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Country size and business cycle volatility: Scale really matters

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In a recent study Andrew Rose found that country size does not matter for several economic outcomes [Rose, A.K., 2006. Size really doesn't matter: In search of a national scale effect. J. Japanese Int. Economies 4, 482–507]. However, he did not consider the effect that country size may have on business-cycle volatility. To investigate the empirical relationship between business cycle volatility and country size, we use a panel data set that includes 167 countries from 1960 to 2000. The results suggest very strongly 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. This holds both in a simple bivariate model and when we include Rose's control variables and openness. Moreover, the results are robust to different sample periods and several detrending methods. It follows that country size really matters, at least in terms of cyclical fluctuations. *J. Japanese Int. Economies* **21** (4) (2007) 424–434. University of Illinois at Chicago, Chicago, IL, USA; University of Palermo, Italy.

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1. Introduction

In recent years there has been a growing economic literature concentrating on the effects of scale and country size on various economic outcomes. From a theoretical point of view, the sign of such a *scale effect* is ambiguous: larger countries should outperform smaller countries only if the benefits of size dominate the costs.

In particular, the main benefits of scale (for example, in terms of population size) have been thought to originate in (a) economies of scale in the production of public goods and redistributive policies[1]; (b) market scale and specialization[2]; (c) market size and competitiveness[3]; (d) market size and human capital accumulation[4]; (e) scale economies and increasing returns on trade[5]; (f) scale effects and growth.[6] On the other hand, however, costs have been modeled as the result of (a) congestion; and (b) heterogeneity of individuals' preferences.[7]

Therefore, whether size matters or not for economic performance, and whether it helps or hurts, is really an empirical question. Recently, Rose (2006) used several economic indicators and found that "size really doesn't matter" for economic success, variously defined. Even though he provided robust evidence in support of this conclusion, we believe that he has neglected an important component of economic performance: business cycle volatility.

Is business-cycle volatility worthy to be considered as an indicator of economic performance, along such other established measures as economic growth and income per capita? While in the highly influential monograph *Models of Business Cycles* Robert Lucas (1987) famously argued that the costs associated with business cycles are virtually nonexistent, more recent research has challenged Lucas's conclusions. For example, Mendoza (2000), Jones (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. Krusell and Smith (1999), and Storesletten et al. (2001) showed that in a model with heterogeneous agents the benefits from eliminating business cycle fluctuations are sizeable. More recently, Barlevy (2004) argues that economic fluctuations remarkably decrease 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. We conclude that business-cycle volatility matters. Thus, if country size can be shown to have a significant effect on volatility, it follows that country size matters too.

The objective of this paper is to investigate the empirical relationship between business cycle volatility and country size. To this purpose, we use a panel data set that includes 167 countries with observations from 1960 to 2000. The 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 is very robust, suggesting that size does matter, at least for the severity of cyclical fluctuations.

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1 For a more detailed discussion see Bolton and Roland (1997), Alesina and Spolaore (2003), Alesina et al. (2004).

2 Adam Smith (1986) already had the intuition that market size is positively related to the degree of specialization.

3 See, for example, Aghion and Howitt (1998), and Aghion et al. (2002).

4 Romer (1986), Lucas (1988), and Grossman and Helpman (1991) were among the first to point out the importance of scale in the accumulation of capital and the transmission of knowledge.

5 See, for example, Helpman and Krugman (1985).

6 See, for example, Barro and Sala-i-Martin (1995), Jones (1999), and Ventura (2005).

7 Easterly and Levine (1997) and Alesina et al. (2003) showed that fractionalization is negatively related to several economic indicators of performance.

The rest of the paper is organized as follows. The next section presents a simple theoretical sketch in order to provide a mechanism that generates a negative relationship between size and volatility. The third section presents the paper's empirical methodology used to test for the relationship between country size and several measures of macroeconomic volatility. The fourth section presents the results. Finally, Section 5 concludes with the main findings.

