Arms exports and growth in France

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La question de l’influence des exportations d’armes sur l’économie de la France a souvent fait l’objet de débats politiques, les uns assurant qu’elles ont une influence positive considérable sur l’économie nationale, les autres considérant qu’elles exercent des effets plutôt négatifs en termes de coûts d’opportunité. Sur la base d’un modèle macroéconomique relativement simpliste, les exportations d’armes ne semblent pas avoir d’effets positifs sur la croissance économique à court terme. Les raisons de leur essor semblent plus faire appel à des considérations politiques, stratégiques et diplomatiques A plus long terme, les effets deviennent négatifs sauf à augmenter sans cesse les ventes d’armes, à des prix supérieurs à leur coût marginal, ce qui n’a pas toujours été le cas dans certaines ventes à fondements politiques.

The question of the influence of arms exports on the French economy has often been the subject of political debate, with some claiming that they have a considerable positive influence on the national economy, while others consider that they have rather negative effects in terms of opportunity costs. On the basis of a relatively simplistic macroeconomic model, arms exports do not appear to have a positive effect on economic growth in the short term. In the longer term, the effects become negative unless arms sales are continually increased, at prices above their marginal cost, which has not always been the case in some politically motivated sales.

Arms export, economic growth, arms industries, France
Exportations d’armes, industries d’armement, Croissance économique.

Weapons sales have long been a significant aspect of world political economy. However, there is a paucity of systematic studies of their economic impacts. The major demand for weaponry comes from the nations of the Third World. For the most part, weapon sales come from industrial nations of the North. Over the 1970s global arm exports showed considerable growth, but this trend reversed somewhat during the 1980s, with the "developing" world showing a leveling off during the first one half of the decade, and a minus 3.2 percent decline in arms purchases during the second half (ACDA, 1990, page 7). The size of the market remains substantial, reflecting about $56 Billion in sales during recent years. According to the U.S. Arms Control and Disarmament Agency, Iraq was the world's leading arms importer during recent years, importing roughly five Billion dollars of weaponry per annum during the latter part of the 1980s.

Internationally, arms transfers have considerable political import ranging from alliance maintanence, through power brokering, to military domination. With the exception of India each of the top six arms importers have been involved in armed conflict during the last decade. One the one hand, the transfer of weapons, largely by the United States and France, has in 1991 been "blamed" for the aggressive policies of Sadam Hussein vis-à-vis Kuwait. On the other, the transfer of weaponry to Israel during the Gulf War of 1991, is credited with preventing a widening of the war. These international aspects of the global arms market do not concern us here. Rather, we focus on the domestic impacts of arms exportation in one of the major players in the international marketplace for weaponry, France.

France has long been an important agent in the international arms market, not only for hosting important weapons "fairs", but also for its role as one the leading arms exporters in the world. During the 1970s, French exports claimed at times as much as 15 percent of the world total. During the 1980s however, policy changed and France began reducing its role in the global arms market. Accordingly, it now accounts for about one twentieth of the global arms market. Moreover, France has provided a wide range of up-to-date weaponry to its customers. It has promoted this technology with aggressive commercial policies. Further, France has for many years maintained a sales policy with respect to weaponry (and technology) that has been largely divorced from foreign policy considerations.

French arms sales have been promoted for many reasons, but chief among them is the argument that in order to maintain a French arms industry that could supply the latest technology to the French military, it is necessary for cost considerations to defray some of the expense by external sales. In terms of internal economic impacts there are two major arguments. The first of these has to do with the crucial role of the export industry in subsidizing the domestic arms process. In France for example it is widely assumed that about 300,000 are employed by the two major arms concerns, Thompson and Aerospatiale. Second, it is argued that the export market is crucial in keeping the per unit price of domestically produced weapons systems at reasonable and afforadable levels. The per unit price of 500 Raephel fighters, two hundred of which are sold abroad, is argued to be much less than the per unit price of 300 fighters all of which are acquired domestically.

