Effects of Exchange Rate Regime Choice on European Union Business Cycles

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April 28, 2008

Final Draft[1]

Abstract

This paper studies the impact of nominal exchange rate regimes on the business cycles of the original twelve members of the European Currency Union under the Euro as well as the United Kingdom. The data spans the years 1960-2005 encompassing three distinct periods according to their respective exchange rate regimes: the Bretton Woods regime of fixed exchange rates, the following era of floating exchange rates, and the currency union under the Euro. The data is examined using both a fixed period approach searching for behavioral differences among the periods in their entirety, as well as a rolling approach to look for periods of behavioral differences that do not correspond to years of regime change. The variance of the business cycle is decomposed into the portion attributable to world growth and an idiosyncratic or country specific component. While no first order relationship between exchange rate regime and the business cycle can be found, several interesting behavioral features are discovered. Although no regime induced effects can be found for the business cycle in its entirety, both Imports and Exports exhibit a period of anomalous behavior corresponding to the shift from the Bretton Woods system to the period of flexible rates; even when taking into consideration effects of the oil crisis of 1973. Additionally, the variance decomposition of the business cycle provides evidence of a "Great Moderation" in volatility of both the world and idiosyncratic components. This phenomenon is also observed when applied to a more global sample. The results of this study are of interest because much economic theory implies an important relationship between nominal exchange rate regime and macroeconomic aggregate behavior. Also, this study addresses the literature on a moderation in business cycle volatility that occurs over the course of the sample.

[1] Special thanks to Professor Mario Crucini for his continued help and support throughout the process of creating this paper.

Introduction

This paper investigates the impact of nominal exchange rate regime choice on the business cycle and on fluctuations of individual macroeconomic variables. The sample countries are comprised of the 12 original members[2] of the European Union and the United Kingdom to compare the behavior of output, exports, imports, and industrial production across the various exchange rate regimes that occurred over the sample periods (roughly 1960-2006 subject to availability of data). The three principle regimes examined are the primarily fixed-rate regime occurring under the Bretton Woods System pre-1973, the largely flexible rate regime following the demise of the Bretton Woods System from 1973-1998, and the currency union under the Euro occurring from 1999 through the remainder of the sample.

The paper uses two common de-trending procedures for the purpose of these analyses. The first is a simple log differencing to obtain the annual growth rates of the data. The second method employs the Hodrick-Prescott filter. This filter works by removing the low frequency events, or the trend of the data, while leaving the higher frequency events in attempt to isolate the business cycle. This filter helps to solve the problem of autocorrelation within the data, allowing for common statistically analyses that assume independence to be performed more reliably.

Section 1 of the paper attempts to find evidence of a systematic change in the behavior of the business cycle employing two distinct approaches. The first method fixes the test periods to correspond to the three distinct exchange rate periods, and then looks for differences in behavior when comparing the regimes in their entirety. The second method uses using a rolling test-window to look for evidence of a systematic break other than the years where a regime change occurred. Results from the first, fixed-period, analysis show little to support a significant

[2] Original Membership defined as countries that received original European Central Bank currency issuance.

difference of behavior in real terms. The rolling analysis does not provide conclusive evidence of a structural shift based on regime choice either; defined as one regime behaving systematically differently from the others, but there is evidence of possible "break" periods where the variance of a rolling sample period differs from the behavior of the rest of the sample. However this period also corresponds to the oil-crisis of 1973. Therefore, Section 2 attempts to parse out any oil-shock effects in order ascertain the cause of these breaks and see if this anomalous behavior is actually caused by rising oil prices rather than a regime effect.

Section 3 examines the behavior of the sample as a whole by decomposing each country's growth into a world component and an idiosyncratic, or country specific, component that cannot be explained by world growth. World growth is a simple country-size weighted average of national growth, and the portion of the growth that cannot be explained by the world figure is considered to be the country specific growth. The variance of this idiosyncratic growth is then examined to see if the countries' behavior relative to each other exhibits any evidence of an exchange rate effect. While conclusive evidence of a regime specific effect cannot be found, the data does exhibit a decreasing idiosyncratic and total variance throughout the sample. This may be indicative of an increasing integration of the EU; however, since the trend is shared by the U.S. it would require either a spillover of the Euro-effect or be attributed to some other cause. Furthermore, there was evidence of a statistical change in behavior around the time of the implementation of the Euro. Therefore, Section 4 examines this finding at a more global level by repeating the analysis using a more representative world sample to see if the EU behaved independently, or if these observations mirrored a larger international trend. Finally, the data from the global analysis was used to look for a possible moderation in business cycles occurring over the sample. Interestingly, while the overall trend shows a decline in variance, there is

evidence of a small spike in variance corresponding to the adoption of the Euro which could be a result of increased global economic integration and co-movement.

The study of business cycles is one of the oldest topics in macroeconomics and was first investigated in a statistical manner by Wesley Clair Mitchell and the National Bureau of Economic Research during the 1920's. Mitchell found business cycles were becoming increasingly correlated across time for countries with highly developed economies. He attributed this increase in correlation to a growth in international financial linkages[3].

Since Mitchell, a neoclassical approach has developed that business cycles are similar and need not be classified by country or time period. One paper that examines this theory in detail is *Business Cycles and the Exchange Rate System: Some International Evidence* by Marianne Baxter and Alan C. Stockman (1988). They examine if a country's choice of exchange rate regime (fixed versus floating) has a systematic effect on the country's business cycle. Their research examines the macroeconomic variables of 21 OECD countries and 23 Non–OECD countries, comparing the Bretton Woods period (characterized largely by fixed exchange rates) to the largely flexible-rate regime period adopted after the fall of the Bretton Woods system. They found evidence that: i) international correlation of outputs decreased in the post-1973 period, ii) correlation between consumption and national output increased in the post-1973 period, iii) international correlation between government purchases increased in the post-1973 period, iv) imports, exports, and real exports all increased in volatility for the post-1973 period. However, they were unable to show that any of these changes were caused by the change in exchange rate regime.

Baxter continues researching the effects of regime shifts in *Business cycles, stylized facts, and the exchange rate regime: evidence from the United States* (1991). Here Baxter again

[3] Baxter and Stockman (1988)

focuses on a statistical analysis of the behavior of macroeconomic aggregates in the pre and post-1973 periods, however this time with specific focus on the de-trending methods used by many researchers. She shows how the results may differ depending on the methods used and the treatment of the data as a single stochastic process versus allowing for observed differences in the two periods, but concludes that none of the methods used show conclusive evidence of a systematic change.

This paper serves, in a way, to update the Baxter-Stockman (1988) analysis, as well as to limit the focus. It attempts to find evidence of a structural change in the functioning of the business cycle for the 13 highly developed economies of the original European Union members and the United Kingdom. Also, this paper uses Gross Domestic Product figures as well the Industrial Production figures used in Baxter Stockman (1988). The belief behind the use of GDP is that since the production of services represents such a large portion of all sample countries' total output, it may be possible to see changes that would otherwise be missed when isolating measures to industrial output. Additionally, this paper extends the study by attempting to find evidence of a systematic break that occurred in a year other than a regime change year by using rolling variance and F-test analyses. Finally, and possibly most notably, the paper includes the period under the Euro in order to test a third exchange rate regime to see if the currency union provides evidence of a systematic change that was not found comparing the largely fixed and flexible periods in the Baxter-Stockman (1988) analysis.

However, this paper reaches largely the same conclusion as the Baxter-Stockman (1988) analysis and is unable to find conclusive evidence of a systematic change in the behavior of the business cycle due to the choice of exchange rate regime.

The results of this paper are of interest because as discussed in Duarte, Restuccia, and Waddle (2007) "Modern theories of exchange rate determination typically imply a close relationship between exchange rates and other macroeconomic variables such as output, consumption, and trade flows.[4]" This intuition relates to the optimization of consumption by equating the real exchange rate of the two countries to the marginal rates of substitution between the countries, and is based upon the principle that exchange rates are neutral with respect to real outcomes at first approximation. That is, changes in a nominal unit of account such as the exchange rate do not have a large impact on real variables such as real output growth. However, their work as well as the work Baxter and Stockman calls into question the validity of these theories based on the weak evidence supporting such a relationship. Such work supports the neoclassical view that business cycles do not differ across time and place and brings to light the phenomenon Obstfeld and Rogoff (2001) call "the exchange rate disconnect puzzle."

Data and Methodology

The data for this paper was obtained from the web versions of the World Development Indicator database (WDI) and the International Financial Statistics (IFS) database. The WDI database is provided by the World Bank, while the IFS database is provided by the International Monetary Fund. Both databases were accessed through Vanderbilt University's subscription. The Real GDP figure comes from the WDI database and is found using the value added approach calculated at purchaser prices plus any product taxes not included in this valuation. Country data is converted from nominal to real terms using a domestic price deflator and then converted to constant year 2000 US$ using the average official exchange rate as reported by the IMF[5]. It is

[4] Duarte, Restuccia, and Waddle (2007).
[5]The World Bank. World Development Indicators 2007. Washington D.C.: Green Press Initiative, 2007.

important to note that due to data availability issues Germany is not included in the sample until 1971. The Industrial production data is expressed in real terms of year 2000 constant US$, and is converted in the same manner**.** In regards to Imports and Exports, data comes from both the IFS database as well as the WDI database. The reason for this double sampling stems from the desire to accurately reflect all country's impacts while using the most appropriate figures possible. The IFS data provides import and export data expressed in billions of $US and contains a complete time sample for Germany. This desire to accurately reflect Germany is significant as it accounts for roughly one-third of total output in the sample.

