Response to

"Response of Garey and Valerie Ramey to "Are Average Growth Rate and Volatility Related?" by Partha Chatterjee and Malik Shukayev"

Partha Chatterjee
partha@nus.edu.sg

Malik Shukayev
mshukayev@bank-banque-canada.ca

In our paper "Are Average Growth Rate and Volatility Related?" we do not find a consistent and significant relationship between average growth rates and volatility. Recently Professors Garey and Valerie Ramey has written a note in response to our paper. They have argued that our results are due to the bad *choice* of definition for average growth rates. However, we would like to be very clear that we *do not choose* any definition for the average growth rate.

For all the samples we report results for two different measures, log difference and year-to-year percentage change, [1] and for some samples, for four definitions of average growth rates, the two mentioned above and the geometric growth rate and a growth rate which is calculated as the coefficient of an OLS regression of GDP per capita on time. We find that, for *any* definition of growth rate, there are a large number of cases for which the there is no significant relationship between average growth rate and volatility.

The objective of the paper is to find out if there is any consistent relationship

[1] By choosing to call the year-to-year percentage change as "standard definition", we do not imply any superiority of that definition over the others. We chose to call that the standard definition because of lack of a better concise name for the definition and also since it is used by common data sources like PWT and NIPA.

for any definition. To that end, as pointed out by Ramey and Ramey, we investigate whether there is a consistent and significant relationship between average growth rate and volatility of growth rates in two dimensions:

1. by using various datasets, and

2. by using different definitions of growth rate.

Though Ramey and Ramey do not comment on the first point, we would like to begin with a brief discussion of our results on this dimension and then discuss the other aspect.

Robustness across datasets

In the Ramey and Ramey (1995) paper the analysis was done for the period 1962-1985 for countries for which data was available in PWT 5.0. However, when we did our analysis we were fortunate to have data for a longer period of time and for a larger number of countries from an updated version of the Penn World Tables, PWT 6.1. [2] Further we got data from IFS, [3] though for a smaller number of countries. This allows us to test the relationship for various datasets and years.

In all the samples that we have used, we have reported regression results using two definitions of growth rate—log difference (the definition used in Ramey and Ramey (1995)) and percentage changes (which we refer to as the standard definition in the paper). In a majority of the cases, the coefficient of regression between the two variables of interest is insignificant for **both** the definitions.

[2] There has been some updates to the data between versions 5 and 6.1 in PWT including updating the source of national accounts, base year, etc. More details are available from the PWT website.

[3] The advantage of IFS is that the data is in local currency. As a result it does not suffer any problem that might be associated with conversion to a common currency.

Table 1: Regressions on samples from different sources for 1962-1985

Data Source	No. of countries	**Significant?**			
		log difference	*% change*	*Geometric*	*OLS*
PWT 5.0	92	Yes	**No**	Yes at 10% (No at 5%)	**No**
PWT 6.1	112	**No**	**No**	**No**	**No**
IFS	34	**No**	**No**	**No**	Yes

In fact it is interesting to focus on the period 1962-1985 (the period of analysis in Ramey and Ramey (1985)) and consider a sample of all possible countries we could get data on. Consider the three sources of data, PWT 5.0, PWT 6.1, and IFS and the four different definitions of average growth rates.

From the above table we observe that the coefficient is significant only for 3 out of 12 cases. The coefficient is not significant even when growth rate is calculated as the log difference for either data from PWT 6.1 or IFS. Similarly, from the analysis of data on various subsets and for different periods the coefficient of interest is not significant most often. This suggests a lack of any consistent relationship between the average growth rate and volatility of growth rates, irrespective of the definition for average growth rate we choose.

Discussion on definition of growth rates

There are several ways the average growth rate of GDP per capita can be calculated. The reason we do the whole analysis for more than one definition is because we recognize that there are shortcomings to these definitions and do not want our analysis to be dictated by the choice of the definition.

The average of year-to-year percent changes, as Ramey and Ramey point out in their response using the example of El Salvador, can overestimate growth rates, particularly for countries like El Salvador which has suffered a negative growth rate

Table 2: Comparisons of Growth Rates

	El Salvador	South Korea
Standard Deviation	0.038211724	0.040667612
(1) *Average % change*	0.007539987	0.058560499
(2) *Average log diff.*	0.006813674	0.056120567
(3) *Geometric average*	0.007187293	0.058049256
(1)-(3)	0.000352694	0.000511243
(2)-(3)	-0.000373619	-0.001928689

of more than -10% in some years. On the other hand, the log difference measure will underestimate growth rates, particularly high ones.

