Maturing Capitalism And Economic Stabilization: International Evidence

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Abstract

Recent literature has found that the US business cycle has experienced a substantial decrease in volatility since the mid-1980s. Most authors have considered this as a recent phenomenon particular to the US, which narrows the search for potential causes. In this paper we go one step further and investigate whether this recent change is unique to the US and a phenomenon particular to the 1980s alone or if this is part of a long run trend in volatility shared by several countries. In particular, we examine whether maturing capitalism has engendered a continuous stabilization of business cycles in eleven industrialized countries over time. We do not try to quantify changes in volatility pre and post-War, which could be compromised by differences in the quality of the data. Instead, we focus on examining structural changes in the long run trend of volatility in these countries. Recursive stabilization tests are applied to examine breaks in the volatility of production in these countries, assuming that their dates are unknown. We find strong evidence of multiple structural breaks leading to more stability in these countries over time, and that the recent decrease in US output volatility is part of a broader long-term trend shared by all industrialized countries studied.

Introduction

Recent literature has found that the US business cycle has experienced a substantial decline in its amplitude since the mid-1980s. Even during the 2001-2002 recession, output volatility was at historical lows. An increased stability of business cycle fluctuations has important policy implications since it affects the frequency, duration, and probabilities of future recessions and expansions.¹ The findings are that the increased stabilization is widespread across many sectors of the US economy. Most authors have however considered this as a recent phenomenon particular to the US, which narrows the search for potential causes.²

This paper goes one step further and investigates whether this recent stabilization is unique to the US and a phenomenon particular to the 1980s alone or whether this is part of a long run trend in volatility, shared across many industrialized countries over a long period of time. In particular, we examine whether maturing capitalism has engendered a continuous stabilization of business cycles in eleven industrialized countries over the last 140 years. This possibility leads one to search among a broader set of secular factors than if this were a trend specific only to the US. This includes causes such as technological and information changes, institutional reforms that lead to greater stability, shifts toward more stable sectors of the economy, and more informed government economic policies and decision making by private agents. Globally, as many countries develop these more stable propagation mechanisms, the shocks transmitted across countries may be significantly smaller. That is, as economic activity becomes more stable in response to local disturbances, the shocks transmitted from one country to another are also less severe.

¹ Chauvet and Potter (2001) show the link between a reduction in volatility and the implied reduction in the frequency, duration, and probabilities of business cycle phases.

² An exception is Blanchard and Simon (2000). McConnell and Perez-Quiros (2000) find a structural break in the volatility of US GDP growth and all its major components in the first quarter of 1984. These authors find that the most important contributing component to the increased stability of output is the reduction in the volatility of durable goods production, mainly accounted for by inventories. Chauvet and Potter (2001) also show that the reduction in volatility of US GDP is not specific to aggregate output, but is shared by several other aggregate series such as retail sales, consumption, personal income, wages and salaries, industrial and manufacturing production, hours worked and total payroll employment. This is corroborated by Sensier and van Dijk (2001), who study the behavior of 215 macroeconomic real and nominal series for the US and find that 90% of them have experienced a reduction in volatility since the early 1980s.

There is a large literature comparing the US GDP volatility in the period pre and post-World Wars. The long expansion in the 1960s spurred debates about economic stabilization, speculations about the end of business cycles, and a search for potential causes of the ‘tamed business cycles’. This is summarized in Arthur Burns’ (1960) statement describing the stabilization of the US economy since World War II:

“There is no parallel for this sequence of mild – or such a sequence of brief - contractions, at least during the past hundred years in our own country.”

Burns’ statement points to two research directions regarding the same phenomenon of economic stabilization. The first is related to the decrease in volatility (‘mildness’) of the US business cycles. The second, which is closely related to the first, refers to changes in the duration (‘briefness’) of business cycle phases. Several economists have studied these questions and the general consensual evidence is that an increased stabilization did occur in the US economy comparing the periods before and after the Wars. The magnitude of this increased stability, however, was the subject of fierce debates.

Now, forty years later, Burns’ statement could possibly be the starting point of McConnell and Perez-Quiros’ (2000) study and several other economists who are currently revisiting the debate about the post-War business cycles stabilization – this time motivated by the structural break in the volatility of the US output growth in the first quarter of 1984.

In this paper we aim to obtain an international and historical perspective on this issue, which now, with much more data, can shed light on the secular causes of stabilization in industrialized countries in the last century. For that, we examine two sets of data. First, we use over one hundred years of annual production of eleven industrialized countries, taking into account possible inconsistencies in the series over time, as suggested by several authors. Second, we use a smaller dataset of highly reliable quarterly GDP data for these same countries over the past fifty years. These two sources of evidence, taken together, provide a better estimate of changes in volatility than either source taken on its own. That is, the combined evidence obtained from these two independent sources leads to stronger conclusions based on less measurement error than each part separately.

We do not try to quantify changes in volatility pre and post-War, which could be compromised by differences in the quality of the data. Instead, we focus on examining structural changes in the long run trend of volatility in these countries. Recursive tests are applied to examine potential breaks in the volatility of production in these countries, assuming that their dates are unknown.

