Queen's Economics Department Working Paper No. 832

Cross-Country Variations in Aggregate Volatility: Evidence from 56 Countries

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9-1991

Discussion Paper # 832

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by

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September 1991

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Abstract

Relationships between country size (measured by both population and aggregate GDP) and standard of living (measured by per capita GDP) and the volatilities of aggregate output, consumption, and investment are investigated for a sample of 56 countries. Both characteristics are shown to be negatively related to the volatilities of the growth rates of all three aggregates for the period 1950-85. The relationships between the importance of nontradable goods (measured by the ratio of consumption expenditures on nontradables to expenditures on tradables) and the volatilities of aggregates are studied for a sub-sample of 23 countries. This characteristic and the volatilities of all three aggregates are shown to be negatively related. These results are consistent with the predictions of theoretical models studied by Crucini (1990) and Head (1991).

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I. INTRODUCTION:

Several studies have contributed to a growing body of documented empirical regularities relating to international properties of business cycles. (e.g. Backus & Kehoe, (1987,89), Baxter & Stockman (1988), Stockman, (1988), Tesar (1989)) These studies have generally examined data from several countries (usually developed countries) for evidence of either broad similarities in fluctuations or comovements of aggregates across countries. Generally they have not analyzed the relationships between the different characteristics of the individual countries and similarities or dissimilarities in the fluctuations of their aggregates. Rather than focusing on heterogeneities among the economies being compared, they have concentrated on identifying similarities in aggregate fluctuations across countries, and evidence for or against the existence of a world business cycle.

Canova and Dellas (1990) adopt a different focus, studying the influence of countries' trade interdependence on their pairwise comovements of aggregate output. They also analyze the relationship between a country's degree of openness[1] and the volatility of its aggregate output. Thus, their paper deals with the influence of specific dimensions of international heterogeneity on differences in the fluctuations and comovements of aggregates across countries. This research is in a similar spirit. The relationships between the volatilities of aggregates and country size (as measured by both population and aggregate GDP), standard of living (as measured by per capita GDP), and the relative importance of nontradable goods (measured by the ratio of consumption expenditures on nontradables to

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[1]Measured as the average share of imports in aggregate output over the sample period.

those on tradables) are analyzed using time series data on real gross domestic product (GDP) and its major components for two samples of countries.

The data analysis indicates relationships between all three of the dimensions of international heterogeneity studied and the volatilities of the growth rates of aggregate output, consumption, and investment. These findings are broadly consistent with the predictions of the theoretical economies studied in Crucini (1990) and Head (1991). Both of these papers find that country size is negatively related to the volatilities of aggregate output and investment in complete markets general equilibrium models. Head (1991) also finds that the volatilities of output, consumption, and investment are all negatively related to steady state per capita output. In that paper the volatilities of investment and output are also negatively related to the ratio of consumption expenditures on nontradables to expenditures on tradables while consumption volatility is positively related to this measure.

The rest of the paper is organized as follows. Section II describes the data. Section III presents the results of the analysis. Section IV summarizes the findings and discusses their implications for theoretical research in open economy business cycles. All tables and figures referred to in the paper come at the end.

II. THE DATA:

II.1 Sample 1; 56 Countries:

The relationships between the volatilities of the growth rates of a country's aggregate output, consumption, and investment, and its size as measured by both the log of its population and the log of its *aggregate* GDP are studied for the countries in this sample. These data are also used to

examine the relationship between standard of living, as measured by the log of a country's *per capita* GDP and the volatilities of its aggregates.

Data on population, aggregate GDP, per capita GDP, consumption expenditures, and gross capital formation are taken from the Penn World Table (Mark 4) of Summers and Heston (1988). The data series are annual and cover the period 1950-85. All series are in logarithms, and growth rates are computed as first differences of the logged series. The measures of volatility are per cent sample standard deviations of growth rates.[2]

Table 1 contains both the volatilities of the growth rates of aggregates and measures of country size and standard of living for the 56 countries in sample 1. The first two columns of the table list country names and three letter abbreviations that will be used in the tables and figures. Per cent sample standard deviations of the growth rates of aggregate GDP, consumption expenditures, and gross capital formation, denoted σ_Y, σ_C, and σ_I respectively, occupy the next three columns. The sixth, seventh, and eighth columns contain measures of country size and standard of living for the year 1980.[3] The sixth column, labelled "POP"

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[2]All of the analysis presented in this paper using growth rates was repeated using data detrended with the Hodrick-Prescott (1980) filter. While certain empirical regularities regarding international properties of business cycles have been shown not to be robust to different methods of detrending, (see, for example, Baxter and Stockman (1988) and Canova and Dellas (1990)) all of the results presented in this paper are. For this reason, only the analysis using the volatilities of growth rates is presented here. A summary of the results obtained using HP filtered data is available from the author on request.

[3]For all countries in the sample, population, aggregate GDP, and per capita GDP experience growth over the period 1950-85. Furthermore, the growth rates of all three vary considerably from country to country. (Summers and Heston, 1988) This makes using stock variables as measures of country characteristics over a period of time problematic. The values of these variables for 1980 are reported throughout the paper. Values and rankings for other years were also used in computations, but are not reported to save space. From which year the characteristic measures are taken, moreover, makes very little difference in any of the statistics reported, and no

contains the log of each country's population in 1980. The seventh column, labelled "AGP", contains the log of aggregate GDP in 1980, and the eighth, labelled "PCG", contains the log of the country's per capita output computed in 1980 "world prices" (Summers & Heston, 1988).

Certain general properties of aggregate fluctuations are evident in Table 1. Consumption fluctuations are generally of similar magnitude to those of output[4]. Investment growth is considerably more volatile than either of the other two series. These general properties have been noted previously for smaller samples comprised mainly of developed countries (e.g. by Backus and Kehoe (1987,89).

Table 2.a contains summary statistics for the countries in sample 1. Note that there is considerable variation within the sample with regard to the volatility of the growth rates of output, consumption, and investment over the period 1950-85. There is also considerable heterogeneity with regard to country size, as measured by both population and aggregate GDP, and standard of living, as measured by per capita GDP.

