (in April 2008), industrial production fell at the same rate as in the Great Depression and global trade fell much faster. Since then there has been some recovery, but as Eichengreen and O'Rourke (2010) note, 20 months into the crisis, industrial production and trade were, respectively, 6 percent and 20 percent below their previous peaks. The economic contraction experienced by some countries could scarcely have been imagined. For example, the German economy, which grew at an average rate of 1½ percent a year in the last two decades (with a standard deviation of 1¼ percent), contracted by 5 percent in 2009, a contraction not experienced in the last 70 years. Forecasters have been repeatedly humbled as new data releases have been associated with sizeable real time revisions of growth projections.

The unusually high volatility since mid-2008 came as a complete surprise. It followed an extended period of declining output volatility—the so-called "Great Moderation"—that had embraced a large number of advanced industrialized nations. Kim and Nelson (1999), McConnell and Perez-Quiros (2000), and Blanchard and Simon (2001) drew early attention to the decline in the variability of U.S. GDP growth. Bernanke (2004, p. 1) then reported on similar declines in the volatility of output and inflation "at about the same time in other major industrial countries, with the recent exception of Japan…" The passage of time has only reinforced the empirical confidence in these trends. Gali and Gambetti (2009) conclude, "… there is widespread consensus among macroeconomists on the existence and rough timing of the Great Moderation."

The sense of the Great Moderation's durability was reinforced by the investigation of its determinants. The possibility that "good luck" (milder "shocks" to the economic system) played a role has generally been discounted, with the moderation increasingly attributed to advances in the design and implementation of monetary policy, better inventory management, and financial innovation (Gali and Gambetti, 2009; and Giannone, Lenza, and Reichlin, 2008). Jaimovich and Siu (2009) have argued that the changing age distribution of the workforce has helped: the labor input of young workers tends to be particularly volatile and the declining share of young workers in the workforce has accounted for one-fifth to one-third of the decline in GDP volatility.

An important feature of studies of the Great Moderation is that, even when considering multiple countries, they have typically dealt with individual country experiences. In contrast, the international dimension of the reduction in volatility received less attention. This is surprising in view of the rapid globalization in recent decades. Does the extended global reach of finance and trade make no difference to global volatility trends? As Cecchetti, Flores-Lagunes, and Krause (2006) discuss, more commercial openness can have opposing effects: greater diversification of risks can reduce volatility, but heightened susceptibility to international shocks can increase volatility. Albeit weak, their evidence is that the more commercially-open a country, the greater its volatility.

Stock and Watson (2005) go one step further. They place the global economy at center stage, defining "common international" shocks as those experienced contemporaneously across countries and "spillovers" as country-specific idiosyncratic shocks that are transmitted to other countries with a lag. Their procedure allows the decomposition of a country's GDP growth volatility into domestic, common international, and spillover components. And they trace the source of the great moderation to a fall in international shocks.

The Stock and Watson (2005) methodology allows for a perspective on volatility that is germane to an increasingly integrated global economy. We unabashedly deploy the basic technique and extensions, making no attempt at a methodological contribution. Our effort, instead, is directed at enlarging the sample of countries and extending the time period of analysis. We expand the sample of countries from the G-7 to 22 OECD economies. Also, our data extends to the end of 2007; however, as discussed below, the requirements of the main analysis imply that the presentation of the findings runs through the end of 2006. These extensions highlight the significant and growing role of international spillovers.

The paper has three main findings. First, the reduction in output volatility apparently ceased in some advanced industrialized countries by the mid-1990s, and a mild tendency towards increased volatility was evident in some countries. Besides Japan (documented by Bernanke, 2004), one large country experiencing an increase in output growth volatility is Germany. Second, and of greater significance for interpreting recent events, the bottoming out of the decline in volatility and its possible reversal was associated with an increased role for spillovers, starting sometime in the mid-1990s. Third, it was not the size of the spillover "shocks" but rather the sensitivity of countries to these shocks that increased over time.

The evidence in this paper is consistent with the idea that improved domestic policies and structural changes drove down the size of domestic shocks and hence aggregate volatility. But potent though these forces were, the increasingly-interconnected nature of the global economy introduced countervailing tendencies. As the global economy became more integrated, shocks from one country were transmitted more rapidly and to more countries. In the long expansion between 2001 and 2007, these linkages reinforced global growth. However, the intensity of the recent crisis was in no small measure due to the speed at which domestic shocks traveled across borders, amplifying the original shocks. Countries most reliant on global financial and trade links were hardest hit.

Our paper is related to the literature on the comovement of business cycles (Kose, Otrok, and Whiteman, 2005; and Kose, Otrok, and Prasad, 2008). In the cross-section, the higher a country's trade intensity, the higher is the comovement of its cycle with that of other countries; however, an *increase* in global trade and finance intensities has not been accompanied by an *increase* in business cycle comovement. This is not altogether surprising.

As Cecchetti, Flores-Lagunes, and Krause (2006) and Kose, Otrok, and Prasad (2008) note, comovement will not increase if greater integration is primarily associated with increased specialization. Hence, it is the nature of globalization that influences the changes in the degree of comovement. Our analysis suggests that in the early to mid-1990s, the tendency towards greater country alignment through rapid spillovers was associated with a particular form of trade integration, namely, an acceleration of vertical specialization. By linking countries in an international supply chain, such trade creates a tighter relationship between a country's exports and its imports, creating the conditions for swift production spillovers.

The analysis also highlights the role of emerging markets. Most visibly, Mexico, China, and emerging Europe became key nodal points in the global supply chain in the 1990s. Given their bilateral export and import relationships with key advanced industrialized economies, they served to transmit and amplify international shocks. Moreover, most emerging economies have not yet achieved the structural maturity necessary for dampening domestic volatility. Included in countries with continuing high levels of volatility are Ireland and Iceland, both of which have also long been part of the global vertical specialization process. All of these countries thus contribute to the pool of international spillovers through their own national shocks and the transmission of external shocks to which they are subject.[2]

The heightened importance of global linkages starting around the mid-1990s is consistent with results reported by Forbes and Chinn (2004). They find that bilateral trade linkages had low power in explaining the transmission of financial sector shocks through to 1995. But thereafter, such linkages become "substantially more important" (p. 720). Thus, besides their direct impact on output volatility, trade relationships can also have an indirect impact through transmitting financial shocks.

The rest of the paper is organized as follows. In Section II, we present the trends in output volatility, based on the Stock and Watson (2005) approach, but for a larger number of countries and through 2006. Section III then reports the decomposition of a country's volatility into its domestic, common international, and spillover components. In Section IV, we decompose spillovers into the size of country shocks that contribute to global spillovers and the reactions to those shocks. In Section V, we relate the timing of increased spillover shares through the perspective of the vertical specialization and the role played by emerging markets in such specialization. A final section concludes.

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[2] In interpreting the recent crisis, some may argue that emerging economies have played a stabilizing role and past emerging market crises have tended to be regionally contained (Mody and Taylor, 2007). However, the analysis does caution that their higher average volatilities are part of a feedback loop with material implications for global output volatility.

II. Trends in Growth Volatility

The data used are quarterly values of the logarithm of per capita real GDP.[3] Stock and Watson (2005) cover the period 1950:Q1 to 2002:Q4, with several results presented for shorter samples. Their focus is on the G-7 economies. Our data starts in 1960 but, importantly, concludes in the last quarter of 2007, allowing analysis from 1977 through 2006 using the "down-weighting" procedure discussed below. Extending the sample allows us to examine the evolution and sources of volatility beyond the point at which Stock and Watson (2005) conclude their analysis, which is also the point at which most other studies end (recent exceptions include Cesaroni, Maccini, and Malgarini, 2009; and Fogli and Perri, 2009). We add another 15 OECD economies to the sample of countries. Thus the countries for our analysis are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Iceland, Ireland, Italy, Japan, Korea, Mexico, the Netherlands, Norway, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States.[4]

As in Stock and Watson (2005), annualized quarter-on-quarter GDP growth rates are first detrended. For most of the analysis, the Baxter-King (1999) band pass (BP) filter with eight leads and lags and a pass-band of 6-32 quarters has been used. However, they use alternatives suitable for particular analyses, noting that the method of detrending does not influence the findings. The vector Y_t, of stacked detrended growth rates is regressed on its lag, Y_{t-1}.

$$Y_t = A(L)Y_{t-1} + v_t \tag{1}$$

Four lags for own country growth and one lag for other countries' growth are used. Thus, domestic shocks are assumed to have more lasting effects than foreign shocks.

Volatility is measured as the time-varying variance of this model. To compute volatility changes over time, for each date, t, a regression is estimated by weighted least squares using two-sided exponential weighting. The observation at date s receives a weight of $\delta\ |t-s|$, and δ is set to a value 0.97. Thus, observations further away from the point of interest, t, receive an exponentially-lower weight. In our estimates s takes values between 1960:Q1 and 2007:Q4, while t takes values between 1977:Q1 and 2006:Q4. We allow t to run through the end of 2006 because we are interested in recent trends. But the implication is that the weighting is

[3] The database used is the OETSADB, and the variable used is the "Gross domestic product, volume, at market prices." For population, we used population on December 31 in OECDALFS database, which was spliced quarterly to compute the per capita values.