All variables in the data contain observations over approximately the period of 1960-2006 with slight variations due to data availability as summarized in Table 1 below:

Table 1.) Variable Summary

Category	Frequency	Time span	Missing Data points	
Real Variables				
Exports $2000	Annual	1960-2005	Germany 1960 - 1971	WDI
Imports $2000	Annual	1960-2005	Germany 1960 - 1971	WDI
GDP $2000	Annual	1960-2005	Germany 1960 - 1971	WDI
Industrial Production $2000	Annual	1961-2005[6]		WDI
Nominal Variables				
Exports in $ Billions	Annual	1957-2006	Belgium 1960-1993 Luxembourg 1960-1968	IFS
Imports in $ Billions	Annual	1957-2006	Belgium 1960-1993 Luxembourg 1960-1968	IFS

These variables were chosen in order to examine various effects of the choice of exchange rate regime on the business cycle. The first component, GDP, was chosen because if it is possible to determine a first order effect of regime choice on the volatility of GDP (i.e. the business cycle) then there could be extreme policy implications. However, as all countries

[6] Begins in 1961 instead of 1960 because it is the first year where figures for all 13 countries are available.

included in the sample have extremely developed economies, all GDP figures include a large component for the production of services. Since some of these services are not economically feasible to trade, this portion of GDP may not be as susceptible the choice of regime. Therefore, industrial production was added in attempt to measure the effect of exchange rate regime on the production of more easily tradable, tangible goods produced in the economy. A summary of Hodrick-Prescott filtered variables is shown below in Table 2.

Table 2.) Summary Standard Deviation of Cyclical Component by Period

	Indstrial Production $2000			GDP $2000			Exports $2000			Imports $2000		
Country	Fixed	Flexible	Euro	Fixed	Flexible	Euro	Fixed	Flexible	Euro	Fixed	Flexible	Euro
AUSTRIA	1.142	1.215	0.682	0.231	0.191	0.097	1.556	1.883	1.176	1.612	2.238	2.237
BELGIUM	0.412	1.529	0.147	0.172	0.254	0.072	1.330	1.702	1.182	1.758	1.973	1.536
FINLAND	1.784	3.633	0.953	0.587	2.417	0.127	1.871	2.943	2.532	3.567	2.709	2.629
FRANCE	0.617	2.453	0.392	0.093	0.233	0.134	1.620	1.528	1.737	1.891	2.296	2.260
GERMANY	3.019	1.685	0.252	NMF	NMF	NMF	1.222	2.186	1.453	0.885	1.755	1.914
GREECE	2.223	1.197	0.588	1.074	1.262	0.032	3.896	3.489	3.830	3.087	2.669	1.408
IRELAND	0.738	1.754	5.010	0.470	0.637	0.843	2.135	2.172	2.845	1.992	3.368	2.984
ITALY	0.517	1.482	0.236	0.167	0.292	0.061	1.598	2.076	1.832	3.145	3.007	0.697
LUXEMBOURG	1.900	5.513	0.738	0.850	1.105	0.461	2.170	2.871	1.819	2.704	2.254	2.951
NETHERLANDS	1.616	1.039	0.265	0.202	0.298	0.386	1.438	1.464	1.588	1.578	1.802	1.954
PORTUGAL	1.548	3.080	0.620	1.041	1.332	0.449	4.597	3.944	1.057	4.818	4.238	0.960
SPAIN	1.276	1.632	0.431	0.555	0.526	0.105	2.965	1.947	1.346	4.831	3.204	2.873
UNITED KINGDOM	0.519	1.598	0.202	0.373	0.624	0.018	1.572	1.461	1.233	1.575	2.110	2.258
Median	1.276	1.632	0.431	0.421	0.575	0.116	1.620	2.076	1.588	1.992	2.296	2.237
Mean	1.332	2.139	0.809	0.485	0.764	0.232	2.152	2.282	1.818	2.572	2.586	2.051

From this table it is possible to see that the largest differences across periods occur for Industrial Production followed by Exports and Imports, which is intriguing because intuitively Imports and Exports should be more sensitive to changes in nominal exchange rate behavior. However, there is not conclusive evidence that any of these differences are indicative of a systematic change in behavior of the cyclical properties of these variables due to regime choice.

In order to determine the effect of regime choice on the business cycle, Section 1 examines the independent behavior of countries using two fundamental approaches. The first approach involves fixing the test periods to correspond to each regime and then testing the periods against one another. This test allows one to see if when comparing entire regimes, there is a systematic difference in business cycle volatility. Although this is a good first test, it

presumes the regime change date is known and the impact on business cycle properties begins at the outset of the regime change. Therefore, the second test uses a rolling interval to look for "break points" or periods that differ significantly from the rest of the sample. This test allows the data to inform us about the possible points of a shift in volatility which may or may not coincide with the date of regime shift.

The two fixed-interval tests used were an F-test by period, which set end years to correspond to regime change years, and a regression comparing the volatility of growth for the different periods. The regression serves as a brute-force method of determining if a systematic change in behavior occurred when fixing the end-points of the period to correspond with the years of regime changes. The regression is as follows:

(1) $$v_{yjt} = \delta_0 + \delta_1 D_1 + \delta_2 D_2$$

Where v_{yjt} represents output variance using a 5-year rolling test-interval for country j and D_1 and D_2 are dummy variables representing the fixed and flexible exchange rate regimes, respectively. The most recent regime under the Euro is considered the base case while D_1 is set to equal 1 for all the years before 1973 and zero elsewhere, and D_2 is set to equal 1 for the years 1973-1998 and zero elsewhere. The intuition behind this regression is if the coefficients are significant and not equal this indicates a fundamental difference in the volatility of output between exchange rage regimes. Also, if neither of the coefficients is significant then this indicates that the exchange rate regime likely does not have a first order effect on output variance.

The second analysis, or the rolling "break point" test, uses a 5-year base-length rolling window. This was done by testing the first 5 years of the data against the remainder of the sample, then testing the next 5 year interval against the remainder of the sample plus the first year of the sample. This process was repeated until the end of the sample was reached by the end

of the 5 year rolling window. The details of the rolling interval F-test are depicted below in equation (2).

(2)

$$F_{1962} = \delta^2_{(1960\text{-}1964)} / \delta^2_{(1965\text{-}2005)}$$
$$F_{1963} = \delta^2_{(1961\text{-}1965)} / \delta^2_{(1966\text{-}2005,\ 1960)}$$
$$F_n = \delta^2_{((n-2)\text{-}(n+2))} / \delta^2_{(\text{remainder of sample, previous years of sample})}$$

Each p-value returned is the probability that the period centered on that year has a variance that that *does not* differ systematically from the variance of the rest of the sample. Therefore, lower p-values values indicate a *higher* probability that the two variances are statistically different. This test was performed for both the log differenced data as well as the Hodrick-Prescott filtered data. In addition to the base-length 5-year interval, both 7 and 9 year intervals were also applied to the data. The reason for this multiple test interval length comes from the trade-off that exists when choosing interval size. Smaller intervals are more sensitive to slight variations in the data, but such intervals may indicate an event is significant when it is really not. Conversely, larger intervals may average away meaningful changes in variance. This trade-off can be considered analogous to Type I and Type II error when selecting a confidence interval. We do not want to deem an event significant when it is not; however, we do not want to reject statistically meaningful events either. Additionally, the ideal interval choice depends on what one feels to be the ideal choices for the persistence of shocks and the length of business cycle. Therefore, for robustness purposes multiple interval lengths were used to analyze the data.

In the case of the log differenced data, the F-test examines whether the variance of the growth during the rolling period differs significantly from the rest of the sample. The Hodrick-Prescott filter is a more widely accepted transformation for isolating the business cycle

component of a variable than is the growth transformation because it helps to eliminate the auto-correlation of the data and allows for greater independence. The filter is defined by the equation:

$$(3) \quad \min \sum_{t=1}^{T} (y_t - \tau_t)^2 + \lambda \sum_{t=2}^{T-1} [(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})]^2.$$

Where output (y_t) is comprised of trend component (z_t) and a cyclical component (c_t) which is calculated as output less the trend component $(y_t - z_t)$. The first component measures deviations of output from the trend using the square function and the second component applies a penalty (λ) to the squared deviations of changes in the estimated trend. Thus, changes in λ effectively alter the smoothness of the trend relative to the original series (see Baxter and King (1999) for an insightful discussion of business cycle filters, including their preferred filter, a band-pass filter)

In a nutshell, the F-tests of the data look to see if the variance, or volatility, of the business cycle during one period differs systematically from that of another with the alternative filtering methods providing some robustness checks on the results in terms of how that cycle is actually extracted from the raw data. Both tests failed to provide conclusive evidence of a behavioral shift as an effect of nominal exchange rate regime choice, but the rolling samples did indicate several periods of interest that will be discussed later.

Section 3) attempts to separate the growth rates of each country into a world growth rate and an idiosyncratic, or country specific growth rate. To do so it was first necessary to define the world growth rate. Due to restrictions of data availability weights were based on 1971 GDP levels since this was the first year output data was available for Germany. This decision was based on the fact that Germany represents such a large percentage of Europe's total output and the desire to reflect its impact as accurately as possible. When deriving world growth for the years prior to 1971 countries were given their 1971 weights and then Germany's share was

distributed uniformly across the other countries. The equation for world growth rate is defined as follows:

(4) $$w_t = \sum_{j,t=1}^{J,T} \theta_j \Delta \log(y_{jt})$$

$$\sum_{j=1}^{J} \theta_j = 1$$

Where w_t represents the world growth rate and θ_j represents each country's relative share of total output. Although this process is not ideal for finding the world growth rate from 1961-1971 it is necessitated by the lack of real GDP data. After the world growth rate is found, each country's individual growth rate is regressed against the world growth rate figure using the equation:

(5) $$\Delta \log(y_{jt}) = \beta_0 + \beta_1 w_t + v_{jt}$$

In this equation the error term v_{jt} represents the idiosyncratic growth of country j; that is, the growth that cannot be explained by the average growth of world output. It is important to note that β_1 should have a positive coefficient because, intuitively, it is unlikely that any country will systematically grow in the opposite direction to the average of the other European countries However, it will also be positively correlated to the weighted average by construction because world growth is in part determined by $\theta_j \Delta \log Y_{jt}$. Thus, it is likely that the coefficient β_1 will be higher and more significant for the larger countries of the sample as they have a greater effect in the calculation of the world growth figure. After all regressions are run, it will be possible to perform the rolling F-test analysis discussed earlier in attempt to see if any country's idiosyncratic growth behavior exhibits any fundamental changes over the sample period.

Results

Section 1. Fixed and Rolling Interval Analysis of Variables

1.1.1 Fixed Interval F-tests

As previously discussed, the original test on the data served as a first-pass estimation testing whether, as a whole, the regime periods differed systematically from one another. This was done by performing an F-test on both the log differenced data and the Hodrick-Prescott filtered data. The results are listed below in Tables 3.