We find strong evidence of multiple structural breaks leading to more stability in these countries over time, and that the recent decrease in US output volatility is part of a broader long-term trend shared by all industrialized countries studied. Since these breaks tend to be clustered for groups of countries, this makes it easier to investigate major common historical experiences that may explain changes in volatility.

The paper is organized as follows. The next section gives a brief outlook on the debate about economic stabilization in the US and the data used in this paper. The third section describes the stability tests implemented. The fourth section presents the empirical findings. The fifth section concludes.

Data Analysis³

There is a large literature examining changes in the magnitude and duration of economic fluctuations across the pre- and post-WWII periods. Although the quantified evidence of the increased stability is mixed, the general consensus is that an increased stabilization did occur in the US economy comparing the periods before and after the War. For example, Gordon (1986), Zarnowitz (1992), DeLong and Summers (1986) and Romer (1986a, 1986b, 1989, 1994, 1999) analyze changes in the US business cycles since the mid-1800s. The first authors find strong evidence of reduced volatility from the prewar to the postwar period, whereas Romer finds mild evidence and attributes

³ For details of the data discussion the reader is referred to Backus and Kehoe (1992).

most of the difference to discrepancies in the way the data were measured across periods. Some researchers have studied an alternative but closely related view on the issue. Diebold and Rudebusch (1992) address the issue of stabilization comparing the duration of business cycle phases in the pre and postwar periods. They find evidence of longer expansions and smaller contractions in the postwar period. On the other hand, Watson (1994) argues that changes in the duration of business cycle phases is a figment of data due to the way the NBER business cycle reference dates were chosen across periods.

While these studies examine US data, Backus and Kehoe (1992) bring the stabilization debate to an international context.⁴ They study fluctuations in output of ten countries, using over a century of annual data. Their findings suggest that the prewar and interwar real output fluctuations are uniformly larger than those in the postwar period, hence providing additional evidence for stabilization. The magnitude of difference, however, varies across the countries.

In spite of the debate on the magnitude of the prewar and the postwar stabilization of the economy in the literature, there is a general consensus towards stabilization of the output volatility over time. Meanwhile another break in the volatility of the output was found in 1984, as shown in the pioneer work of McConnell and Perez-Quiros (2000). These authors find further evidence of output stability now comparing pre-1984 and post-1984 quarterly data. This result is free of the 'Romer-Watson' criticism since the source and measurement of the data obtained before and after 1984 has been consistent over time.

In this paper we examine two sets of data. First, we use over one hundred years of annual production of eleven industrialized countries, taking into account possible inconsistencies in the series over time, as suggested by several authors. Second, we use a smaller dataset of highly reliable quarterly GDP data for these same countries over the past fifty years. The combined evidence obtained from these two independent sources leads to stronger conclusions based on less measurement error than each part separately.

We use output data of eleven industrialized countries: Australia, Canada, Denmark, France, Germany, Italy, Japan, Norway, Sweden, the United Kingdom, and the United States. For all countries the data used are available at both annual and quarterly frequency, with the exception of France, for which only quarterly data are available. The annual data cover at least a century for most of the countries and quarterly data cover the second half of the 20th century. (See Appendix for more details).

Stability Tests

In this section we discuss the stability tests implemented on both annual and quarterly data. The objective is to test for structural stability in the variance and mean of GDP growth rate when the breakpoint date is not known. In order to do this we rely on the asymptotically optimal tests developed by Andrews (1993) and Andrews and Ploberger (1994).

We test two separate hypotheses. First, we test for the possibility of a break in the variance of GDP growth assuming that the mean has remained constant. However, the results of this test would be unreliable if there were a break in the parameters of the underlying model. In this case, evidence of a break in the volatility from this test could be due to neglected structural change in the conditional mean of the GDP growth rate. In order to account for this, we also test for a break in the conditional mean of GDP growth rate, allowing for changing variance.

⁴ Sheffrin (1988) also did the international analysis, however Backus and Kehoe (1992) paper includes a broader set of countries and new data for some of the countries.

Test for Breaks in Variance given Stable Mean

We model GDP growth, Δy_t , as following an autoregressive process, based on the Akaike Information Criteria.⁵

$$\Delta y_t = \mu + \phi \Delta y_{t-1} + \varepsilon_t \quad (1)$$

where $\varepsilon_t | \Omega_{t-1} \sim N(0, \sigma_t^2)$, Ω_{t-1} is the information set at time t consisting of lagged values of Δy_t and ε_t . In order to test for a break in volatility, we specify the following equation for the estimated residuals:

$$\sqrt{\frac{\pi}{2}} |\hat{\varepsilon}_t| = \alpha_1 D_{1t} + \alpha_2 D_{2t} + \eta_t \quad (2)$$

for $\begin{cases} D_{1t} = 1 & \text{if } t \leq T, \text{ and } 0 \text{ if } t > T \\ D_{2t} = 0 & \text{if } t \leq T, \text{ and } 1 \text{ if } t > T \end{cases}$

where α is the estimator of the standard deviation and T is the unknown break date. Given that ε_t follows a normal distribution, $\sqrt{\frac{\pi}{2}} |\hat{\varepsilon}_t|$ is an unbiased estimator of the standard deviation of ε_t . The first hypothesis to be tested is:

$$\begin{cases} H_0^1 : \alpha_1 = \alpha_2 \\ H_A^1 : \alpha_1 \neq \alpha_2 \end{cases}$$