2. A simple theoretical model

This section does not attempt to provide a thorough theoretical treatment of the relationship between economic size and volatility. Rather its goal is to outline a simple mechanism (almost surely, one of many) which could generate a relationship consistent with the one we estimate below in Section 4. This theoretical sketch follows the model recently proposed by Imbs (2007), and it is also related to earlier contributions made by Costello (1993) and Stockman (1988). Let $y_{ij,t}$ denote the output growth rate of sector i $(i = 1, \dots, I)$ at time t, for country j, and suppose that it is given by:

$$y_{ij,t} = trend_{ij} + \varepsilon_t + \varepsilon_{j,t} + \varepsilon_{i,t}. \tag{1}$$

Equation (1) says that a sector's output growth rate can deviate from the average trend because of three zero-mean independent shocks: a global shock (ε_t); a country-specific shock ($\varepsilon_{j,t}$); and a sector-specific shock ($\varepsilon_{i,t}$). Country "size" here is determined by the number of sectors: the higher the value of I, the larger the economy's size.

Assuming for simplicity that all sectors have the same share in aggregate output, as in Imbs (2007), the country-level variance can be expressed as:

$$V_j = \mathrm{Var}\left(\frac{1}{I}\sum_i y_{ij,t}\right) = \sigma_t + \sigma_j + \frac{1}{I^2}\sum_i \sigma_i \tag{2}$$

where $\sigma_t = E_t(\varepsilon_t^2)$, $\sigma_j = E_t(\varepsilon_{j,t}^2)$ and $\sigma_i = E_t(\varepsilon_{i,t}^2)$. Equation (2) demonstrates that larger countries, normally characterized by a higher number of sectors, will tend to have a lower aggregate volatility.

3. Empirical methodology

We use real GDP in 1996 international prices from the Heston et al. (2006) data base. The dataset consists of the 167 countries which had available data for each of the years from 1960 to 2000. We use the log of its population as our measure of a country's size.

We rely on three different detrending methods in order to compute the cyclical component of economic activity (log of real GDP) 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.[8] Finally, business cycle volatility is measured by the standard deviation of the cyclical component obtained by each of the filtering methods.[9]

We set up our estimated models in a number of different ways. Part of our aim was to replicate Rose's (2006) estimation strategy in order to examine the robustness of the relationship between country size and macroeconomic volatility within his empirical framework. 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 variables (IV) estimation both in a bivariate model and in models with control variables.[10]

Again following Rose's (2006) strategy, we use four different sets of control variables, all obtained from Rose's website (http://www.haas.berkeley.edu/~arose). The first three sets of controls are the ones used by Rose to test the effect of country size on income and other economic indicators. 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) regional dummies for developing countries from (1) Latin America, (2) Sub-Saharan Africa, (3) East Asia, (4) South Asia, (5) Europe-Central Asia, (6) and Middle East-North Africa, and (h) language dummies for countries that speak (1) English, (2) French, (3) German, (4) Dutch, (5) Portuguese, (6) Spanish, (7) Arabic, and (8) Chinese. The *second set* of control variables augments the first set with: (a) a dummy for countries created post-World War 2, (b) a dummy for countries created after 1800 but before 1945, (c) a dependency dummy, (d) an OPEC dummy, and (e) 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. Finally, the *fourth set* of control variables adds another variable to the third data set: openness. 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.[11]

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

$$\sigma_{it} = \beta \ln(Pop_{\mathrm{it}}) + \alpha + \{\gamma_{\mathrm{t}} T_{\mathrm{t}}\} + \Sigma_{\mathrm{j}} \delta_{\mathrm{j}} X_{\mathrm{ijt}} + \{\zeta_{\mathrm{i}} I_{\mathrm{i}}\} + \varepsilon_{\mathrm{it}} \tag{3}$$

[8] The HP6.25 and Band-Pass filters produce very similar cyclical components, in the same way the HP100 filter produces a cyclical component comparable to the one obtained by differencing. This robustness will be formally confirmed by the findings in the remainder of this section.

[9] The standard deviation of the cyclical component (obtained by filtering methods or by the growth rate of GDP), is a standard and widespread measure of volatility used in the economic literature. See for example, Backus et al. (1992), Razin and Rose (1992), Martin and Rogers (2000), Aghion et al. (2005).

