E C O N O M I C S B U L L E T I N

Business cycle volatility and country zize :evidence for a sample of OECD countries

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Abstract

The main purpose of this paper is to investigate the relationship between business cycle volatility and country size using quarterly data for a sample of OECD countries over 1960-2000. The results suggest very strongly that the relationship between country size and business cycle volatility is negative and statistically significant. This finding is very robust, suggesting that country size does matter, at least for the severity of cyclical fluctuations.

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1. Introduction

Countries come in all shapes and sizes, but economic models are divided on whether size is one of the determinants of economic performance. Some of the most influential economic models, such as the Solow (1956) growth model for example, have no role for country size. Even when size is included in a theoretical model, its effect is generally theoretically ambiguous,[1] and thus needs to be resolved empirically.

In such a recent empirical paper, Rose (2006) found that country size really does not matter for several important economic outcomes. However, he did not consider the effect that country size may have on business cycle volatility.[2] When this was examined by Karras (2006) and Furceri and Karras (2007) using annual data for a large number of countries, they found that smaller countries are subject to more volatile business cycles than larger countries.

The annual frequency, however, is not ideally suited to business-cycle questions. The main purpose of this paper is to investigate whether the negative relationship between country size and business-cycle volatility still holds if quarterly data are used for the definition and measurement of each country's business cycle. In particular, we use quarterly data on real GDP for a set of OECD countries for which the series are available from 1960 to 2000. While the use of quarterly data restricts us to OECD countries, it also reduces the likelihood that our measure of volatility is affected by measurement errors.

Our results suggest that country size really matters for business cycle volatility: the larger the size of the country, the less volatile its business cycle. This finding, consistent with Karras (2006) and Furceri and Karras (2007), is very robust, suggesting that country size does matter, at least for the severity of cyclical fluctuations.

The rest of the paper is organized as follows. The next section presents the paper's empirical methodology used to test for the relationship between country size and several measures of macroeconomic volatility. The third section presents the results. Finally, section 4 concludes with the main findings.

2. Empirical Methodology

We use quarterly data for real GDP from the OECD World Economic Outlook database (2006). The dataset consists of 25 countries: the 20 countries which have available data from 1960 to 2000,[3] the 5 countries which have available data from 1990 to 2003,[4] and the one

[1] For a more detailed discussion about benefits and costs see, Bolton and Roland (1997), Aghion et al. (2002), Alesina and Spolaore (2003), Rose (2006), and Furceri and Karras (2007).

[2] Mendoza (1997), Jones et al. (1999), Matheron and Maury (2000), Epaulard and Pommeret (2003) showed that business cycle volatility reduces welfare, not least because of its negative effect on growth. More recently, Barlevy (2006) argues that economic fluctuations remarkably reduce welfare by affecting the growth rate of consumption. At the same time, a growing empirical literature starting with Ramey and Ramey (1995) has showed that cyclical volatility negatively affects growth and investment.

3 Australia, Austria, Belgium, Canada, Switzerland, Germany, Denmark, Spain, Finland, France, UK, Greece, Italy, Mexico, Netherlands, Norway, New Zealand, Portugal, Sweden, USA

4 Czech Republic, Hungary, Ireland, Slovak Republic.

country for which we have available data from 1970 to 2003.[5] We use the log of its population, taken from the Penn World Table (2006), as our measure of a country's country-size.

We rely on three different detrending methods in order to compute the cyclical component of economic activity and, then, business cycle volatility measures: (i) simple differencing (which approximates the annual GDP growth rate), (ii) the Hodrick-Prescott (HP) filter, and (iii) the Band-Pass (BP) filter. While minor differences among the results obtained by the three filters are not difficult to detect (for example, differencing generally produces the most volatile series, while the BP the smoothest), the main characteristics are remarkably similar.[6] Finally, business cycle volatility is measured by the standard deviation of the cyclical component obtained by each of the filtering methods.