The presence of the nuisance parameter T under the alternative hypothesis, but not in the null implies that the Langrange multiplier (LM), the Likelihood ratio (LR), and the Wald tests do not have standard asymptotic properties. Andrews and Ploberger (1994) develop a test that overcomes this problem. The test is as follows. Let the function $F_n(T)$ denote the LR, LM or the Wald test for the null hypothesis H_0^1 for each possible value of T , where n is the number of observations. The test statistics are unbounded in the limit if the potential break points include the endpoints of the sample. Thus, T is assumed to lie between T_1 and T_2 , where $T_1 = 0.15n$ and $T_2 = 0.85n$.⁶ Andrews (1993) and Andrews and Ploberger (1994) give the asymptotic properties of the statistic $F_n(T)$. Specifically we consider the following statistics:

$$SupF = \sup_{T_1 \leq T \leq T_2} F_n(T) \quad (3)$$

$$AveF = \frac{1}{T_2 - T_1 + 1} \left(\sum_{T=T_1}^{T_2} F_n(T) \right) \quad (4)$$

$$ExpF = \ln \left(\frac{1}{T_2 - T_1 + 1} \left(\sum_{T=T_1}^{T_2} \exp(1/2 * F_n(T)) \right) \right) \quad (5)$$

The optimal tests are (4) and (5). However, the statistics $SupF$ is also of particular interest since it gives the estimated date of the break. The critical values for these test statistics are tabulated by Andrew and Ploberger (1994). In our analysis we apply Wald test, although the results from the LM and LR tests are similar.

⁵ Several authors such as McConnell and Perez-Quiros (2000), Harding and Pagan (2001) or Albert and Chib (1993), among others, have found the GDP growth in the US and other countries is better modeled as a low autoregressive process.

⁶ One implication of this trimming is that the test does not allow identification of breakpoints that occur towards the end of the sample.

Test for Breaks in Conditional Mean given Changing Variance

The second test examines the presence of breaks in the mean of GDP growth, allowing for changing variance. The model is now written as:

$$\Delta y_t = \mu_1 D_{1t} + \mu_2 D_{2t} + \phi_1 D_{1t} \Delta y_{t-1} + \phi_2 D_{2t} \Delta y_{t-1} + \varepsilon_t, \quad (6)$$

where D_{1t} and D_{2t} are defined as above and ε_t is again assumed to be heteroskedastic. The hypothesis tested is:

$$\begin{cases} H_0^2 : \mu_1 = \mu_2; \phi_1 = \phi_2 \\ H_A^2 : \mu_1 \neq \mu_2; \phi_1 \neq \phi_2 \end{cases}$$

If the breakpoint date were known we could use the Wald test with a chi-square distribution given by:

$$W = (\hat{\theta}_1 - \hat{\theta}_2)'(\sigma_1 + \sigma_2)^{-1}(\hat{\theta}_1 - \hat{\theta}_2)$$

where $\theta \equiv (\mu, \phi)$ is the coefficient vector. However, since we do not know the date of the break, Wald test is applied at every point between $T_1=0.15n$ and $T_2=0.85n$. The statistics now used are those given by equations (3), (4) and (5). As explained above, these statistics do not follow standard chi-square distribution. Thus, we use Andrews and Ploberger (1994) asymptotic distribution of these statistics, which overcomes this problem.

Empirical Results*International Stabilization – Secular Evidence*

The empirical results provide evidence of increasing economic stability over time, and that the recent decrease in US GDP volatility is part of a broader long-term trend shared by all the industrialized countries studied. First, the amplitude of output volatility cycles has been decreasing over time. Second, the long run trend in output volatility is negative for all countries considered. Finally, the empirical results provide evidence that there have been multiple structural breaks in the countries studied, leading to greater stability over time.

There are different ways of measuring volatility. A widely used proxy is the squared deviations of output growth from its mean. Another possibility is to use the standard deviation of the log GDP from its trend, while the trend can be modeled in different ways, such as using the two-sided moving average process from Hodrick-Prescott (H-P) filter, exponential smoothing techniques or modeling the trend as following a linear process. We undertake the empirical analysis using all these methods for all countries and for both quarterly and annual data. Since the results obtained are qualitatively very similar, we report the ones obtained from volatility measured as the squared deviation of output growth from its mean.