[10] 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 Drazen (2000).

[11] For a theoretical deviation of such an inverse relation between steady state trade and openness and economic size in the context of an optimizing growth model, see Spolaore and Wacziarg (2005). For an empirical investigation of economic size, openness, and business-cycle volatility, see Karras (2006).

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 country-specific fixed effects,
- $\{X_j\}$ denotes a set of control variables,
- ε is a well-behaved residual, and
- α, $\{\gamma\}$, $\{\delta\}$, $\{\zeta\}$ are nuisance coefficients.

4. Results

Figures 1 and 2 provide two scatter plots of output volatility (measured by the standard deviation of the HP6.25 cyclical component) against country size (measured by the natural logarithm of population) for the entire period 1960–2000. Both figures exhibit negative and statistically significant relations between these two variables. Figure 1 estimates this simple bivariate relation for the full sample:

$$\begin{aligned}\sigma_{it} &= \underset{(7.13)}{0.064} - \underset{(-2.93)}{0.003}\ln(Pop_{it})\end{aligned}$$

with $R^2 = 0.05$, and t statistics are in parenthesis. The relationship is clearly negative and statistically significant. Moreover, it does not seem to be affected by outliers. To confirm this, Fig. 2 plots again output volatility against population, this time excluding outliers,[12] and the negative relationship is actually strengthened:

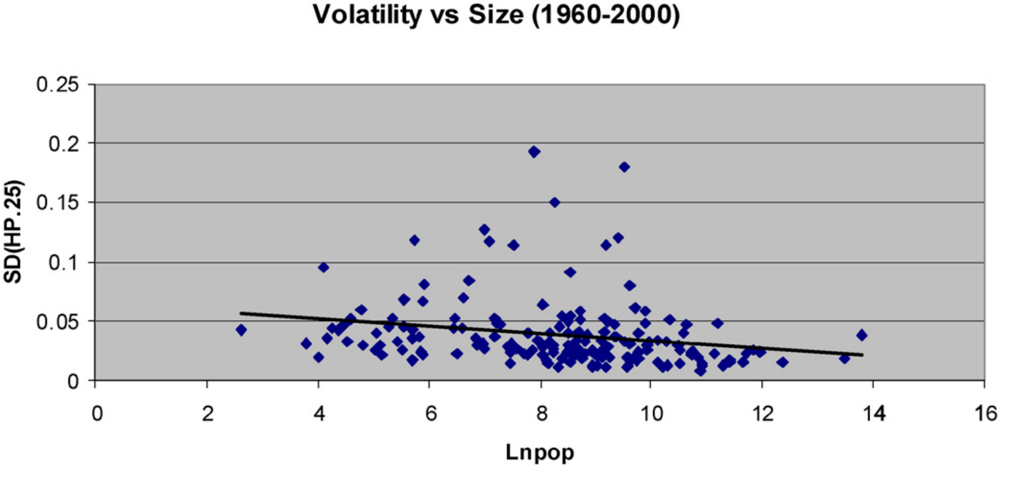

Fig. 1. All observations.

[12] We eliminate all observations with volatility higher than 0.01.