Table 3.a contains cross correlations of the characteristic measures within countries. The correlations indicate that for the countries in sample 1 standard of living and country size are not highly correlated. The two size measures, aggregate GDP and population, are highly but not perfectly correlated, and the correlation of a country's standard of living with its size differs considerably depending on the measure of size used.

II.2 Sample 2: 23 Countries:

A sub-sample of the entire 56 country sample is used to examine the

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difference in the overall results.

[4]The consumption data used in this study includes expenditures on consumer durables. It is likely that a considerable share of the volatility of aggregate consumption is accounted for by fluctuations in this component.

relationships between the share of aggregate consumption expenditure devoted to the purchase of nontradable goods in a country and the volatilities of its output, consumption, and investment. These 23 countries are the countries of the OECD excepting Turkey[5]. Disaggregated consumption expenditure data for these countries over the period 1976-88 were taken from *OECD National Accounts, Volume II: Detailed Tables.* These data were used to construct measures of the shares of consumer expenditure devoted to tradable and nontradable goods. Private consumption expenditures on services plus government expenditures comprise "nontradables". All private expenditures that were not directly attributable to services were classified as "tradables". The following chart details the definitions of tradables and nontradables, where the categories aggregated are those for which the OECD provides data on expenditure:

Classification of Expenditure Categories as Tradable and Nontradable.

(Capitalized Terms identify categories used in OECD National Accounts, Volume II: Detailed Tables)

Tradables:	Food, Beverages, and Tobacco Clothing and Footwear Gross Rent, Fuel, and Power Household Furnishings *less* Household Services Personal Transportation Equipment Personal Care Goods Miscellaneous Other Goods
Nontradables:	Household Services Medical Care and Health Expenses Transportation & Communication *less* Personal Transport Equipment Recreation, Entertainment, Educational, and Cultural Services Expenditures in Restaurants, Cafes, and Hotels Government Final Consumption

[5]Turkey was eliminated from sample 2 due to the lack of disaggregated consumption data.

The countries of sample 2 come last in Table 1. The rightmost column of Table 1 contains the average annual ratio of consumption expenditures on nontradables to expenditure on tradables, NTS, over the period 1976-88 for each of these countries.

Table 2.b contains summary statistics for the countries of sample 2. Note that the countries in the sample are indeed heterogeneous with regard to the relative importance of nontradables. There is also considerable variation within this sample in country size, as measured by both population and aggregate GDP. There is much less diversity in this sample than in sample 1, however, with regard to standard of living as measured by per capita output. This is not surprising as sample 2 is comprised entirely of developed countries while sample 1 also includes developing and less developed countries. It is also the case that the ranges of the standard deviations of output, consumption, and investment are considerably narrower for sample 2 than for sample 1.

Table 3.b contains correlations of the measures of country size, standard of living, and the importance of nontradables for sample 2. The correlations indicate that for the countries in sample 2 the two size measures, AGP and POP, are very highly correlated. PCG and country size are not highly correlated, and this correlation differs somewhat depending on the measure of size used. This is the same general pattern observed for the countries in sample 1 in Table 3.a.

The first column of Table 3.b shows that the ratio of consumption expenditures on nontradables to expenditures on tradables is positively correlated with both country size and standard of living. The relationship between this ratio and country size is stronger for size as measured by aggregate GDP rather than by population. The relationship between the importance of nontradables and standard of living is stronger than that

between the importance of nontradables and size. NTS is plotted against PCG in Figure 1. In this figure a strong positive relationship between the two characteristics is apparent.

III. THE ANALYSIS:

The data are analyzed using scatter plots and Spearman rank correlation coefficients. The scatter plots are useful for identifying general relationships between country characteristics and measures of volatility. These plots also indicate important outliers. Rank correlation coefficients are useful for qualitatively identifying positive or negative relationships, especially in the presence of outliers. These numbers are used as test statistics for tests of regression dependence between the measures of size, standard of living, and the importance of nontradables, and the volatilities of aggregates.

III.1. Country Size:

The relationships between the volatilities of aggregates and country size are studied for two different measures of country size, population and aggregate GDP. Figures 2 and 3 contain plots of 1980 POP and 1980 AGP respectively against the sample standard deviations of the growth rates of aggregate GDP, consumption, and investment for the 56 countries of sample 1. None of the panels in Figure 2 appears to depict a strong relationship between POP and the volatility of the aggregate. By contrast, in all three panels of Figure 3 there appears to be a negative relationship between the log of aggregate GDP and the per cent standard deviation of the growth rate of the aggregate. Such a relationship is more visible in panel C than in panels A or B.

The relationships between country size as measured by both POP and AGP

and the volatilities of aggregates are further investigated using rank correlation coefficients. The first and fourth rows of Table 5contain rank correlation coefficients for the standard deviations of output, consumption, and investment and the average rankings of POP and AGP respectively over the sample period.[6] These correlation coefficients indicate negative relationships between the volatility of all three aggregates and population. The coefficients are all significant at the .05 level, although only $\rho(\sigma_I, POP)$ is statistically significant at the .01 level. The evidence is stronger for size measured by aggregate GDP. In this case all three correlation coefficients are statistically significant at the .001 level.

It is of interest to examine whether the relationships between country size and the volatilities of aggregates differ across subsets of sample 1. It is possible that the whole sample may exhibit strong relationships between this measure of country size and volatility, while certain sub-samples exhibit only very weak relationships, or none at all. Also, since relationships between both size and standard of living and the volatilities of aggregates are studied in this research, it is of interest whether one dimension of heterogeneity affects the relationships between the other and the volatilities of aggregates. Two sub-samples are examined, each comprised of a group at one end of the ranking of countries with regard to per capita GDP in 1980. Sub-sample 1 is comprised of the 20 countries in sample 1 with the highest per capita GDP's, and sub-sample 2 of the 20

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[6]As noted previously, the choice of a date for ranking population is problematic, given that the rankings change somewhat over the period 1950-85. The average ranking was chosen because it makes use of the rankings in all years, rather than just at one point in time. Whether this ranking or the ranking for any of the individual years were used, however, made little difference in the Spearman rank correlation coefficients, and did not affect their statistical significance, or lack thereof, at either the .05,.01, or .001 level.

countries with the lowest per capita GDP's. Table 4 contains the lists of countries in each sub-sample.