[4] Of the OECD economies, we do not include the so-called transition countries—the Czech Republic, Hungary, Poland, and Slovakia—since consistent data for them is available only from the mid-1990s. Also since increasing the size of the sample made the computation increasingly difficult, we dropped Luxembourg and New Zealand (which are relatively small) and Portugal and Greece (which did not add to the conclusions reached).

not symmetrical: in other words, observations towards the end of our sample have fewer observations ahead of them than the preceding observations. [5]

Figure 1 reports trends in output growth volatility—the time-varying variance of the BP filtered growth in percentages—using the full sample of countries. As a way of presenting key patterns in a digestible manner, the countries are categorized into four groups. Although there are variations within a group, the differences across the groups highlight, in our view, the key interesting patterns in levels and trends of volatility. The volatility of each group is a weighted average, using country purchasing power parity valuation of GDP as weights.[6]

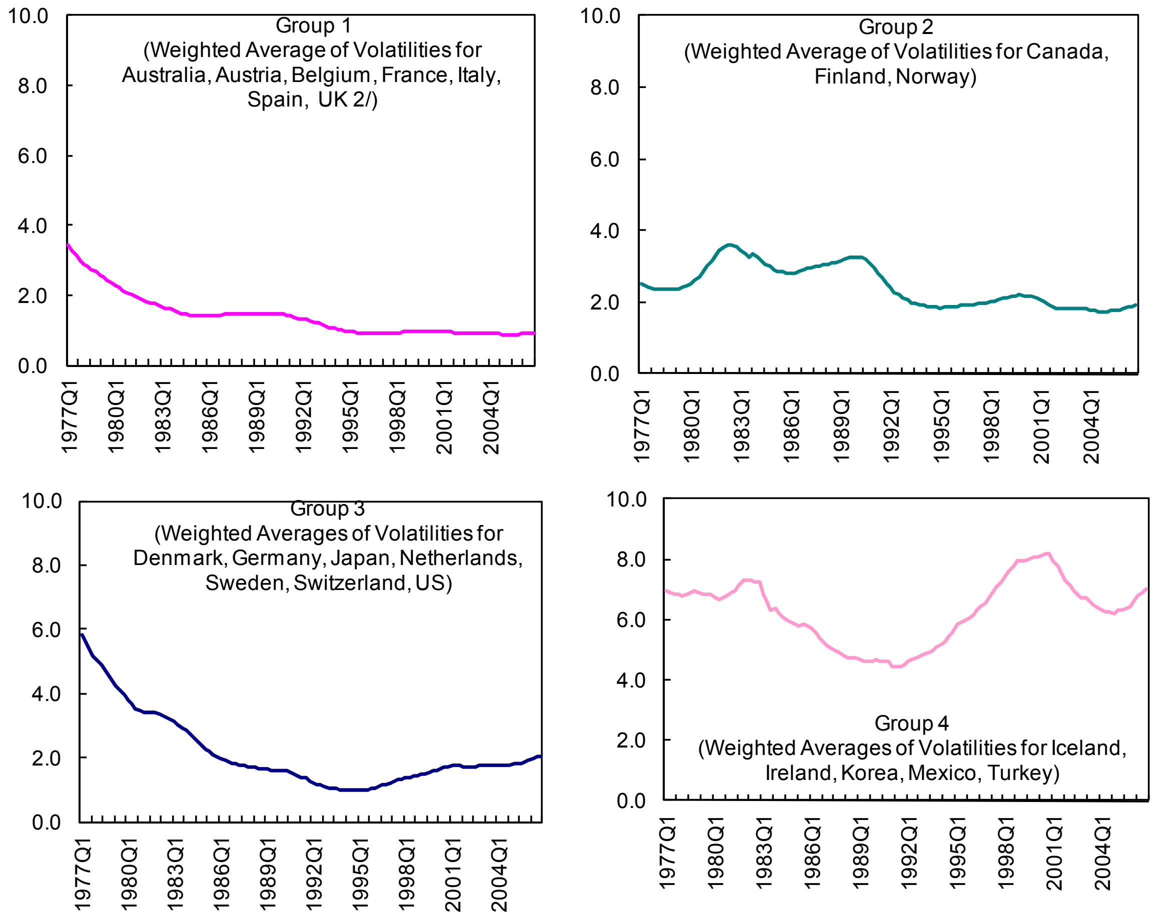
Output growth volatility has declined in a sustained manner since 1977 in Group 1. In this group are Australia, Austria, Belgium, France, Italy, Spain, and the United Kingdom. Group 2, which is less homogenous than the first, includes Canada, Finland and Norway. In Norway, the overall decline in volatility was modest. Finland experienced bouts of high volatility associated with episodes of global and/or regional crises. In Canada, the volatility appears correlated with the business cycle. What holds these countries together is relatively low average level of volatility and some mild tendency for the volatility to decline over time.

The third group starts in the late 1970s with relatively high volatility, which is followed by a substantial decline through to the mid-1990s. Then there is a tendency for volatility to increase. Two important countries—Germany and Japan—belong to this group. The increase in volatility in Japan starting in the mid-1990s has been widely documented. Results for the United States vary with the sample size (the number of countries), less so for Japan, but not for Germany. In other words, the very mild increase in volatility observed in the United States is accentuated when including the emerging market countries in the sample. Other countries in this group include: Denmark, the Netherlands, Sweden, and Switzerland, where there has also been a tendency towards increased volatility. Of course, even following the increase, the level of volatility at the end of the 2006 is substantially lower than it had been in the 1980s before the great moderation started.

[5] We have estimated rolling variances of innovations with several starting and ending dates. As discussed below, our principal findings remain robust to the different time periods. The presentations focus on 1977–2006 because this period includes actual data for all countries, and has enough lags and leads to do all computations.

[6] Given our primary interest in spillovers, discussed in the next section, we do not try to explain the underlying features of the economies that distinguish their volatility trends.

Figure 1: Volatilty of Real Output Growth
(Measured as Time-Varying Estimates of Variances of Filtered Growth 1/)



1/ Time varying variances estimated with a two-factor structural VAR over 1977:Q1 - 2006:Q4, using a two-sided exponential weighting scheme for data 1960:Q1 - 2007:Q4. The observation at time *t* in this graph represents the estimate of the variance from 1977:Q1 - 2006:Q4, with data having a value of 1 for quarter *t*, and each observation preceding it or succeeding it having a weight that decreases exponentially until 1960:Q1, or 2007:Q4, with a discount factor of δ=0.97. Adapted from Stock and Watson (2005).

2/ Weights calculated using GDP PPP per group. Groups divided according to volatility pattern.

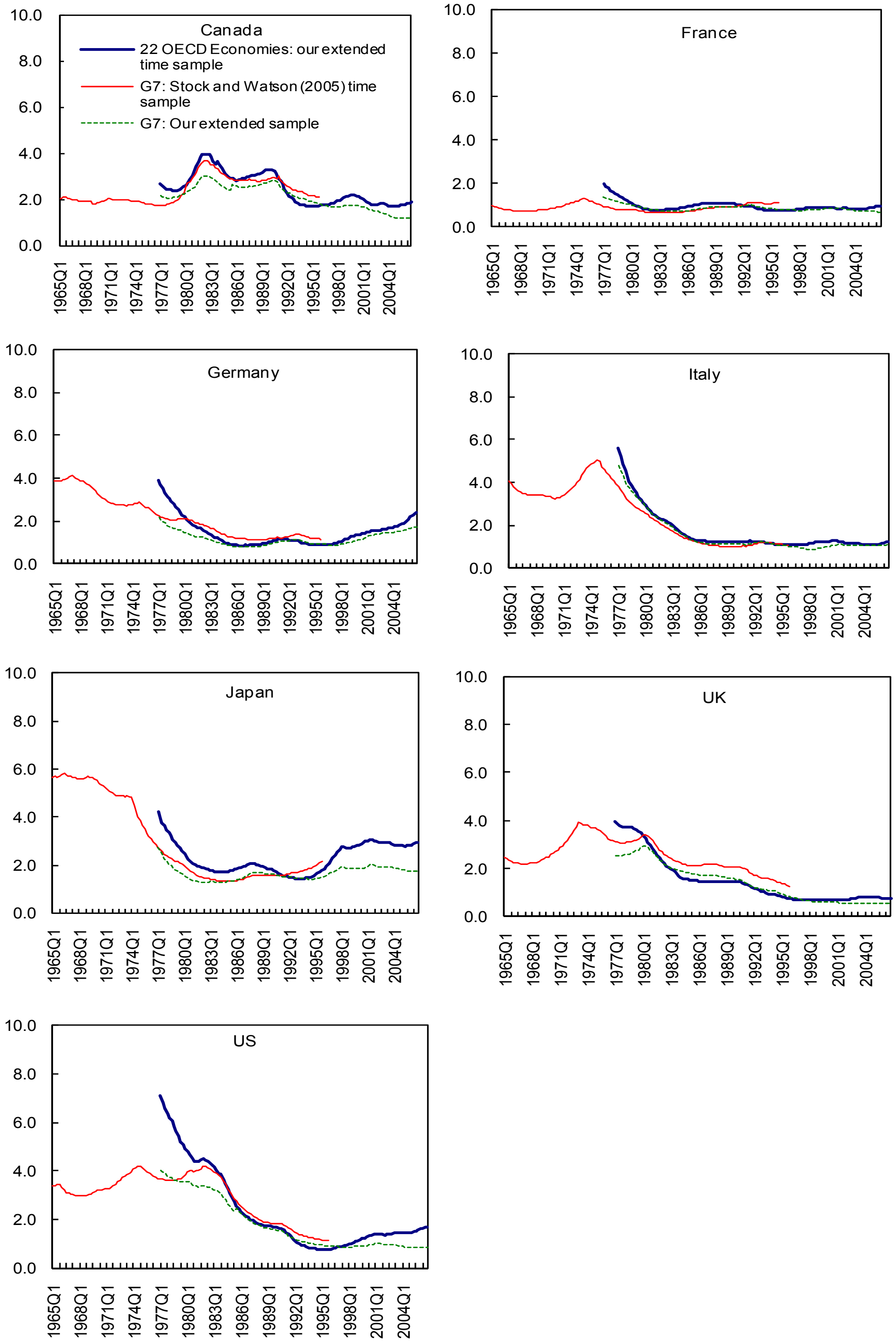
Finally, volatility has remained relatively high, with large swings, in some countries. These include the emerging economies Turkey, Korea, and Mexico. Their volatility rose during periods of international financial crises. Iceland and Ireland also belong in this group given their volatility pattern. It is noteworthy that volatility had increased in Iceland from 2000, well before the trauma of the recent crisis. And, despite its "miracle growth," which graduated Ireland into the ranks of the richest countries in the world in per capita income terms, volatility never really fell in Ireland. In other words, Ireland did not achieve the relatively low volatility that characterizes rich countries. Once again, Ireland's sharp decline in GDP during this latest crisis, which is expected to lead to a cumulative decline in GDP that will likely be larger than in any other advanced economy, is consistent with its volatility in the run up to the crisis.