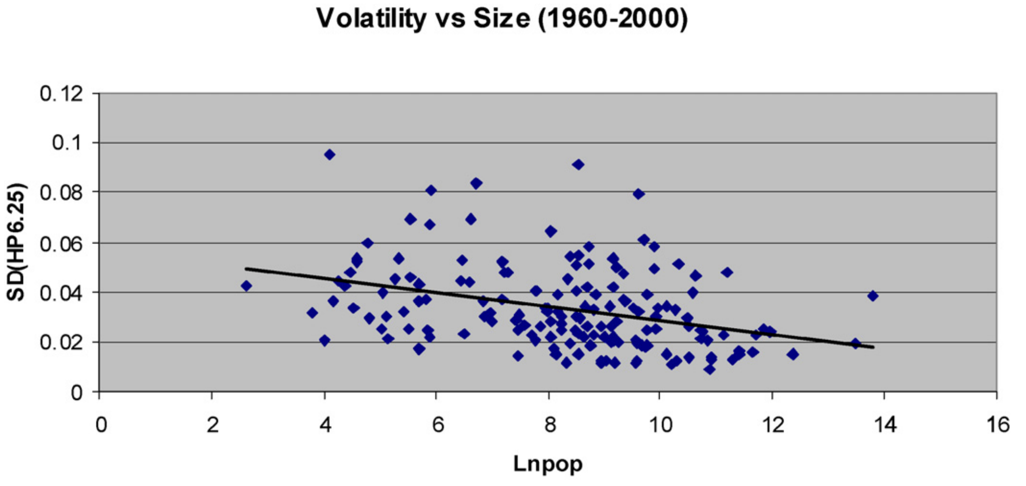

Fig. 2. Excluding outliers.

$$\sigma_{it} = \underset{(11.31)}{0.057} - \underset{(-4.85)}{0.003} \ln(Pop_{it})$$

with $R^2 = 0.13$, and t statistics are in parenthesis.[13]

We now proceed with more formal statistical evidence. Table 1 reports the estimated slope coefficient (β) of country size, along with the associated t-statistics in parentheses for several specifications of Eq. (3). The four sections in the table correspond to the four detrending methods employed: HP with smoothing parameter of 6.25, HP with smoothing parameter of 100, the BP filter, and simple differencing. In each of the four sections of the table, we present the results for the full period (pooled)[14] and for each of the four 10-year subperiods: 1960–1969, 1970–1979, 1980–1989, 1990–1999.

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

[13] We replicate the estimate of output volatility against population, using the coefficient of variation of the growth rate of GDP as an alternative measure of volatility. The regression results show that this relation is still negative and significant. For the entire sample, we get:

$$cv_{it} = \underset{(2.34)}{11.574} - \underset{(-1.93)}{0.817} \ln(Pop_{it})$$

Once more, the negative effect is not generated by outliers. Eliminating the outlier (making use of Hadi's, 1994 procedure) the result is even more significant:

$$cv_{it} = \underset{(9.99)}{2.811} - \underset{(-5.48)}{0.165} \ln(Pop_{it})$$

[14] We consider four observations for each country, one for each subperiod.

Table 1
Size and business cycle volatility (real GDP)