Long Run Volatility Cycles

Figure 1 shows the average annual volatility of output growth for all industrialized countries from 1862 to 2000, and the series is smoothed. Analysis of the volatility dynamics for this long time span uncovers patterns that may be concealed when one examines only more recent data. From this long run perspective, output volatility has experienced three major phases in the last 140 years: low volatility phases before and after the World War periods, and a high volatility phase in the intra-war period. In addition, the amplitude of the cycles has been decreasing over time.⁷

Until the onset of the World War I, the economy of the countries studied went through a phase of relative calmness. The period of the two World Wars and the Great Depression is characterized by acute oscillations that affected all industrialized countries, albeit with different intensity. The least affected countries were Australia, Nor-

⁷ The 1860s and 1880s were marked by a phase of relatively high volatility in some countries, particularly the US, Australia, and Canada. This coincides with periods of recessions and stock market crashes that affected these countries. However, since several other countries did not share this instability, the overall average volatility indicates that this was not a particularly high phase.

way, and Sweden, while countries that were more involved in the wars presented much higher instability during this period.

Around the end of the World War II output volatility in industrialized countries dropped substantially. In particular, the combined evidence from several countries indicates that in the after-war period output volatility has been decreasing continuously, reaching unprecedented lows in the last 25 years of the 20th century. Further, the low volatility phase in the second half of the last century is considerably tamer compared to the low volatility phase in the pre-War period. This corroborates the evidence of several authors for the US economy. This can be seen in Figure 1, which shows a striking reduction in the average output volatility since mid 1940s.

Table 1 illustrates the dimension of the reduction: the average volatility was 15.6 in the 51 years between 1862 and 1912. In the 54 years between 1947 and 2000 the average volatility dropped to 8.1, a 50% decrease compared to the period pre-War. On the other hand, the average volatility in the 34 years between 1913 and 1947 increased almost three times compared to the first part of the sample, and six times compared to the post-war period.

Table 1 - Long Run Average Volatility Cycles: Annual Data

Periods	Volatility Phase	Mean/Stand. Dev.
Pre-World War I	Low	15.6 (9.9)
World Wars I and II	High	42.7 (31.8)
Post-World War II	Low	8.1 (9.1)

Long Run Volatility Trends

Another way to assess whether output volatility in industrialized countries has been decreasing over time is to examine its long run trend. Here again we estimate volatility trends using different methods including the exponential smoothing, one-sided moving averages, H-P filter, and fitting a linear trend to the volatility series. Since the results obtained from these methods were similar, we report the one obtained from fitting a linear trend to output volatility. The beginning of the sample was chosen in such a way that the initial observations were not outliers.

Figure 2 plots the volatility trends from all ten countries studied using annual data. The pattern that stands out is that all countries display a negative volatility trend over the last 140 years. The countries that underwent the steepest decline were Australia, United States, and Canada. On the other hand, output volatility in Sweden and Norway has not been historically very high and its decline over the centuries has been smoother compared to the other countries studied. The decline in output volatility Japan and UK has also been steadier.⁸

Long Run Volatility Breaks

A third way of evaluating secular volatility patterns used in this paper is to determine whether volatility trends and cycles have experienced major structural breaks towards stabilization. The results of the tests described in Section III are summarized below.

All countries present several structural breaks in output volatility in the last 140 years, which are reported in Table 2. Figure 3 summarizes these results using annual data, plotting a dummy that takes the value of 1 when a country experienced a break and 0 otherwise. Notice that when more than one country experiences a break in the same year, the dummy takes a value higher than one. There have been three major clustering of breaks: around the beginning of the World War I, around the end of the World War II, and in the early 1980s. Notice that the stability tests do not include a fraction of the endpoints and, thus, cannot detect breaks in the 1990s using our available annual data.

⁸ We will show in the sections to follow that this slow decline for UK and Japan is related to the economic slowdown experienced by these two countries in the last decade.

Table 3 summarizes the information on the dates and nature of the volatility breaks. The dates of the breaks correspond to major international events such as the beginning and end of the World Wars. With the exception of the ones occurring during the World Wars I and II, all other breaks indicate a change towards increasing economic stability. In particular, most countries studied experienced volatility breaks indicating the beginning of a high volatility phase around 1912 and 1926.⁹ This phase ended with the end of the war, and all countries displayed breaks towards stabilization within 1945 and 1955. Japan and Germany, which were involved in the reconstruction of their economy during the post War period showed a later stabilization.

Table 3 - Clustering of Volatility Trend Breaks: Annual Data

Volatility Breaks	Nature of Break
Second Half 19 th Century	Stability
1912-1926	Instability
1945-1955	Stability
Post-World War II (Early 1980s)	Further Stability

In the post-war period, there have been multiple volatility breaks towards stability in the countries studied. An important finding is that there is a clustering of volatility breaks across countries in the early 1980s. That is, the economic stabilization since this period is not a phenomenon particular to the US. In particular, six other countries in addition to the US display a structural break toward stabilization in this period: Canada (1984), Australia (1984), Denmark (1982), Italy (1984), Japan (1981), and Norway (1980).