Table 3.) Cross-Country Average P-values of Fixed-Period F-test

Variable	Comparison Periods					
	Fixed vs. Flexible		Fixed vs. Euro		Flexible vs. Euro	
	HP Filter	Log Diff.	HP Filter	Log Diff.	HP Filter	Log Diff.
Real Variables						
Exports $2000	0.542	0.434	0.499	0.435	0.465	0.823
Imports $2000	0.335	0.236	0.309	0.640	0.385	0.658
GDP $2000	0.201	0.089*	0.358	0.751	0.205	0.317
Industrial Production $2000	0.254	0.188	0.491	0.643	0.080*	0.128

Note: Critical Values are testing null-hypothesis that Variances are the same. Lower values indicate higher probability of behavioral shift in variables (* indicates significance at 10% level).

From this table it is possible to see that in real terms there is not compelling evidence of a systematic shift in the behavior of any of the variables. Only the tests of GDP for the Fixed versus the Flexible period and Industrial Production for the Flexible period against the Euro period showed significance at even the 10% level ($p = 0.089$ & $p=0.080$ respectively). One intriguing results from these tables occur where the Hodrick-Prescott filtered variables demonstrate more evidence of a systematic variance shift then the log differenced data by returning lower p-values. Therefore, it could be possible that when placing greater emphasis on the cyclical component (as the HP Filter is designed to do); there is more evidence of a change in the behavior of certain variables across the periods.

It is also interesting to note that using the log differenced data, the test of the fixed against the flexible period returns a lower p-value than when either period is compared against the Euro regime the in the majority of cases. Assuming that gradual shifts or trends in the data would show greater statistical difference between the fixed and flexible periods when tested against the Euro rather than against each other, this finding could be evidence of a behavioral change specific to the flexibility of the regimes rather than a long-term trend in the data.

It is important to note that idea is based on the assumption of more volatile nominal exchange rates under a floating rate regime, which may not always be the case assuming countries coordinate their monetary and fiscal policies. However, the figure below shows this assumption to hold true, which is important for the analyses performed throughout this paper.

Figure 1.) Rolling Variance of Nominal Exchange Rate for both LCU/USD & LCU/DM

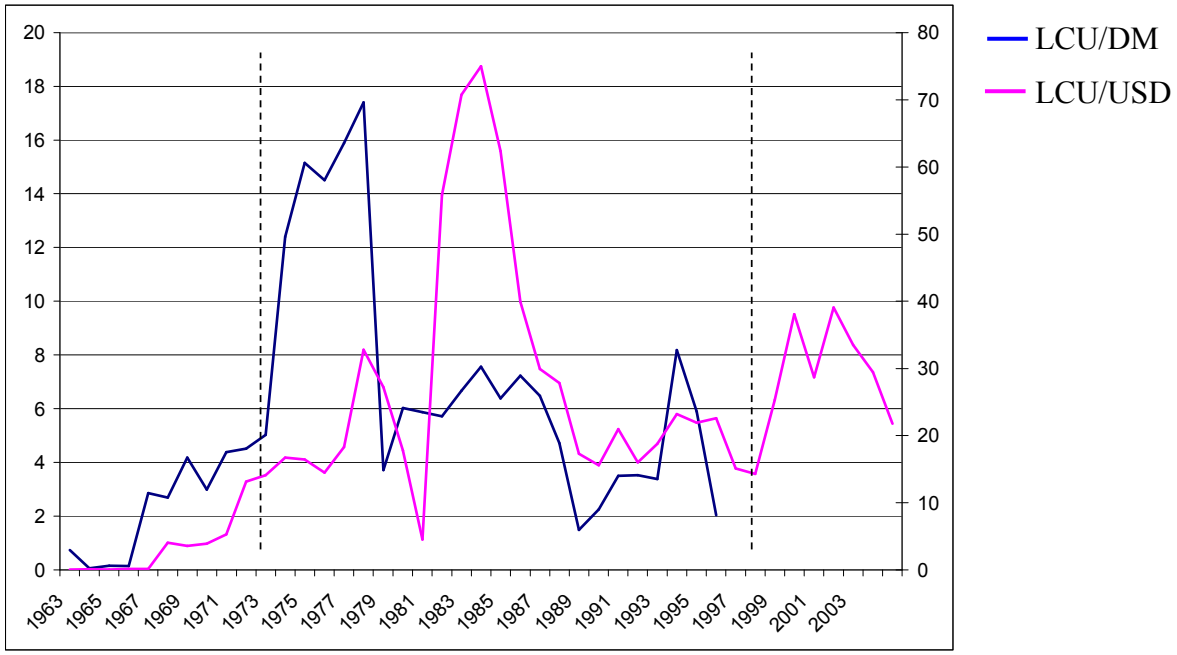


Figure 1 plots the median rolling variance value for the nominal exchange rate in terms of both Local Currency Units (LCU) per Deutschemark (DM) as well as LCU per US Dollar (USD)[7].

[7] Rate for LCU to USD and DM chosen to see behavior of European countries relative to EU's largest member as well as behavior relative to United States for comparison purposes.

The figure shows that for both exchange rates the period of highest volatility occurred during the Flexible rate period. Additionally, the Flexible period proves to be much more volatile as a whole than the fixed period. For the LCU/DM rate the variance of the Fixed period in it entirety is 1.45 compared to 4.15 for the Flexible period, and the LCU/USD rate has a variance of 4.11 for the Fixed period compared to 30.80 for the Flexible period.

1.1.2 Fixed-Interval Regression of Growth Variance

The second fixed-interval test applies the regression from equation (1) to the data, using dummy variables to examine whether the volatility of output growth of any one regime differs from the others. If the coefficients on the dummy variables are significant and different, then there is evidence that the volatility of the business cycle of the periods differed significantly from the volatility others. The results of these regressions are listed in table 4)

Table 4.) Fixed-Interval Regression Estimates

Country	δ0	δ1	δ2	Prob>F	Adj-R^2
Austria	0.25	0.29	0.10	0.17	0.04
	(0.16)	(0.20)	(0.18)		
Belgium	0.30	0.10	0.32	0.19	0.04
	(0.19)	(0.23)	(0.21)		
Finland	0.45	0.74	0.91	0.32	0.01
	(0.55)	(0.67)	(0.60)		
France	0.21*	-0.06	0.10	0.15	0.05
	(0.10)	(0.12)	(0.11)		
Germany	0.21	NMF	0.34	0.08	0.07
	(0.21)	NMF	(0.34)		
Greece	0.04	1.58	1.81	0.29	0.01
	(1.03)	(1.27)	(1.13)		
Ireland	0.83**	0.02	0.15	0.68	0.03
	(0.22)	(0.26)	(0.24)		
Italy	0.16	0.42	0.49	0.30	0.01
	(0.29)	(0.35)	(0.31)		

Table 4.) Cont'd.

Country	δ0	δ1	δ2	Prob>F	Adj-R^2
Luxembourg	1.43*	0.44	0.49	0.79	0.01
	(0.65)	(0.80)	(0.71)		
Netherlands	0.42**	0.17	-0.07	0.10	0.07
	(0.13)	(0.16)	(0.14)		
Portugal	0.44	0.69	1.36	0.20	0.03
	(0.75)	(0.91)	(0.81)		
Spain	0.06	0.59**	0.43*	0.03	0.13
	(0.17)	(0.21)	(0.19)		
United Kingdom	0.09	0.33	0.68*	0.03	0.12
	(0.25)	(0.31)	(0.28)		
Cross-Country Median	0.27	0.25	0.36	0.17	0.04
	(0.18)	(0.21)	(0.19)		
Cross-Country Average	0.39	0.43	0.58	0.16	0.04
	(0.27)	(0.33)	(0.30)		

*indicates significance at 5% level / ** for significance at 1% level

Based on the F-test probability values, these results do not provide conclusive evidence of regime choice having a significant effect on output volatility. However, there are several periods where the dummy variable is a significant predictor for output volatility. Most notably are Ireland and the Netherlands for the Euro period and Spain for the fixed period. All these figures achieve significance at the 1% level. However, the fact that results are not very robust (as Spain is the only country with more than 1 coefficient significant at even the 5% level) is not surprising since the F-test of the fixed regime periods on real GDP could not find evidence of a statistical difference in variance. Therefore, it is reasonable that the coefficients would generally not be strong predictors of output volatility (v_{yjt}) either.

Section 1.2.1 Rolling Interval Analysis of Variables

Moving to the rolling period analysis, the data was tested to find where any statistical changes in behavior occurred throughout the sample. To review, this was done performing, as a base-case, an F-test of a rolling 5-year interval against the rest of the sample to if the cyclical volatility of a macroeconomic variable changed significantly over any sub-periods of the sample. Sample intervals of 7 and 9-years were also applied to allow for more thorough analysis. Discussion begins with the results for Gross Domestic Product which contains several interesting features.