	Bivariate	Control1	Control2	Control3	Control4	FE	IV	IV & Control4
				HP(6.25)				
Volatility pooled	−0.003	−0.005	−0.006	−0.007	−0.009	−0.012	−0.001	−0.008
	(−4.99)***	(−5.18)***	(−4.86)***	(−3.95)***	(−4.23)***	(−2.93)***	(−1.99)**	(−2.67)***
1960–1969	−0.002	−0.004	−0.005	−0.007	−0.004		−0.001	−0.008
	(−1.40)	(−1.76)*	(−1.98)**	(−1.29)	(−0.64)		(−0.65)	(−0.87)
1970–1979	−0.005	−0.005	−0.006	−0.008	−0.013		−0.001	−0.007
	(−4.00)***	(−3.28)***	(−3.45)***	(−2.73)***	(−2.57)**		(−1.99)**	(−1.50)
1980–1989	−0.003	−0.004	−0.006	−0.006	−0.006		−0.001	−0.007
	(−3.97)***	(−3.40)***	(−4.06)***	(−3.19)***	(−3.45)***		(−1.32)	(−3.02)***
1990–1999	−0.001	−0.007	−0.004	−0.003	−0.004		0.000	−0.007
	(−1.04)	(−1.86)**	(−1.84)*	(−1.10)	(−1.35)		(−0.03)	(−1.29)*
				HP(100)				
Volatility pooled	−0.004	−0.008	−0.010	−0.012	−0.014	−0.015	−0.002	−0.014
	(−5.31)***	(−4.22)***	(−4.72)***	(−4.70)***	(−5.15)***	(−2.52)***	(−2.43)**	(−3.28)***
1960–1969	−0.003	−0.005	−0.007	−0.008	−0.007		−0.002	−0.012
	(−1.47)	(−1.65)*	(−2.44)**	(−1.45)	(−0.92)		(−0.94)	(−1.24)
1970–1979	−0.008	−0.007	−0.007	−0.012	−0.018		−0.004	−0.008
	(−4.01)***	(−3.23)***	(−3.15)***	(−2.95)***	(−2.67)***		(−1.90)*	(−1.26)
1980–1989	−0.004	−0.006	−0.010	−0.010	−0.012		−0.002	−0.013
	(−4.07)***	(−3.56)***	(−4.12)***	(3.44)***	(−3.83)***		(−1.37)	(−3.18)***
1990–1999	−0.002	−0.012	−0.010	−0.008	−0.010		0.000	−0.017
	(−1.33)	(−2.19)**	(−2.16)**	(−1.460)	(−1.94)***		(−0.10)	(−1.77)*
				Band Pass				
Volatility pooled	−0.002	−0.004	−0.007	−0.008	−0.010	−0.021	0.000	−0.011
	(−4.07)***	(−1.85)*	(−4.91)***	(−3.67)***	(−4.12)***	(−1.90)*	(0.21)	(−3.11)***
1960–1969	−0.003	−0.013	−0.012	−0.013	−0.014		0.000	−0.015
	(−1.14)	(−1.29)	(−1.16)	(−0.97)	(−0.78)		(−0.20)	(−0.86)
1970–1979	−0.005	0.002	−0.006	−0.010	−0.012		−0.003	−0.008
	(−3.03)***	(0.21)	(−2.44)**	(−2.44)***	(−2.61)**		(−2.31)**	(−1.66)*
1980–1989	−0.003	−0.004	−0.007	−0.006	−0.007		−0.002	−0.008
	(−4.35)***	(−3.90)***	(−4.54)***	(−3.45)***	(−3.73)***		(−1.70)*	(−3.74)***
1990–1999	−0.001	−0.007	−0.006	−0.005	−0.007		0.000	−0.013
	(−1.07)	(−2.01)**	(−2.29)**	(−1.43)	(−1.66)*		(−0.00)	(−1.73)*
				Differencing				
Volatility pooled	−0.005	−0.008	−0.010	−0.012	−0.014	−0.014	−0.002	−0.014
	(−4.98)***	(−4.20)***	(−4.49)***	(−4.18)***	(−4.32)***	(−3.71)***	(−2.04)**	(−2.93)***
1960–1969	−0.004	−0.009	−0.010	−0.012	−0.010		−0.003	−0.019
	(−1.85)*	(−2.01)**	(−2.19)**	(−1.24)	(−0.91)		(−0.99)	(−1.21)
1970–1979	−0.008	−0.008	−0.009	−0.014	−0.022		−0.003	−0.012
	(−3.72)***	(−3.05)***	(−3.32)***	(−2.94)***	(−2.68)***		(−1.43)	(−1.50)
1980–1989	−0.004	−0.006	−0.008	−0.010	−0.011		−0.002	−0.014
	(−3.66)***	(−3.25)***	(−3.88)***	(−4.14)***	(−3.59)***		(−1.53)	(−3.76)***
1990–1999	−0.002	−0.011	−0.010	−0.007	−0.008		0.000	−0.014
	(−1.16)	(−2.10)**	(−2.19)**	(−1.19)	(−1.53)		(−0.08)	(−1.46)

* Significant at the 10% level.
** Idem, 5%.
*** Idem, 1%.

$\{\delta\} = 0$; (vii) Instrumental Variables with $\{\delta\} = \{\zeta\} = 0$; and (viii) Instrumental Variables with $\{\zeta\} = 0$, fourth set of controls.

Focusing on the full-period (pooled) results first, it can be readily seen that the relation 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 eight 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 four different detrending methods we used to obtain the cyclical component of GDP.

Looking at the various 10-year samples, it emerges that the relationship between country size and business cycle volatility is almost always negative and it is also statistically significant in the great majority of cases (in fact, negative and statistically significantly estimated βs are near universal for the central periods 1970–1979 and 1980–1989).