Do our results depend on the time period of analysis or the sample of countries? In Figure 2, the three lines represent the Stock and Watson (2005) estimates, our estimates when we use only the G-7 sample, and our estimates when all the 22 countries in our sample are included. The basic message is that updating the sample does not change the story for the period covered by Stock and Watson (2005). The evidence of the Great Moderation through to the mid-1990s is clear. The extension in time of the sample suggests that moderation does not persist in all countries, with some countries experiencing a modest increase from around 1995.

The results do show that the introduction of the larger set of economies results in a larger rise in volatility since the mid-1990s in Germany and Japan. By introducing a bigger set of countries in this analysis, we allow for more variation in the sample (cross-section and time series). However, that is not necessarily why output growth volatility is heightened: if that were the case, the measured increase in volatility would be uniform across countries. The two largest countries for which the increase in volatility since the mid-1990s is emphasized are those with an export-driven growth strategy, particularly of durables and investment goods. From the mid-1990s, global trade experienced rapid growth, punctuated by serious, although short-lived, crises. Countries with greater dependence on world trade were more subject to these global influences. The implication of our findings is that the relationships in growth since the mid-1990s embodied in the VAR were not necessarily stable. This is manifested in lower predictability and hence in greater variance.

In sum, after the long period of decline, output growth volatility stabilized and, more intriguingly, showed some modest tendency to increase in some countries. This increase is not definitive and formal tests of breaks give mixed results. However, the fact that, before the recent turmoil of 2008-09, there was a tendency for volatility to increase seems to us notable because it points to forces that were latent but had the potential of more virulent expression. In particular, the greater integration of the global economy over time suggests the possibility that the transmission of country shocks can amplify global volatility. When economic prospects weaken, collective decisions create the possibility of more severe outcomes.

Figure 2. Evolution of Output Growth Volatility in the Main Industrialized Countries: Different Samples 1/



III. SOURCES OF VOLATILITY: THE ROLE OF INTERNATIONAL SPILLOVERS

If the Great Moderation is moderating or even reversing, can we gain further insight into this process by examining the sources of volatility? Stock and Watson (2005) attributed the decline in volatility associated with the Great Moderation, running from the 1960s through the mid-1990s, to the decline in common external shocks. We find that since the mid-1990s, when volatility has tended to stabilize or even increase, external impulses have once again been important, but this time not in the form of common global shocks but as spillovers.

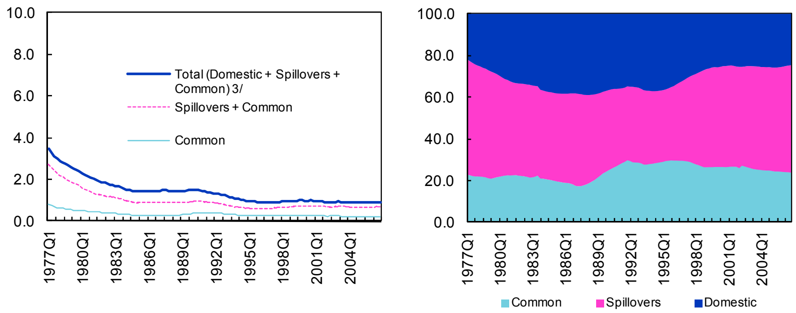
To compute the decomposition of volatility, Stock and Watson (2005) use a reduced-form "factor-structural" VAR (FSVAR). The VAR errors, v_t, from (1) are decomposed into common international shocks and country-specific shocks: $v_t = \Gamma f_t + \xi_t$, where the f_t are the common international factors or shocks, Γ is the 22 x k matrix of factor loadings (22 countries times k factors), and ξ_t are the country-specific or idiosyncratic shocks. The common international shocks and the domestic shocks are assumed to be uncorrelated. $E(f_t f_t^{'}) = diag(\sigma f_1, ..., \sigma f_k)$ and $E\left(\xi_t \xi_t^{'}\right) = diag\left(\sigma_{\xi_1}, ..., \sigma_{\xi_1}\right)$. Stock and Watson (2005) determine that a two-factor model is appropriate. The parameters of the model are estimated Gaussian maximum likelihood, and the variance for each shock is calculated using spectral decomposition.

The FSVAR allows for a decomposition of the variance of the shocks into domestic shocks, common international shocks that affect all countries in the same quarter, and spillovers—defined as country-specific shocks that affect other countries after one quarter. Thus, an event that occurs within the quarter is treated as a common shock whereas if the event affects countries sequentially spaced by at least a quarter, it is identified as a spillover.

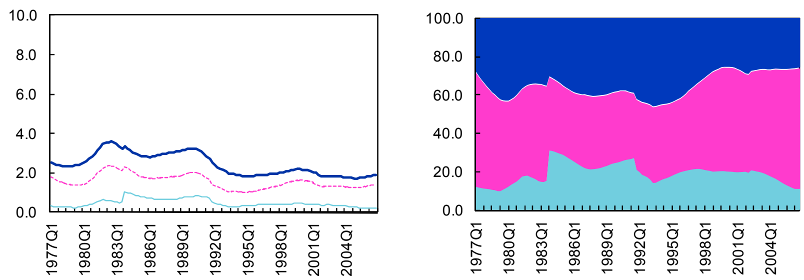
The robust finding of this paper is the increase in the contribution of spillovers to country volatility. This can be seen both in terms of the country groupings introduced in Figure 3 and at the individual country level in Figures A1-A4 in the Appendix. In Figure 3, the continuous bold line in the left-hand panel repeats the aggregate volatility for each group (and, as such, is the same as in Figure 1). The successive lines below report the contributions of the three sources of volatility. The right-hand panel reports the shares of the volatility sources. The share of the spillovers' contribution, which was relatively high in the late 1970s, diminished somewhat in the 1980s (when domestic volatility gained prominence). But spillovers remerged as a salient force in the mid-1990s. Despite the fact that the levels and trends in volatility differ across groups, as discussed, the rise in the contribution of spillovers has played out in a remarkably similar manner across all country groups.

Figure 3: Real GDP Growth Volatility and its Main Sources 1/
Presented by Groups as Levels (Left Panels) and Shares (Right Panels) of Total Volatility

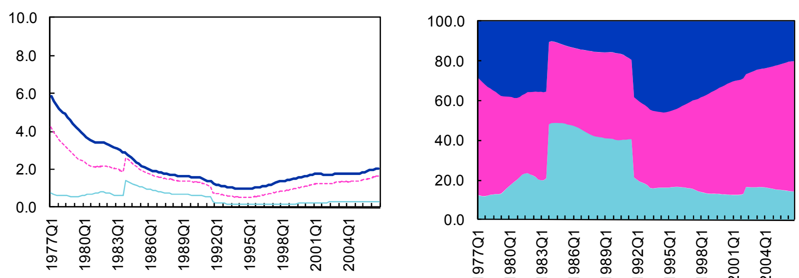
Group 1
(Australia, Austria, Belgium, France, Italy, Spain, UK) 2/



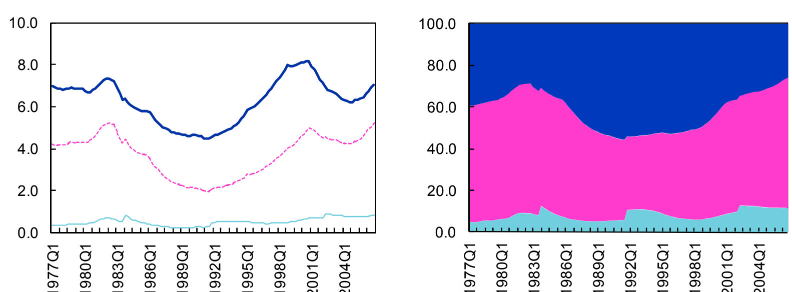
Group 2
(Canada, Finland, Norway)



Group 3
(Denmark, Germany, Japan, Netherlands, Sweden, Switzerland, US)



Group 4
(Iceland, Ireland, Korea, Mexico, Turkey)



1/ Measured as time-varying variance of real GDP filtered growth and its decompostion from a two-factor structural VAR, based on Stock and Watson (2005).
2/ Weights calculated using GDP PPP per group. Groups divided according to volatility pattern.
3/ Left panel shows total (top line) as the total variance, the sum of variances of common, spillovers and own idiosyncratic shocks (domestic). Common shocks are assumed to affect all countries simultaneously, and their variance is represented here as the bottom line. Spillovers are idiosyncratic shocks in one country assumed to affect other countries after one lag. They are represented here as the difference bewteen the middle and the bottom line. Domestic (own) idiosyncratic shocks are represented here as the difference between the top and the middle line.
Right panel shows the shares of common, spillovers and domestic shocks in the total variance.