Chart i.) GDP 5-year Interval

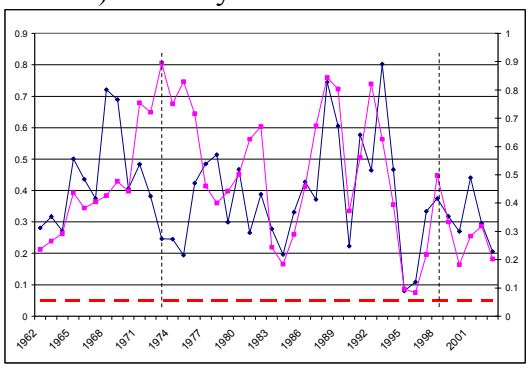


Chart ii.) GDP 7-year Interval

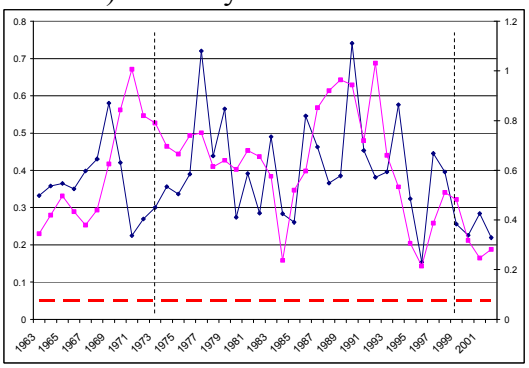
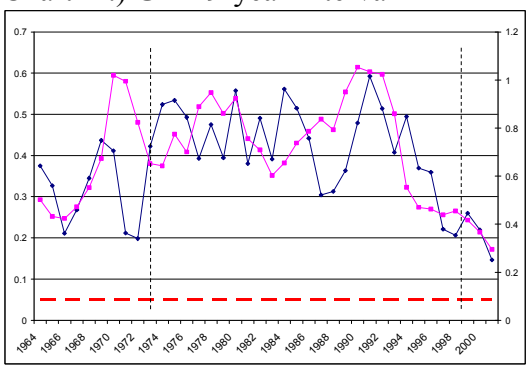


Chart iii.) GDP 9-year Interval



First, it is interesting to note that the two lowest p-values occur near the years of regime changes, in about 1975 and 1996 respectively, but neither can be considered significant at the 5% level. Only the second value in 1996 can even be considered significant at the 10% level. Also, it is important to compare these results to charts ii.) and iii.) which perform the analysis using a 7-year and a 9-year rolling interval. If either of the periods discussed earlier provided evidence of a prolonged change in behavior rather than a one-time variance shock, it would likely be possible to extend the test interval and still find evidence of a change in behavior. However, these charts demonstrate that the larger the size of the rolling interval, the smaller the probability there is that any period differed statistically. Therefore, the tentative conclusion is that real GDP data does not present strong evidence of a systematic change in behavior, since there is only one period of significance at even the 10% significance level (p=0.08) for the 5-year interval that cannot be considered at all meaningful when using the longer intervals.

Another interesting feature of the data is the general decline in variance that has occurred since the early 90's. This trend can be seen most clearly at the 9-year interval in chart iii.), which indicates that in real terms GDP is on average deviating from its long-term trend by a decreasing amount every year over this period. This finding is consistent with the emerging literature on a

"Great Moderation," discussing a trend of declining volatility in business cycle variation. (Stock and Watson, 2002). This phenomenon of business cycle variance moderation will be addressed further in Sections 3 and 4 of the paper.

The results from the rolling tests on Industrial Production exhibit different results from GDP, but do show significance at the longest interval length.

Chart iv.)
Industrial Production 5-year Interval

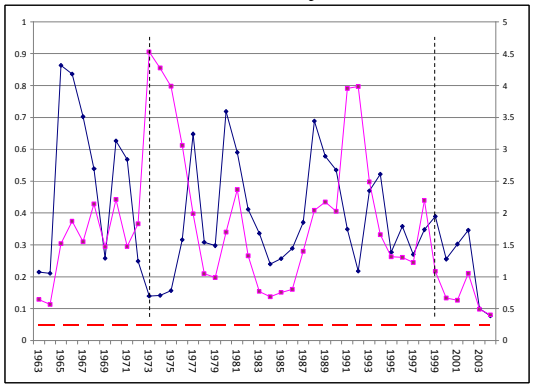


Chart v.)
Industrial Production 7-year Interval

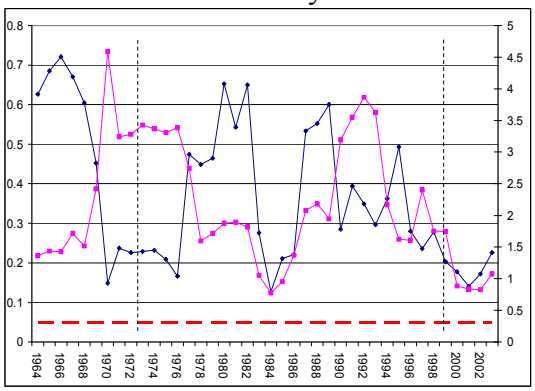
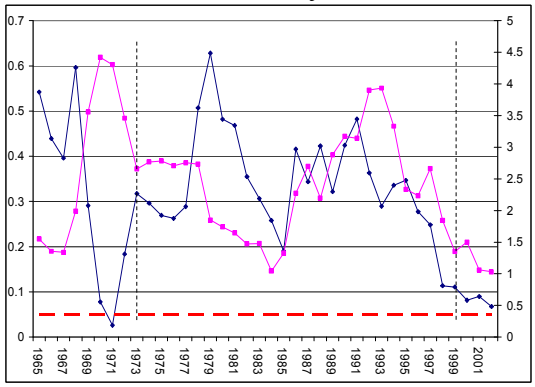


Chart vi.)
Industrial Production 9-year Interval



P-Values (Med)
Variance (Med)
5% Significance Level

Interestingly, Industrial Production does not exhibit any break points at even the 10% significance level until the 9-year interval is used. Using this interval it is even significant at the 5% level with a p-value of 0.026. This could be evidence of a more prolonged exchange rate regime effect, as it coincides with the regime shift from Bretton Woods to the flexible rate

period. However, given that oil is an essential input in the manufacturing of industrial goods, this figure will be examined more closely in Section 2 in attempt to parse out oil effects from the shock that occurred during this period.

The data for imports and exports; however, does show evidence of a statistic break even when applying multiple test interval lengths; as can be seen in the graphs below.

Chart vii.) Exports 5-year Interval

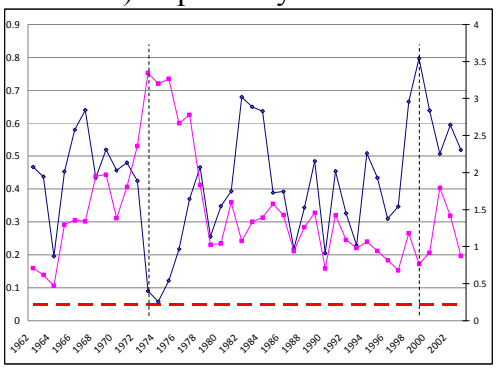


Chart ix.) Exports 9-year Interval

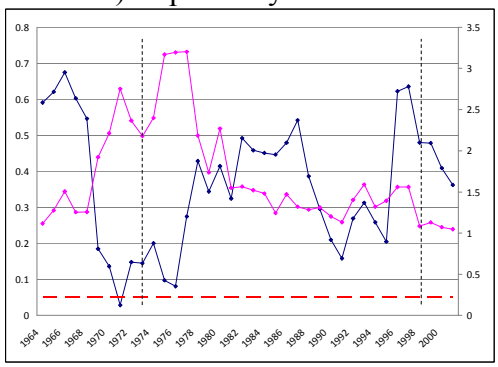
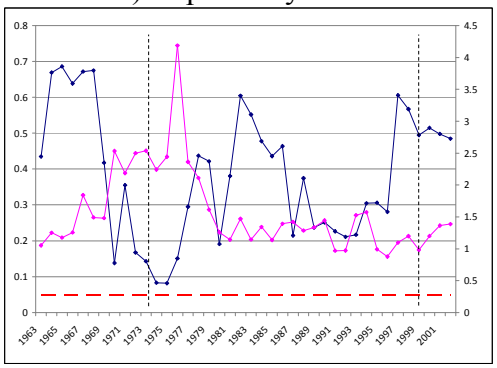
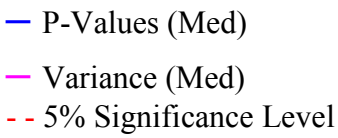


Chart viii.) Exports 7-year Interval





In real terms, exports exhibit a break period in the early 70's and it is interesting to note that this break becomes more significant at the largest test interval size. Using the 5 and 7-year intervals the break period is only significant at the 10% level with p-values of 0.057 and 0.083, respectively. However, for the 9-year interval the significance levels increase to the 5 % level with a p-value of 0.028. This increase in significance corresponding to the increased window size may signify that this period exhibited a meaningful, extended change in behavior. This higher

significance could indicate that the period being tested against the shorter intervals included some observations from the "break period" and therefore lowered the significance of the test. However, as with industrial production, this period corresponds to both the end of the Bretton Woods regime and the 1973 oil crisis. Therefore, exports will be examined further in Section 2 in order to see if this change in behavior is an oil induced effect, or if it may indeed be evidence of a regime effect.

Imports exhibit a similar trend to exports, and therefore merit a similar examination into the historical context of the period to make more definite conclusions about the cause and nature of these break periods observed in the data.

Chart x.) Imports 5-year Interval

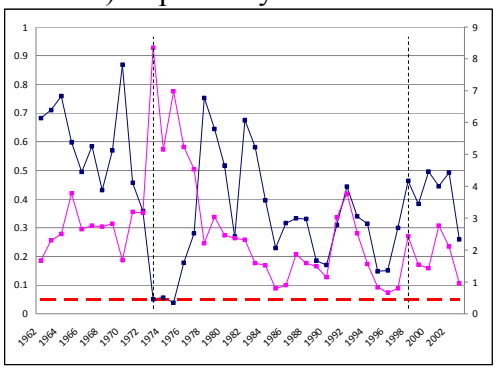


Chart xii.) Imports 9-year Interval

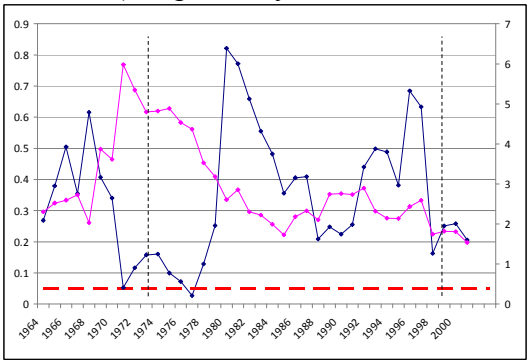
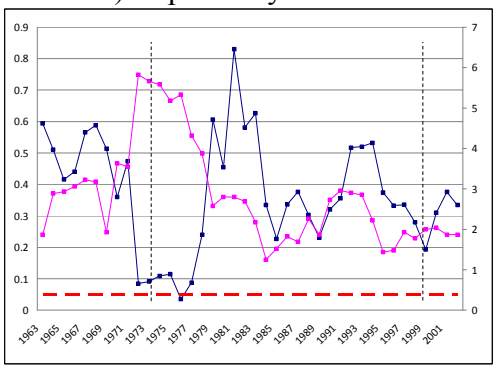
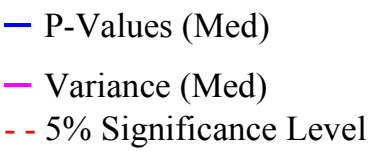