Rank correlation coefficients for the rankings of the standard deviations of output, consumption, and investment with the 1980 rankings of the size measures for each sub-sample are also found in Table 5. These correlation coefficients show that there is indeed a negative relationship between country size as measured by population and the volatility of aggregates for the 20 countries with the greatest 1980 PCG. In fact the evidence for a relationship appears to be stronger for this sub-sample than for the sample as a whole. This is not true for the 20 countries with the lowest 1980 PCG. For this sub-sample there appears to be no relationship between this measure of country size and either σ_Y or σ_C. There is some evidence in this sub-sample for a negative relationship between a country's population and its σ_I, although this coefficient is not significant at the .05 level either.

The correlation coefficients also indicate that there is a negative relationship between country size as measured by AGP and the volatilities of the growth rates of aggregates for the 20 countries with the greatest 1980 per capita GDP. There is also a strong negative relationship between this measure of country size and σ_I for the 20 countries with the lowest 1980 PCG. There appears to be no relationship, however, between AGP and either σ_Y or σ_C for the second sub-sample.

Thus, the evidence for relationships between country size and the volatilities of the growth rates of aggregate output and consumption, is stronger for the 20 countries with the highest 1980 PCG than for the entire sample of 56 countries, regardless of whether country size is measured by population or aggregate GDP. The evidence for relationships between country size by either measure and the volatilities of aggregate output or

consumption is weak for sub-sample 2. For this sub-sample, however, the negative correlation coefficient between AGP and the volatility of aggregate investment is significant at the .05 level.

Overall, large countries exhibit less volatility in their aggregates than do small countries. The evidence for these relationships is stronger for size measured by aggregate GDP than by population. The relationships between country size and the volatility of aggregates are strongest for countries with relatively high per capita output, i.e. the developed countries. For less developed countries no relationships are observed between country size (by either measure) and the volatilities of output or consumption. A negative relationship between country size as measured by aggregate GDP and the volatility of aggregate investment is observed, however, for the 20 countries with the lowest per capita output.

A possible explanation for the greater volatility of small countries is that their economies may be dominated by a smaller number of industries or sectors than those of large countries, making their aggregates more sensitive to disturbances in individual industries. Sectoral diversification (or the lack of it) could perhaps also explain the lack of a relationship between size and the volatilities of aggregates for the poorest countries. It may be the case that while these economies differ considerably in size they do not differ greatly with regard to diversification in this sense.

III.2. Standard of Living:

Figure 4 contains plots of the log of per capita GDP in 1980 (PCG) against the sample standard deviations of the growth rates of aggregate GDP, consumption, and investment respectively. With the exception of certain outliers, notably Cyprus, Trinidad and Tobago, and Ethiopia, the

data in panel A appear to be bunched around a downward sloping line. A negative relationship is even more noticeable in panel C. Panel B also exhibits a negative relationship, but there are a number of outliers, particularly to the northeast.

Rank correlation coefficients for the standard deviations of output, consumption, and investment and the average ranking of per capita GDP over the sample period (Table 5) confirm the visual evidence for negative relationships between the volatility of the growth rates of all three aggregates and standard of living. Again it was the case that whether the average ranking of PCG, or the ranking for any one of the individual years in the period 1950-85 was used made little difference in these coefficients. All rank correlation coefficients computed were significant at the .001 level.

It was shown that groups of countries at different ends of the ranking with regard to standard of living exhibit different relationships between country size and the volatility of aggregates. It is of interest now whether the relationships between PCG and the volatilities of aggregates discussed above differ across groups of countries of different sizes. Two sub-samples are defined by country size as measured by AGP. Sub-sample 3 is comprised of the 20 countries with the largest 1980 AGP, and sub-sample 4 is comprised of the 20 countries with the smallest 1980 AGP. Table 4 contains the lists of countries comprising the two sub-samples.

Rank correlation coefficients for the standard deviations of the growth rates of aggregate output, consumption, and investment with 1980 per capita GDP for each sub-sample indicate that there are indeed negative relationships between standard of living as measured by PCG and the volatilities of the growth rates of aggregates for the 20 countries with the greatest 1980 aggregate GDP. The evidence is somewhat weaker, however, for

the relationship between PCG and σ_I for this sub-sample than for the sample as a whole. For sub-sample 4 there is a very strong relationship between PCG and σ_I, nearly as strong as that for the whole of Sample 1. There is no evidence, however, for any relationship between PCG and either σ_Y or σ_C for this sub-sample.

The entire 56 country sample exhibits strong relationships between standard of living as measured by the log of per capita GDP and the volatilities of the growth rates of aggregates over the period 1950-85. A sub-sample consisting of the 20 countries with the lowest aggregate output, however, exhibits strong relationships only between this measure of standard of living and the volatility of the growth rate of gross capital formation, and no relationship between PCG and either σ_Y or σ_c.

Overall, relatively rich countries exhibit less volatility in their aggregates than do relatively poor ones. The evidence for relationships between a country's standard of living and the volatility of aggregate output and consumption is strong for relatively large countries and weak for relatively small ones. The relationship between the volatility of aggregate investment and standard of living by this measure is, however, stronger for the small countries than for the large ones.

The greater volatility of relatively poor countries can perhaps also be explained by a lack of diversification. Relatively poor countries may have smaller manufacturing and service sectors, and may rely heavily on on agriculture or mining to produce a small number of exportable products. This, however, would not explain the lack of a relationship between per capita output and the volatilities of aggregates for the smallest countries. It may be the case that very small rich countries, like Iceland and Luxembourg, are dominated by a few sectors, and thus are similar to poor countries in this respect. When small countries are compared, then, the

differences in per capita output do not reflect different degrees of diversification, and thus are not related to differences in the volatilities of aggregates.

III.3. The Relative Importance of Nontradables

Figure 5 contains plots of the average ratio of consumption expenditures on nontradables to expenditures on tradables (NTS) over the period 1976-88 against the per cent sample standard deviations of the growth rates of aggregate GDP, consumption, and investment respectively, for the 23 countries of sample 2 over the period 1950-85. In panels A and C the data points appear to be bunched loosely around downward sloping lines. In panel B, with the exception of outliers Iceland, New Zealand, and possibly France, the data appears bunched around a line with a very slight downward slope.