Consider Group 1, where the volatility came down, and remained low. In the late 1970s, following the first oil shock of 1973 and in the midst of the second shock, international common shocks and, especially, international spillovers were the dominant contributors to the high volatility. Thus, international shocks were passed around like a hot potato. This group's decline in volatility has essentially been a story of moderation of international shocks and their spillovers. Note, though, that although volatility declined over time, spillovers remained an important contributor to volatility. In recent years, spillovers have contributed an increasingly large share (in 2006 about 50 percent) of the volatility.

Similarly, in Group 2, which has not displayed a clear trend of a significant decline in overall volatility, the contribution to volatility has changed: domestic shocks have declined to compensate for the increase in spillovers.

The two groups of countries for which the reemergence of spillovers is most striking are Groups 3 and 4. For Group 3, the increase in volatility is entirely attributable to the increase in spillovers. For Group 4, volatility and spillovers spiked in the late 1990s and early years of this decade, associated with emerging market financial crises. As the after effects of those crisis abated, the spillovers and volatility declined in this country group. But they appear to have resumed a more moderate upward trend recently.

The results presented above are confirmed by a further decomposition of volatility for the periods 1977-1994 and 1995-2007. Here the change in volatility is measured as the change in average standard deviation of the forecast error in these two periods. The split into these particular two periods is based on our observation above that a shift occurred in the mid-1990s, when the contribution of spillovers accompanied an increase in volatility in some countries, and by formally testing for breaks.[7] Of course, the increase from the trough noticeable in a continuous depiction may not be evident in period averages. However, Table 1 confirms the general findings above, especially for Groups 3 and 4. An increase in volatility occurs in the second period: Germany (at the 8-quarter horizon),[8] Iceland (at the 1-, 2-, and 4-quarter horizons), Ireland (all horizons), Japan (at the 2-, 4-, and 8-quarter horizons), Korea (at the 4- and 8-quarter horizons), Switzerland (at the 4- and 8-quarter horizons), and Turkey (at the 2-, 4-, and 8-quarter horizons).

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[7] We have used the same tests as in Stock and Watson (2005). They used 1984 as the break year for all countries, although a formal break in conditional variance occurred only for the United States (both for the break, and the trend and break models). In our case, the results are significant for Belgium, Iceland, Ireland, Germany, and Sweden for the break model around mid-1990s. Canada and Denmark also have a break, but slightly earlier than mid-1990s.

[8] The results do not reflect German reunification of 1990, with the volatility increase beginning in a sustained manner only by the mid-1990s.

Table 1. Variance Decompositions Based on the Two-Factor Structural VAR: Common Shocks, Spillovers and Own-Country Shocks 1/

		1977 - 1994				1995 - 2007			
			Fraction of forecast error variance due to:				Fraction of forecast error variance due to:		
Country	Horizon	Forecast error standard deviation	International	Spillovers	Own shock	Forecast error standard deviation	International	Spillovers	Own shock
Australia	1	3.26	0.02	0.00	0.98	1.59	0.50	0.00	0.50
	2	2.51	0.01	0.09	0.89	1.25	0.48	0.19	0.33
	4	1.99	0.01	0.27	0.72	1.11	0.29	0.47	0.24
	8	1.61	0.02	0.46	0.52	1.19	0.10	0.79	0.12
Austria	1	2.22	0.28	0.00	0.72	0.46	0.01	0.00	0.99
	2	1.84	0.30	0.21	0.49	0.58	0.01	0.15	0.84
	4	1.39	0.32	0.28	0.40	0.62	0.01	0.57	0.42
	8	1.02	0.30	0.32	0.38	0.69	0.04	0.68	0.28
Belgium	1	0.64	0.52	0.00	0.48	1.08	0.07	0.00	0.93
	2	0.75	0.59	0.06	0.36	0.80	0.07	0.26	0.66
	4	0.91	0.58	0.18	0.24	0.86	0.06	0.61	0.33
	8	0.77	0.48	0.37	0.15	0.78	0.14	0.74	0.13
Canada	1	2.25	0.05	0.00	0.95	1.03	0.54	0.00	0.46
	2	2.11	0.07	0.12	0.81	1.09	0.46	0.20	0.35
	4	1.89	0.05	0.28	0.67	1.07	1.40	0.36	0.24
	8	1.76	0.06	0.35	0.58	1.11	0.21	0.68	0.11
Denmark	1	2.40	0.17	0.00	0.83	2.81	0.05	0.00	0.95
	2	1.99	0.18	0.06	0.76	1.92	0.03	0.37	0.60
	4	1.90	0.18	0.10	0.71	1.56	0.04	0.55	0.41
	8	1.39	0.16	0.21	0.63	1.22	0.10	0.61	0.30
Finland	1	3.95	0.04	0.00	0.96	1.33	0.28	0.00	0.72
	2	2.93	0.04	0.20	0.46	1.09	0.26	0.29	0.45
	4	2.61	0.04	0.22	0.74	1.13	0.24	0.48	0.28
	8	2.52	0.03	0.38	0.59	1.47	0.15	0.67	0.17
France	1	1.24	0.53	0.00	0.47	0.97	0.30	0.00	0.70
	2	1.03	0.42	0.20	0.38	0.72	0.25	0.18	0.56
	4	0.97	0.38	0.34	0.28	0.66	0.13	0.53	0.34
	8	0.80	0.30	0.53	0.18	0.71	0.08	0.72	0.20
Germany	1	2.79	0.34	0.00	0.66	1.29	0.02	0.00	0.98
	2	2.09	0.32	0.25	0.43	1.23	0.04	0.39	0.57
	4	1.51	0.34	0.36	0.29	1.35	0.02	0.71	0.26
	8	1.22	0.35	0.41	0.24	1.43	0.02	0.81	0.17
Iceland	1	1.03	0.00	0.00	1.00	6.34	0.30	0.00	0.70
	2	1.45	0.00	0.03	0.96	4.26	0.17	0.42	0.41
	4	1.95	0.01	0.14	0.85	2.75	0.13	0.54	0.33
	8	2.23	0.02	0.35	0.63	2.00	0.10	0.66	0.25
Ireland	1	0.86	0.15	0.00	0.85	4.68	0.06	0.00	0.94
	2	1.18	0.15	0.04	0.81	3.17	0.03	0.24	0.72
	4	1.61	0.16	0.13	0.71	2.62	0.02	0.47	0.51
	8	1.56	0.15	0.26	0.59	2.53	0.01	0.71	0.28
Italy	1	1.87	0.11	0.00	0.89	1.17	0.03	0.00	0.97
	2	1.61	0.15	0.09	0.76	1.04	0.05	0.37	0.59
	4	1.31	0.21	0.22	0.56	0.92	0.02	0.65	0.33
	8	1.07	0.18	0.39	0.43	0.84	0.09	0.78	0.13
Japan	1	2.25	0.02	0.00	0.97	1.59	0.13	0.00	0.87
	2	1.60	0.03	0.25	0.73	2.08	0.14	0.46	0.39
	4	1.36	0.05	0.34	0.60	2.27	0.16	0.62	0.22
	8	1.37	0.08	0.47	0.45	2.48	0.20	0.63	0.17
Korea	1	3.88	0.09	0.00	0.91	2.54	0.37	0.00	0.63
	2	3.05	0.06	0.16	0.78	2.52	0.33	0.29	0.37
	4	2.41	0.07	0.28	0.65	2.72	0.34	0.41	0.25
	8	1.98	0.06	0.40	0.54	2.52	0.38	0.43	0.18
Mexico	1	3.22	0.11	0.00	0.89	2.83	0.18	0.00	0.82
	2	2.52	0.08	0.19	0.72	2.45	0.14	0.33	0.53
	4	2.34	0.11	0.33	0.56	2.14	0.09	0.61	0.30
	8	2.18	0.11	0.50	0.38	1.88	0.06	0.80	0.14