As arms exports began to slow down during the 1980s, there was considerable concern

in France over the so-called "crisis" in the international weapons market. Moreover as orders were reduced, the electronics and aeronautics sectors began to experience some slowdowns in activity as well. It thus seems useful to pose the question of whether arms exports tend to exhibit beneficial or deleterious effects on the economy as a whole. Considerable literature exists on whether military *spending* helps or hurts the macroeconomy, yet we are unaware of any studies of whether exports have a similar role. Recently, there has been considerable credance attached to exports as a source of growth (Balassa, 1982; Feder, 1982), particularly given the success stories of the Asian "tigers". We explore the role of arms exports in France as a case study of the confluence of export policy, military policy, and economic productivity.

Feder (1982) proposed a simple neoclassical formulation of economic growth to account for the role of exports in economic productivity. This has been modified (Ram, 1986) to account for the role of government spending as an "engine" of growth, and further modified (Huang and Mintz, 1990; Mintz and Huang, 1990; Mintz and Huang, 1991) to specific the separate effects of military as opposed to nonmilitary spending programs. Departing from Feder's original purpose, to highlight the marginal productivities of export sectors on growth in less developed societies, recent use of the basic model has been slanted toward examining the marginal productivities of government spending on economic growth (Carr, 1989; Ram, 1986; Ram, 1987; Ram, 1989; Rao, 1989) although it has also been used in one form or another to examine military spending in a variety of recent studies of industrializing societies (Biswas and Ram, 1986; Ward, 1991; Ward et al., 1991c; Ward et al., 1991a; Ward et al., 1991b; Cochran and Ward, 1991) and in studies of the United States (Mintz and Huang, 1990; Huang and Mintz, 1990; Mintz and Huang, 1991; Ward

and Davis, 1990).

While this departure has been important and has generated a variety of interesting findings, we return in this effort to the rôle of exports in growth, focusing on the putative rôle of arms exports.

We recognize the many difficulties in studying arms exports. These include secrecy of important data, the convoluted nature of accounting practices in this arena, the complicated nature of the transaction price for weaponry including as it often does political and economic sidepayments and offsets, and price comparison difficulties in what is in many ways a quasi-barter market. Indeed, we discuss these difficulties below. However, we feel that the importance of the topic of weapons transfers is such that the benefit of proceeding cognizant of the difficulties far outweighs the costs of being incapacitated by them.

2 French Arms Exports

French arms exports during the 1970s and 1980s have been formidable. In contrast to the boom years of the 1970s, the bear market of the 1980s was not welcome news in France. In fact some have questioned whether or not the so-called "locomotive of economic growth" resides in a military-industrial complex in France (eg., Chenais and Serfati, 1990), and others have questioned whether recent downturns in French productivity could be placed at the door of the Ministry of Defense and its prime contractors (J.-P. Hébert, 1991). During the 1970s France skillfully used its special status and independence from the United States and the Soviet Union to obtain a considerable share (reaching fifteen

percent) of the global arms market. During the 1980s, its competitive position eroded considerably vis-à-vis Germany, Japan, and Brazil, it revised its desired level of arms sales, and economic difficulties in the Third World reduced arms orders. These three aspects brought about a slowdown in French arms sales. Excellent discussions of French arms trade can be found in (Fontanel and Pilandon, 1990; Hébert, 1988; Chesnais and Serfati, 1990; Kolodziej, 1987; and Dussauge, 1985).

Yet despite the recent slowdown in arms sales, French arms export orders tend to come in just over 40 Billion francs per year, only recently falling slightly below this figure. The bulk (approximately 70 percent) of these figures result from electronics and aeronautics sales. Initially, these sales were primarily to the Middle East (77 percent as recently as 1984), currently there is an equal share of sales to North America and Europe. The range of items delivered is impressive, spanning a relatively full spectrum of technology. Recent deliveries to Iraq, for example, have included Mirage F-1 E (built by Dassault), AS-332 Super Puma Heliocopters, Exocet AM-39 missiles, and AS-30 laser guided missiles (built by Aérospatial).

