The Journal of Private Enterprise 30(2), 2015, 61–82

The Empirical Volatility-Growth Relationship: Is Economic Freedom the Missing Link?

John W. Dawson*
Appalachian State University

Abstract
This paper examines the role of economic freedom in the empirical relationship between business cycle volatility and long-run growth across countries. In a diverse sample of ninety-nine countries, accounting for economic freedom's influence on volatility mitigates or even eliminates the negative impact of volatility on growth. Evidence also suggests that the impact of volatility on growth is not homogeneous across countries at different levels of freedom. In particular, volatility has a negative impact on growth only in countries at very low levels of economic freedom. Mixed results in previous studies suggested a more complicated relationship between volatility and growth, but there was no clear evidence that economic freedom was the missing link.

JEL codes: E32, O43
Keywords: business cycles, volatility, growth, economic freedom

I. Introduction

Ramey and Ramey (1995) is widely regarded as the benchmark empirical study of the relationship between business cycle volatility and long-run economic growth. The Rameys report a negative relationship between volatility and growth in a broad cross-section of countries. A number of more recent studies confirm the finding of a negative volatility-growth relationship, including Martin and Rogers (2000), Fatas and Mihov (2003), Mobarak (2005), Badinger (2010), and Furceri (2010). Still other recent studies, however, report a positive relationship; see, for example, Stastny and Zagler (2007) and Lee (2010). Two studies that predate Ramey and Ramey—often ignored in this literature—also examine the volatility-growth relationship. In their broad search for determinants of cross-country

* I am grateful to Jim Gwartney, Mark Strazicich, session participants at the 2014 annual meetings of the Association for Private Enterprise Education in Las Vegas, and two anonymous referees for helpful comments that improved the quality of this paper. Any remaining errors are my own.

growth, Kormendi and Meguire (1985) and Grier and Tullock (1989) find evidence of a positive relationship between volatility and growth.

At first glance, it seems that the available evidence on the empirical relationship between volatility and growth is contradictory. A closer look at the evidence, however, reveals some interesting patterns in the data. First, Ramey and Ramey's finding of a negative relationship in a ninety-two-country sample becomes positive and statistically insignificant when their sample is restricted to countries belonging to the Organisation for Economic Co-operation and Development (OECD). Similarly, Kormendi and Meguire's positive relationship is obtained in a sample of forty-seven mostly developed countries, and the positive relationships found in the studies by Stastny and Zagler and by Lee are obtained in samples restricted to OECD and Group of 7 (G7) countries. In addition, Dawson and Stephenson (1997) find no evidence of a volatility-growth relationship across the U.S. states. All of this information suggests that the generally accepted negative relationship between volatility and growth may not be an accurate description of the process at work in more developed economies.

It is interesting to consider which characteristic of more developed economies drives this pattern. Specifically, this paper considers whether the volatility-growth relationship varies with levels of economic freedom across countries and whether volatility is serving as a proxy for economic freedom in studies of the volatility-growth relationship. It is well known that economic freedom is an important determinant of growth across countries; see, for example, studies by Dawson (1998) and by Gwartney, Lawson, and Holcombe (1999), among many others.[1] More recently, Lipford (2007) and Dawson (2010) have shown that economic freedom is also related to business cycle volatility across countries. It is possible, then, that volatility is serving as a proxy for economic freedom in studies of the volatility-growth relationship that do not explicitly control for differences in freedom across countries. It is also possible that volatility and growth are positively related or unrelated in countries with higher levels of economic freedom and negatively related in countries with lower levels of freedom. Such possibilities could explain why volatility and growth are negatively related in diverse samples of countries, but found to be positively related or

[1] De Haan, Lundstrom, and Sturm (2006) and Hall and Lawson (2014) provide useful surveys of the large literature on economic freedom and growth.

insignificant in samples restricted to more developed countries where freedom is at a higher and more uniform level. It can also explain why volatility and growth are not related across the U.S. states where freedom is also at a higher and more uniform level.

Evidence provided by Grier and Tullock also supports this conjecture, where a positive volatility-growth relationship is found in a large, diverse sample of countries using a specification that includes several institutional proxies—and the size and significance of the volatility coefficient is reduced when an explicit measure of institutions is included. Studies that find a negative relationship between volatility and growth in broad samples of countries may also be consistent with the idea that economic freedom matters in the volatility-growth relationship. If such studies ignore the role of freedom, the analysis may attribute to volatility the influence that is actually due to freedom.

This paper explores the possibility that economic freedom is the missing link in the relationship between macroeconomic volatility and economic growth. The next section provides a brief theoretical perspective on the volatility-growth relationship. The third section discusses the empirical model, methodology, and data in detail. A discussion of the empirical results appears in the following two sections, and the final section offers concluding remarks.

II. Volatility and Growth: A Brief Theoretical Perspective

In terms of theory, relatively little attention has been paid to the effect of business-cycle volatility on long-run economic growth. Indeed, the literatures on business cycles and economic growth have existed largely in isolation from one another. There are reasons, however, to believe that volatility and growth may be related. For example, economic uncertainty and credit constraints during periods of increased macroeconomic volatility may reduce investment, capital accumulation, and presumably growth. Along similar lines, if investment is to some extent irreversible, increased volatility can lead to lower investment and thus lower growth; see, for example, Bernanke (1983). Both of these channels suggest a negative relationship between volatility and growth.

There are also reasons to suspect a positive relationship between volatility and growth. Black (1987) suggests that economies face a positive risk-return trade-off where riskier technologies (that ultimately lead to higher volatility) are adopted only if they are expected to pay a higher return and hence produce higher growth

rates. Separately, Sandmo (1970) and Mirman (1971) hypothesize that more variable income streams lead to higher savings, more investment, and presumably more growth. These channels both imply a positive volatility-growth relationship.

Clearly, there are different possible channels through which volatility may affect growth, some with positive and some with negative predicted relationships. In addition, different channels may be dominant in different economies, causing different estimated relationships in different groups of countries. Which channel dominates in an economy may well depend on certain characteristics in that economy. In particular, different institutional arrangements may determine which channel is dominant. For instance, economies with more market-oriented institutions (i.e., more economic freedom) may be able to adjust to volatility more readily, thus mitigating the negative effect of volatility on investment. This arrangement may, in turn, result in a statistically insignificant or positive estimated volatility-growth relationship in high-freedom countries. Similarly, myopic behavior in countries with low levels of economic freedom may dampen precautionary saving motives even in times of high volatility, thus reducing the positive influence of volatility on growth. This structure could leave a negative volatility-growth relationship at work in these countries.