For an illustration let us reconsider the example of El Salvador along with that of South Korea (Republic of Korea) for the years 1960-2000. The data is form PWT 6.1 (details are reproduced in the appendix).

The first row of Table 2 reports standard deviations of the log differences for both countries. The next three rows give the average growth rates for both countries for the different definitions. The last two rows in Table 2 report the difference between average geometric growth rate (which is the *exact* growth rate between any two given years) and the other two averages.

For both El Salvador and South Korea, average of percentage changes and average of log differences are both biased compared to the geometric growth rate – while average percentage change overestimates, average log difference underestimates. In the case of El Salvador, which has experienced low average growth over the period of consideration, the difference from geometric mean for both the averages are comparable. However, for South Korea, which has experienced high average growth over the period, the difference between average log difference and geometric mean is 3.77 times that of the difference between average percentage change and geometric mean.

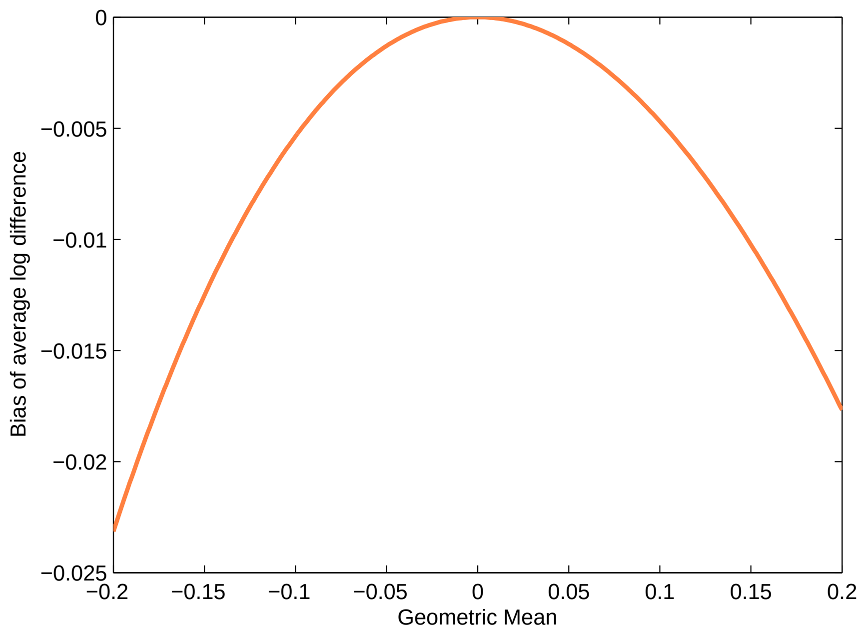
Ramey and Ramey explains in their response how the average percentage change can be biased. It is also easy to see that average log difference will be biased downwards compared to the geometric mean.

Geometric mean $= (\frac{Y_T}{Y_0})^{1/T} - 1 = Z - 1$, where, $Z = (\frac{Y_T}{Y_0})^{1/T}$

Average of log difference $= \frac{1}{T}\log(\frac{Y_T}{Y_0}) = \log(Z)$

Thus the bias is $\log(Z) - (Z - 1)$. This bias is plotted against geometric mean.

Figure 1: Bias of average log difference



The geometric mean also, however, is not free from all problems, particularly for our purposes when we are interested in a general relationship between average growth rate and volatility of growth rates. It is quite sensitive to the choice of the initial year and the final year, a problem that it shares with the other two. One way to avoid that problem is to calculate the average growth rate as the coefficient of an OLS regression of GDP per capita on time. (We also calculate average growth rate by this method for the sample used by Ramey and Ramey. Using this method we again find that the coefficient of regression between average growth rate and volatility of growth rate is insignificant. The result is reported in Table 4 in our paper.) Of course, for both of the last two definitions we will still have to use one of the other definitions to calculate standard deviations, since neither geometric growth rate nor growth rate as the regression coefficient gives us year-to-year changes in the GDP per capita.

To conclude, we restate that our objective in the paper is to look for a consistent relationship between average growth rate and volatility of growth rates. We search for this relationship in various datasets and using multiple definitions of growth rate. Our aim was never to comment on the suitability of different measures of average growth rates. Our results, that we do not find any consistent relationship across various datasets holds for any definition of growth rate.