Why has France been involved in the arms market? First and foremost, exports in general and arms exports in are thought to be beneficial, high profit activities that promote general economic productivity and health. Secondly, similar to the United States, France has a very well developed and powerful military-industrial sector. Thompson-CSF, Aèrospatiale, AMD-BA, Snecma, Matra are all very important firms in the French economy. Their profits are inimitably linked to their activities in the military sector. Thompson-CSF and Matra, for example, have virtually all of their profits derived from military, as opposed to civilian, activities (Chesnais and Serfati, 1990, page 209). Further,

military sales are believed to involve considerable spin-off benefits for the economy as a whole, spanning employment, new activities, and considerable sidepayments. Finally, French strategic policy dictates independence of French military weaponry, in effect. Since arms production is characterized not only by high profits, but also by high research and development costs and considerable economies of scale, arms exports have become a way to reduce per unit costs by increasing volume and to thereby subsidize domestic consumption of weaponry by foreign weapons sales. In general, exports of weaponry in France comprise about one-third of total arms production (Fontanel and Pilandon, 1990).

3 The Model

We recapitulate Feder's (1982) supply side model of aggregate output. The aggregate growth function presumes a simple two-sector economy with export (X) and non-export (N) sectors. Sector inputs are Labor (L), capital (K), and exports (X). The aggregate production function for each sector is simply a function of aggregate inputs:

$$N = F(L_N, K_N, X) \tag{1}$$

$$X = G(L_X, K_X), \tag{2}$$

where N is non-exports and X exports, L and K are labor and capital, respectively; subscrpts refer to sectoral inputs (e.g., L_N represents $\frac{\partial L}{\partial N}$.

The differentials of these two functions are:

$$\frac{dN}{dt} = F_K \frac{dK_N}{dt} + F_l \frac{dL_N}{dt} + F_X \frac{dX}{dt} \tag{3}$$

$$\frac{dX}{dt} = G_K \frac{dK_X}{dt} + G_l \frac{dL_X}{dt}, \tag{4}$$

Since the total output of the economy Y is $Y \equiv N + X$, it follows that:

$$\frac{dY}{dt} \equiv \frac{dN}{dt} + \frac{dX}{dt}. \tag{5}$$

It is assumed that the marginal productivity of labor and capital may be different in the export and non-export sectors, differing by δ. Thus,

$$\frac{G_K}{F_K} = \frac{G_L}{F_L} = (1 + \delta). \tag{6}$$

Substitution of equations 3 and 4 into equation 5 yields:

$$\frac{dY}{dt} = F_L\frac{dK_N}{dt} + F_L\frac{dL_N}{dt} + F_X\frac{dX}{dt} + G_K\frac{dK_X}{dt} + G_L\frac{dL_X}{dt}. \tag{7}$$

However, we know by definition that $\frac{dL}{dt} = \frac{dL_N}{dt} + \frac{dL_X}{dt}$ and similarly that $\frac{dK}{dt} = \frac{dK_N}{dt} + \frac{dK_X}{dt}$.

Further manipulation yields

$$\frac{dY}{dt} = F_L\frac{dL}{dt} + F_K\frac{dK}{dt} + \left(\frac{\delta}{1+\delta} + F_X\right)\frac{dX}{dt}, \tag{8}$$

where F_X is the marginal externality effects of exports on outpus in the non-export sector. Next, the marginal productivity of labor in a given sector is further assumed to be linearly proportional to the average output of labor in the entire economy. This implies that $F_l = \beta\frac{Y}{L}$. F_K is assumed to be constant and denoted α. This yeilds:

$$\frac{dY}{dt} = \alpha\frac{dK}{dt} + \beta\frac{Y}{L}\frac{dL}{dt} + \left(\frac{\delta}{1+\delta} + F_X\right)\frac{dX}{dt}, \tag{9}$$

which, when multiplied by $\frac{1}{Y}$, yeilds:

$$\frac{\frac{dY}{dt}}{Y} = \alpha\frac{\frac{dK}{dt}}{Y} + \beta\frac{1}{Y}\frac{Y}{L}\frac{dL}{dt} + \left(\frac{\delta}{1+\delta} + F_X\right)\frac{\frac{dX}{dt}}{Y}\frac{X}{X}, \tag{10}$$

Remembering that gross investment I is the sum of changes in capital stock, this yields Feder's well-known result (equation 11 in Feder, page 62):

$$\frac{\frac{dY}{dt}}{Y} = \alpha\frac{I}{Y} + \beta\frac{\frac{dL}{dt}}{L} + \left(\frac{\delta}{1+\delta} + F_X\right)\frac{\frac{dX}{dt}}{X}\frac{X}{Y}. \tag{11}$$

Thus, the so-called sources of growth equation, (11), illustrates how the growth rate of national income is "produced" by the investment, changes in labor productivity, and the gains brought about by shifting from low productivity sectors to high ones.