While the preceding theoretical discussion is obviously far from complete, the point is to illustrate that theory alone cannot settle the debate over the relationship between volatility and growth. Moreover, the question of which theoretical relationship emerges in an economy may depend on the institutional framework. Ultimately, it is an empirical issue. The analysis in the remainder of the paper addresses this empirical question.

III. Empirical Model, Methodology, and Data

The following empirical specification is typical of that used in studies of the volatility-growth relationship:

$$\Delta \ln y_i = \alpha + \lambda \sigma_i + \Sigma_j \beta_j X_{ji} + \varepsilon_i.$$

The dependent variable, $\Delta \ln y$, is the average annual growth rate of real GDP per capita. X_j represents a common set of conditioning variables found by Levine and Renelt (1992) to be robustly related to growth. These conditioning variables include the initial income level, the investment share of GDP, and population growth. σ is the volatility measure and λ is the coefficient of interest. This basic specification is used as a starting point in the analysis that follows.

The explanatory variable of interest, macroeconomic volatility, is measured using the standard deviation of annual growth rates of real GDP per capita. This is a standard measure of business cycle volatility that has been used in a number of recent studies, including the pure cross-section specification in Ramey and Ramey. This volatility measure implicitly assumes that the trend growth rate is constant and equal to the mean for each country.[2]

To determine whether the volatility-growth relationship varies across countries with different institutional environments, measures of economic freedom are added as explanatory variables in the specification above. In regressions that include economic freedom, both the initial level of freedom and the change in freedom over the sample period are included. Changes in economic freedom have been shown to be important, along with the level of freedom, in explaining long-run growth experiences across countries in a number of studies (see, e.g., Dawson [1998]).

In addition, Pitlik (2002) shows that a measure of the volatility of economic freedom over time is negatively related to long-run growth rates across countries even after controlling for other factors related to growth, including the level and changes in freedom. This result shows that volatile liberalization policies depress growth even when they generally tend toward increased levels of economic freedom. It seems particularly important to control for volatility in the path toward freedom in the analysis that follows, given that the focus of the analysis is on macroeconomic volatility more generally. Thus, a measure of the volatility of economic freedom over the sample period is also included (along with the initial level and change in freedom) in regressions that explicitly control for economic freedom. Pitlik shows that the appropriate measure of volatility is the standard deviation of the time series of changes in economic freedom over the sample period. More specifically, for the time period 0, . . ., T in a given country, define:

---

[2] An alternative measure of volatility is the standard deviation of the output "gap" measured as the difference between actual and trend real GDP per capita, where the trend is obtained using a smoothing method such as the Hodrick-Prescott filter. This method allows for a time-varying trend for each country, whereas the standard deviation of growth rates implies a constant trend. Each method has benefits and costs depending on the exact nature of a given country's growth path. In practice, however, the two volatility measures are highly correlated and provide qualitatively similar results in the analysis here. Thus, only the results using the standard deviation of annual growth rates are reported in this paper.

$$SDEF = \sqrt{\frac{1}{T}\sum_{t=1}^{T}\left(\Delta EF_t - \frac{1}{T}\sum_{t=1}^{T}\Delta EF_t\right)^2},$$

where EF_t is a measure of economic freedom and $\Delta EF_t = EF_t - EF_{t-1}$. This measure of the volatility of freedom is used in the analysis that follows whenever measures of freedom are included as explanatory variables.

The data on economic freedom used in the analysis are from the Economic Freedom of the World (EFW) index from Gwartney, Lawson, and Hall (2011). The EFW index is based on the classical conception of individual liberty, which emphasizes personal choice, private property, and freedom of exchange. The EFW index encompasses five areas of freedom, which are aggregated into a single summary index of economic freedom.[3] Within each area, various underlying components are equally weighted to construct an area index. Then, equal weight is given to each of the five area indexes to construct the summary EFW index (i.e., the five area indexes are averaged). The index is available for a large number of countries in five-year intervals from 1975 through 1995, and annually since 1995. The analysis in this paper uses the EFW "chain" index, which Gwartney, Lawson, and Hall suggest is the most consistent version of the index over time.

The empirical methodology used in this paper is cross-country regression analysis. The analysis is strictly cross-sectional, with only one observation for each country. The sample includes ninety-nine countries over the period 1980–2009. The analysis also controls for the possibility that macroeconomic volatility is endogenous. As discussed earlier, the volatility of growth has been shown to be systematically related to levels of economic freedom across countries. To identify causation running from economic freedom to volatility, instrumental variables that isolate the exogenous variation in volatility are used. The instrumental variables are selected in light of the recent literature on the determinants of volatility (see, for example, Dawson [2010]). They include distance from the equator, dummy variables for diversified exporters and landlocked countries, the other exogenous explanatory variables in the analysis (the initial income level,

[3] The five major areas of the index are (1) size of government; (2) legal structure and security of property rights; (3) access to sound money; (4) freedom to trade internationally; and (5) regulation of credit, labor, and business. The underlying data that comprise each area are listed in Gwartney, Lawson, and Hall (2011), p. 5. All underlying data are converted to a scale from 0 (representing the least free) to 10 (most free).

investment share, and population growth rate), and the various measures (initial level, change, and volatility) of economic freedom (when included as explanatory variables in the primary regression). Distance from the equator and the dummies for diversified exporters and landlocked countries are from the World Bank Global Development Network's growth database.