We set up our estimated models in a number of different ways. In particular, we used (i) OLS both in a bivariate model and in models controlling for a country-specific volatility effect; (ii) Fixed effects estimation; and (iii) Instrumental-variable (IV) estimation with various control variables.[7]

Again following Rose's (2006) strategy, we use three different sets of control variables, all obtained from Rose's website (www.haas.berkeley.edu/~arose). In particular, the *first set* of control includes: (a) the urbanization rate, (b) population density, (c) the log of absolute latitude (kilometers from the equator), (d) a binary dummy variable for a landlocked country, (e) an island-nation dummy, (f) a high income country dummy, (g) language dummies for countries that speak 1) English, 2) French, 3) German, 4) Dutch, 5) Portuguese, 6) Spanish, (h) openness.[8] The *second set* of control variables augments the first set with: (a) a dependency dummy, and (b) a COMECON dummy. The *third set* of controls adds two more variables to the second set: (a) log real GDP per capita in Purchasing Power Parities, and (b) the proportion of land within 100 km of ice-free coastline or navigable river.

To summarize, we estimate the effect of country size on business cycle volatility (β) using the following regression model:

$$\sigma_{it} = \beta \ln(Pop_{it}) + \alpha + \{\gamma_t T_t\} + \Sigma_j \delta_j X_{ijt} + \{\zeta_i I_i\} + \varepsilon_{it} \qquad (1)$$

where:

- σ measures business cycle volatility for country i at time t,
- Pop denotes population,
- $\{T_t\}$ and $\{I_i\}$ denote mutually exclusive and jointly exhaustive sets of time- and

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5 Korea.

6 This robustness will be formally confirmed by the findings in the remainder of this section.

7 We use the logarithm of the country's total area as an instrumental variable for the log of its population as did Rose (2006) and as argued by Drazen (2000).

8 In fact, there are good reasons to think that economic size and openness are related. Clearly, the larger the economy, the greater the degree to which it will be self-sufficient, reducing trade openness; whereas, a smaller economy will normally be more dependent on foreign trade, resulting in greater openness. For a theoretical derivation of such an inverse relation between steady state trade openness and economic size in the context of an optimizing growth model, see Spolaore and Wacziarg (2005).

country-specific fixed effects,

- $\{X_j\}$ denotes a set of control variables.
- ε is a well-behaved error term, and
- α, $\{\gamma\}$, $\{\delta\}$, $\{\zeta\}$ are nuisance coefficients.

3. Results

Table 1 reports the estimated slope coefficient (β) of country size, along with the associated t-statistics in parentheses for several specifications of equation (1). The table's three sections correspond to the three detrending methods employed: HP with smoothing parameter of 1600, the BP filter with cutoff frequencies of 6 and 32 quarters, and simple differencing. In each of the three sections of the table, we present the results for the full period (pooled).

The seven columns of Table 1 correspond to: (i) bivariate OLS with $\{\delta\} = \{\zeta\} = \{\gamma\} = 0$; (ii) OLS with $\{\zeta\} = \{\gamma\} = 0$, first set of controls; (iii) OLS with $\{\zeta\} = \{\gamma\} = 0$, second set of controls; (iv) OLS with $\{\zeta\} = \{\gamma\} = 0$, third set of controls; (v) fixed effects with $\{\delta\} = \{\gamma\} = 0$; (vi) fixed effects with $\{\delta\} = \{\zeta\} = 0$; and (vii) Instrumental Variables with $\{\zeta\} = \{\gamma\} = 0$, third set of controls.