Netherlands	1	3.72	0.40	0.00	0.60	1.21	0.08	0.00	0.92
	2	2.64	0.38	0.18	0.43	1.09	0.03	0.20	0.77
	4	1.98	0.35	0.31	0.34	1.07	0.02	0.43	0.55
	8	1.51	0.31	0.40	0.28	1.35	0.02	0.52	0.46
Norway	1	4.04	0.22	0.00	0.78	2.06	0.54	0.00	0.46
	2	2.64	0.21	0.19	0.60	2.19	0.23	0.66	0.10
	4	1.92	0.19	0.24	0.57	1.49	0.26	0.64	0.10
	8	1.57	0.15	0.32	0.52	1.07	0.17	0.74	0.09
Spain	1	2.65	0.36	0.00	0.64	0.74	0.14	0.00	0.86
	2	1.87	0.35	0.11	0.54	0.65	0.11	0.20	0.70
	4	1.76	0.35	0.12	0.53	0.67	0.06	0.47	0.47
	8	1.63	0.32	0.18	0.50	0.83	0.04	0.69	0.27
Sweden	1	3.50	0.02	0.00	0.98	0.94	0.13	0.00	0.87
	2	2.64	0.08	0.19	0.73	0.97	0.20	0.25	0.54
	4	2.02	0.12	0.33	0.55	1.10	0.26	0.33	0.41
	8	1.81	0.08	0.57	0.35	1.07	0.27	0.52	0.21
Switzerland	1	1.74	0.35	0.00	0.65	1.38	0.20	0.00	0.80
	2	1.49	0.26	0.19	0.55	1.47	0.15	0.35	0.49
	4	1.40	0.24	0.34	0.42	1.57	0.07	0.62	0.31
	8	1.26	0.18	0.48	0.34	1.33	0.03	0.75	0.22
Turkey	1	5.80	0.06	0.00	0.94	4.71	0.24	0.00	0.76
	2	4.46	0.03	0.18	0.79	5.07	0.23	0.44	0.33
	4	3.42	0.04	0.27	0.69	5.03	0.18	0.67	0.14
	8	2.33	0.07	0.33	0.60	4.36	0.18	0.76	0.05
UK	1	2.44	0.09	0.00	0.91	0.72	0.26	0.00	0.74
	2	1.88	0.08	0.31	0.61	0.66	0.20	0.18	0.62
	4	1.58	0.11	0.37	0.52	0.68	0.14	0.42	0.44
	8	1.39	0.12	0.43	0.46	0.72	0.08	0.68	0.24
US	1	2.86	0.20	0.00	0.80	1.11	0.19	0.00	0.81
	2	2.34	0.17	0.11	0.72	1.05	0.24	0.36	0.41
	4	1.93	0.17	0.25	0.58	0.99	0.16	0.58	0.27
	8	1.52	0.19	0.34	0.46	1.06	0.09	0.76	0.15

1/ This table shows the standard deviation and three-way decomposition of variance of filtered annual GDP growth at quarterly observations. The standard deviations are in percentage points at annual rate ((400/h) times the forecast error, where h is the forecast horizon). These results are based on the two factor structural VAR model using the detreneded growth.

Moreover, echoing the results presented earlier in this section, the share of spillovers increased in all countries—and typically at all horizons (as noted above, at the 1-quarter horizon, spillovers are by assumption zero). With that increase, in the post-1995 period, at the 4- and 8-quarter horizons, the share of spillovers ranged between half and three-quarters, thus forming the dominant source of volatility. The decline in the share of other sources of volatility occurred differently for different countries, with international shocks contributing less in some and domestic shocks contributing less in others.

The comparisons *over time* discussed above maintain the same country sample size. But before moving on, it is worth noting that a larger sample of countries tends to give larger shares of spillovers at any given point in time. It is appropriate, in our view, to work with the larger sample since it captures the substantive idea that the economic boundaries of the world are bigger and the world is more interconnected than a focus on the G-7 implies. With increased linkages, domestic shocks tend to have a smaller impact at home and a bigger impact on other countries. The bigger the world, the more complex the interactions, implying that shocks are not necessarily transmitted all at once. They might also be transmitted via other countries.

IV. More Spillovers or a Faster Response to Foreign Impulses?

If the share of spillovers has increased, the final question is: was there an increase in country-specific shocks that contributed to the spillovers or did the sensitivity to foreign shocks increase?

We proceed as follows. Let V_p denote the variance of the four-quarter ahead forecast errors in a given country, calculated using the VAR, in a period *p* where *p*=1 or 2 corresponding to 1977-1994 or 1995-2007. The variance decomposition attributes a portion of V_p to each of the 24 shocks in the model (the international shock, the domestic shock, and the 22 sources of spillover shocks). We can write $V_p = V_{p,1} + \ldots + V_{p,j} + \ldots V_{p,24}$, where $V_{p,j}$, the variance in period *p* attributed to shock *j*. Thus the change in the variance between the two periods is $V_2 - V_1 = \left(V_{2,1} - V_{1,1}\right) + \ldots + \left(V_{2,j} - V_{1,j}\right) + \left(V_{2,24} - V_{1,24}\right)$.

As Stock and Watson (2005) note, in an identified structural VAR, the variance component $V_{p,j}$ can be rewritten as $a_{pj}\sigma_{pj}^2$, where a_{pj} is a term depending on the squared cumulative impulse response to shock *j* in period *p* and σ_{pj}^2 is the variance of shock *j* in period *p*. Thus, the change in contribution of the *j*th shocks can be decomposed as:

$$V_{2j} - V_{1j} = \left(\frac{a_{1j} + a_{2j}}{2}\right)\left(\sigma_{2j}^2 - \sigma_{1j}^2\right) + \left(\frac{\sigma_{1j}^2 + \sigma_{2j}^2}{2}\right)\left(a_{2j} - a_{1j}\right)$$

That is, the change in the variance can be decomposed into the contribution from the change in the shock variance plus the contribution from the change in the impulse response. To ensure an identified VAR, we assume, as in Stock and Watson (2005), that the factor loadings are uncorrelated and that the second factor has no impact effect on the United States. This, in turn, yields plausible factors.

The results in Table 2 suggest the following principal findings. Virtually everywhere, the shock variance itself declined over time (20 out of 22 countries). The decline in this shock variance reflected also a decline in spillover shocks. In contrast, the response to shocks increased virtually everywhere (15 out of 22 countries). The response to spillover shocks increased more broadly (17 out of 22 countries). And where the aggregate response coefficient increased, the main contributor to that increased response typically was the response to spillover shocks. Thus, for example, in Germany and Japan, the aggregate change in the response coefficient would have been negative if not for the coefficient on spillovers.[9]

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[9] Thus, while Forbes and Chinn (2004) document spillovers in financial markets from major industrialized to emerging markets, our results could imply that the industrialized countries were also the recipients of spillovers.

Table 2: Then and Now - Were the Shocks Larger or the Transmission Different?

Decomposition of Changes in the Variance of Four-quarter-ahead FSVAR Forecast Errors into Changing Impulses and Changing Propagation

	Variances			Contribution of change in shock variance				Contribution of change in impulse response function			
	1977-1994	1995-2007	Change	Total	International	Spillovers	Own	Total	International	Spillovers	Own
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9	Column 10	Column 11
Australia	3.96	1.24	-2.72	-3.99	0.06	-1.74	-2.31	1.27	0.26	1.25	-0.24
	(0.76)	(0.22)	(0.79)	(0.92)	(0.16)	(0.78)	(0.48)	(1.01)	(0.32)	(0.90)	(0.35)
Austria	1.92	0.39	-1.54	-2.18	-0.06	-0.5	-1.62	0.65	-0.54	0.18	1.01
	(0.39)	(0.06)	(0.40)	(0.60)	(0.11)	(0.45)	(0.37)	(0.67)	(0.24)	(0.50)	(0.31)
Belgium	0.82	0.73	-0.09	-0.54	-0.02	-1.07	0.55	0.45	-0.41	1.37	-0.51
	(0.16)	(0.11)	(0.19)	(0.37)	(0.10)	(0.33)	(0.12)	(0.44)	(0.18)	(0.38)	(0.10)
Canada	3.56	1.14	-2.43	-3.75	-0.01	-1.44	-2.29	1.32	0.27	0.87	0.18
	(0.68)	(0.21)	(0.72)	(0.85)	(0.19)	(0.65)	(0.48)	(0.95)	(0.38)	(0.74)	(0.38)
Denmark	3.59	2.43	-1.16	-1.43	0.10	-2.45	0.91	0.27	-0.67	3.41	-2.47
	(0.71)	(0.41)	(0.82)	(1.38)	(0.24)	(1.29)	(0.45)	(1.69)	(0.50)	(1.49)	(0.46)
Finland	6.83	1.27	-5.56	-3.98	-0.01	0.25	-4.23	-1.58	0.00	-1.15	-0.43
	(1.25)	(0.20)	(1.27)	(1.81)	(0.21)	(1.58)	(0.80)	(1.88)	(0.50)	(1.72)	(0.53)
France	0.94	0.44	-0.51	-0.39	0.00	-0.37	-0.02	-0.12	-0.30	0.28	-0.10
	(0.17)	(0.07)	(0.19)	(0.31)	(0.08)	(0.29)	(0.07)	(0.36)	(0.16)	(0.32)	(0.05)
Germany	2.29	1.83	-0.46	-3.05	-0.05	-2.25	-0.75	2.58	-0.70	2.72	0.57
	(0.44)	(0.30)	(0.54)	(1.19)	(0.21)	(1.14)	(0.24)	(1.43)	(0.38)	(1.30)	(0.20)
Iceland	3.80	7.59	3.79	32.92	0.08	-9.15	41.99	-29.13	0.90	12.73	-42.75
	(0.67)	(1.23)	(1.40)	(9.36)	(0.46)	(3.84)	(8.47)	(9.67)	(0.80)	(4.52)	(8.24)
Ireland	2.58	6.85	4.27	22.61	-0.01	-8.37	30.99	-18.34	-0.27	11.23	-29.30
	(0.46)	(1.21)	(1.28)	(6.23)	(0.40)	(3.25)	(5.32)	(6.41)	(0.78)	(3.80)	(4.99)
Italy	1.71	0.85	-0.86	-1.53	-0.04	-1.02	-0.47	0.67	-0.31	1.19	-0.21
	(0.33)	(0.14)	(0.36)	(0.64)	(0.11)	(0.61)	(0.15)	(0.76)	(0.22)	(0.69)	(0.13)
Japan	1.84	5.14	3.29	-5.51	13	-4.64	-1.00	8.80	0.58	7.19	1.03
	(0.30)	(0.93)	(0.98)	(2.69)	(0.47)	(2.58)	(0.33)	(3.32)	(0.88)	(3.05)	(0.33)
Korea	5.80	7.40	1.60	-9.88	0.30	-6.67	-3.50	11.47	1.79	8.13	1.55
	(1.14)	(1.40)	(1.81)	(3.26)	(0.79)	(2.87)	(0.94)	(4.17)	(1.55)	(3.37)	(0.82)
Mexico	5.49	4.58	-0.91	-4.51	-0.08	-3.72	-0.71	3.60	-0.08	4.69	-1.01
	(0.94)	(0.78)	(1.23)	(3.65)	(0.38)	(3.58)	(0.48)	(4.15)	(0.77)	(3.99)	(0.41)