Underlying data on real GDP per capita, population, and investment shares are from the Penn World Tables, version 7.0. Johnson et al. (2013) show that Penn World Table (PWT) data vary substantially across different versions of the PWT and that the methodology used to estimate growth rates leads to systematic variation in PWT data. They further show that these problems matter in the empirical growth literature. More specifically, they show that Ramey and Ramey's finding of a negative volatility-growth relationship is not robust across different versions of the PWT. Previously, Dawson et al. (2001) also found that Ramey and Ramey's negative volatility coefficient was not robust after controlling for data quality within the version of the PWT used by Ramey and Ramey. However, Johnson et al. show that this issue only applies to studies that use high-frequency (particularly annual) data in general and to Ramey and Ramey's panel analysis using annual data in particular, and that studies using low-frequency data remain robust to data revisions in the PWT. As such, the pure cross-section analysis that follows is not subject to the problems identified in these studies. Thus, pure cross-section analysis remains a useful and valid technique for uncovering fundamental relationships in the underlying data and the results reported below are comparable to Ramey and Ramey's pure cross-section results. In addition, since the Johnson et al. analysis leaves intact Ramey and Ramey's finding of a significantly negative volatility-growth relationship in their pure cross-section analysis, it seems the perfect setting to explore the role of economic freedom in the volatility-growth relationship.

IV. Empirical Results

This section discusses the empirical results for the model discussed previously. After including the measures of economic freedom, the specification to be estimated is

$$\Delta \ln y_i = \alpha + \lambda \sigma_i + \Sigma_j \beta_j X_{ji} + \gamma_1 EF_{0i} + \gamma_2 \Delta EF_i + \gamma_3 SDEF_i + \varepsilon_i,$$

where $\Delta \ln y$ is the average annual growth rate, σ is the standard deviation of annual growth, X_j are conditioning variables found by Levine and Renelt (1992) to be robustly related to growth (initial

income, investment share, and population growth), EF_0 is the initial level of freedom, ΔEF is the change in freedom, and $SDEF$ is the volatility of freedom. Investment shares and population growth rates are averages over the period 1980–2009. Initial income and initial freedom are 1980 values entered as natural logarithms. The change in freedom is the change in the EFW chain index between 1980 and 2009. The volatility of freedom is the standard deviation of changes in freedom (as defined in the previous section) over the 1980–2009 period.

Estimation of all variations of this model is by ordinary least squares (OLS) and, for the instrumental variables (IV) analysis, two-stage least squares. Reports of statistical significance are based on White heteroskedasticity-consistent standard errors. The sample of ninety-nine countries used in the analysis is the largest sample for which data are currently available for all variables. Note that the analysis of individual areas of freedom may include more or fewer than ninety-nine countries because some areas of freedom have more or fewer observations than the composite EFW index.

Table 1 provides estimates of the model. Column 1 provides the results when the volatility measure alone is included as an explanatory variable in the OLS regression. The coefficient on volatility is negative and statistically significant when no other correlates of growth are included. When the common set of control variables (initial income, investment share, and population growth) are included in the regression, as reported in column 2, the coefficient on volatility remains significantly negative. The coefficients on the control variables all have the expected sign and are statistically significant. To allow for the possibility that the volatility measure is endogenous, the model is estimated using two-stage least squares. The results of the IV analysis are reported in column 3. The coefficient on volatility remains negative, but is only marginally significant in the IV analysis. The first-stage F-statistic suggests the instruments are sufficiently strong, but a version of the Hausman specification test proposed by Davidson and MacKinnon (1989, 1993) suggests endogeneity is not a problem in the OLS specification. Thus, the results in column 2 appear valid for this specification. The finding of a significantly negative volatility coefficient in this broad sample of countries is consistent with numerous results in the literature.

Table 1: Volatility-Growth Regressions, 1980–2009

	Estimation Method				
	OLS	OLS	IV	OLS	IV
Variable	(1)	(2)	(3)	(4)	(5)
Constant	0.027***	0.055***	0.066***	−0.007	0.029
	(0.0032)	(0.0181)	(0.0220)	(0.0241)	(0.0349)
Volatility	−0.251***	−0.182**	−0.336*	−0.091	−0.278
	(0.0711)	(0.0881)	(0.1943)	(0.0679)	(0.1892)
Initial Income	—	−0.005**	−0.005**	−0.007***	−0.007***
		(0.0019)	(0.0020)	(0.0020)	(0.0018)
Investment Share	—	0.001***	0.001***	0.0008***	0.0009***
		(0.0003)	(0.0003)	(0.0003)	(0.0003)
Population Growth	—	−0.771***	−0.646**	−0.726***	−0.605**
		(0.2253)	(0.2428)	(0.2072)	(0.2302)
Initial Freedom	—	—	—	0.034***	0.025
				(0.0118)	(0.0162)
Change in Freedom	—	—	—	0.009***	0.007**
				(0.0026)	(0.0031)
Volatility of Freedom	—	—	—	−0.017	−0.012
				(0.0112)	(0.0120)
Adjusted R^2	0.11	0.37	0.33	0.45	0.41
First Stage *F*-value	–	–	9.864***	–	8.584***
Hausman *p*-value	–	–	0.3110	–	0.2127
Observations	99	99	99	99	99

Source: Author's calculations.

Notes: The dependent variable is the average annual growth rate of real GDP per capita, 1980–2009. Initial income and initial freedom are entered as natural logarithms. Investment share and population growth are averages over the sample period. Estimation is by ordinary least squares (OLS) and instrumental variables (IV), as indicated at the top of each column. Instruments for the IV estimation include the exogenous explanatory variables from the analogous OLS regression (i.e., all regressors except volatility) along with distance from the equator and dummies for diversified exporters and landlocked countries. First stage *F*-value is the *F*-statistic from the regression of volatility on the instruments. Hausman *p*-value is the level of significance of the *t*-statistic for the null hypothesis that the OLS coefficients are consistent based on the version of the Hausman test proposed by Davidson and MacKinnon (1989, 1993). Heteroskedasticity-consistent (White) standard errors are shown in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Next, the initial level of economic freedom, the change in freedom, and the volatility of freedom are added to the specification as explanatory variables. The OLS results are reported in column 4. Both initial freedom and the change in freedom are significantly positive, as expected. The volatility of freedom is negative, but statistically insignificant. All of the control variables remain significant with the expected sign. However, the coefficient on volatility becomes statistically insignificant with the addition of the economic freedom variables to the model. One possible explanation for the insignificance of volatility when the freedom variables are added as regressors is that volatility is serving as a proxy for freedom in specifications that do not explicitly control for differences in freedom across countries. To account for the possibility that volatility

is endogenous, the model is also estimated via IV analysis. The results are reported in column 5. Volatility remains statistically insignificant in the IV analysis, but the Hausman test again suggests that the OLS estimates are valid. Thus, it appears that including economic freedom variables in the analysis mitigates the estimated impact of volatility on growth.[4]

For volatility to proxy for economic freedom in specifications that ignore the role of freedom in the growth process, volatility and freedom must be systematically related. Lipford (2007) and Dawson (2010) show that volatility and freedom are indeed related in broad samples of countries even after controlling for other factors that are important in explaining output volatility across countries. Both studies report that volatility is lower in countries with higher freedom ratings and vice versa.