Figure 4 shows the breaks for each individual country. The countries studied can be divided into three major groups, according to similarities in their volatility dynamics. The first group is composed of Norway, Sweden, and Denmark, whose output volatility displays a similar behavior with respect to the timing and magnitude of changes. In particular, the intra-wars high volatility phase started and ended around the same time.¹⁰

The second group is composed of the United States, Canada, United Kingdom, and Italy. The output volatility of these countries was affected in similar ways during and after the World Wars. In particular, the volatility in the US and Canada increased significantly during the Great Depression and when the US entered the War World War II in 1940. For the United Kingdom, output volatility increased in the intra-war period, but was particularly high during the Great Depression. In Italy, the greatest oscillation in output occurred during World War II. For the post-war period, volatility has been decreasing continuously in these countries, especially in Italy. This will be further examined in section B below.

A third group is composed of countries with output dynamics that are relatively different from the ones in the other groups: Japan, Germany, and Australia. In the case of Australia, output volatility has been decreasing over time since the second half of the 19th century, and its economic volatility was less affected in the intra-war period. On the other hand, Japan and Germany showed a much later stabilization, in 1960 and 1980, respectively. For break in the mean there is no consistent pattern.

From the end of the Second War until the year 2000, the estimated volatility breaks for all countries were towards increased stability. That is, the economies of industrialized countries have been displaying increasingly tamer fluctuations over time, corroborating the evidence from the analysis of trends and cycles above. In particular, several countries have undergone multiple breakpoints towards increased volatility. This evidence for the second half of last century is examined in more detail together with the results from quarterly data in the section below.

⁹ Some of the countries do not display breaks due to missing output data for the intra-war period.

¹⁰ Notice that the data for output during the wars are missing for Norway, which impedes the implementation of stability tests around this period.

Recent Economic Stabilization

For the period after the Second World War, we can substantiate our empirical evidence from the annual data with the more reliable quarterly data. In this section we examine further the recent economic stabilization in industrialized countries using quarterly data. As it was done with annual data, we evaluate volatility changes using different methods: examining its cycles, trends, and structural breaks.

Volatility Cycles

Figure 5 plots the average quarterly volatility of output growth for industrialized countries from 1950 to 2000. Since for most countries the sample starts in early 1960s, it is difficult to compare the 1950s decade. In addition, the relative contribution of each country can be obscured due to missing observations. Looking at the overall average volatility overcomes these problems since it takes into account the sample size for each country. This figure also shows the series smoothed. Several distinct patterns are revealed by analysis of the recent dynamics of volatility cycles. First, there have been several phases of high and low volatility in the last fifty years. Second, the high volatility phases are associated with periods of low economic growth or recession experienced by most of the countries studied. Third, the amplitude of the cycles has been decreasing over time, both during expansions and recessions. As found in the annual data, this feature is particularly accentuated since the mid-1980s. Fourth, the smoothed series depicts a decreasing volatility trend, which is going to be discussed further in the next section.

Table 4 reports the statistics of the average international volatility for several sub periods before and after 1984, which is the date found by several authors marking a break towards stability in the US economy. This evidence illustrates the declining trend in volatility output as well as the decrease in amplitude of volatility cycles, as observed in Figure 5. The period between 1970:1 and 1984:1 shows a very mild decline in volatility compared to the 1950s and 1960s to 1984. From 1984 on, however, international output volatility exhibits an accentuated fall to around 1/3 of the previous decades.

Table 4 - Average International Volatility: Quarterly Data

Periods	Volatility Phase	Mean (Stand. Dev.)
1950:1 – 1984:1	Low	37.18 (38.89)
1960:1 – 1984:1	High	37.79 (36.50)
1970:1 – 1984:1	Low	35.51 (37.74)
1984:2 – 1999:4	Low	12.93 (8.20)

This pattern is also observed across recessions and expansions. Chauvet and Yu (2001) show that the G-7 countries taken altogether experienced recessions at about the same time as the NBER-dated recessions in the US.¹¹ Using their result, we illustrate the changes in international volatility across expansions and recessions as dated by the NBER. Table 5 shows international statistics for output volatility during expansions and recessions before and after 1980. Notice that the second sub sample includes the recessions from the early 1980s, which were marked by a substantial increase in volatility. Comparing the two sub-samples, there is a major difference (towards a decrease) in the international volatility, both for the recessions and expansions, with the mean international volatility for expansions dropping by around 1/3 after 1980:1.

¹¹ The exception is the 1969:4-1970:4 US recession, which was not simultaneously shared by all G-7 countries.

Table 5 - Average International Volatility: 1950:1 – 1999:4

NBER Business Cycles	Mean (Stand. Dev.)
Recessions	45.01 (38.27)
Expansions	25.71 (32.48)
Recessions before 1979:4	49.55 (43.72)
Recessions after 1980:1	35.94 (22.97)
Expansions before 1979:4	34.86 (39.63)
Expansions after 1980:1	13.34 (10.05)

Adding up, the evidence from international output volatility is that the amplitude of its cycles is decreasing over time. This is observed for the entire sample as well as for recessions and expansions, but it is particularly strong in the last two decades and for expansions.