Table1. Size and Business Cycle Volatility (real GDP)

	HP(1600)						
	Bivariate	Control1	Control2	Control3	FE *i*	FE *t*	IV & Control3
lnpop	-0.003	-0.003	-0.003	-0.003	-0.030	-0.004	-0.005
	(-2.01)**	(-2.47)**	(-2.60)***	(-2.22)**	(-1.73)*	(-1.94)**	(-3.09)***
	Band Pass(6.32)						
	Bivariate	Control1	Control2	Control3	FE *i*	FE *t*	IV & Control3
lnpop	-0.003	-0.002	-0.003	-0.002	-0.022	-0.002	-0.003
	(-1.67)*	(-1.87)*	(-2.31)**	(-2.04)**	(-1.40)*	(-1.57)	(-2.29)**
	Differencing						
	Bivariate	Control1	Control2	Control3	FE *i*	FE *t*	IV & Control3
lnpop	-0.004	-0.002	-0.002	-0.002	-0.028	-0.004	-0.005
	(-2.72)***	(-1.74)*	(-1.77)*	(-1.25)	(-2.25)**	(-2.66)***	(-2.78)***

Note: ***Significant at 1%; **Significant at 5%; *Significant at 10%

Considering the estimated βs of Table 1, it is apparent that the relationship between country size and business cycle volatility is negative and statically significant: the larger the size of the country, the less volatile its business cycle. This result holds for each of the seven estimated models. In particular, we believe it is significant that country size is shown to reduce business cycle volatility even when we control for openness, since trade openness is the only variable Rose (2006) found to be significantly related with country size. We also note that the

estimated relationship between size and business cycle volatility is robust to the three different detrending methods we used to obtain the cyclical component of GDP.

Next we examine whether the relation between volatility and country size has been constant over time.[9] To this purpose we split our full period in two sub-periods: 1960-1979 and 1980-2000. The results for our seven different specifications are reported in Table 2. They show that the relationship between volatility and country size remains negative in all cases and significant in most, especially during the second sub-period. The fact that the negative estimates for the first sub-period are not significant in five of the seven regressions can be attributed to the small number of degrees of freedom that we have due to the lack of observations for some of the control variables for 1960. Moreover, when we restrict our analysis just to 1970 the results become again significant.

Table2. Size and Business Cycle Volatility (real GDP-*HP*)

				1960-1979			
	Bivariate	Control1	Control2	Control3	FE i	FE t	IV & Control3
lnpop	-0.007	-0.005	-0.006	-0.007	-0.059	-0.007	-0.008
	(-1.91)*	(-1.23)	(-1.55)	(-1.50)	(-1.07)	(-1.87)*	(-1.56)
				1980-2000			
	Bivariate	Control1	Control2	Control3	FE i	FE t	IV & Control3
lnpop	-0.004	-0.04	-0.003	-0.003	-0.017	-0.001	-0.005
	(-0.58)	(-2.46)**	(-2.30)**	(-2.74)***	(-1.10)	(-0.63)	(-2.82)***

Note: ***Significant at 1%; **Significant at 5%; *Significant at 10%

Finally, as an additional robustness test, we check whether our results might be driven by the composition of our sample. To this purpose we now consider only the countries for which we have data for the entire time period. Again, the relation between macroeconomic volatility (computed using the HP filter) and country size is negative and statistically significant for all regressions (Table 3).

Table3. Size and Business Cycle Volatility (real GDP)

				HP			
	Bivariate	Control1	Control2	Control3	FE i	FE t	IV & Control3
lnpop	-0.004	-0.002	-0.002	-0.002	-0.032	-0.004	-0.004
	(-2.14)**	(-1.74)*	(-1.99)**	(-1.31)	(-1.80)*	(-2.01)**	(-2.29)**

Note: ***Significant at 1%; **Significant at 5%; *Significant at 10%

[9] We are grateful to an anonymous referee for suggesting this and the following robustness checks.

Overall, the results of Tables 1, 2, and 3 make it safe to conclude that business cycle volatility and country size are negatively related, so that the economies of smaller countries are systematically more volatile than those of larger countries.

4. Conclusions

Following Rose's (2006) estimation strategy we investigate the relationship between country size and cyclical fluctuations, using quarterly data to estimate business-cycle volatility for a set of OECD economies. Our findings show that the relationship between country size and business cycle volatility is negative and statistically significant. This implies that smaller countries are subject to more volatile business cycles than larger countries and reinforces the findings of Karras (2006) and Furceri and Karras (2007), which were based on annual data. We conclude that country size really matters, at least in terms of cyclical fluctuations.

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