It is also interesting to explore the possibility that the volatility-growth relationship is not homogeneous across countries with different levels of freedom. To determine if the volatility-growth relationship varies with the level of freedom, the regression model is re-estimated with a multiplicative interaction term. Including the interaction term, the model to be estimated is

$$\Delta \ln y_i = \alpha + \lambda\sigma_i + \gamma_1 EF_{0i} + \delta(\sigma_i \times EF_{0i}) + \Sigma_j \beta_j X_{ji} + \gamma_2 \Delta EF_i + \gamma_3 SDEF_i + \varepsilon_i.$$

With the interaction term included in the regression, the marginal effect of volatility on growth is no longer given by the coefficient on volatility, λ, alone.[5] Instead, the marginal effect of volatility conditional on the level of freedom is given by

$$\frac{\partial \Delta \ln y_i}{\partial \sigma_i} = \lambda + \delta EF_{0i}.$$

[4] It is possible that volatility's effect on growth operates primarily through an effect on investment. If so, volatility's estimated impact on growth should increase in size and significance if investment is removed as an explanatory variable in the analysis. Removing investment as a regressor generally has little effect on the estimated coefficients on volatility reported here, but it does increase the estimated size and significance of the economic freedom variables in explaining growth. This effect is consistent with results reported in Dawson (1998), which suggest that economic freedom affects growth at least in part through an indirect effect on investment. Thus, investment is included as an explanatory variable in all remaining results.

[5] The value of λ captures the impact of volatility on growth when economic freedom equals zero, which has little practical relevance here since zero is a hypothetical lower bound for the EFW index used to measure freedom and no countries in the sample actually have a zero value in the index.

This means the usual hypothesis testing of regression coefficients does not tell the whole story of volatility's impact on growth. As suggested by Braumoeller (2004) and by Brambor, Clark, and Golder (2006), it is important to calculate substantively meaningful marginal effects of volatility and corrected standard errors.[6]

Table 2 reports the regression results for the interaction model. The first column reports the results when no additional control variables are included.[7] The estimated coefficients on volatility and the interaction term are both statistically significant. Figure 1 shows the estimated marginal effect of volatility on growth, conditional on the level of initial freedom, along with a 95 percent confidence interval. A statistically significant effect of volatility on growth occurs only when the zero line falls outside the confidence interval. Figure 1 indicates a significantly negative effect only at initial levels of freedom below 5.24 on the EFW index. Forty-one of the ninety-nine countries in the sample have initial freedom levels in this range. Column 2 reports the results when the control variables (initial income, investment share, and population growth) are included. All the control variables are statistically significant with the expected signs. Figure 2 shows the marginal effect of volatility for this specification. Again, volatility is negative and statistically significant only at low levels of initial freedom. In this case, the significant range is below 4.51 on the EFW index, which includes only twenty-one of the ninety-nine countries in the sample. Column 3 reports the same specification estimated in column 2, but uses the IV approach. The first-stage *F*-statistic for the IV regression suggests the instruments are sufficiently strong, but the Hausman test suggests the OLS estimates in column 2 are valid.

[6] The methodology for calculating marginal effects and corrected standard errors is described at Brambor, Clark, and Golder's (2006) companion website, "Detailed Explanation of Stata Code for a Marginal Effect Plot for X."

[7] Initial freedom must be included as a regressor since interaction model specifications require that all constitutive terms be included. See Brambor, Clark, and Golder (2006) for more discussion.

Table 2: Volatility-Growth Regressions with Interaction Term, 1980–2009

	Estimation Method				
	OLS	OLS	IV	OLS	IV
Variable	(1)	(2)	(3)	(4)	(5)
Constant	0.046**	0.076***	0.091	0.036	0.060
	(0.0178)	(0.0222)	(0.1022)	(0.0281)	(0.1219)
Volatility	−0.848***	−0.648***	−0.327	−0.619***	−0.852
	(0.2287)	(0.1610)	(2.4845)	(0.1750)	(2.0800)
Initial Freedom	−0.013	−0.013	−0.032	0.016	0.006
	(0.0096)	(0.0090)	(0.0719)	(0.0145)	(0.0746)
(Volatility × In. Freedom)	0.401**	0.315**	0.015	0.357***	0.398
	(0.1679)	(0.1437)	(1.6302)	(0.1357)	(1.3989)
Initial Income	—	−0.005**	−0.002	−0.006***	−0.006**
		(0.0021)	(0.0056)	(0.0020)	(0.0026)
Investment Share	—	0.0009***	0.0011*	0.0007***	0.0008
		(0.0003)	(0.0006)	(0.0003)	(0.0005)
Population Growth	—	−0.818***	−0.742**	−0.780***	−0.673**
		(0.2423)	(0.3258)	(0.2205)	(0.3368)
Change in Freedom	—	—	—	0.009***	0.007**
				(0.0025)	(0.0030)
Volatility of Freedom	—	—	—	−0.021**	−0.017
				(0.0108)	(0.0195)
Adjusted R^2	0.13	0.37	0.23	0.47	0.43
First Stage *F*-value	–	–	10.187***	–	8.584***
Hausman *p*-value	–	–	0.3447	–	0.2539
Observations	99	99	99	99	99

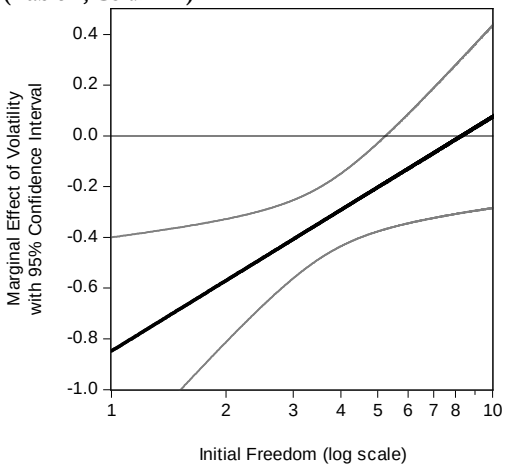
Source: Author's calculations.