Chart xi.) Imports 7-year Interval





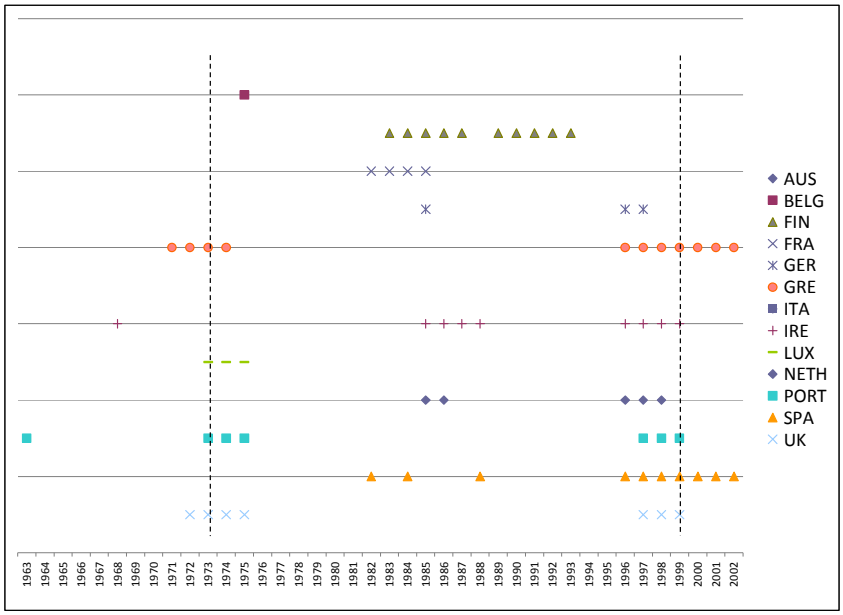
Imports reach a 5% significance level in the period centered on 1975 for the 5-year interval (p=.039) and 1976 for the 7-year interval (p=.035) and achieve the highest significance (p= .027) in the 9-year interval centered on 1977. Additionally, it is intriguing to note that in all intervals, the next lowest p-values correspond to the period around the adoption of the Euro. While none achieve significance at the 10% level, further analysis may be beneficial to see if this is simply coincidental or if evidence of a regime effect exists for both periods.

Section 1.2.2 Rolling Interval Analysis of Variables: A Country-Specific Study

While the initial rolling interval test is beneficial for the results of European Union behavior as a whole, it has the weakness of averaging out variance among countries and implicitly imposes a common break year on all countries. In other words, if 2 countries demonstrate a "break" in 1973 and 2 other countries break in 1975, both years may be averaged out to show no behavior change when using the median values; even though there were actually 4 countries exhibiting meaningfully different behavior. Therefore, this section reports the country-level F-test results to see if any break periods were overlooked using the cross-country median results from the previous section.

Looking at the results for GDP we see can see this phenomenon in the chart below. The chart plots all points where the 5-year rolling F-test for each country resulted in P-value of 0.05 or less.

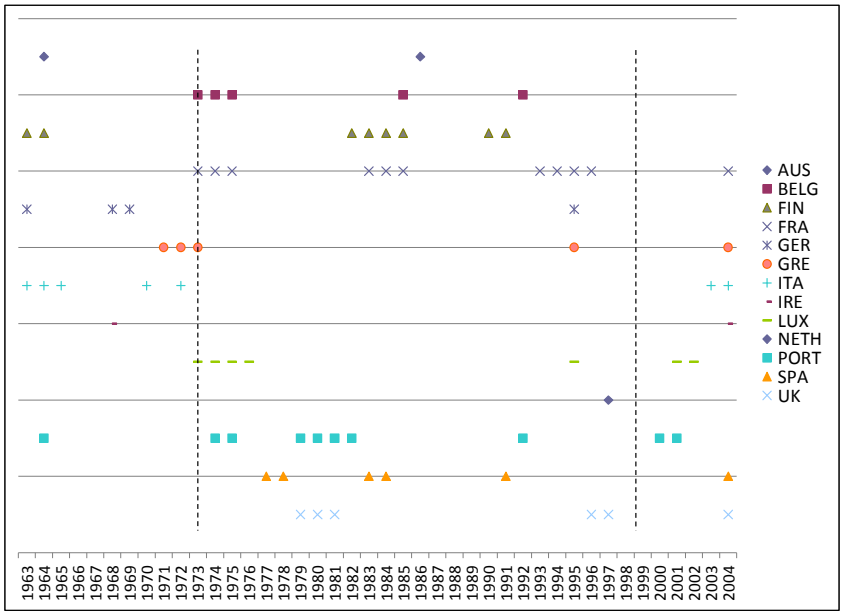
Chart xiii.) GDP Country-Level Break Periods (5% Significance)



Whereas no test intervals achieved 5% significance in the previous section ,when the cross-country results were reported, there are multiple countries that individually exhibited a behavioral break at this level of significance. Most notably are the groupings of countries surrounding the periods of regime change. Corresponding to the end of the Bretton Woods System there are 5 countries within 2 years of the regime change that are significant at the 5% level, while there are 7 countries that reach this significance level within the 1-year on either side of the adoption of the Euro. It is interesting to note how these break periods begin slightly before official implementation of the Euro in 1999; however, this is not surprising as the currency union was agreed on years before the implementation of the Euro. Therefore, it can be somewhat expected for countries to effectively function in the manner of a currency union even before the official start date.

Moving to Industrial Production, the results are not as stark as those for GDP in terms of exchange rate implications, but the idea of slightly varying break points is demonstrated well.

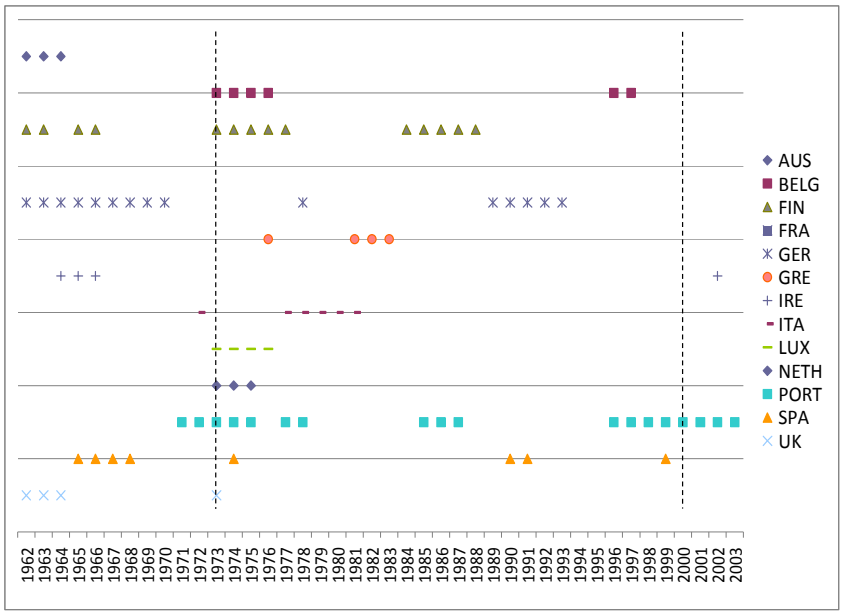
Chart xiv.) Industrial Production Country-Level Break Periods (5% Significance)



While there is again not significance at the 5% level using the cross-country results, there are 6 countries that demonstrate a break at the 5% level within 1-year on either side of the regime change from Bretton Woods. However, only half of these countries exhibit a break exactly on the regime change year, while the other half break the year before or after change. This may be in part why the results are most significant for industrial production, as well as imports and exports at the 9-year interval; it is the interval that best picks up all the varying "break-years," making the results more significant.

For Exports, the results of the country specific test are very impressive. Although the cross-country median result just missed significance at the 5% level corresponding to the end of the Bretton Woods System, there are 8 individual countries that demonstrate this level of significance for the same period.

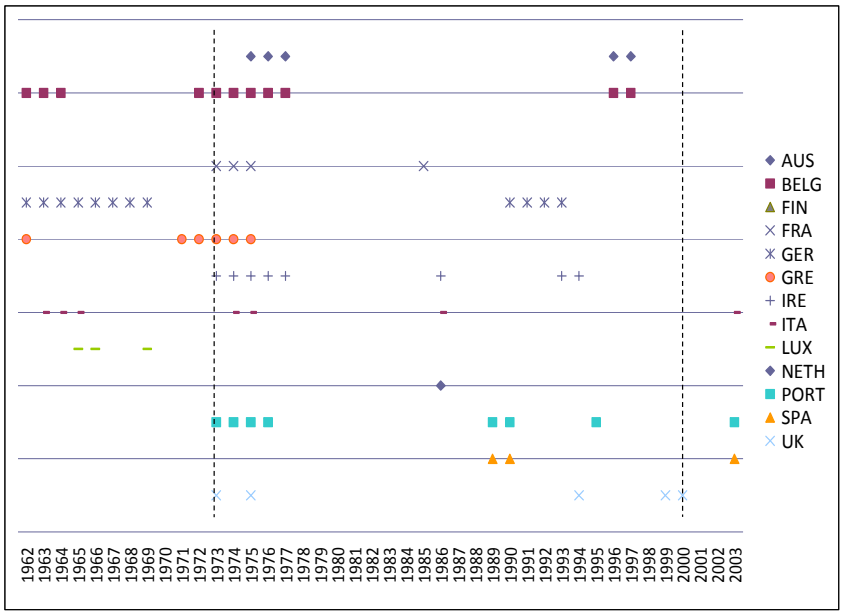
Chart xv.) Exports Country-Level Break Periods (5% Significance)



This result is important because it shows the impact that reporting the country-specific rather than cross-country results can have. By reporting the country-level tests, it is possible to allow for a degree of flexibility in country-specific response time to events as well as eliminate the muting of variance that comes from the inherent averaging in the cross-country results. In this case, it gives more conclusive evidence of a behavioral shift in Exports than was found using the previous method.

The same can be said of Imports where 7 countries exhibit a break on or within 1 year of fall of Bretton Woods. Additionally, it is possible to see the effect of a timing impact on the country specific level. Although many countries exhibit a "break" on the interval centered on 1973, it is also possible to see that several countries begin this behavior slightly before or after the regime change year. For example, Belgium and Greece begin their behavioral shift a year before the regime while Italy follows a year after the shift and Austria reacts two years after the break.

