
Profiles of current Latin American arms producers

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In a recent article,¹ Stephanie Neuman examines several critical factors that separate developing countries into arms producers and arms nonproducers. She ranks countries according to a weighted index of military production capability (derived from length of production, production capacity, and technical capabilities) and also according to the following seven socioeconomic indicators: population, land size, size of military, gross national product (GNP), GNP per capita, number of professional and technical workers, and number of industrial workers. She computes correlation coefficients (Kendall's tau) by region (Latin America, South Asia, and the Far East) and for twenty-six arms producers worldwide.

Neuman concludes that in developing countries there exists "a hierarchically shaped arms production system based largely on factors of scale." Furthermore, she notes that "the existence of a large military to provide an adequate market, combined with a generous national income and a sizable population to support the necessary infrastructure, significantly affect a state's long-term ability to produce major weapon systems as well as the quantity and sophistication of its product."²

In this research note we shall present the results from an additional analysis that profiles countries as arms producers or arms nonproducers. The sample comprises twenty-one Latin American and Caribbean countries. Our analysis differs from Neuman's analysis in two main ways.

First, we employ a discriminant analysis to explore which characteristics best profile the sample group into producers and nonproducers. Although the rank correlation analysis Neuman uses has the ability to test statistically

We wish to thank C. J. LaCivita and the referees for their valuable help. An earlier version of this article was presented at the North American Economics and Finance Association third international meeting, Symposium on the Public Enterprise, Mexico City, June 1985.

1. Stephanie Neuman, "International Stratification and Third World Military Industries," *International Organization* (Winter 1984), pp. 167-97.

2. *Ibid.*, pp. 185, 186.

International Organization 40, 3, Summer 1986 •

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the null hypothesis of no relationship between two ranks, a discriminant analysis incorporates many variables simultaneously, as a group rather than as one-on-one correlations. Furthermore, ranking often masks the quantitative differences between countries (i.e., distances between rankings are equal), whereas the discriminant analysis uses the variable measurement itself. Consequently, we consider discriminant analysis to be a supplemental approach rather than a preferred one.

Second, although we recognize the role that size and population play as necessary conditions for arms production, we explicitly incorporate into our analysis other factors that Neuman's analysis excludes—contact with the world economy, public debt, and growth in foreign trade. In addition, success as a producer will depend on a highly developed collateral industry, a supportive government, and general industrial development.³ As Ron Ayres notes, the appropriate variables that distinguish countries might be related to the stages a typical country goes through as it becomes a producer.⁴ These stages include: (1) arms imported but maintained domestically; (2) license procurement and production facilities established; (3) production begins and imported subassemblies are assembled locally; (4) subassemblies and then components are produced locally from imported raw materials; (5) raw materials are produced locally; (6) complete indigenous production. As can be seen, the infant producer will depend on the developed country for a substantial period of time. This suggests that the ability to earn foreign exchange (or borrow external funds) might be crucial for success.

The mean values of the size, military, and economic variables used for the Latin American arms producers and arms nonproducers appear in Table 1.⁵ In general, the producers are more highly developed in terms of per capita income, and (as Neuman predicts) their income, population, and area are larger. The producers have a much larger public external debt, although the debt as a percentage of GNP is considerably higher for the nonproducers. The producers were also able to sustain a much higher level of imports and exports over the period than were the nonproducers.

Empirical results

Using Neuman's classification of Latin American arms producers in 1979–80, the discriminant function reduces the multiple measurements to composite

3. Cf. the discussion in James Katz, "Understanding Arms Production in Developing Countries," in James Katz, ed., *Arms Production in Developing Countries* (Lexington, Mass.: Lexington Books, 1984), pp. 6–8, for several of these factors.

4. Ron Ayres, "Arms Production as a Form of Import-Substituting Industrialization: The Turkish Case," *World Development* (1983), p. 814.

5. In this note a country is classified as either a producer or a nonproducer of at least one major weapon system in 1979–80. The index of military capability that Neuman constructs to rank the countries is not employed. Neuman identifies the nine Latin American countries that are producers in "International Stratification," Table 2, pp. 172–73.