Notes: The dependent variable is the average annual growth rate of real GDP per capita, 1980–2009. Initial income and initial freedom are entered as natural logarithms. Investment share and population growth are averages over the sample period. Volatility of freedom is the standard deviation of changes in the EFW "chain" index over the 1980–2009 period, as defined in the text. Estimation is by ordinary least squares (OLS) and instrumental variables (IV), as indicated at the top of each column. Instruments for the IV estimation include the exogenous explanatory variables from the analogous OLS regression (i.e., all regressors except volatility) along with distance from the equator and dummies for diversified exporters and landlocked countries. First stage *F*-value is the *F*-statistic from the regression of volatility on the instruments. Hausman *p*-value is the level of significance of the *t*-statistic for the null hypothesis that the OLS coefficients are consistent based on the version of the Hausman test proposed by Davidson and MacKinnon (1989, 1993). Heteroskedasticity-consistent (White) standard errors are shown in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

The results reported in columns 4 and 5 add to the specification changes in economic freedom and the volatility of the path to freedom. Diagnostic measures again suggest the OLS estimates are valid, so attention is restricted to the OLS results in column 4. All of the conditioning variables remain significant with the expected signs. Changes in freedom and the volatility of freedom are also individually significant, with increases in freedom enhancing growth and a more volatile path to freedom reducing growth. These results are consistent with those reported in the existing literature. Figure 3 shows the conditional effect of volatility on growth for this specification. The range of countries for which volatility affects growth is further reduced,

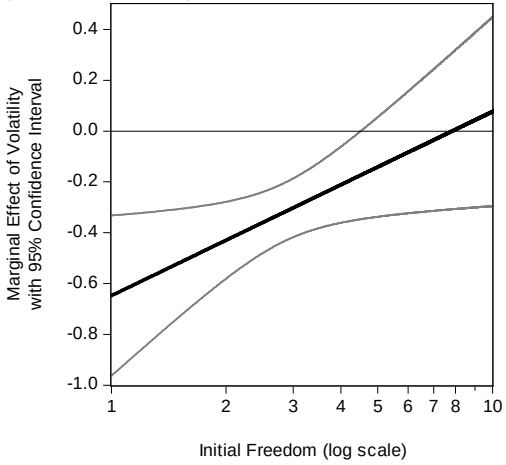
with a significantly negative effect only in countries with initial freedom levels below 4.15 on the EFW index. Only ten countries in the ninety-nine-country sample have such a low level of initial freedom.[8]

Figure 1: Marginal Effect of Volatility, Conditional on Initial Freedom (Table 2, Column 1)



Source: Author's calculations

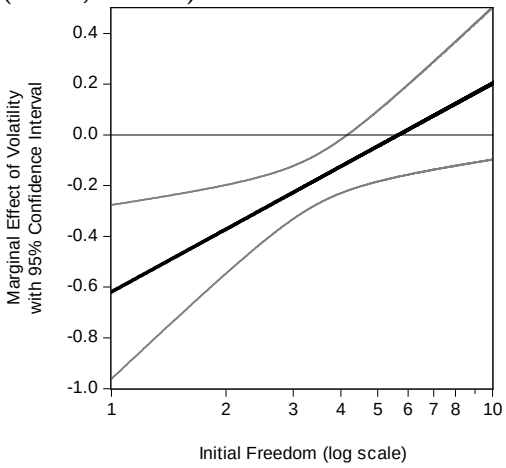
Figure 2: Marginal Effect of Volatility, Conditional on Initial Freedom (Table 2, Column 2)



Source: Author's calculations

[8] Similar results are obtained when the most developed countries are excluded from the sample. In a sample of seventy less-developed countries, volatility is found to have a significantly negative effect on growth only in countries with initial freedom below 4.2 in the EFW index. Thus, the results suggested in table 2 and in figures 1–3 are not driven by the volatility-growth relationship in the most developed countries, which are also generally the countries with the highest levels of freedom.

Figure 3: Marginal Effect of Volatility, Conditional on Initial Freedom (Table 2, Column 4)



Source: Author's calculations

Taken together, the analysis suggests that findings of a negative volatility-growth relationship in diverse samples of countries may be driven by a failure to account for differences in economic freedom across countries. Once the analysis controls for differences in freedom, it is questionable whether volatility is a statistically significant determinant of cross-country growth. When the volatility-growth relationship is allowed to vary across countries at different levels of freedom, a significantly negative relationship is found only in countries at very low levels of freedom. No evidence of a statistically significant relationship between volatility and growth is found in countries at moderate or high levels of freedom. There is no evidence of a positive volatility-growth relationship, even in countries at the highest levels of freedom, once the systematic relationship between freedom and volatility is taken into account.

V. Analysis of the Underlying Areas of Freedom

This section takes a closer look at the five underlying areas of freedom that make up the EFW index. Recall that the EFW index is a composite of five individual areas of freedom (see note 3). The analysis in this section will allow a determination of whether the different areas of freedom have a different impact on the volatility-growth relationship. For example, it may be argued that unsound money policies that lead to high and variable rates of inflation in an economy cause more macroeconomic volatility, which is contemporaneously associated with lower growth. As such, volatility

will be found to be a determinant of growth in regressions that do not control for this aspect of economic freedom. Likewise, if the composite EFW index is sufficiently correlated with the sound money area of freedom, use of the broad composite in empirical analysis (such as in the previous section of this paper) may proxy for the role that is actually attributable to the more narrow area of freedom. In other words, the desire is to determine which, if any, particular areas of freedom are driving the results discussed earlier.