Rank correlation coefficients for the standard deviations of the growth rates of aggregate output, consumption, and investment and the average ratio of consumption expenditures on nontradables to tradables (Table 5) are in all cases negative, and thus confirm the rather weak visual evidence for negative relationships. Only the correlation coefficient between σ_c and NTS is not significant at the .05 level.

The ratio of consumption expenditures on nontradables to expenditures on tradables appears to be strongly related to the volatilities of aggregate output and investment for the 23 countries of sample 2 over the period 1950-85. The evidence for a relationship of any kind between this measure of the importance of nontradables and the volatility of aggregate consumption is, however, weak.

Given that the importance of nontradables (measured by NTS) is highly correlated with standard of living (measured by PCG) and that PCG is negatively related to the volatilities of aggregates, it is perhaps not

surprising that negative relationships are observed between NTS and the volatilities of aggregate output and investment. These results may also be consistent with the intuition given for relationships between country size and standard of living and the volatility of aggregates. If indeed economies that are more diversified are less volatile, then to the extent that people in richer countries spend a higher fraction of their budget on services (the main component of nontradables), and to the extent that the richer economies are more diverse, we would expect the importance of nontradables to be negatively related to the volatility of aggregates.

IV. CONCLUSIONS:

The results of the data analysis include evidence for relationships between the volatilities of aggregates and all three of the specific dimensions of international heterogeneity studied. These results are broadly consistent with the predictions of theoretical economies studied by Crucini (1990) and Head (1991). With the exception of the results concerning consumption volatility the findings presented here are broadly consistent with both of these theoretical papers. A possible reason for discrepancies regarding consumption may be that the consumption data examined here includes purchases of durable goods, making it rather a different variable than consumption expenditures in either of these theoretical models.

Overall the findings of this study indicate that certain specific dimensions of heterogeneity among countries are systematically related to the volatilities of the growth rates of aggregate output, consumption, and investment. This suggests that while aggregate fluctuations in different countries may exhibit many similarities, there are considerable quantitative differences relating to particular characteristics of individual countries.

It may be the case that the sectoral composition of an economy is related to the volatility of its aggregates. In this case it would be useful to study business cycles with a model in which countries are heterogeneous in this dimension. Certainly, further research into the role of these and other country characteristics in international patterns of aggregate fluctuations is needed if we wish either to understand or characterize fully the important causes and features of business cycles, either for individual countries, or for the world as a whole.

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Table 1: Statistics *(The first 56 countries constitute Sample 1. Countries are listed alphabetically by region.)*

Country	Abbr	σ_Y	σ_C	σ_I	POP	AGP	PCG	NTS
Egypt	EGP	1.51	2.29	5.85	7.49	10.31	2.81	---
Ethiopia	ETH	1.08	1.60	9.77	7.42	9.92	2.50	---
Kenya	KEN	2.12	3.00	8.18	7.03	9.74	2.71	---
Mauritius	MAU	2.76	2.89	8.90	5.88	8.98	3.11	---
Morocco	MOR	2.20	2.58	11.45	7.15	10.05	2.90	---
Nigeria	NIG	3.79	3.59	8.68	7.77	10.55	2.78	---
South Africa	SAF	1.34	1.98	6.33	7.33	10.84	3.51	---
Uganda	UGA	2.66	3.21	9.03	6.94	9.45	2.51	---
Zaire	ZAR	2.84	4.42	14.43	7.32	9.78	2.46	---
Burma	BUR	2.34	2.95	17.74	7.41	9.97	2.55	---
India	IND	1.83	1.90	4.84	8.72	11.45	2.74	---
Israel	ISR	2.50	2.13	6.24	6.42	10.01	3.59	---
Phillipines	PHI	1.42	1.36	6.56	7.53	10.55	3.02	---
Sri Lanka	SRL	2.15	2.73	7.19	7.06	10.06	3.00	---
Taiwan	TAI	3.38	4.38	6.30	7.11	10.22	3.11	---
Thailand	THA	2.04	2.05	4.83	7.52	10.51	2.99	---
Cyprus	CYP	4.66	3.97	9.10	5.77	9.19	3.42	---
Turkey	TUR	2.44	2.96	5.30	7.52	10.73	3.21	---
Costa Rica	CSR	2.05	2.61	10.41	6.19	19.50	3.31	---
Domincan Rep.	DOM	2.54	3.23	11.35	6.60	19.68	3.09	---
El Salvador	ELS	1.86	2.45	9.18	6.51	19.60	3.09	---
Guatemala	GUA	1.13	1.18	8.33	6.70	19.86	3.17	---
Honduras	HON	1.54	1.74	8.50	6.39	19.32	2.93	---
Mexico	MEX	1.53	1.54	5.26	7.67	11.11	3.44	---
Panama	PAN	1.67	2.17	7.02	6.13	19.38	3.25	---
Trini.& Tobago	TRI	3.41	4.49	6.11	5.97	19.69	3.72	---
Bolivia	BOL	2.25	2.09	11.49	6.61	9.67	3.05	---
Colombia	COL	1.16	1.24	4.48	7.28	10.51	3.23	---
Ecuador	ECU	1.96	1.53	5.92	6.73	19.91	3.18	---
Paraguay	PAR	1.72	1.98	7.39	6.33	19.44	3.10	---
Peru	PER	1.71	2.05	10.06	7.08	10.38	3.29	---
Uruguay	URU	2.12	2.93	8.72	6.43	19.96	3.54	---
Venezuela	VEN	2.18	3.12	6.30	7.00	10.70	3.70	---