TABLE 1. Characteristics of Latin American arms producers and nonproducers

Variables	Variable Means		
	Total Sample	Producers	Nonproducers
<i>Size (1982)</i>			
GNP Per Capita (GNPCAP) (U.S. \$ millions)	1861.4	2092.2	1688.3
Gross Domestic Product (GDP) (U.S. \$ millions)	33961.9	72663.3	4935.8
Population (POP) (millions)	17.1	34.9	3.7
Area (thousands km ²)	65.6	1964.2	185.5
Industrial Labor Force (ILF) (thousands)	401.8	838.2	74.4
Labor Force (LF) (thousands)	945.9	1941.5	199.3
<i>Military (1981)</i>			
Armed Forces (AF) (thousands)	65.6	133.4	14.8
Total Military Expenditures (MILEX) (U.S. \$ millions)	571.2	1138.3	107.2
Military Expenditures % GNP (MILGNP)	2.1	2.1	2.1
Military Expenditures Per Capita (MILCAP) (U.S. \$)	39.7	47.8	32.9
<i>Economic</i>			
Public External Debt, 1970 (70 DEBT) (U.S. \$ millions)	743.5	1521.3	160.2
Public External Debt, 1982 (82 DEBT) (U.S. \$ millions)	8041.9	16619.8	1608.5
Public External Debt % GNP, 1970 (70 DEBTGNP)	14.7	12.9	16.1
Public External Debt % GNP, 1982 (82 DEBTGNP)	35.8	24.8	44.2
% Growth in Exports, 1960-70 (6070 EX)	5.2	2.1	7.6
% Growth in Exports, 1970-82 (7082 EX)	2.3	4.5	0.8
% Growth in Imports, 1970-82 (7082 IM)	2.1	4.5	0.1

Sources. Economic and size variables from the World Bank, *World Development Report, 1984* (New York: Oxford University Press, 1984); military variables from U.S. Arms Control and Disarmament Agency, *World Military Expenditures and Arms Transfers, 1972-1982* (Washington, D.C.: U.S. Arms Control and Disarmament Agency, 1984).

TABLE 2. Profile of Latin American arms producers, size variables

Discriminating Variables

	I	II	III	IV	V	VI
	POP GDP Area AF GNPCAP LF ILF	POP GDP Area AF	POP GDP Area ILF	MILEX AF MILGNP MILCAP	AF MILEX MILGNP 1982 GDP	AF MILEX MILGNP MILCAP POP ILF GDP
<i>Producers</i>						
Venezuela	99.37	77.82	93.78	67.90	95.07	99.86
Mexico	99.46	99.21	93.89	88.38	86.53	94.62
Brazil	99.96	99.72	93.89	99.61	99.73	99.97
Ecuador	20.89 ^b	29.01 ^b	49.56 ^b	27.04 ^b	27.60 ^b	79.79
Colombia	98.49	14.15 ^b	48.39 ^b	39.71 ^b	17.17 ^b	97.08
Dominican Republic	16.26 ^b	27.52 ^b	32.83 ^b	20.70 ^b	18.40 ^b	7.31 ^b
Chile	99.98	97.64	68.70	73.76	89.45	99.56
Argentina	98.60	77.27	20.01 ^b	99.74	99.52	99.93
Peru	96.84	98.61	53.72	78.04	79.79	89.39
Average	81.09	68.99	62.29	66.10	68.14	85.28
<i>Nonproducers</i>						
Nicaragua	80.82	52.10	70.29	89.93	87.67	99.79
Honduras	98.76	86.86	80.17			
Costa Rica	98.33	91.41	80.43	82.74	86.41	99.60
Bolivia	99.99	98.11	82.84	78.57	86.52	99.53
Guatemala	95.28	85.78	75.76	79.42	87.30	95.68
El Salvador	98.14	85.88	82.92	82.08	91.50	99.16
Paraguay	99.34	92.11	70.55	81.76	81.07	97.75
Panama	86.99	86.89	72.07	81.76	81.31	98.70
Uruguay	88.17	65.43	77.97	82.61	73.02	98.93
Jamaica	97.64	90.63	74.54	82.33	85.80	98.12
Trinidad	99.56	87.18	75.53	83.44	80.24	99.65
Haiti	82.97	90.84	50.88	84.74	87.09	9.75 ^b
Average	94.67	84.44	74.50	82.19	84.36	90.61

Probability^a

a. Of correct classification.

b. = probability less than 50%.