Chart xvi.) Imports Country-Level Break Periods (5% Significance)



These findings again are important because by examining the variance on a more individualistic level we are able to allow for the additional flexibility of slightly non-synchronous response time between countries. These features add even more flexibility to the original rolling test and provide a more in-depth look into the original rolling-interval results.

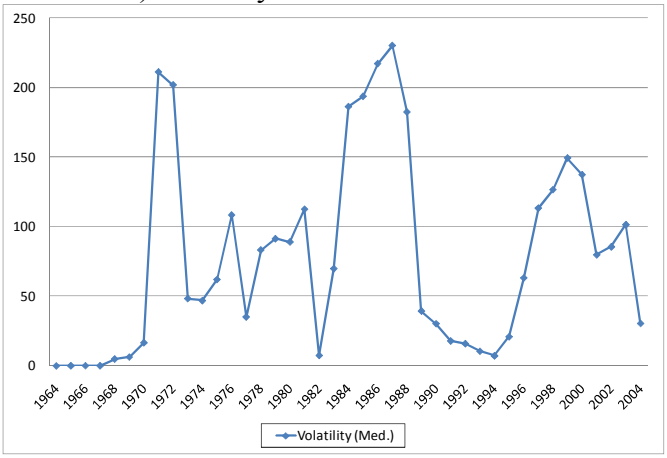
Section 2. Removing the Effects of Oil

Many of the variables studied in Section 1.2 demonstrated evidence of behavioral shifts corresponding to the period of regime change from Bretton Woods to the flexible period. However, given that this was also a period of significant oil price volatility due to the 1973 oil crisis, it is necessary to attempt to isolate the oil effects in order to see what, if any, exchange rate implications exist.

The first variable tested was Industrial Production due to the importance of oil as an input in its products. Chart xvii) tests the variance of relative growth in real oil price to

the real growth rate of industrial production. Specifically, the Y-axis measures the variance of the ratio of real oil price growth-over-real Industrial Production growth.

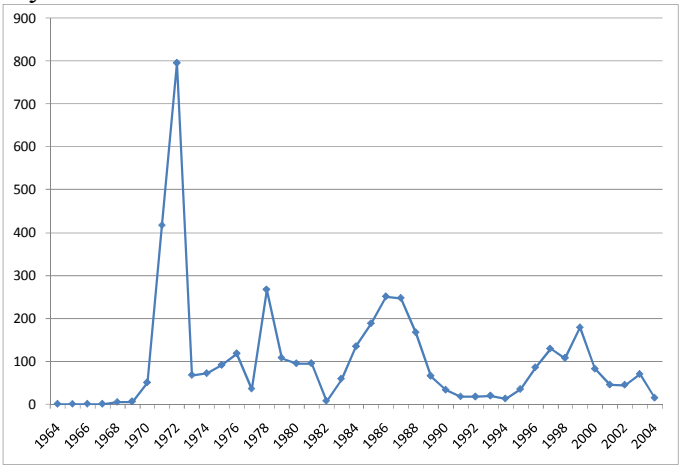
Chart xvii.)Volatility of Relative Growth in Real Oil Price[8]-to-Real Industrial Production



This graph appears to reinforce the idea that changes in the behavior of Industrial Production are closely related to oil shocks. The two points where volatility is the highest, meaning oil price growth is at its highest relative to industrial production growth correspond to both the "break point" around 1973 and the period in the 1980's where Industrial Production again demonstrates a change in behavior. (See 7-year test interval in Chart v.) Additionally, the "break point" stands out again when the rolling variance of oil price is compared directly to the rolling variance of industrial production below.

[8] Real Oil Price defined as Average nominal Price in $US divided by CPI deflato. Industrial Production Variance uses median variance figure.

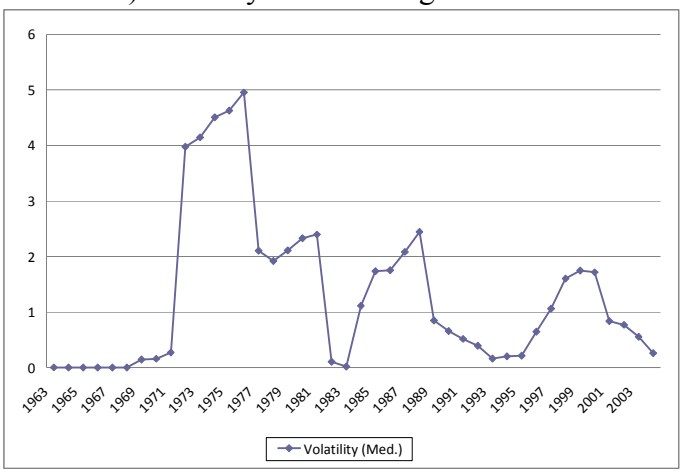
Chart xiix.) Relative variances Real Price of Oil and Industrial Production; 5-year interval



The variance of oil price relative to Industrial Production shows a dramatic spike in relative variance during the "break period" in the early 1970's. This may signify that although Industrial Production does exhibit evidence of a break coinciding with a regime change, it is likely coincidental and the changes in behavior are probably more reflective of an oil price shock rather than a regime specific effect.

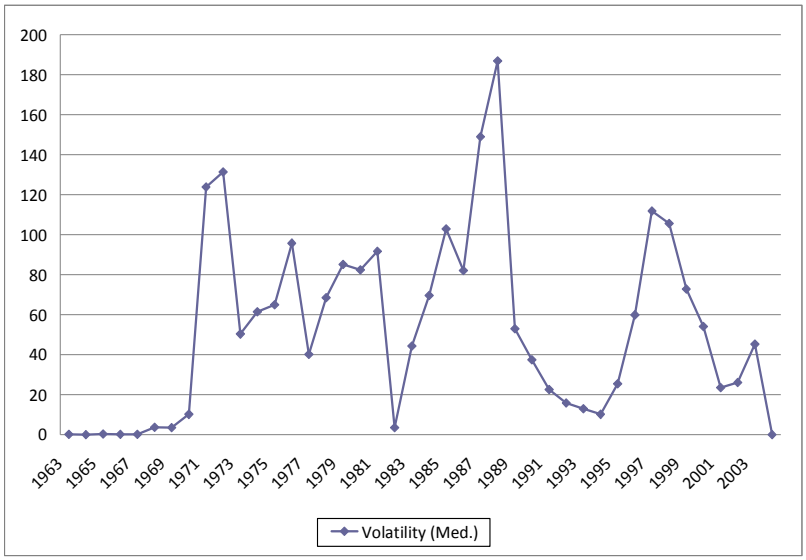
When applying the same tests of Relative growth volatility and Relative variance, the analyses yield similar results to the tests on Industrial Production, but have slightly different implications.

Chart xix.)Volatility of Relative growth in Real Oil Price-to- Real growth Exports



Note: Chart Plots volatility of ratio real oil-price growth/ Exports growth using 5-year Interval

Chart xx.) Relative variances of Real Price of Oil and Exports; 5-year interval

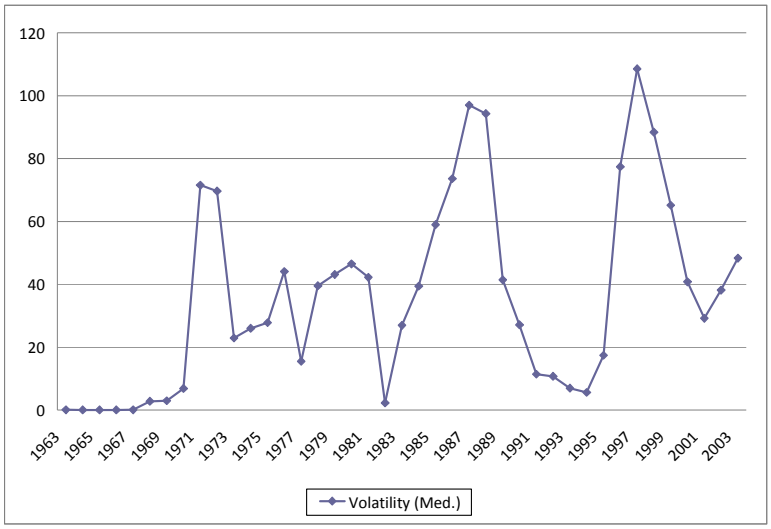


Note: Chart plots ratio of volatility of oil price over volatility of Exports using 5-year interval

Both figures show similar results to the industrial production test, in that real oil price growth and variance is at its highest relative to export growth and variance during the Oil-crisis in the 70's; however, there are other spikes in these figures that do not correspond to meaningful changes in export volatility. Also, in terms of their relative variance, oil price is actually most volatile relative to exports in the mid-80's. This suggests that oil may not be the driving factor since Export variance does not exhibit a change in behavior when oil price is at its most volatile relative to exports. This could be evidence of a regime specific effect on Exports, or at least an adjustment period, corresponding to the move from the Bretton Woods system to the largely flexible-rate period that followed.

Imports not surprisingly exhibit similar results to exports in that a spike occurs corresponding with the oil-crisis in 1973, but again it is not the largest spike in their relative variances.

Chart xxi.) Relative variances of Real Price of Oil and Imports; 5-year interval



Therefore, since the impact on import behavior in this period seems to exceed the size of the shock, based on the relationship between oil price and import variance throughout the rest of the sample, this may be evidence of an exchange rate regime effect on imports. Again, as with exports this may be an adjustment or type of market correction as exchange rates adjust to the appropriate levels in the new flexible regime, but there is evidence of exchange rate choice impact on this "break-period" for both imports and exports.

This analysis of the impact of oil is useful because it shows that while the behavior of Industrial Production appears to be very closely linked to the real price of oil, imports and exports move more independently. This is not surprising due to the direct correlation between the cost of producing the goods that comprise the Industrial Production and oil price; however, it does provide more compelling evidence of a change in import and export behavior corresponding to a regime change

Section 3. Common and Idiosyncratic Variance of European Union

The next test performed regressed each country's individual growth rate against the weighted average "world" growth rate (is actually weighted average growth rate of sample countries). The regression equation and results are listed below where y_{jt} represents the log difference growth rate, w_{jt} represents the weighted average world growth, and v_{jt} is the error term representing the idiosyncratic growth that cannot be explained by the world growth rate. The regression results are listed below in tables 5.) and table 6.).