Volatility Trend

As for annual data we estimate volatility trends using different methods including the exponential smoothing, one-sided moving averages, H-P filter (shown in Figure 5), and fitting a linear trend to the volatility series. Here again, since the results obtained from these methods were similar, we report the one obtained from fitting a linear trend to output volatility.

Figure 6 shows the volatility trends for the countries studied using quarterly data. All countries display a negative volatility trend in the last 50 years. This corroborates the findings obtained from 140 years of annual data, as discussed in the previous section. Norway, Sweden, and Australia display the most accentuated decline in volatility in the last 50 years. For the case of the Scandinavian countries, this is in contrast with the evidence from annual data, which shows a much smoother decline over a longer period span. In the case of Australia, however, the findings from both annual and quarterly data are that this country has experienced the fastest economic stabilization. The volatility trends of the United States, Canada, and United Kingdom share a similar milder inclination. On the other hand, Japan and France exhibit the least steep trend towards stabilization. The average volatility trend of all countries, as plotted in Figure 5, shows an overall negative inclination in the last 50 years.

Volatility Breaks

The results of the stability tests applied to quarterly data are reported in Table 6 and summarized in Figure 7a. This figure plots a dummy taking the value of one at the breakpoints and 0 otherwise. There are three major dates in which several countries experienced volatility breaks. The first one was in the early 1970s, and the breaks mark the beginning or end of a high volatility phase associated with the oil shocks and recessions during this period. The second one is around the early 1980s and, this time the breaks are only towards stability. The third was in the early 1990s.

Figure 7b combines the evidence on breaks obtained from quarterly and annual data. The dates for most breaks obtained from each of the frequencies coincide for each of the countries. However, the sample availability, measurement error in the data, and the fact that the test does not include endpoints of the sample yield some difference in the results. Thus, these two sources of evidence, taken together, provide a better estimate of changes in volatility than either source taken on its own. That is, the combined evidence obtained from these two independent sources leads to stronger conclusions based on less measurement error than each part separately.

As observed, the largest clustering of breakpoints in volatility occur in the early 1980s. With the exception of Germany all other countries have a break in the early to mid 1980's. In particular, seven countries display breaks in this period up to 1985: United States (quarterly and annual), Canada (quarterly and annual), United Kingdom (quarterly and annual), Denmark (annual), Japan (annual), Italy (annual), and Australia (annual). France displays a break in 1987 (quarterly) and Norway in 1988 (quarterly).

An interesting finding is that several of these breaks are concentrated in one year: 1984. In particular, five countries display breaks towards stabilization in this year: Australia, Canada, Italy, and United States. Several authors find this as a breakpoint date towards stability for the U.S. economy. We provide evidence that this recent change is not unique to the US.

Figure 8 shows the volatility series along with their trends and shaded areas representing the breakpoints for each individual country. As found using annual data, output volatility for United States, Canada, and United Kingdom exhibits similar dynamics, regarding trends, cycles and breaks. It is harder to compare the other countries as their data availability differs. However, the common features are that the volatility trends and cycles show evidence of increasing stabilization in the last 50 years. The one exception is Japan, whose economy has been more unstable in the 1990s than in the 1980s. During this period the Nippon stock index crashed and the real economy has been in a long lasting low-growth phase.

For break in the mean again there is no consistent pattern. US we see a break in the volatility towards a decrease but no significant break in the mean growth rate of the GDP. For Australia the break in early 1970s and the 1984 break in volatility coincide with a break in the mean of the output growth rate. Both the times the switch was towards high mean and lower standard deviation. For U.K. also the early 1980s break in the volatility coincides with the break in the mean, but the break is towards higher volatility. For Norway and Sweden also the break in the volatility is towards a slight increase, both the countries however see no break in their mean output growth rate.

For Japan the pattern is slightly from the other countries. We detect a break in the volatility and the mean in the mid 1970s. Comparing the period from 1950-1974 with the period 1975-1991, there is a decrease in both the mean growth rate and the standard deviation of the growth rate. Another break in volatility is detected in 1991, a break in mean is detected at the same time but it is not significant, this time it is towards a further decrease in mean but an increase in the volatility. The period since 1991 coincides with the long recession the Japanese economy has been in.

Conclusion

The two main findings of this paper are, first that the recent stabilization in the US economy is common to several other industrialized countries. Second, we find that this phenomenon is not particular to the 1980s alone, but it is part of a long run trend in volatility shared across many industrialized countries over a long period of time. Though there have been several phases of high and low volatility in the last 140 years (particularly the last fifty years), the analysis of volatility dynamics reveals three interesting stylized facts.

First, the amplitude of output volatility cycles has been decreasing over time, both during expansions and recessions, and the feature is particularly accentuated since the mid 1980s. Second, the long run trend in output volatility is negative for all countries considered. Finally there is evidence of multiple structural breaks in volatility, leading to greater stability over time. One can point out three important breaks in the volatility of all the countries considered. First just before WW I, leading into a phase of high instability, second at the end of WW II, this time towards stability and third in the mid 1980s, once again towards greater stability.