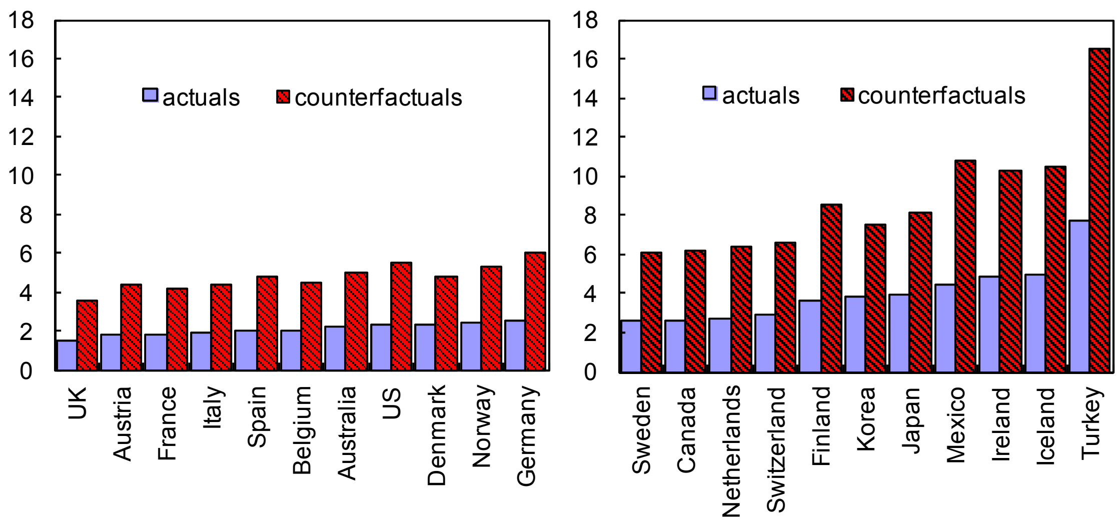
Netherlands	3.91	1.14	-2.77	-3.36	-0.15	-1.05	-2.16	0.59	-1.21	0.33	1.47
	(0.75)	(0.20)	(0.78)	(0.99)	(0.25)	(0.76)	(0.61)	(1.20)	(0.47)	(0.90)	(0.52)
Norway	3.70	2.21	-1.49	-4.13	-0.07	-2.55	-1.51	2.64	-0.05	3.07	-0.38
	(0.71)	(0.36)	(0.80)	(1.43)	(0.27)	(1.35)	(0.33)	(1.66)	(0.49)	(1.54)	(0.20)
Spain	3.11	0.45	-2.66	-1.34	0.15	0.16	-1.64	-1.32	-1.22	-0.31	0.21
	(0.61)	(0.07)	(0.61)	(0.80)	(0.21)	(0.64)	(0.45)	(0.90)	(0.48)	(0.71)	(0.24)
Sweden	4.09	1.20	-2.89	-2.18	0.04	2.47	-4.68	-0.71	-0.20	-3.44	2.93
	(0.73)	(0.21)	(0.76)	(1.84)	(0.20)	(1.55)	(0.91)	(1.86)	(0.43)	(1.66)	(0.76)
Switzerland	1.97	2.45	0.48	-3.48	-0.03	-3.25	-0.21	3.97	-0.28	4.10	0.14
	(0.36)	(0.42)	(0.55)	(1.31)	(0.23)	(1.27)	(0.23)	(1.57)	(0.46)	(1.46)	(0.18)
Turkey	11.72	25.34	13.62	-39.84	-0.27	-36.06	-3.51	53.46	4.51	49.89	-0.94
	(2.26)	(4.48)	(5.06)	(13.09)	(1.94)	(12.79)	(1.40)	(16.13)	(3.78)	(15.17)	(1.31)
UK	2.50	0.46	-2.05	-2.56	0.06	-0.67	-1.95	0.51	-0.26	-0.07	0.85
	(0.44)	(0.08)	(0.45)	(0.55)	(0.10)	(0.35)	(0.42)	(0.59)	(0.24)	(0.40)	(0.34)
US	3.72	0.99	-2.73	-1.71	0.19	-0.26	-1.64	-1.02	-0.67	-0.09	-0.25
	(0.74)	(0.16)	(0.76)	(1.09)	(0.24)	(0.98)	(0.40)	(1.30)	(0.49)	(1.13)	(0.26)

The first three columns give variance of BP-filtered GDP (in percentage points) by subsamples, using the estimated FSVAR (identified as described in section II and following Stock and Watson (2005)). The remaining cloumns decompose this difference into changes in the variance of the shocks, and changes in the impluse response function. The sum of the international, "spillovers" and "own" column equals the "total" column. In parantheses we report estimated standard errors.

(2) - (1) =(3)
(3) = (4) + (8)
(4) = (5) + (6) +(7)
(8) = (9) + (10) + (11)

To provide a quantitative sense of these changes, we ask the following questions: what would volatility in the second period have been if the shocks were of the same size as in the first period but the response was as in the second period. In other words, we use the transmission mechanism of the second period and the shocks from the earlier part of the sample to calculate the counterfactual. The calculations are based on the standard deviation of annual GDP filtered growth computed using the two-factor structural VAR. The counterfactual in Figure 4 shows that volatility would have been substantially higher in all countries. Given our discussion above, absent the change in the spillover response, the counterfactual volatility in the second period would have increased less and actually declined in some countries.

Figure 4. Actual and Counterfactual Volatility for 1995 - 2007
(Standard Deviation of Annual Growth 1/)



1/ At quarterly level, computed using a two factor structural VAR. Actual volatility refers to the standard deviation of annual growth of filtered growth computed using estimated parameters for 1995 - 2007, and variances of shocks (common and own) for period 1995 - 2007. Counterfactual volatility refers to the standard deviation computed using estimated parameters for 1995 - 2007, but the variances of shocks for 1977 - 1994.

V. Interpreting the Results

What accounts for the increased role of spillovers and their speed? In this section we offer a tentative explanation. Though the nature of globalization in recent decades has been multifaceted, encompassing trade and finance, one particular development seems to fit the timing of increased spillover shares as well the speed of spillovers. The rise in global trade intensity has been increasingly characterized by vertical specialization, with a central role for emerging markets. Vertical specialization occurs when countries engage primarily in a particular stage of a product’s processing. Thus the material for a garment may be cut in the United States, the cut pieces may be sewed in Jamaica, and the final packaging done in

Europe for customers on that continent. More elaborate vertical specialization may occur in the assembly of electronics products and automobiles.

Vertical specialization increases the trade content of production while increasing global interconnectedness (Yi, 2003). Because of the interconnections, Yi (2003) argues that vertical specialization responds non-linearly to lower tariffs and other reductions in trade costs and, as such, can account for a substantial fraction of the increase in the trade share of global production. The non-linearities inherent in vertical specialization imply that it is a natural mechanism of sizeable and speedy spillovers.

Few studies document the rise in vertical specialization over the time span of interest to us. Breda, Cappareillo, and Zizza (2008) estimate vertical specialization—measured as the import content of exports—for several European countries for 1995 and 2000. They reach an important conclusion (p. 10): "Our evidence supports a significant increase between 1995 and 2000 in the vertical specialization of the countries considered, fairly comparable in terms of magnitude with that detected over a 20-year period by Hummels, Ishii, and Yi (2001)." In Europe, the production of transport equipment emerged as the most vertically-specialized sector and Germany as the country most rapidly increasing its vertical specialization.[10] The timing of this sharp rise in vertical specialization documented by Breda, Cappareillo, and Zizza (2008) coincides with the increased share of spillovers in country volatility, as estimated in this paper.