Table 1 con't: Statistics *(The last 23 countries constitute sample 2)*

Country	Abbr	σ_Y	σ_C	σ_I	POP	AGP	PCG	NTS
Canada	CAN	1.24	1.08	4.25	7.30	11.20	3.90	1.13
United States	USA	1.15	0.75	4.10	8.29	12.25	3.95	1.36
Japan	JAP	1.46	1.49	5.03	8.01	11.59	3.58	1.14
Australia	ASL	1.44	1.46	6.77	7.07	10.87	3.80	1.12
New Zealand	NZD	1.55	3.95	5.79	6.42	10.20	3.78	1.14
Austria	ASR	0.90	0.99	5.36	6.86	10.57	3.70	1.07
Belgium	BEL	0.92	1.13	3.45	6.97	10.75	3.78	0.99
Denmark	DEN	1.13	1.25	5.97	6.68	10.52	3.84	1.17
Finland	FIN	1.36	1.66	5.15	6.66	10.38	3.72	1.12
France	FRA	0.86	0.79	2.87	7.69	11.47	3.78	1.28
Germany	GER	1.36	1.24	3.51	7.76	11.56	3.80	0.96
Greece	GRE	1.87	1.45	6.77	6.94	10.31	3.37	0.78
Iceland	ICE	2.03	2.85	6.62	5.29	9.06	3.78	0.91
Ireland	IRE	0.96	1.46	6.16	6.49	10.00	3.52	0.83
Italy	ITA	1.18	0.94	4.72	7.72	11.35	3.63	0.89
Luxembourg	LUX	1.62	0.93	5.24	5.52	19.39	3.87	1.12
Netherlands	NTH	1.24	1.30	5.51	7.09	10.87	3.78	1.23
Norway	NRY	0.97	0.92	3.82	6.58	10.40	3.83	1.11
Portugal	POR	1.53	2.08	7.28	6.96	10.29	3.32	0.72
Spain	SPA	1.92	2.04	4.70	7.52	11.08	3.57	0.91
Sweden	SWD	0.77	0.83	3.85	6.89	10.70	3.81	1.26
Switzerland	SWT	1.41	0.91	5.51	6.76	10.66	3.90	0.91
United Kingdom	UKG	0.79	0.91	4.61	7.73	11.51	3.78	1.27

Key:

σ_Y: Per cent sample std. dev. of first differences of log aggregate GDP

σ_C: Per cent sample std. dev. of first differences of log personal consumption expenditures

σ_I: Per cent sample std. dev. of first differences of log gross capital formation

POP: Log 1980 population
AGP: Log 1980 aggregate GDP
PCG: Log 1980 per capita GDP
NTS: Average ratio of consumption exps on nontradables to exps on tradables for the period 1976-88

Table 2: Summary Statistics

a. Sample 1

Variable x	$\bar{x}$	σ_x	min X	max X
σ_Y	1.81	0.78	0.79	4.67
σ_C	2.08	1.01	0.75	4.49
σ_I	6.93	2.79	2.87	17.74
POP	6.97	.67	5.29	8.72
AGP	10.32	.73	8.98	12.25
PCG	3.35	.42	2.46	3.95

b. Sample 2

Variable x	$\bar{x}$	σ_x	min X	max X
σ_Y	1.29	0.36	0.77	2.03
σ_C	1.45	0.74	0.75	3.95
σ_I	5.09	1.19	2.87	7.28
AGP	10.74	0.73	9.06	12.25
POP	7.01	0.72	5.29	8.29
PCG	3.73	0.16	3.32	3.95
NTS	1.06	0.17	0.72	1.36

Table 3: Correlations, Characteristic Measures.

a. Sample 1:

	POP	AGP	PCG
POP	1	----	----
AGP	.820	1	----
PCG	-.173	.423	1

b. Sample 2:

	NTS	POP	AGP	PCG
NTS	1	---	---	---
POP	.272	1	---	---
AGP	.426	.975	1	---
PCG	.702	-.053	.170	1

Table 4: Sub-samples

Sub-Sample 1: *The top 20 countries in 1980 PCG*									
ASR	FRA	LUX	SWT	USA	DEN	ICE	NRY	CAN	ASL
BEL	GER	NTH	UKG	VEN	FIN	ITA	SWD	TRI	NZD
Sub-Sample 2: *The bottom 20 countries in 1980 PCG*									
THA	TAI	ZAR	ETH	PHI	NIG	HON	BUR	PAR	MAU
GUA	ELS	DOM	UGA	IND	KEN	MOR	EGP	BOL	SRL
Sub-Sample 3: *The top 20 countries in 1980 AGP*									
IND	ASL	JAP	USA	NTH	TUR	SWT	GER	SPA	MEX
NIG	ASR	CAN	UKG	SAF	FRA	ITA	BEL	SWD	VEN
Sub-Sample 4: *The bottom 20 countries in 1980 AGP*									
MAU	UGA	PAN	LUX	HON	CYP	ELS	DOM	PAR	BOL
CSR	URU	TRI	ETH	ZAR	ECU	GUA	BUR	KEN	ICE

Table 5: Rank Correlation Coefficients

Var.	Sample	$\rho(\sigma_Y, \cdot)$	$\rho(\sigma_C, \cdot)$	$\rho(\sigma_I, \cdot)$
POP	Sample 1	-.234*	-.254*	-.364**
	Sub-sample 1	-.460*	-.457*	-.475*
	Sub-sample 2	-.068	-.033	-.304
AGP	Sample 1	-.532***	-.552***	-.716***
	Sub-sample 1	-.513**	-.520**	-.537**
	Sub-sample 2	-.069	-.056	-.468*
PCG	Sample 1	-.582***	-.594***	-.647***
	Sub-sample 3	-.579**	-.734**	-.379*
	Sub-sample 4	-.033	-.132	-.635**
NTS	Sample 2	-.462*	-.290	-.439*