Table 5.) – Regression Estimates

$y_{jt} = b_0 + b_1 w_t + v_{jt}$

Country	b_0	b_1	R-squared	Prob > F	Prob > chi2
Austria	0.196	0.875	0.577	0.000	0.297
	(0.165)	(.114)			
Finland	0.257	0.881	0.250	0.005	0.602
	(0.233)	(0.337)			
France	0.072	1.001	0.844	0.000	0.483
	(0.096)	(0.066)			
Germany	-0.157	1.050	0.681	0.000	0.800
	(0.149)	(0.127)			
Greece	-0.245	1.469	0.413	0.000	0.036
	(0.387)	(0.267)			
Ireland	1.954	0.110	0.005	0.660	0.927
	(0.362)	(0.249)			
Italy	-0.222	1.179	0.708	0.000	0.206
	(0.167)	(0.115)			
Luxembourg	0.664	0.820	0.168	0.005	0.553
	(0.404)	(0.278)			
Netherlands	0.082	0.939	0.555	0.000	0.002
	(0.186)	(0.128)			
Portugal	-0.342	1.551	0.615	0.000	0.245
	(0.271)	(0.187)			
Spain	0.052	1.306	0.626	0.000	0.019
	(0.223)	(0.154)			
United Kingdom	0.276	0.605	0.300	0.000	0.549
	(0.204)	(0.141)			

Table 6.) - Robust Estimates

$y_{jt} = b_0 + b_1 w_t + v_{jt}$

Country	Observations	b_0	b_1	prob > F
Greece		-0.512	1.716	0.000
		(0.318)	(0.219)	
Netherlands		0.826	0.699	0.021
		(0.291)	(0.422)	
Spain		0.102	1.261	0.000
		(0.218)	(0.150)	

Table 6.) List robust regression results for all country's that whose Breusch-Pagan / Cook-Weisberg test for heteroskedasticity resulted in p-values of below 0.05 signifying heteroskedasticity was present in data. For the remainder of the paper, these robust figures will be used for Greece, The Netherlands and Spain, but the original regression results will be used for all other countries.

The results of this regression are not extremely surprising in terms of the coefficients; however, the fact that the Ireland coefficient has such an insignificant p-value when regressing on world growth is interesting. Also, the fact that all but one of the other coefficients have such highly significant p-values (over 99% confidence level) is intriguing, but the fact the figures are significant is not surprising. Intuitively, it would seem that the weighted average growth for the European Union would be a significant

factor in explaining the growth of its member countries. Beyond this, the coefficients for b_1 seem largely reasonable in terms of both signs and magnitudes. All are positive, as discussed in the data section, because it is unlikely any country would systematically move opposite to the rest of Western Europe. Also, the largest coefficients belong to (in order) Greece, Portugal, Spain, and Italy. This is somewhat expected as these countries are historically know for their volatile growth patterns. The coefficients closest to unity belong to Germany and France which is also logical because these are the two of the largest weighted countries in the average. Therefore, it makes sense that each would have a coefficient very close to 1 due to their output comprising almost half of the average (47.0% using post-1971 weight). The coefficient that is most surprising is the United Kingdom. The UK has a greater weight than France, but it has the second lowest coefficient ahead of only Ireland. This indicates that either the United Kingdom behaved more independently from the other sample countries, or it demonstrated a low growth rate relative to the rest of the EU members. To test this hypothesis each country's total variance was decomposed into the portion attributable to the variance of the world component and the portion attributable to the variance of the idiosyncratic component. The results of this decomposition are expressed as percentages in the table below.

Table 7) Variance Decomposition by Country

Country	Variance Y_t	Variance From World Component*	Variance From Idiosyncratic Component**
	δ_{Yt}^2	$B_1^2\delta_{Yw}^2$	$\delta_{\varepsilon t}^2$
Austria	0.642	57.93%	42.26%
Finland	1.511	24.97%	75.05%
France	0.585	83.28%	15.56%
Germany	0.555	68.09%	31.92%
Greece	2.538	41.32%	58.70%
Ireland	1.307	0.45%	99.55%
Italy	0.954	70.79%	29.20%
Luxembourg	1.947	16.78%	83.20%
Netherlands	0.772	55.52%	44.52%
Portugal	1.902	61.46%	38.52%
Spain	1.323	62.65%	37.40%
United Kingdom	0.592	30.06%	69.96%

Uses identity $Var(y_t)=\beta_1^2 var(y_w)^2+var(\varepsilon_t)^2$

This table supports the theory that the low coefficient on UK and Ireland is a result of their more independent behavior since 70% and almost 100% of their variance is attributable to their respective idiosyncratic movements. This table is also interesting in that France and Germany have two of the highest percentages of variance attributable to world growth. As mentioned before, this is due in part to their large weights in the calculation of the world component, but may also be indicative of their political and economic importance in Europe (meaning that the behavior of these two countries is likely to impact the group as whole).

This relative independence of England and insignificant coefficient on Ireland is interesting because as studied by Baxter and Stockman (1988), Ireland fixed its currency to the British pound until 1979, but even after removing this peg, still performed more similarly (at least in terms of real exchange rate) to the United Kingdom than to Germany. Additionally, the correlation between industrial production for Ireland and the United Kingdom actually rose after Ireland abandoned its peg [9]. Given the hypothesis that the low coefficient on the United Kingdom represents a difference in behavior from the

[9] Baxter-Stockman (1988).

rest of Europe, the low coefficient on Ireland may be based on two factors. The first is a similarity in behavior to the United Kingdom, therefore making the average weighted growth figure a poor explanatory variable (except for the percentage attributable to the UK), and the second is its relatively small weight (less that 1% post-1971) in the calculation of the average. Therefore, assuming it behaved differently from the continental European countries and given its small effect on the weighted average growth, the world growth figure would likely account for a small portion of Ireland's growth.

. When the rolling F-test and variance measures are applied to the results from the regression there are several interesting features.

Chart xxii.)
Idiosyncratic Variance 5-year Interval

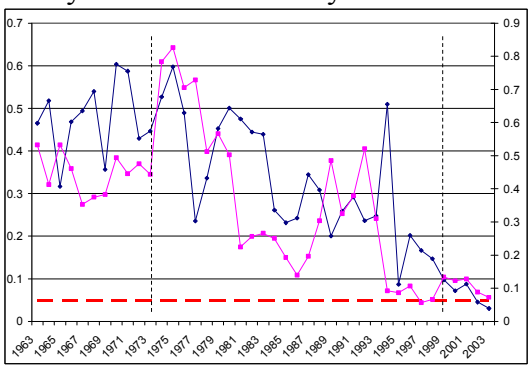


Chart xxiii.)
Idiosyncratic Variance 7-year Interval

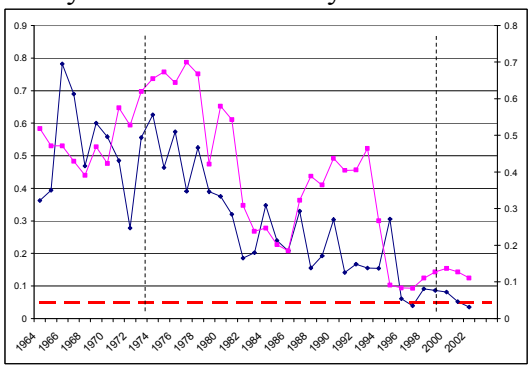
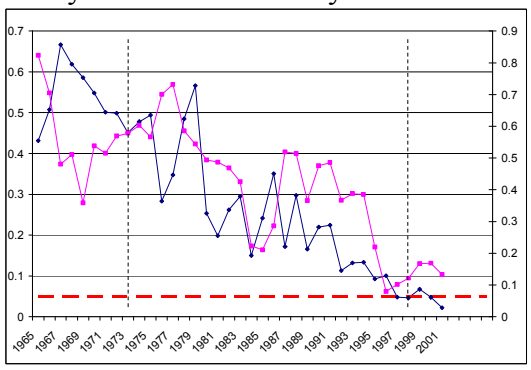


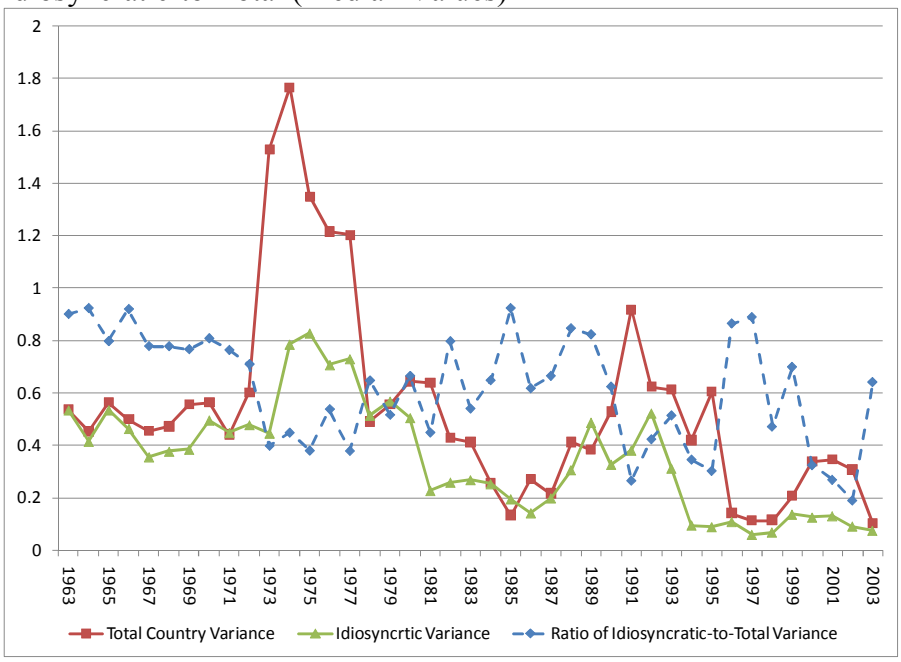
Chart xxiv.)
Idiosyncratic Variance 9-year Interval



P-Values (Med)
Variance (Med)
5% Significance Level

First, is the robust decrease in variance throughout the sample that becomes even more striking as the size of the interval used increases. There are two possible interpretations of this finding. The first relates to the idea of a "Great Moderation" in business cycle volatility. This suggests that while country specific variance is decreasing it may simply be a proportionate result of a larger, global trend of variance moderation. The second, and more interesting, interpretation suggests that this decline in idiosyncratic variance may be evidence of an increasingly international business cycle where countries function more relative to the whole and exhibit less independent growth. In order to examine these hypotheses, the figure below plots the median values for total country variance, idiosyncratic country variance, and the ratio of idiosyncratic-to-total variance.