So far, we have quantified the severity of business-cycle fluctuations using the volatility of *aggregate* real GDP. While this is the most frequently used measure in the literature, Table A.1 in the appendix, also looks at the volatility of real GDP per capita as an alternative measure. Table A.1 is organized in the same format as Table 1, and uses the same detrending methods and sets of control variables. It is easy to see that this does not change our findings, as the results of the two tables are extremely similar in terms of both magnitude and statistical significance.

Overall, we believe that our findings 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.

5. Conclusions

Countries come in all shapes and sizes, but economic models are divided on whether size is one of the determinants of their 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, 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 economic outcomes. However, he did not consider the effect that country size may have on business cycle volatility.

Our goal is to examine this missing link using a panel data set that includes 167 countries with observations from 1960 to 2000. Following Rose's (2006) estimation strategy we estimate the relationship between country size and business cycle volatility. Recent research has made a convincing case that business-cycle volatility is one of the important components of economic performance. Thus, if country size can be shown to have a significant effect on economic fluctuations, then size can be said to matter.

The results of the paper suggest very strongly that the relationship between country size and business cycle volatility is negative and statistically significant, even when we include Rose's (2006) control variables and openness. This is consistent with the findings of Karras (2006) and implies that smaller countries are subject to more volatile business cycles than larger countries. It follows that country size really matters, at least in terms of cyclical fluctuations.

The implications for further research are straightforward. Empirically, the nature of the negative relationship between size and fluctuations needs to be investigated further, looking more closely at the role of the various components of aggregate demand, as well as the importance of stabilization policies and productivity shocks.

If, as we expect, the negative relationship we identified here survives, what does it mean? What are its origins? A theoretical link between size and volatility, almost totally missing currently, should be provided. This paper's Section 2 has made a simple start, but the paper's empirical results offer additional helpful leads. They suggest, for example, that trade openness is not likely to be the main reason why small countries are more volatile. It is tempting to treat openness as a usual suspect—after all, more open economies are more exposed to "foreign" shocks. In this regard, it is interesting to note that our results obtain even when we control for openness, so other factors (such as production diversification) should be primarily responsible.

A theoretical framework is also necessary for any short of extrapolating from our results. For example, would the business cycle be minimized if there were only a single country on earth? Do economic unions reduce volatility by increasing economic size?

Future research must also address a peculiar contradiction between theory and empirics regarding scale effects. While numerous theoretical growth models predict scale effects on steady-state growth or levels of income, these effects have not been easy to detect empirically. At the same time, while the empirical evidence is pointing to significant size effects for cyclical fluctuations, theoretical business-cycle models normally ignore country size completely. The results of this paper suggest that this is an omission worth addressing.

Acknowledgments

We wish to thank Andrew Rose for helpful comments and suggestions. Errors and omissions remain ours.

Appendix A

Table A.1
Size and business cycle volatility (real GDP per capita)

	Bivariate	Control1	Control2	Control3	Control4	FE	IV	IV & Control3
				HP(6.25)				
Volatility pooled	−0.003	−0.006	−0.007	−0.008	−0.01	−0.003	−0.001	−0.009
	(−5.55)***	(−5.09)***	(−4.59)***	(−4.08)***	(−4.30)***	(−3.55)***	(−2.03)**	(−2.38)**
1960–1969	−0.003	−0.004	−0.004	−0.005	−0.003		−0.002	−0.008
	(−2.35)***	(−1.84)*	(−1.64)*	(−1.35)	(−0.60)		(−1.04)	(−1.36)
1970–1979	−0.006	−0.008	−0.007	−0.009	−0.013		−0.003	−0.007
	(−4.68)***	(−4.96)***	(−4.72)***	(−3.09)***	(−2.60)**		(−2.31)**	(−1.97)**
1980–1989	−0.001	−0.004	−0.005	−0.005	−0.006		0	−0.006
	(−3.21)***	(−3.88)***	(−4.01)***	(−2.77)***	(−3.22)***		(−0.16)	(−2.87)***
1990–1999	−0.001	−0.007	−0.007	−0.007	−0.009		0	−0.011
	(−1.29)	(−2.14)**	(−1.80)*	(−1.61)*	(−1.72)*		−0.01	(−1.90)*
				HP(100)				
Volatility pooled	−0.004	−0.009	−0.01	−0.011	−0.014	−0.004	−0.002	−0.011
	(−5.36)***	(−4.74)***	(−5.24)***	(−5.39)***	(−5.63)***	(−3.32)***	(−2.32)**	(−2.96)***