To analyze the role of the underlying areas of freedom, the regression analysis considered previously is repeated using the individual areas of freedom in place of the composite EFW index. More specifically, the initial level and change in each underlying area of freedom is included individually in volatility-growth regressions analogous to those reported in the previous section. To be clear, each regression includes the initial level and change in one of the five underlying areas of freedom. All regressions control for the volatility of the composite EFW index using the same *SDEF* measure as defined earlier (i.e., the volatility of each underlying area of freedom is not included). In the interest of conserving space, attention is restricted to the interaction model specification. For convenience, the specification to be estimated is

$$\Delta \ln y_i = \alpha + \lambda\sigma_i + \gamma_1 \mathrm{AREA}n_{0i} + \delta(\sigma_i \times \mathrm{AREA}n_{0i}) + \Sigma_j \beta_j X_{ji} + \gamma_2 \Delta \mathrm{AREA}n_i + \gamma_3 SDEF_i + \varepsilon_i,$$

where $\mathrm{AREA}n_i$, for $n = 1, 2, \ldots, 5$, is one of the five underlying areas of freedom in country i and all other variables are as defined above.

The results are reported in table 3, where each column presents results for a different area of freedom.[9] The common set of conditioning variables is generally significant with the expected sign in all regressions. Changes in freedom for areas 2 (secure property rights), 3 (sound money), and 4 (freedom to trade internationally) are found to be significantly growth enhancing. Figures 4–8 show the marginal effects of volatility conditional on each of the five areas of freedom. For area 1 (size of government), figure 4 indicates that volatility is statistically insignificant regardless of the initial level of freedom in this area. In figure 5, volatility has a significantly negative impact on growth in countries with an initial level of freedom in area 2 (secure property rights) below 3.18. In the available sample of eighty-seven countries, twenty were below this level of area 2

[9] Regression diagnostics from IV analysis suggest that OLS estimates of these specifications are valid, so OLS estimates only are reported in table 3.

freedom in 1980. Additionally, a statistically positive impact of volatility is found for initial levels of area 2 freedom above 6.65, a level achieved by thirty countries in the sample. This result differs from those found previously using the composite EFW index, where no positive impact of volatility was found. Thus, it appears that a sound legal system and secure property rights can reverse the negative volatility-growth relationship found in much of the empirical literature. Once again, these results are generally consistent with the notion that a negative impact of volatility on growth occurs only in countries at low levels of freedom—and in the case of area 2 freedom, this effect disappears and even becomes positive at higher levels of freedom.

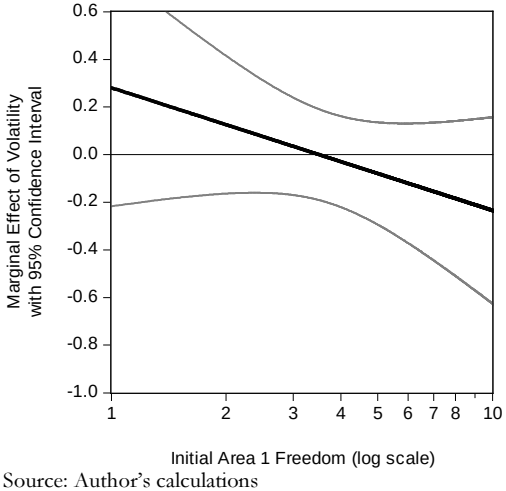
Table 3: Volatility-Growth Regressions with Interaction Term, Individual Areas of Freedom, OLS Estimation, 1980–2009

	Area of Freedom Included in Regression				
Variable	Area (1)	Area (2)	Area (3)	Area (4)	Area (5)
Constant	0.036	0.063***	0.057**	0.069***	0.071**
	(0.0247)	(0.0178)	(0.0243)	(0.0243)	(0.0285)
Volatility	0.281	−0.628***	−0.268***	−0.789**	−0.972***
	(0.2542)	(0.1280)	(0.0866)	(0.3173)	(0.3124)
Initial Freedom	0.009	−0.001	0.001	−0.001	−0.008
	(0.0079)	(0.0074)	(0.0082)	(0.0121)	(0.0135)
(Volatility × In.	−0.224	0.439***	0.177***	0.435**	0.568***
Freedom)	(0.1782)	(0.1032)	(0.0560)	(0.2046)	(0.1952)
Initial Income	−0.004**	−0.004**	−0.005***	−0.005***	−0.005**
	(0.0021)	(0.0022)	(0.0020)	(0.0016)	(0.0021)
Investment Share	0.0010***	0.0004*	0.0007***	0.0006***	0.0007**
	(0.0003)	(0.0002)	(0.0003)	(0.0002)	(0.0003)
Population	−0.820***	−0.783***	−0.680***	−0.745***	−0.731***
Growth	(0.2077)	(0.2232)	(0.2138)	(0.1822)	(0.2165)
Change in	0.0008	0.004***	0.003**	0.005***	0.003
Freedom	(0.0013)	(0.0014)	(0.0016)	(0.0015)	(0.0020)
Volatility of	−0.015	−0.019*	−0.027***	−0.022**	−0.002
EFW	(0.0092)	(0.0100)	(0.0095)	(0.0102)	(0.0107)
Adjusted R^2	0.34	0.42	0.35	0.42	0.37
Observations	105	87	108	92	97

Source: Author's calculations.

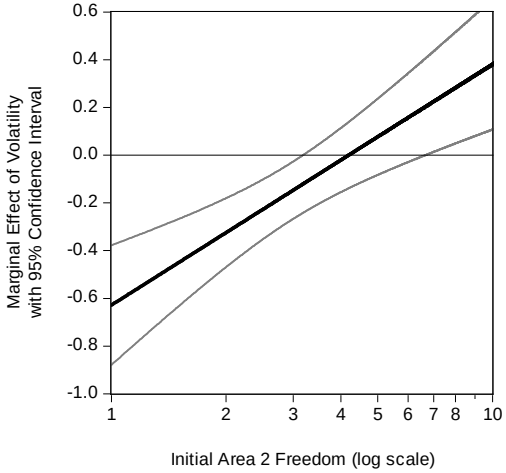
Notes: The dependent variable is the average annual growth rate of real GDP per capita, 1980–2009. Initial income and initial freedom are entered as natural logarithms. Investment share and population growth are averages over the sample period. Initial freedom is the 1980 value of each area of freedom as indicated at the top of each column; change in freedom is the 1980–2009 change in each area of freedom. See footnote 3 for additional information on the five areas of freedom. Volatility of freedom is the standard deviation of changes in the EFW "chain" index over the 1980–2009 period, as defined in the text. Estimation is by ordinary least squares (OLS). Heteroskedasticity-consistent (White) standard errors are shown in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Figure 4: Marginal Effect of Volatility, Conditional on Initial Area 1 Freedom (Table 3, Column 1)