This specification does not permit econometric estimation of the separate effects of δ and the elasticity of exports for the non-export part of the economy. It is sometimes assumed that government expenditures effect civilian production with some constant elasticity, θ. Thus, the partial will be a constant function of the ratio of levels of the variables:

$$\frac{\partial N}{\partial X} \equiv \theta\frac{N}{X}.$$

Therefore,

$$\frac{\frac{dY}{dt}}{Y} = \alpha\frac{I}{Y} + \beta\frac{\frac{dL}{dt}}{L} + \left(\frac{\delta}{1+\delta} - \theta\right)\frac{\frac{dX}{dt}}{X}\frac{X}{Y} + \theta\frac{\frac{dX}{dt}}{X}. \tag{12}$$

In this form, the equation may be econometrically estimated to provide a separate estimates of θ and δ. To facilitate further discussion we change notation slightly and define $\dot{Y} = \frac{dY}{dt}$. The two different formulations then become:

$$\frac{\dot{Y}}{Y} = \alpha\frac{I}{Y} + \beta\frac{\frac{dL}{dt}}{L} + \left(\frac{\delta}{1+\delta} + F_X\right)\frac{\dot{X}}{X}\frac{X}{Y} \tag{13}$$

$$\frac{\dot{Y}}{Y} = \alpha\frac{I}{Y} + \beta\frac{\dot{L}}{L} + \left(\frac{\delta}{1+\delta} - \theta\right)\frac{\dot{X}}{X}\frac{X}{Y} + \theta\frac{\dot{X}}{X}. \tag{14}$$

Equation 14 is preferable to equation 13 on theoretical grounds since it allows specification of externalities as well as size effects. Accordingly, we drop equation 13 from further consideration.

We modify this equation to allow us examine the separate impacts of arms exports and non-exports. We follow the basic argument made in Mintz and Huang (Mintz and Huang, 1990; Mintz and Huang, 1991; Huang and Mintz, 1990) which noted that government spending may be seperated into two parts, one representing military activities, the other representing nonmilitary spending programs. Instead we define exports to have two components: $X \equiv A + B$, where A is arms exports and B is comprised of nonmilitary exports. Adding a constant and an error term, the modified equation becomes:

$$\frac{\dot{Y}}{Y} = \alpha_0 + \alpha\frac{I}{Y} + \beta\frac{\dot{L}}{L} + \left(\frac{\delta_1}{1+\delta_1} - \theta_1\right)\frac{\dot{A}}{Y} + \theta_1\frac{\dot{A}}{X} + \left(\frac{\delta_2}{1+\delta_2} - \theta_2\right)\frac{\dot{B}}{Y} + \theta_2\frac{\dot{B}}{X} + \epsilon \quad (15)$$

We use first differences to approximate the differential in the above equation. The following data are required: Gross National Product Y, Gross Fixed Investment I, a measure of labor L, arms exports A, and total exports T, where $T - A = B$. For the period from 1956 to the 1987 national economic data on France are available from the *IMF* and *OECD* yearbooks. Labor force data — which are typically employed in production function models of the sort utilized here — are avaliable from the *National Accounts of OECD Countries, 1960-1988, volume 1.* Finally, *ACDA* provides information on arms exports in its annual publications. These data are provided in Table 1.

Armed with the data, which were transformed to constant 1985 million Francs, and the specification of the model, we turn to an examination of the empirical results.