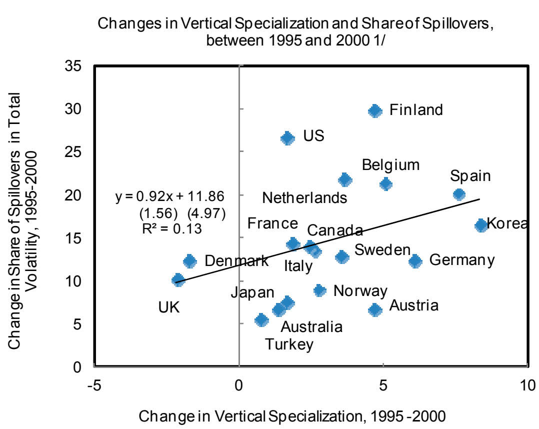
The timing is also consistent with a more prominent role played by emerging economies in the global vertical specialization process. Anticipating the North American Free Trade Agreement (NAFTA), which came into force in 1994, an increasing share of sales of Mexican affiliates was to parent companies in the United States, reaching one-third of all sales by 2000. Noting this development, Burstein, Kurz, and Tesar (2008) also find that the comovement of Mexican and U.S. business cycles increased along with the vertical integration. This period also saw the emergence of China as a global source of manufactured products. Koopman, Wang, and Wei (2008) find that imports accounted for about half of Chinese exports between 1997 and 2006, this high ratio reflecting the importance of "processing" exports.[11] And, at the same time, the formerly-planned economies of Eastern Europe emerged as suppliers within Europe—in Sinn's (2006) language, the "work benches" of Germany moved to Eastern Europe.

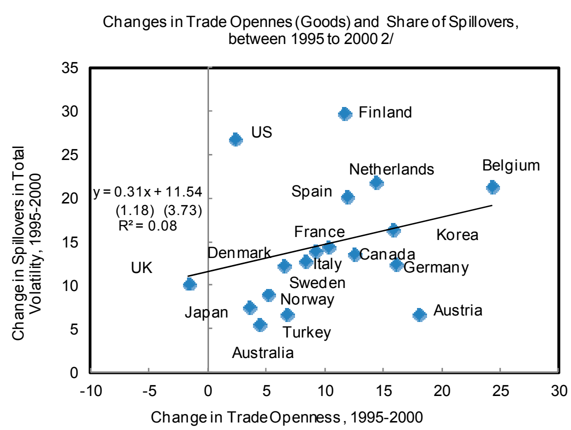
[10] Sinn (2006) also notes Germany's propensity to engage in vertical specialization during the same period: the import share of German exports increased from 27 percent in 1991 to 39 percent in 2002. Sinn, however, regards this trend as an unwelcome development, characterizing Germany as increasingly a "the bazaar economy." Manufacturing goods on their way from Slovakia to America pass, he says, through German statistics.

[11] Absence of comparable data precluded inclusion of China in this analysis.

Thus, the evidence is that there was a general acceleration of vertical specialization in the early- to mid-1990s aided by the greater role of lower-wage emerging economies that formed key links in the global supply chains. With vertically-specialized trade closely tied to production decisions, this timing is consistent with the increased importance of spillovers of shocks to GDP growth. As a further exercise we examined if the increased share of spillovers in an individual country's volatility was also related to its increased vertical specialization. The results are supportive, though by no means conclusive. The left panel of Figure 5 plots the increase in the share of spillovers against the increase in vertical specialization between 1995 and 2000 for all countries for which the OECD reports the vertical specialization measure. There is a positive relationship between vertical specialization and spillovers. It is, however, a suggestive but not a tight relationship, with a *t*-statistic of 1.56. The U.K. and Denmark reduced their vertical specialization and experienced relatively small increase in their share of spillovers; at the other end, Spain and Korea experienced sizeable increases on both dimensions. In contrast, the U.S. and Finland experienced large increases in their spillover share without a correspondingly large increase in vertical specialization. In the right panel of Figure 5, we plot the increase in the share of spillovers against the increase in trade/GDP ratios of the same countries. This line also slopes upwards, which is not surprising since the increase in trade shares and increase in vertical specialization are highly correlated. However, the generally weaker relationship between trade intensity and spillovers (in terms of the *t*-statistic and R-squared) suggests that it is the vertical specialization component of trade intensity that matters for spillovers.

Figure 5. Role of Trade Globalization in the Change of Spillovers





Source: OECD, WEO, and IMF staff calculations.

1/ Sample includes only 18 countries, as data for Vertical Specialization is not available for 1995 for Iceland, Ireland, Mexico, and Switzerland, and for 2000 for Iceland and Mexico. Regression estimated with OLS. *t* statistics of coefficients shown in parentheses.
2/ Trade Openness measured as the sum of exports and imports over the GDP, expressed in nominal terms, U.S. Dollars. To ensure comparability, the left-and right-hand side panels have the same countries.

Finally, while increased vertical specialization and a more prominent role of spillovers occurred during a relatively benign global economic period (punctuated by brief crises), the virulent downturn that started in the spring of 2008 is consistent with the analysis laid out in this section. The precipitous fall in global production was associated with an even more precipitous decline in global trade. While many explanations have been offered for the fall in trade, a plausible explanation has been the importance of vertical specialization, which can unwind in a non-linear manner (Yi, 2009; and Levchenko, Lewis, and Tesar, 2009). As Yi (2009) emphasizes, a feature of vertical specialization is the speed at which it acts.[12] Thus, while vertical specialization acted to support production and trade during the long period of globally-coordinated expansion, the same mechanism acted more malignantly to reinforce the crisis.

VI. Conclusions

While the extreme volatility that the world has recently witnessed could not have been anticipated, it should not have come as a complete surprise. The Great Moderation was a robustly-established trend. The factors identified as underlying the Great Moderation, in turn, were durable. Domestic volatility was declining as a consequence of improved policy management and innovations in the private sector. But these analyses did not factor into the ongoing integration of the global economy. We find that the international transmission of a country's volatility was emerging as a latent source of volatility amplification. In a benign global environment, the international transmission also worked in a relatively benign manner. However, with the convergence of several large shocks—to the financial sectors and to the real economies of several countries—the transmission process added to the rapidity with which the crisis crossed borders and the sense of panic it generated in the past couple of years.

The policy lessons are simple in principle but complex to implement. Imbalances in or shocks experienced by one country have increasingly important implications for other countries. While this observation is widely accepted, our contribution has been to show that the magnitude of the effects underlying global integration is increasing and large. If we are correct in the mechanism identified for the transmission of the shocks—vertical specialization—the vulnerability is likely to persist. Vertical specialization is a benign force for global growth and welfare but can turn rapidly to amplify downturns. Countries responded *ex post* to the urgency of the recent crisis by coordinating (to varying degrees) financial, monetary, and fiscal policies. Looking ahead, all countries have a stake in the policy stance and approaches of other countries. Recent efforts to achieve greater transparency and coordination of policy on a much larger scale than in the past under the auspices of the G-20 and within the European Union augur well in this regard. But ultimately, as Obstfeld and Rogoff (2002) point out, the best *ex ante* coordination is likely to be sensible economic policies followed in a country's self interest. On the outcome of these efforts may depend whether the next crisis threatens another upheaval.

[12] Though financial shocks were likely the original source of the crisis, vertical specialization, in this view, acted to transmit the shocks to the global "real" economy. Financial shocks had direct spillover effects through the global interconnections of banks (Eichengreen et al., 2009).