Source: Author's calculations

Figure 5: Marginal Effect of Volatility, Conditional on Initial Area 2 Freedom (Table 3, Column 2)

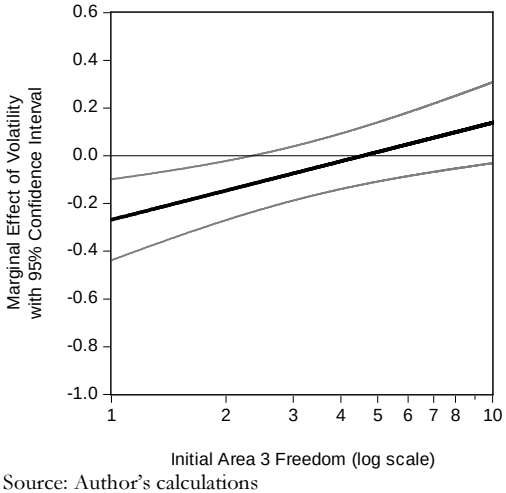


Source: Author's calculations

The results for area 3 (sound money) in figure 6 indicate that volatility is significantly negative only for initial levels of area 3 freedom below 2.33. Such a low level of area 3 freedom applies to only eight of the 108 countries in the available sample for this specification. In the area 4 (freedom to trade internationally) results shown in figure 7, volatility is significantly negative at initial levels of area 4 freedom below 4.56. In the ninety-two-country sample available for this specification, twenty-nine countries fall below this initial level of freedom. The area 5 (regulation of credit, labor, and

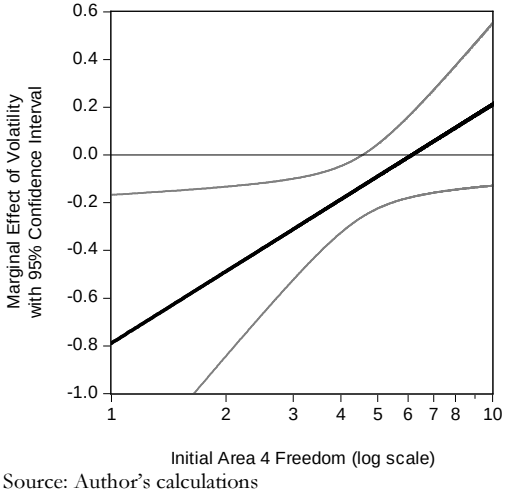
business) results in figure 8 indicate that volatility is significantly negative for initial levels of area 5 freedom below 4.37 and significantly positive for levels above 9.00. This upper threshold is a hypothetical level that has not been achieved by any of the ninety-seven countries in the available sample, while twenty countries fall in the lower range where volatility is significantly negative.

Figure 6: Marginal Effect of Volatility, Conditional on Initial Area 3 Freedom (Table 3, Column 3)



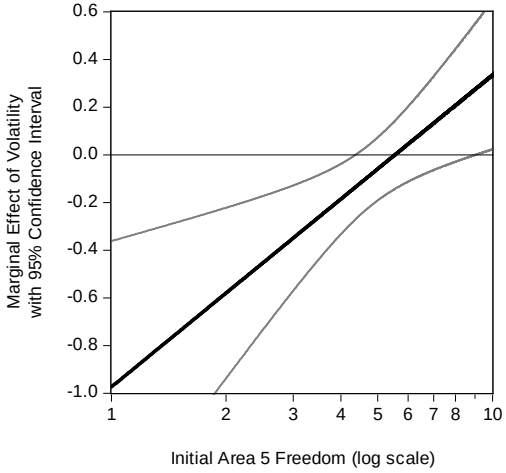
Source: Author's calculations

Figure 7: Marginal Effect of Volatility, Conditional on Initial Area 4 Freedom (Table 3, Column 4)



Source: Author's calculations

Figure 8: Marginal Effect of Volatility, Conditional on Initial Area 5 Freedom (Table 3, Column 5)



Source: Author's calculations

Taken together, the area results suggest that areas 2 (property rights), 4 (freedom to trade), and 5 (regulation) of the EFW index contribute to a negative volatility-growth relationship, but only at fairly low levels of freedom in these areas. Volatility is insignificant at moderate to high levels of freedom in all areas, except for area 2 (property rights), which is associated with a positive volatility-growth relationship at moderately high levels of freedom. No significant relationship between volatility and growth is found when areas 1 (size of government) and 3 (sound money) are used.

VI. Conclusion

This paper takes a new look at the empirical relationship between macroeconomic volatility and long-run growth across countries. It emphasizes the role of economic freedom in explaining the mixed results on the volatility-growth relationship in the existing literature. In particular, the goal is to determine whether a reported relationship between volatility and growth really reflects differences in economic freedom across countries when the analysis does not explicitly account for such differences. In addition, this paper considers whether the volatility-growth relationship itself differs across countries at different levels of economic freedom. The analysis considers both a broad measure of economic freedom, measured by the composite *Economic Freedom of the World* index, and its underlying component areas of freedom.

Broad measures of economic freedom are included in cross-country growth regressions that are typical of those used in the literature to assess the effect of volatility on growth. The results suggest that a negative and statistically significant coefficient on volatility becomes insignificant after controlling for freedom in a diverse sample of countries. This finding helps to reconcile findings in previous studies of a negative relationship in broad samples of countries (without controlling for freedom) alongside positive or insignificant relationships in samples of developed countries or U.S. states (where freedom is at a higher, more uniform level).

To determine if the volatility-growth relationship itself varies with levels of freedom across countries, an interaction model is considered. The results suggest that a negative relationship between volatility and growth exists only in countries at very low levels of freedom, a condition that applies to only 10–20 percent of the countries considered when other correlates of growth are included in the analysis. No evidence of a positive relationship is found regardless of the level of freedom.

When the underlying areas of economic freedom are used individually in the analysis, aspects of freedom relating to the security of property rights, freedom to trade internationally, and regulation of credit, labor, and business appear to contribute to a negative volatility-growth relationship, but only at fairly low levels of freedom comprising 20–30 percent of the available sample of countries. A sound legal system and secure property rights contribute to a positive volatility-growth relationship in countries achieving a fairly high level of freedom (about 30 percent of the available sample) in this area of freedom. Areas of freedom relating to size of government and sound money leave the volatility-growth relationship insignificant at all levels of freedom.