The findings of this paper have an important implication, they lead us to search among a broader set of secular factors than if this were a trend specific only to the US or the 1980s. This includes causes such as technological and information changes, institutional reforms that lead to greater stability, shifts toward more stable sectors of the economy, and more informed government economic policies and decision making by private agents. Globally, as many countries develop these more stable propagation mechanisms, the shocks transmitted across countries may be significantly smaller. That is, as economic activity becomes more stable in response to local disturbances, the shocks transmitted from one country to another are also less severe.

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Appendix – Data

Annual data, source is Backus and Kehoe, 1992 (BK92 henceforth) updated. This is real GDP at 1980 prices (unless mentioned otherwise). Source of the update is IFS yearbook 1998 (unless mentioned otherwise). The update was available in 1990 prices (unless mentioned otherwise), and had to be converted to the 1980 prices to maintain the continuity of the data.

Australia (1861 - 1997). GDP, 1861 – 1986: BK92; 1987 – 1997: IFS 1998.

Canada (1870 – 1996). GNP, 1870 – 1983: BK92; GDP, 1948-1996: IFS 2000, base 1986.

Denmark (1870 – 1999, with a gap from 1915 to 1920). 1870 – 1985: BK92, before 1948 it is GNP after that GDP; 1986 – 1999: GDP, IFS 2000, update converted from 1995 prices.

Germany (1850 – 1997, with a gap of the war periods). 1850 – 1913, 1925 – 1938, 1950 – 1986: BK92, before 1950 it is NNP, after that GNP; 1987 – 1993: IFS 1994, IFS stopped publishing GNP deflator after 1993, so real GNP is not available after 1993; 1979 – 1997: GDP in 1990 prices, IFS 1998, series 99b.r.

Italy (1861 - 1997). 1861 – 1985: BK92, before 1950 it is GNP, after that GDP; 1959 – 1997: GDP, IFS 1998. IFS revised Italy's data in 1987, the revised series is available only from 1959 on.

Japan (1885 – 1997, with a gap from 1941-1951). GNP, 1885 – 1985: BK92; 1986 – 1993: IFS 1994, IFS stopped publishing GNP deflator after 1993, so real GNP is not available after 1993; 1968 – 1997: GDP in 1990 prices, IFS 1998, series 99b.r.

Norway (1865-1986, with a gap from 1940 - 1945). GDP, 1865 – 1986: BK92; 1987 – 1997: IFS 1998.

Sweden (1861 – 1997). GDP, 1861 – 1986: BK92; 1987 – 1997: IFS 1998.

United Kingdom (1870 – 1997). GDP, 1870 – 1986: BK92; 1987 – 1997: IFS 1998.

United States (1869 – 1999). GDP, 1869 – 1983: BK92; 1929 – 1999: BEA, 1996 prices.

Quarterly Data, source is IFS or the country itself.

Australia: 1959.Q3 to 1999.Q4 (Source: IFS. GDP at 1996-97 constant prices)

Canada: 1961.Q1 to 2000.Q2 (Source: Country, GDP at constant prices)

Denmark: 1988.Q1 to 2000.Q2 (source: Country, GDP at constant prices)

Germany: 1960.Q1 to 2000.Q2 (Source: Country, GDP at constant prices)

Italy: 1960.Q1 to 1999.Q4 (Source: IFS 2000 CD, GDP volume. Index, 1995 =100)

Japan: 1955.Q2 to 2000.Q2 (Source: IFS, GDP at 1990 constant prices)

Norway: 1966.Q1 to 1999.Q4 (Source IFS 2000 CD, GDP volume. Index, 1995 =100)

Sweden: 1969.Q1 to 1999.Q4 (Source IFS 2000 CD, GDP volume. Index, 1995 =100)

UK: 1957.Q1 to 2000.Q1 (Source: IFS, GDP constant prices)

USA: 1947.Q1 to 2000.Q3 (Source: BEA, Table 8.2)

France: 1970.Q1 to 1999.Q2 (Source IFS 2000 CD, GDP volume. Index, 1995 =100)

Table 2a - Stability Tests on Annual Data: Null of No Break in Volatility

Country	Sample	Break Dates (<i>Sup W</i>)
Australia	1861-1997	1888, 1921***, 1947*, 1969*, 1984***, 1991**
Canada (1)	1870-1983	1913, 1942, 1956*
Canada (2)	1948-1996	1984
Canada (p)	1870-1996	1957*
Denmark	1870-1914	1879
	1921-1999	1951***, 1982*
Germany (1)	1850-1913	1904*
	1925-1938	Too few observations
	1950-1993	1977
Germany (2)	1979-1997	1994**
Italy (1)	1861-1985	1887*, 1947*, 1960*
Italy (2)	1959-1997	1984**
Japan (1)	1885-1940	1931**
	1952-1993	1981*
Japan (2)	1968-1997	1974
Norway	1865-1939	1916*
	1946-1997	1980, 1989
Sweden	1861-1997	1913, 1940*, 1950, 1962
U.K.	1870-1997	1886*, 1948**, 1972
U.S. (1)	1869-1983	1917***, 1951*
U.S. (2)	1929-1999	1984*
U.S. (p)	1869-1999	1943, 1959*