Table A.1 (*continued*)

	Bivariate	Control1	Control2	Control3	Control4	FE	IV	IV & Control3
1960–1969	−0.003	−0.003	−0.003	−0.004	−0.006		−0.003	−0.009
	(−1.75)*	(−1.03)	(−1.24)	(−0.83)	(−1.08)		(−1.34)	(−1.63)
1970–1979	−0.009	−0.011	−0.01	−0.013	−0.02		−0.005	−0.009
	(−4.57)***	(−4.66)***	(−4.85)***	(−3.70)***	(−3.22)***		(−2.40)**	(−1.90)*
1980–1989	−0.002	−0.005	−0.007	−0.009	−0.01		0	−0.011
	(−2.79)***	(−3.04)***	(−3.39)***	(3.08)***	(−3.07)***		−0.11	(−2.98)***
1990–1999	−0.003	−0.011	−0.009	−0.007	−0.01		0	−0.012
	(−1.59)	(−2.17)**	(−2.37)**	(−1.60)*	(−2.24)**		(−0.05)	(−2.05)**
				Band Pass				
Volatility pooled	−0.021	−0.027	−0.02825	−0.029	−0.019	−0.027	−0.018	−0.008
	(−5.38)***	(−5.47)***	(−4.28)***	(−3.42)***	(−2.09)**	(−4.04)***	(−3.79)***	(−2.12)**
1960–1969	−0.038	−0.048	−0.04302	−0.038	−0.064		−0.038	−0.033
	(−3.73)***	(−3.17)***	(−2.61)**	(−2.51)**	(−2.56)**		(−2.14)**	(−1.41)
1970–1979	−0.054	−0.066	−0.06757	−0.052	−0.002		−0.057	−0.015
	(−6.38)***	(−6.00)***	(−4.38)***	(−3.08)***	(−0.07)		(−7.48)***	(−0.78)
1980–1989	−0.006	−0.004	−0.00596	−0.005	−0.005		−0.003	−0.006
	(−1.59)	(−3.60)***	(−3.84)***	(−2.10)**	(−2.93)***		(−1.03)	(−3.05)***
1990–1999	0.002	−0.01	−0.00498	−0.003	−0.003		0.003	−0.006
	(−0.60)	(−1.87)*	(−1.93)*	(−0.90)	(−0.92)		−0.53	(−1.21)
				Differencing				
Volatility pooled	−0.005	−0.009	−0.01	−0.011	−0.015	−0.005	−0.002	−0.012
	(−5.40)***	(−4.86)***	(−5.50)***	(−4.27)***	(−4.89)***	(−3.30)***	(−1.94)**	(−2.43)**
1960–1969	−0.004	−0.009	−0.009	−0.013	−0.01		−0.002	−0.008
	(−2.29)***	(−2.57)**	(−2.56)**	(−1.76)*	(−1.18)		(−0.93)	(−1.17)**
1970–1979	−0.008	−0.01	−0.009	−0.012	−0.02		−0.004	−0.008
	(−3.99)***	(−3.93)***	(−3.83)***	(−2.97)***	(−2.67)***		(−1.63)*	(−1.90)*
1980–1989	−0.004	−0.006	−0.009	−0.01	−0.012		−0.001	−0.012
	(−4.30)***	(−4.37)***	(−4.36)***	(−3.74)***	(−4.15)***		(−0.95)	(−3.62)***
1990–1999	−0.002	−0.012	−0.01	−0.009	−0.011		0	−0.011
	(−1.45)	(−2.21)**	(−2.31)**	(−1.81)*	(−1.88)*		(−0.10)	(−1.41)

* Significant at the 10% level.
** Idem, 5%.
*** Idem, 1%.

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