* Indicates significance at the .05 level

** Indicates significance at the .01 level

*** Indicates significance at the .001 level

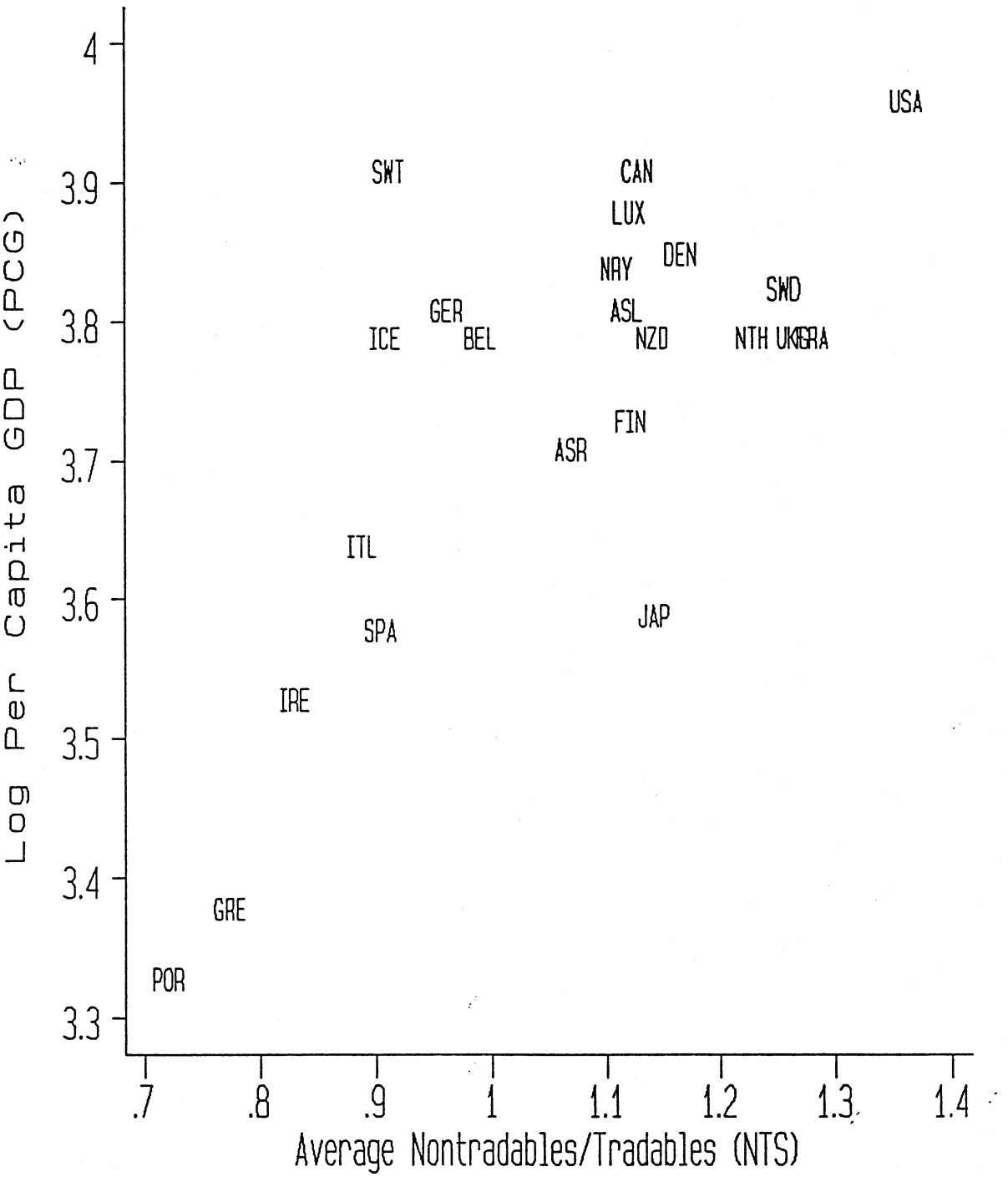
Log Per Capita GDP (PCG)
4
3.9
3.8
3.7
3.6
3.5
3.4
3.3
USA
SWT
CAN
LUX
DEN
NRY
SWD
GER
ASL
ICE
BEL
NZD
NTH UK
FRA
FIN
ASR
ITL
JAP
SPA
IRE
GRE
POR
.7
.8
.9
1
1.1
1.2
1.3
1.4
Average Nontradables/Tradables (NTS)