Chart xxv.) Variance Decomposition: Total, Idiosyncratic, and Relative Variance of Idiosyncratic-to-Total (Median Values)



This figure clearly shows a decline in variance for both the Total Country growth variance (idiosyncratic variance plus variance due to the world component), as well as the country-specific variance. However, although it seems to be fluctuating around a roughly

stationary level using the 5-year interval, the ratio of idiosyncratic-to-total variance does exhibit a downward trend at the 9-year interval. While this does not provide strong evidence of a change in relative idiosyncratic variance based on a structural change, it still provides evidence of a "Great Moderation" in business cycle volatility for the EU. More notably, the period preceding the Euro is of interest due to the sharp decrease in both total and idiosyncratic variance. This period merits further study as it may be an effect of these countries altering their behavior in preparation for the coming currency union. Section 4 attempts to analyze this phenomenon using a more global perspective to see if this is indeed an EU specific event.

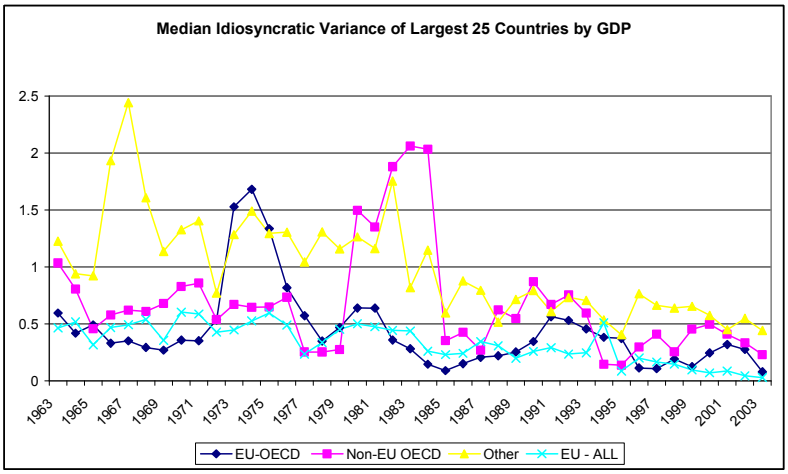
Section 4. Global Variance Decomposition and the Great Moderation

4.1 Common and Idiosyncratic Variance: A Global Perspective

This section uses the same regression employed in Section 3 however the sample is expanded to the 25 largest countries by GDP[10] as of year-end 2007. This sample is chosen to create a peer group for comparison against the large, highly developed economies of the EU member countries. The world sample is divided into 3 groups: EU & OECD Member Countries, Non-EU OECD Member Countries, and Other. Repeating the regression at a global level is significant because it allows comparison between the EU behavior and that of various peer groups in order to see if the observations from Section 3 are unique to the EU or merely reflective of a global trend. The figure below shows the 5-year rolling variance of these groups as well as the EU variance from the original regression (Labeled: EU-ALL).

[10] Actually 25 of 32 largest countries due to data availability issues and complications such as countries that were members of Soviet Union for the majority of the sample period.

Chart xxvi.) World Idiosyncratic Variance of 25 largest GDP's; 5-year Interval



These results show that the decline in variance observed in the original analysis of the EU countries alone is likely not indicative of a regime specific effect, but rather an effect of an international integration and moderation of business cycles. This is further reinforced by an analysis of the rolling variance of the global weighted average.

4.2 The Great Moderation: Analysis of Variance of World Growth

Literature published in recent years has introduced the phenomenon of a "Great Moderation" in business cycle variance. In order to test these findings, a rolling variance was taken of the 25-country global sample weighted average. The results for the 5, 7, and 9 year intervals are shown in the charts below.

Chart xxvii.) Variance of World Business Cycle; 5-year Interval

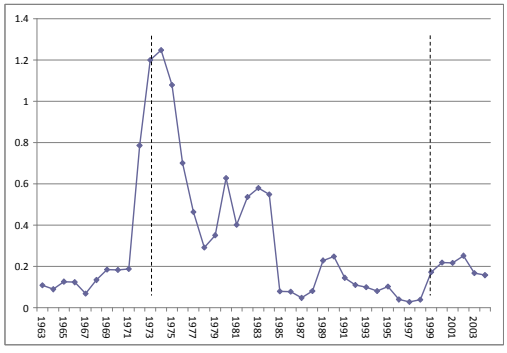


Chart xxiix.) Variance World Business Cycle; 7-year Interval

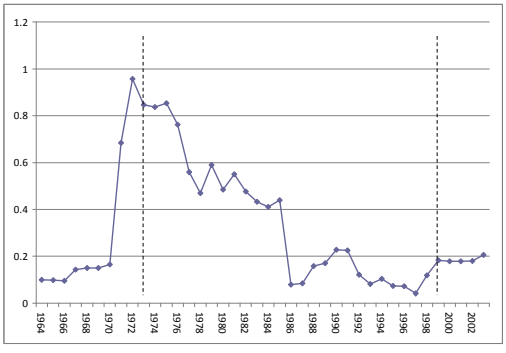
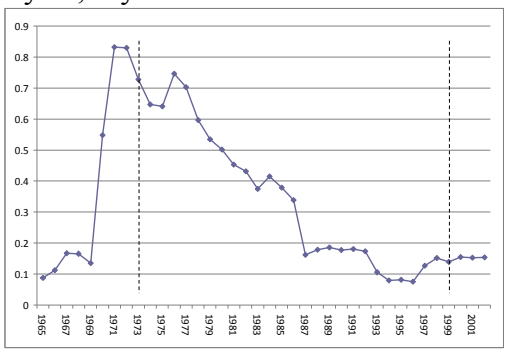


Chart xxix.) Variance of World Business Cycle; 9-year Interval – Weighted average Variance



While these results are somewhat ambiguous using the 5-year test intervals, the longer interval lengths clearly show evidence of volatility moderation. In the 9-year interval, there is almost a perfect linear decline in variance following the spike in the early 1970's until around the adoption of the Euro[11]. However, at this point there appears to be a plateau and then an increase in the variance of the weighted average. One interesting explanation for this is that the period marks some type of structural change in the co-movement or the integration of countries.

The intuition behind this can be described using the analogy of a financial portfolio. The total variance of the portfolio relates not only to the variance of the individual components, but also their covariance. The same logic applies to the sample countries. The weighted average variance depends not only on the variance of the individual member-countries but also their integration (covariance). Using a simplified example of a two-country "world", the world variance is the sum of the individual country variances plus two times their covariance, or as an equation:

$Var(Y_w)=var(c_1)^2+var(c_2)^2+2covar(c_1,c_2)$.

[11] As previously discussed this increased "smoothing" of the variance is a result of the larger sample sizes averaging out the variance shown using the smaller intervals.

Therefore, an increase in covariance between countries actually leads to an increase in total variance. This total variance analysis leads to two possible interpretations for the rise in variance at the end of the sample. Both depend on the idea that while individual country variance was decreasing, the covariance was increasing. The first interpretation is that throughout the sample, country variance is falling at a diminishing rate while covariance between countries continues to increase at a roughly constant rate via international integration. Therefore, the plateau and increase at the end of the sample could be evidence of an inflection point between the two. At this point, the increases in covariance have a greater upward effect on total variance than the downward pressure from the diminished decreases in individual country variances. The second interpretation may be more plausible when looking at the linear rather than parabolic slope of the variance decrease; as a diminishing rate of individual country variance decrease would suggest a parabolic shape. Therefore, this upward movement at the end may be evidence of a structural shift which could possibly suggest an increase in correlation relating to the adoption of the Euro. However further analysis is clearly needed to see if, firstly, this increase is meaningful and then to ascertain a cause.

Conclusion

While evidence of structural changes over the sample period do exist, it is not possible to determine a first-order relationship between exchange rate regimes and the behavior of any of the aggregates studied. The figures that demonstrate the strongest evidence of a regime effect are Imports and Exports. Both figures have a variance "break point," or a period of behavior that systematically differs from the rest of the sample, that coincides with the regime change from the Bretton Woods System to the flexible-rate period. When the rolling interval test was applied at

the country-specific level the results for these periods became even stronger as 8 countries for Exports and 7 countries for Imports demonstrated a break period at the 5% significance level or greater within 1 year of the regime change. Additionally, when studied in relation to the oil-crisis of 1973 these periods still demonstrated a disproportionately large difference in behavior during this period. This finding may be indicative of a regime specific effect; or at very least a market correction as exchange rates were made more flexible and allowed to reset to more appropriate levels.

The regressions examining world growth in Sections 3 and 4 showed evidence of increasing international integration of business cycles in the EU that is mirrored at a more global level when compared against a regression of the 25 largest countries by GDP. Additionally, there exists evidence of a possible structural change occurring around the implementation of the Euro. Although additional work is necessary to determine if the increase in business cycle co-movement of this period is meaningful, this study suggests a possible increase related to the creation of the Euro currency union.

Further study of this paper could focus on these country specific findings; specifically what constitutes a true "break" in behavior. This research could address the question of how many countries must "break" to signify a break period. Must all countries exhibit a change in behavior for it to be a true break? Is changing behavior in half of the countries meaningful? And so on. A scientific method to qualify these results could be extremely beneficial, as even GDP appears to demonstrate some level of exchange rate choice effect due to its grouping of break points around both regime change periods. Also, work could be done specifically on the "break period" observed for Imports and Exports. This period could be analyzed in order to more fully parse out the effects of the oil crisis and see if this phenomenon is the result of general economic

turbulence, evidence of a one-time exchange rate correction, or evidence of a more meaningful change in behavior due to the adoption of a more flexible global exchange rate regime.

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