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APPENDIX

Figure A1. Group 1: GDP Growth Volatility and its Decomposition by Country

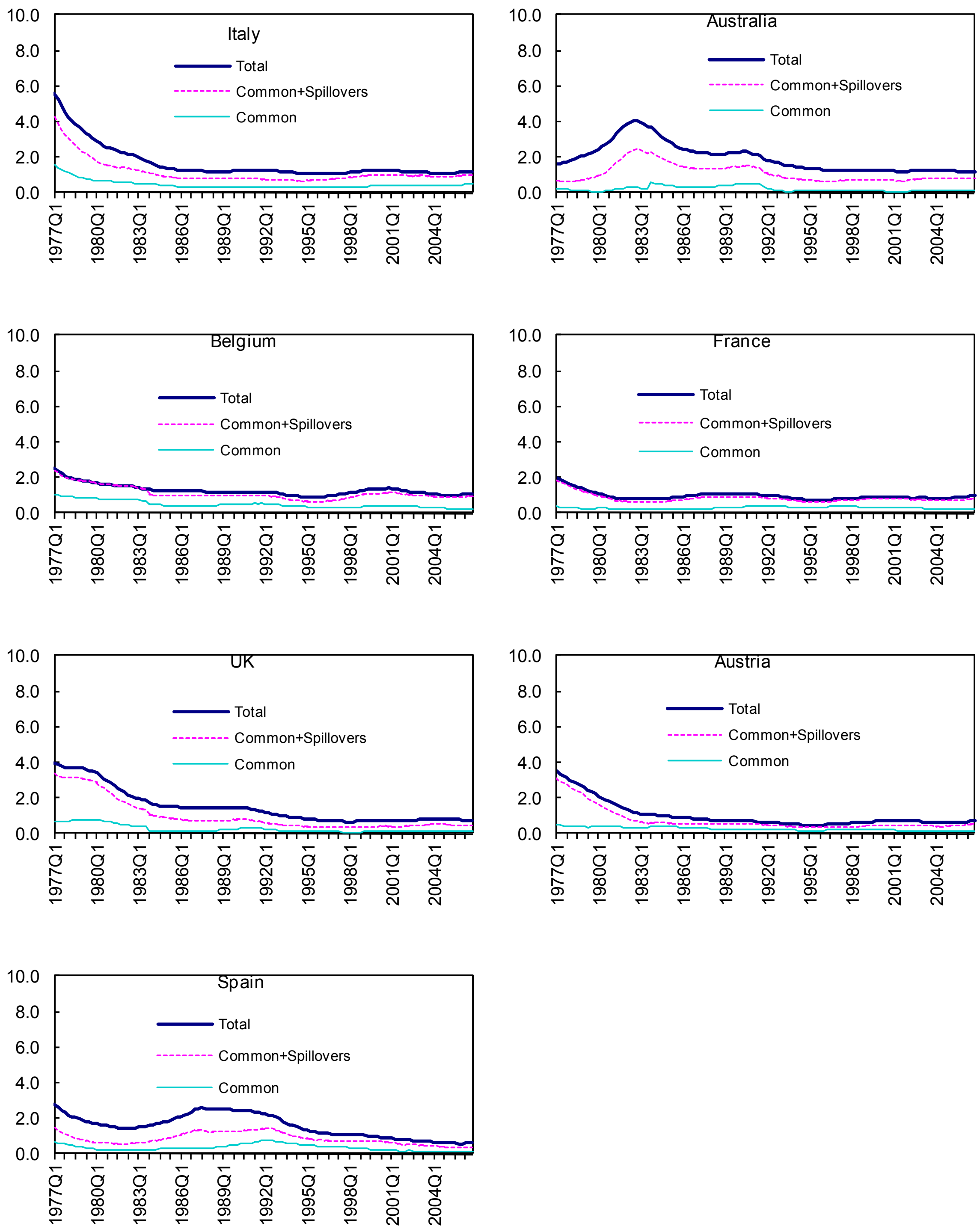

Figure A2. Group 2: GDP Growth Volatility and its Decomposition by Country

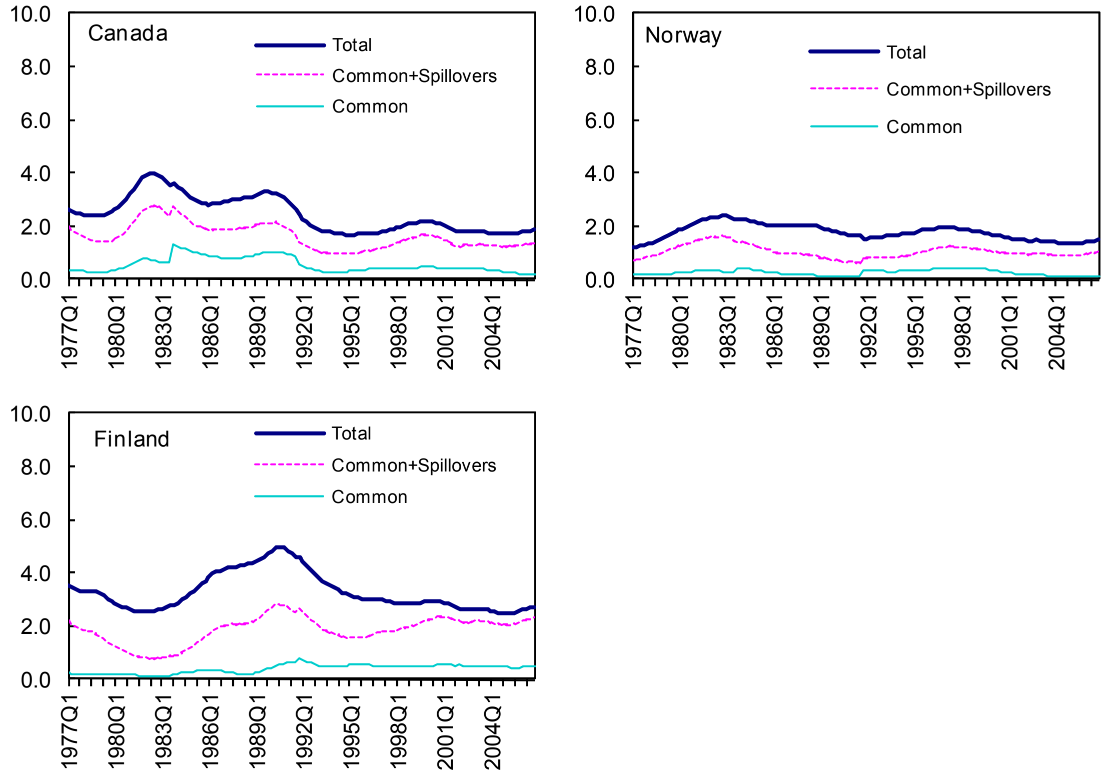

Figure A3. Group 3: GDP Growth Volatility and its Decomposition by Country

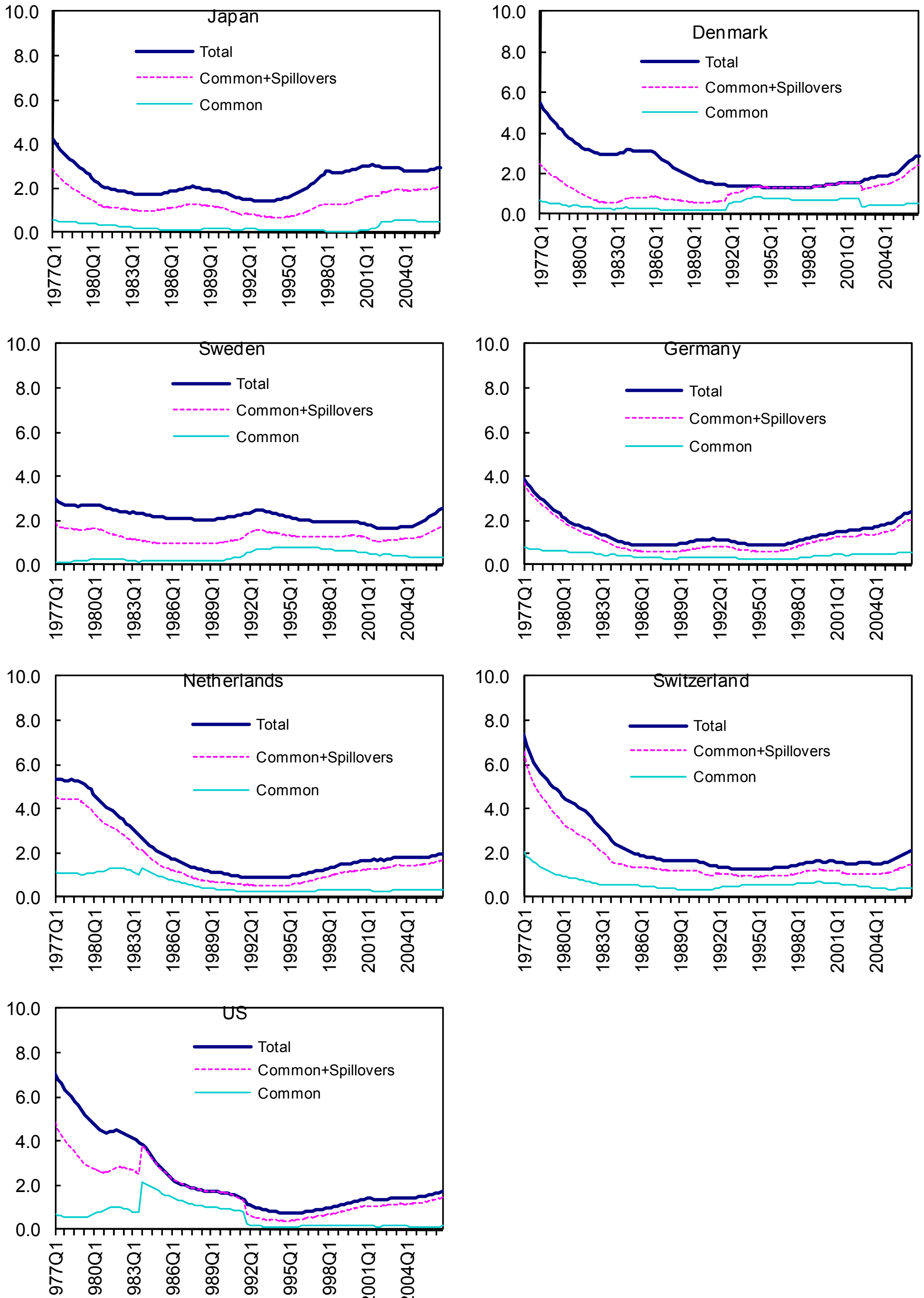

Figure A4. Group 4: GDP Growth Volatility and its Decomposition by Country