Notes: 1. *SupW* is used to get the date of the break.
 2. (*) Reject the null at 1 % level; (**) Reject the null at 5 % level; (***) Reject the null at 10 % level. Where the significance level is got from the optimal test *ExpW*. Critical values are obtained from Andrews (1993, 1994)

Table 2b – Stability Tests on Annual data. Test for a break in the AR(1) coefficients, when the variance across the two samples is not the same. Null of No structural change.

Country	Sample	Break Dates (<i>Sup W</i>)
Australia	1861-1997	1885, 1940**, 1973
Canada (1)	1870-1983	1896, 1925, 1974
Canada (2)	1948-1996	1988**
Canada (p)	1870-1996	1925***, 1942
Denmark	1870-1914	1878
	1921-1999	1973
Germany (1)	1850-1913	1870
	1925-1938	Too few observations
	1950-1993	1960***
Germany (2)	1979-1997	1991*
Italy (1)	1861-1985	1915*, 1945*, 1979**,
Italy (2)	1959-1997	1974*
Japan (1)	1885-1940	1931***
	1952-1993	1973*
Japan (2)	1968-1997	1991
Norway	1865-1939	1918
	1946-1997	1979
Sweden	1861-1997	1917, 1944, 1970**
U.K.	1870-1997	1921, 1940, 1952
U.S. (1)	1869-1983	1919*
U.S. (2)	1929-1999	1947, 1968
U.S. (p)	1869-1999	1919*, 1942

Notes: Same as Table 2a.

Table 6a - Stability Tests on Quarterly Data. Null of No Break in Volatility

Country	Sample	Break Date (<i>Sup W</i>)
Australia	1959.3-1999.4	1969.4*, 1985.1*, 1992.1*
Canada	1961.1-2000.2	1970.3, 1983.2, 1991.2*
Denmark	1988.1-2000.2	1998.2*
France	1970.1-1999.2	1987.2
Germany	1960.1-2000.2	1970.2, 1974.3, 1993.2*
Italy	1960.1-1999.4	1962.4, 1970.1**, 1981.3*, 1990.3
Japan	1955.2-2000.2	1975.2*, 1996.3*
Norway	1966.1-1999.4	1975.3*, 1988.4
Sweden	1970.1-1999.4	1979.4***, 1993.1*
U.K.	1957.1-2000.1	1970.4, 1981.4*, 1992.2*
U.S.A	1947.1-2000.3	1960.4, 1984.1*, 1987.3

Notes:

1. *SupW* is used to get the date of the break.
2. (*) Reject the null at 1 % level; (**) Reject the null at 5 % level; (***) Reject the null at 10 % level. Where the significance level is got from the optimal test *ExpW*. Critical values are obtained from Andrews (1993, 1994)
3. When it was the case, the series were seasonally adjusted using the census X-11 additive method.

Table 6b - Stability Tests on Quarterly data. Test for a break in the AR(1) coefficients, when the variance across the two samples is not the same. Null of No structural change.

Country	Sample	Break Date (<i>Sup W</i>)
Australia	1959.3-1999.4	1974.1, 1981.2*, 1995.3*
Canada	1961.1-2000.2	1976.2, 1979.4*, 1996.2
Denmark	1988.1-2000.2	1991.1
Germany	1960.1-2000.2	1992.1
Germany unified in 1989-90	1960.1-1988.4	1973.1*
	1993.1-2000.2	1999.2**
Italy	1960.1-1999.4	1973.1*, 1995.1**
Japan	1955.2-2000.2	1959.1, 1973.1*, 1991.1*
Norway	1966.1-1999.4	1987.1
Sweden	1970.1-1999.2	1989.4
UK	1957.1-2000.1	1973.1, 1980.1, 1990.3*, 1998.4*
U.S.	1947.1-2000.3	1966.1, 1981.4, 1991.4, 1996.1***

Notes: Same as Table 6a.

Figure 1 – Average (—) and Smoothed (---) Long Run Volatility Cycles for Industrialized Countries: Annual Data

Figure 2 - Volatility Trend – Annual Data

Figure 3 – Summary of Results from Structural Break Tests - Annual Data

Figure 4 - Volatility Series and Breaks (Shaded Area) for Industrialized Countries– Annual Data

Figure 5 – Average (—) and Smoothed (--) Volatility Cycles for Industrialized Countries: Quarterly Data

Figure 6 – Volatility Trends: Quarterly Data

Figure 7 – Volatility Breaks – Combined Evidence for Quarterly and Annual Data

Figure 8 - Volatility Breaks – Evidence from Quarterly Data