4 Empirical Results

Table 2 presents estimates and diagnostic test for our estimates of equation 15. For this analysis we used data on arms exports taken from the U.S. Arms Control and Disarmament Agency. See *World Military Expenditures and Arms Transfers 1989*, pages 137-8, for a discussion of these data. The model passes diagnostic tests for serial correlation, functional form (although barely), normality, and heteroscedasticity. The model "explains" slightly over fifty percent of the variation in French economic growth rates (.565) and has a significant F statistic.

Turning to the estimated coefficients, we find that only the size effects and externality effects of nonmilitary exports are even close to statistical significance, with respective probability levels of .06 and .03. Neither labor nor investment inputs appear to be strongly related to French economic growth rates.

The arms export data are known to be problematic and these errors in measurement might well be responsible for the above results. Secrecy, timing of payments, the nagging problem of non-payment, and the quasi-barter nature of many French arms sales need no further documentation. Fontanel and Pilandon (1990) found that roughly one-half of the value of deliveries result in payment. Recently, Hewitt has argued (1991a, 1991b) that measurement error in ACDA arms transfer data results from the timing of deliveries. He used a three-year moving average to "correct" for this measurement error. Accordingly, we re-estimated the model using a three-year moving average to smooth the French arms export data. These results are presented in Table 3.

The results of the OLS estimation are presented in Table 3. These results are somewhat

stronger. First, the diagnostic tests are stronger, although the residuals still show evidence of some nonnormality. The explained variance is slightly higher (.589), even though the sample has two fewer cases owing to the three-year averaging of arms export data. Finally, the coefficients themselves present a somewhat more understandable picture.

These results suggest that investment is positively related to output, but reaffirm that labor inputs do not strongly correlate with French economic growth rates. Further civilian exports, both in terms of size effects and externality effects, are significantly related to French economic growth rates. However, the main concern of this particular study — arms exports — are shown again to be unrelated to French productivity. The upshot of these two analyses is that using a simple macro-economic model designed to capture the influences of arms exports on growth, we fail to find any credible evidence to suggest that the arms export business of France has a discernible effect on the macro-economic performance.

5 Conclusion

The results of this study should be viewed somewhat cautiously for a number of reasons. First and foremost, the macro-economic model we employ is quite simple and simplistic. It ignores the existence of a differentiated economy, and lumps all sectors from high technology to agriculture together. It also ignores the existence of regional subeconomies, wherein the military-economy linkages in one locale may be stronger or weaker than in the aggregate of France. It also ignores the fact that economies exist in disequlibrium, and that both supply and demand sectors need not be equilibrated, perhaps ever. Caution,

too, is advised whenever dealing with arms export data, for reasons explained above.

In spite of these limitations, the strong arguments about the *economic* necessity of maintaining a strong arms export position, should, if they are on the mark, show up in some form as contribution to the economic position of the macro-economy in France, one of the world's largest arms exporters. That a simple test of this proposition should so conclusively fail is testimony to the fallaciousness of the general proposition. Arms exports do not help the economy of France. Arguments for the export position of France in the international arms market, if they are to be made at all, must rest on political or strategic grounds. There is no economic argument or rationalization that validates them.

In the post-Yalta world, as France dramatically reduces is defense expenditures, high-ticket items will increasingly claim the lion's share of the defense budget. That these high ticket items should be paid for in part by developing nations involved in protracted regional conflicts seems politically problematic as well. If Mirage F-1 E fighter jets will be more expensive for the French Air Force if none are sold to the Middle East, then maybe more expensive and fewer Mirages are what is needed.

Table 1:

Selected French Annual Economic Data: 1963-1988

Year	*Y*	*I*	*L*	*X*	*A*	*Deflator*
1963	410551	94357	192659	52065	514.5945	0.189031
1964	455447	108433	215123	57947	705.7584	0.196867
1965	490258	118740	231935	65300	504.8648	0.202253
1966	530746	130749	250125	71009	1056.532	0.208105
1967	573306	141999	269973	75875	423.1716	0.214726
1968	623123	151209	301803	82652	891.522	0.223851
1969	710501	173154	345178	100232	1143.978	0.238563
1970	793519	192937	391444	125428	1105.78	0.251996
1971	884186	218274	441486	145213	826.56	0.267972
1972	987947	244451	493521	165138	3657.118	0.286715
1973	1129835	285188	566401	198573	3785.9	0.310976
1974	1302978	336123	678946	269637	3366.93	0.347816
1975	1467884	354310	801764	279799	3000.48	0.392929
1976	1700553	407235	932940	332954	5257.56	0.436680
1977	1917803	439349	1061181	392889	7370.1	0.477115
1978	2182588	488441	1203113	445463	8123.04	0.525388
1979	2481097	555074	1363245	526941	6807.04	0.578492
1980	2808295	645753	1575784	604422	11409.12	0.644316
1981	3164804	700530	1792602	714282	23368.78	0.717670
1982	3626021	774278	2054560	790351	26945.61	0.801845
1983	4006498	809601	2259282	900658	29723.07	0.879869
1984	4361913	840364	2425773	1053328	35830.31	0.945496
1985	4700143	905291	2582446	1123930	45824.52	1.000000
1986	5052519	967731	2702543	1074095	29782.23	1.050777
1987	5301320	1033117	2808644	1104258	16228.89	1.081526
1988	5658620	1137830	2944440	1217006	11258.54	1.115102

Sources: See text for an elaboration of all data sources.

Note: National Income (Y), Gross Fixed Capital Formation (I), Compensation of Employees (L), Francs, Exports (X), and Arms Exports A), all given in Millions of Current French Francs. The price deflator (for GNP) is based to unity in 1985.

Table 2:
Exports and the Sources of Growth in France, 1964-1988
Using Raw Arms Export Data

Estimator: OLS, Robust Standard Errors

Coefficients	Value	St. Error	T-Statistic	Probability
Constant	-0.0408	0.0476	-0.8570	0.4027
Investment	0.2873	0.2379	1.2076	0.2428
Labor	-0.0279	0.3129	-0.0892	0.9299
Size Effects of:				
Arms Exports	-12.9633	8.3592	-1.5508	0.1384
Non Arms Exports	-2.1958	1.0909	-2.0129	0.0593
Externality Effects				
Arms Exports	2.5531	1.6788	1.5208	0.1457
Non Arms Exports	0.4967	0.2090	2.3767	0.0288

Diagnostic Tests	
$R^2 =$	.565
$F(6,16) =$	6.195
Log-Likelihood =	78.627

Lagrange Multiplier Tests

Serial Correlation	$\chi^2 =$	0.2028	Probability= 0.6525
Functional Form	$\chi^2 =$	3.8237	Probability= 0.0505
Normality	$\chi^2 =$	4.8240	Probability= 0.0896
Heteroscedasticity	$\chi^2 =$	0.2874	Probability= 0.5919
Stability	$F(7,9) =$	3.1510	Probability= 0.0437

Table 3:
Exports and the Sources of Growth in France, 1966-1988
Using 3-year Averages of Arms Export Data

Estimator: OLS, Robust Standard Errors

Coefficients	Value	St. Error	T-Statistic	Probability
Constant	-0.1023	0.0485	-2.1095	0.0510
Investment	0.6089	0.2487	2.4479	0.0263
Labor	-0.4304	0.3922	-1.0974	0.2887
Size Effects of:				
Arms Exports	3.9133	19.6624	0.1990	0.8448
Non Arms Exports	-2.9501	0.9222	-3.1991	0.0056
Externality Effects				
Arms Exports	-1.5721	4.0687	-0.3864	0.7043
Non Arms Exports	0.6502	0.2261	2.8754	0.0110

Diagnostic Tests

$R^2 =$	.589
$F(6,16) =$	6.167
Log-Likelihood =	74.038

Lagrange Multiplier Tests

Serial Correlation	$\chi^2 =$	0.4789	Probability= 0.4889
Functional Form	$\chi^2 =$	1.5477	Probability= 0.2135
Normality	$\chi^2 =$	6.7032	Probability= 0.0350
Heteroscedasticity	$\chi^2 =$	0.0216	Probability= 0.8831
Stability	$F(7,9) =$	0.3591	Probability= 0.9047

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