TABLE 3. Profile of Latin American arms producers, economic variables

Producers	Discriminating Variables					Probability ^a
	I	II	III	IV	V	
	GNPCAP 70 DEBT 82 DEBT 70-82 DEBT 60-70 EX 70-82 IM	70 DEBT 82 DEBT 70-82 EX 60-70 EX 70-82 EX	70 DEBT 82 DEBT 70 DEBT GNP 82 DEBT GNP 70-80 IM 60-70 EX 70-82 EX	60-70 EX 70-82 EX 70-80 IM	70 DEBT 82 DEBT	
Venezuela	100.00	100.00	100.00	98.96	31.59 ^b	
Mexico	100.00	100.00	100.00	98.64	99.12	
Brazil	99.99	99.97	99.98	52.64	99.43	
Ecuador	99.24	97.29	99.89	97.22	13.33 ^b	
Colombia	100.00	99.99	100.00	97.66	89.23	
Dominican Republic	99.97	99.58	99.68	99.79	16.25 ^b	
Chile	100.00	100.00	100.00	98.78	99.47	
Argentina	99.59	99.71	99.99	81.41	96.55	
Peru	99.20	96.44	99.40	92.91	57.53	
Average	99.78	99.22	99.88	90.92	66.94	
<i>Nonproducers</i>						
Nicaragua	100.00	100.00	100.00	99.71	88.02	
Honduras	100.00	100.00	100.00	99.70	89.01	
Costa Rica	100.00	100.00	99.99	99.14	88.49	
Bolivia	99.29	99.71	100.00	99.03	66.14	
Guatemala	100.00	100.00	100.00	99.03	66.14	
El Salvador	99.77	99.83	99.99	82.31	88.45	
Paraguay	99.09	95.32	99.96	19.00 ^b	87.62	
Panama	100.00	100.00	100.00	99.98	88.63	
Uruguay	93.73	74.21	95.69	10.15 ^b	80.83	
Jamaica	99.10	99.86	99.97	97.04	86.47	
Trinidad	100.00	99.69	100.00	97.58	87.74	
Average	99.18	97.15	99.60	81.82	85.46	

Note. Haiti excluded due to insufficient data.

a. Of correct classification.

b. = probability less than 50%.

scores.⁶ These scores measure the probability that a country will fall into one of the groups. A country is placed in the group that has composite scores most similar to its own. The results of three combinations of discriminating variables based on size alone (Table 2, columns I, II, and III) generally support Neuman's analysis, which we would expect. All the nonproducers were correctly classified, but Ecuador, Colombia, the Dominican Republic, and Argentina were incorrectly classified as being producers. The results based on just military variables (Table 2, column IV) were quite similar. Combinations of both size and military variables (Table 2, columns V and VI) yielded only marginally better results. The overall average probability of correct classification was 85.28 percent for the producers and 90.61 percent for the nonproducers.

The results based on only economic variables were substantially better for correct classification and average probabilities (Table 3). When economic variables and per capita GNP (column I) were combined, all countries were correctly classified into their respective groups. Excluding per capita GNP (column II) did not alter this result. Including public external debt as a percentage of GNP (column III) also yielded a correct classification. Interestingly, when the foreign trade and public debt variables were run separately (columns IV and V, respectively), incorrect classifications resulted in both groups.

Conclusion

Our results suggest that although size and military expenditures are important in determining whether a country will produce a major weapon, the nature of arms production necessitates a certain economic environment for the process to be profitable. Given the nature of the import substitution process in the industry, our results indicate that access to foreign exchange is a necessary condition for a country to become a producer. New entrants to the industry will likely be countries that can finance a substantial volume of imports for a sustained period of time. Hence a fruitful area for future research would be to estimate the probability that any Latin American country not currently producing a major weapons system might become a producer in the near future based on the country's discriminant score and forecasts of its likely holdings of foreign exchange.

6. On the technical exposition of this procedure, see Donald Morrison, "On the Interpretation of Discriminant Analysis," *Journal of Marketing Research* (May 1968), pp. 156-63. Computations were made using the program designed by the Statistical Analysis System Institute; see SAS Institute, *Users Guide: Statistics, 1982 Edition* (Cary, N.C.: SAS Institute, 1982). Country data presented in World Bank, *World Development Report: 1984* (New York: Oxford University Press, 1984). Military variables from United States Arms Control and Disarmament Agency, *World Military Expenditures and Arms Transfers: 1972-1982* (Washington, D.C.: USACDA, 1984).