	GDP per cap. (rgdpl)		Growth Rate as % change		Growth Rate as log diff.	
Year	El Salvador	South Korea	El Salvador	South Korea	El Salvador	South Korea
1960	3306.470151	1570.889639	-0.014163182	-0.012480646	-0.014264437	-0.012559183
1961	3334.483116	1611.174954	0.008472166	0.025644905	0.008436479	0.02532159
1962	3624.742927	1606.535185	0.087047917	-0.002879743	0.083465689	-0.002883897
1963	3650.378989	1722.497473	0.007072519	0.072181605	0.007047626	0.069695456
1964	3779.560218	1820.332723	0.035388443	0.056798487	0.034776664	0.055244043
1965	3884.64549	1869.429155	0.027803571	0.02697113	0.02742407	0.02661382
1966	4005.204393	2060.516138	0.031034725	0.102216755	0.030562885	0.097323384
1967	4119.007509	2126.863494	0.02841381	0.032199387	0.028017625	0.031691853
1968	4134.359502	2328.689818	0.00372711	0.094893877	0.003720181	0.090657443
1969	4150.594033	2614.996088	0.003926734	0.122947362	0.003919045	0.115956802
1970	4149.44485	2776.947238	-0.000276872	0.061931699	-0.00027691	0.060089607
1971	4104.04683	2957.230382	-0.010940745	0.064921343	-0.011001035	0.06290094
1972	4303.703354	3033.920779	0.048648695	0.025933183	0.047502379	0.025602621
1973	4395.59925	3361.219911	0.021352749	0.10787992	0.021127973	0.102448207
1974	4399.804151	3558.873962	0.000956616	0.05880426	0.000956159	0.057140215
1975	4458.540387	3719.545292	0.013349739	0.045146676	0.013261416	0.044157235
1976	4642.366055	4076.701065	0.041230011	0.096021353	0.040402717	0.091686671
1977	4772.082851	4431.816071	0.027941958	0.087108424	0.027558704	0.08352135
1978	4928.624457	4769.685477	0.032803623	0.076237236	0.032277068	0.073470917
1979	4707.368348	5048.226686	-0.044892061	0.058398234	-0.04593092	0.056756665
1980	4159.862654	4829.52261	-0.116308233	-0.043322951	-0.123646957	-0.044289406
1981	3732.442162	5058.014716	-0.102748703	0.04731153	-0.108419303	0.046226433
1982	3485.551477	5351.028709	-0.066147223	0.057930633	-0.06843648	0.056314767
1983	3541.615127	5847.334482	0.016084585	0.0927496	0.015956599	0.088697089
1984	3583.333702	6263.961931	0.011779534	0.071250832	0.011710695	0.068826968
1985	3615.754204	6600.582277	0.009047581	0.053739207	0.009006897	0.052344988
1986	3550.044691	7244.03524	-0.018173114	0.097484273	-0.018340273	0.093020536
1987	3580.412346	7968.661965	0.008554161	0.100030812	0.008517782	0.09533819
1988	3618.05268	8731.550078	0.010512849	0.095736037	0.010457973	0.091426317
1989	3543.220168	9202.639098	-0.020683091	0.053952507	-0.020899982	0.05254739
1990	3529.181851	9958.582867	-0.003962022	0.082144237	-0.003969892	0.078944478
1991	3561.23133	10801.4126	0.009081277	0.084633501	0.009040291	0.081242143
1992	3699.401102	11246.35877	0.038798314	0.041193332	0.038064578	0.04036749
1993	3879.135012	11722.54264	0.048584597	0.042341159	0.047441252	0.041469298
1994	4009.557579	12585.03259	0.033621559	0.07357533	0.033068712	0.070994508
1995	4179.182047	13552.63334	0.042305034	0.076885042	0.041434639	0.074072653
1996	4235.789307	14319.89195	0.013545057	0.056613249	0.013454143	0.055068745
1997	4317.776543	14785.8642	0.019355834	0.032540207	0.019170893	0.032021986
1998	4330.123383	13435.81433	0.002859537	-0.091306794	0.002855456	-0.095747749
1999	4421.499196	14813.35438	0.021102358	0.102527469	0.020882787	0.097605243
2000	4434.905365	15881.33526	0.003032042	0.072095817	0.003027454	0.06961544