Taken together, these results suggest that it is important to account for differences in economic freedom when considering the impact of volatility on growth. Failing to control for differences in freedom—or at least the appropriate underlying components of freedom—may falsely attribute to volatility the influences that are actually due to freedom in the growth process. A key implication of this conclusion is that business cycle volatility ultimately may not be a legitimate determinant of growth across a large, diverse sample of countries. In other words, the existing evidence in support of volatility as a determinant of growth may ultimately be an artifact of the well-known relationship between economic freedom and growth.

In addition, if volatility and growth are related, it appears to be so primarily in countries with low levels of freedom. All these findings are consistent with various results reported previously in the empirical growth literature, but it was not obvious that economic freedom was the missing link in explaining the different results with respect to the volatility-growth relationship.

References

Badinger, Harald. 2010. "Output Volatility and Economic Growth." *Economics Letters*, 106(1): 15–18.

Bernanke, Ben S. 1983. "Irreversibility, Uncertainty, and Cyclical Investment." *Quarterly Journal of Economics*, 98(1): 85–106.

Black, Fisher. 1987. *Business Cycles and Equilibrium*. Oxford, UK: Blackwell.

Brambor, Thomas, William Roberts Clark, and Matt Golder. 2006. "Understanding Interaction Models: Improving Empirical Analyses." *Political Analysis*, 14(1): 63–82.

Braumoeller, Bear F. 2004. "Hypothesis Testing and Multiplicative Interaction Terms." *International Organization*, 58(4): 807–20.

Davidson, Russell, and James G. MacKinnon. 1989. "Testing for Consistency Using Artificial Regressions." *Econometric Theory*, 5(3): 363–84.

Davidson, Russell, and James G. MacKinnon. 1993. *Estimation and Inference in Econometrics*. Oxford: Oxford University Press.

Dawson, John W. 1998. "Institutions, Investment, and Growth: New Cross-Country and Panel Data Evidence." *Economic Inquiry*, 36(October): 603–19.

Dawson, John W. 2010. "Macroeconomic Volatility and Economic Freedom: A Preliminary Analysis." In *Economic Freedom of the World: 2010 Annual Report*, ed. James D. Gwartney, Robert A. Lawson, and Joshua C. Hall, 175–85. Vancouver: The Fraser Institute.

Dawson, John W., and E. Frank Stephenson. 1997. "The Link between Volatility and Growth: Evidence from the State." *Economics Letters*, 55(3): 365–69.

Dawson, John W., Joseph P. DeJuan, John J. Seater, and E. Frank Stephenson. 2001. "Economic Information versus Quality Variation in Cross-Country Data." *Canadian Journal of Economics*, 34(4): 988–1009.

De Haan, Jakob, Suzanna Lundstrom, and Jan-Egbert Sturm. 2006. "Market-Oriented Institutions and Policies and Economic Growth: A Critical Survey." *Journal of Economic Surveys*, 20(2): 157–91.

Fatas, Antonio, and Iliam Mihov. 2003. "The Case for Restricting Fiscal Policy Discretion." *Quarterly Journal of Economics*, 118(4): 1419–47.

Furceri, Davide. 2010. "Long-Run Growth and Volatility: Which Source Really Matters?" *Applied Economics*, 42(13): 1865–74.

Grier, Kevin B., and Gordon Tullock. 1989. "An Empirical Analysis of Cross-National Economic Growth, 1951–80." *Journal of Monetary Economics*, 24(2): 259–76.

Gwartney, James D., Robert A. Lawson, and Joshua C. Hall. 2011. *Economic Freedom of the World: 2011 Annual Report*. Vancouver: The Fraser Institute.

Gwartney, James D., Robert A. Lawson, and Randall. G. Holcombe. 1999. "Economic Freedom and the Environment for Economic Growth." *Journal of Institutional and Theoretical Economics*, 155(4): 643–63.

Hall, Joshua C., and Robert A. Lawson. 2014. "Economic Freedom of the World: An Accounting of the Literature." *Contemporary Economic Policy*, 32(1): 1–19.

Johnson, Simon, William Larson, Chris Papageorgiou, and Arvind Subramanian. 2013. "Is Newer Better? Penn World Table Revisions and Their Impact on Growth Estimates." *Journal of Monetary Economics*, 60(2): 255–74.

Kormendi, Roger, and Philip Meguire. 1985. "Macroeconomic Determinants of Growth: Cross-Country Evidence." *Journal of Monetary Economics*, 16(2): 141–63.

Lee, Jim. 2010. "The Link Between Output Growth and Volatility: Evidence from a GARCH Model with Panel Data." *Economics Letters*, 106(2): 143–45.

Levine, Ross, and David Renelt. 1992. "A Sensitivity Analysis of Cross-Country Growth Regressions." *American Economic Review*, 82(4): 942–63.

Lipford, Jody W. 2007. "Short Run Macroeconomic Performance and Economic Freedom: Can Economic Growth Rates Be Higher and More Stable?" *Journal of Private Enterprise*, 23(1): 3–29.

Martin, Philippe, and Carol Ann Rogers. 2000. "Long-Term Growth and Short-Term Economic Stability." *European Economic Review*, 44(2): 359–81.

Mirman, Leonard J. 1971. "Uncertainty and Optimal Consumption Decisions." *Econometrica*, 39(1): 179–85.

Mobarak, Ahmed Mushfiq. 2005. "Democracy, Volatility, and Economic Development." *Review of Economics & Statistics*, 87(2): 348–61.

Pitlik, Hans. 2002. "The Path of Liberalization and Economic Growth." *Kyklos*, 55(1): 57–80.

Ramey, Garey, and Valerie A. Ramey. 1995. "Cross-Country Evidence on the Link Between Volatility and Growth." *American Economic Review*, 85(5): 1138–51.

Sandmo, Agnar A. 1970. "The Effect of Uncertainty on Saving." *Review of Economic Studies*, 37(3): 353–60.

Stastny, Michael, and Martin Zagler. 2007. "Empirical Evidence on Growth and Volatility." European University Institute Working Paper RSCAS 2007/22.