Figure 1

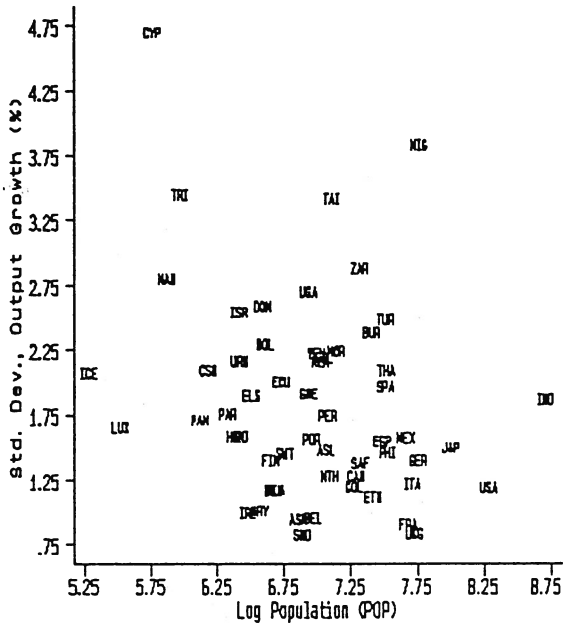

Figure 2.A

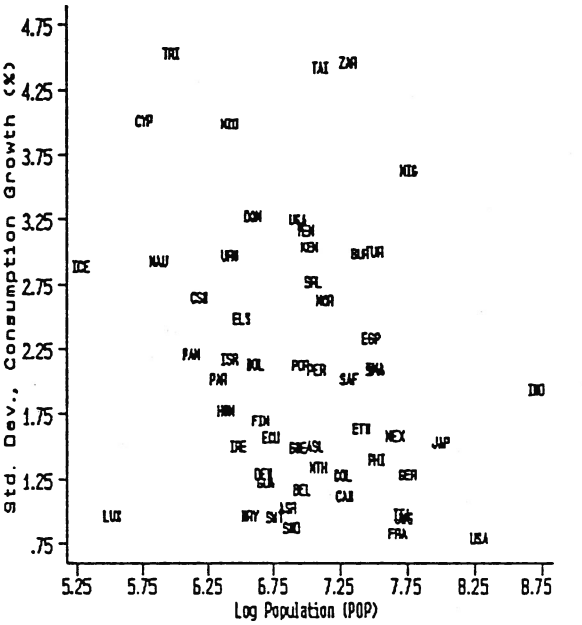

Figure 2.B

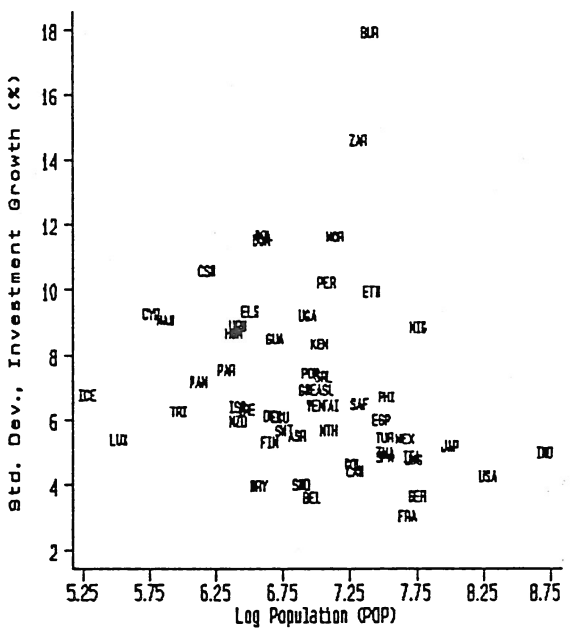

Figure 2.C

Figure 2

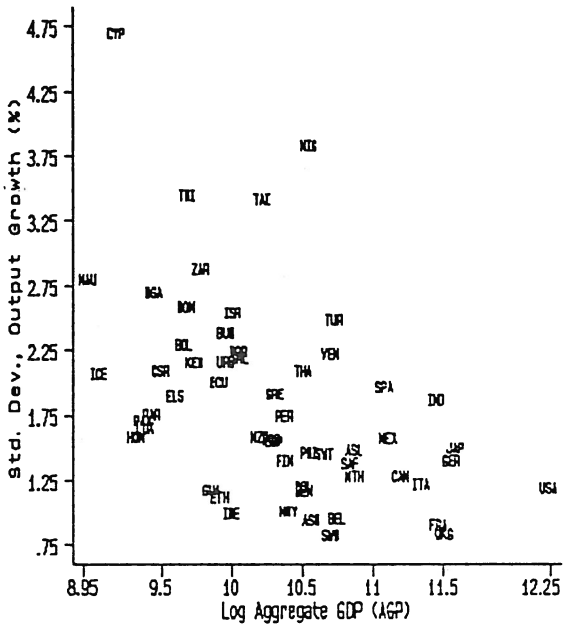

Figure 3.A

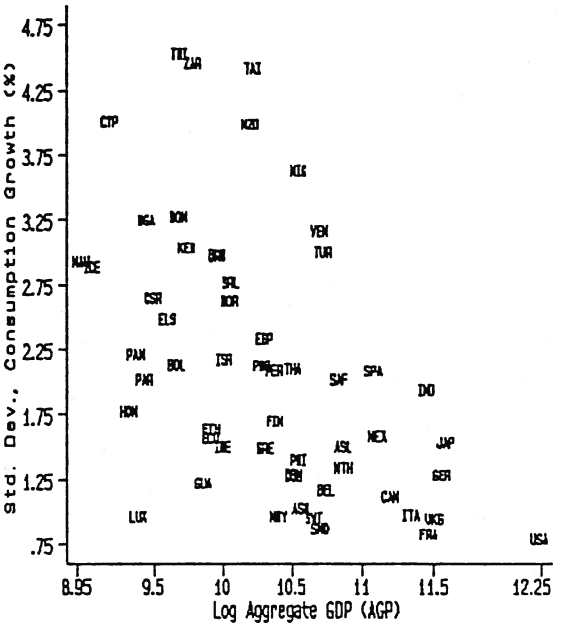

Figure 3.B

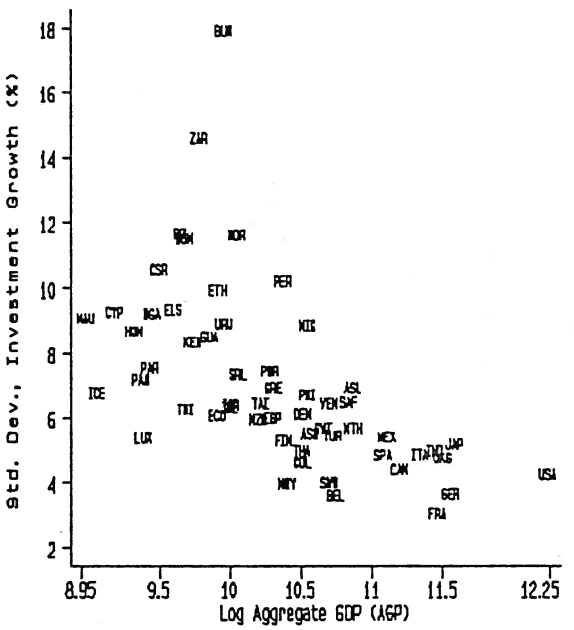

Figure 3.C

Figure 3

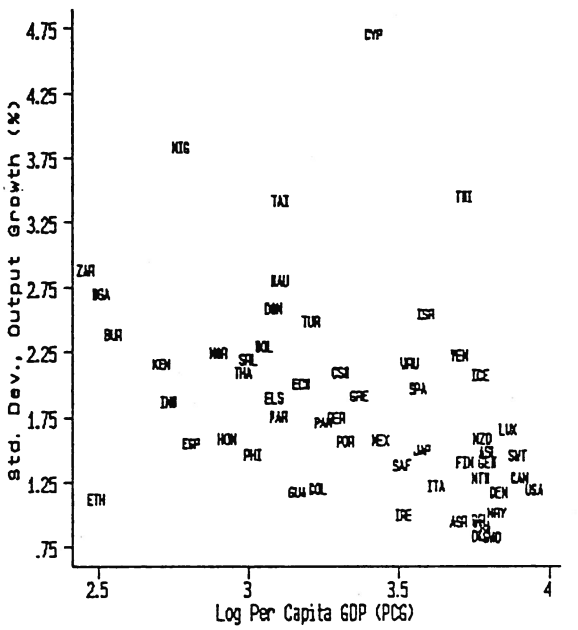

Figure 4.A

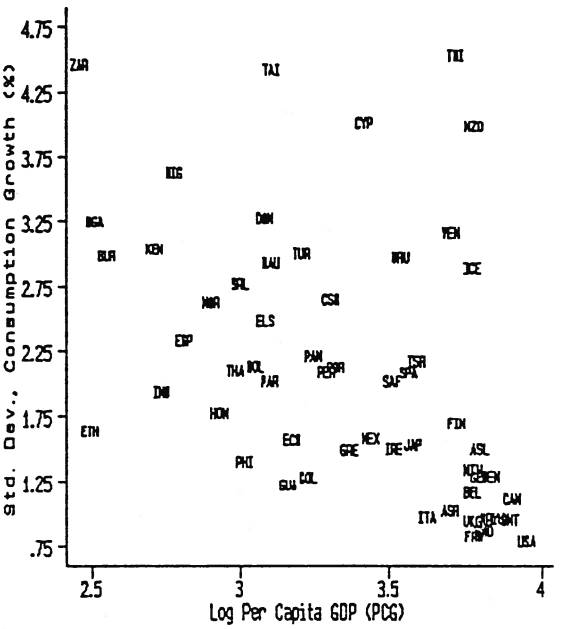

Figure 4.B

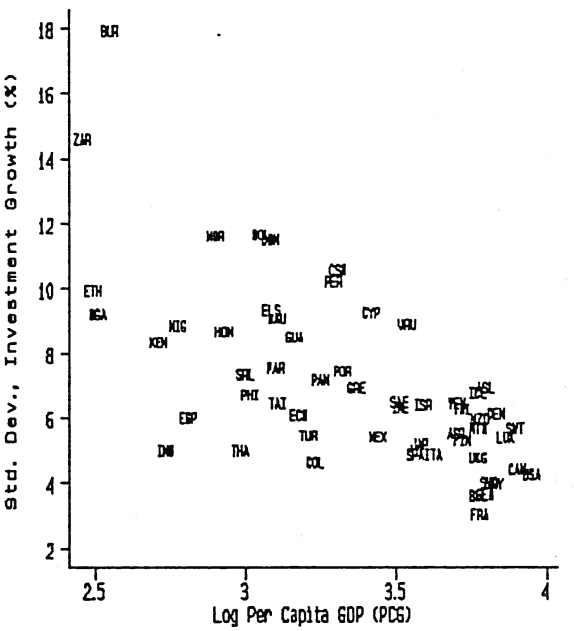

Figure 4.C

Figure 4

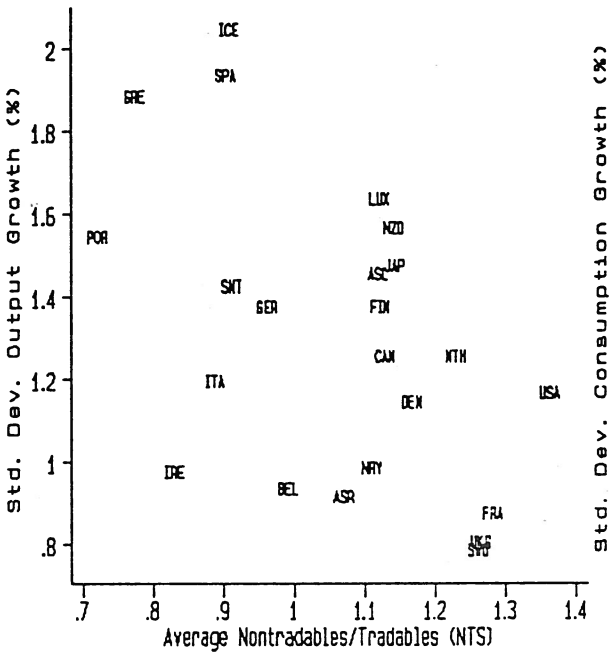

Figure 5.A

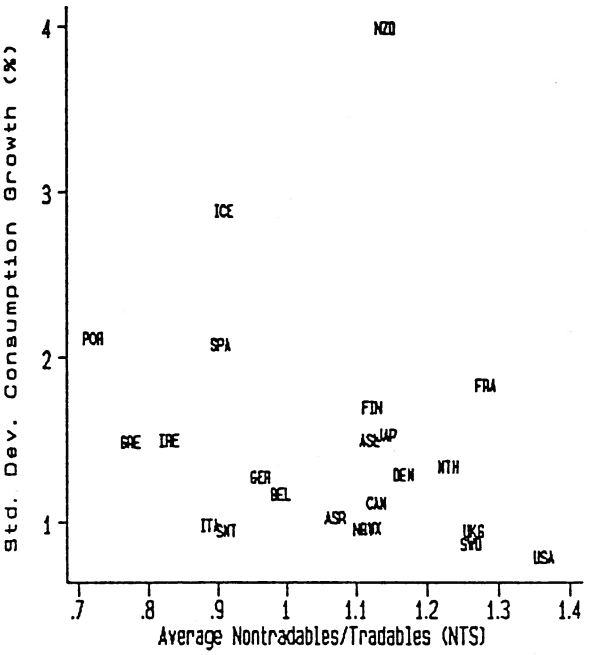

Figure 5.B

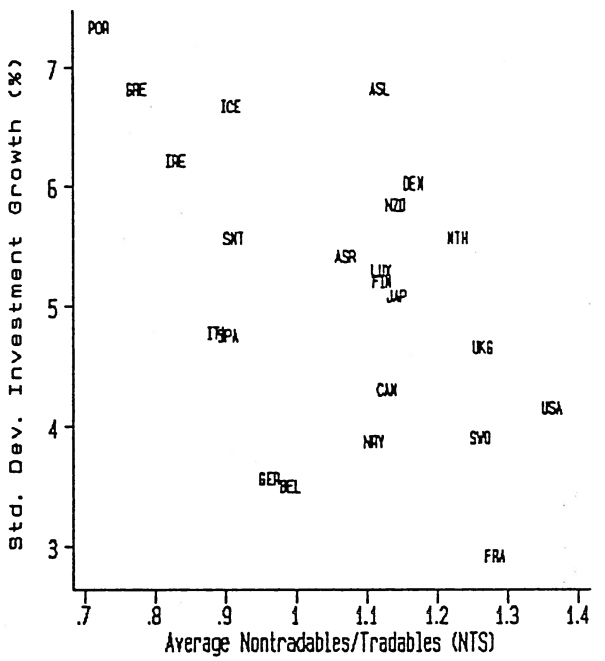

Figure 5.C

Figure 5

Discussion Paper # 832

Cross-Country Variations in Aggregate Volatility: Evidence from 56 Countries

by

Allen C. Head

September 1991