

Short Title: THE INTERNATIONAL ARMS TRADE

Long Title: POLITICAL ECONOMY MODELS OF THE INTERNATIONAL ARMS TRADE: A FRAMEWORK FOR POLICY ANALYSIS.

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Expenditure: £64087.

1. SUMMARY OF RESEARCH RESULTS

The aim of the project was to conduct empirically informed theoretical research which analyses the causes and effects of the arms trade, explains the stylised facts and produces policy conclusions regarding the regulation of weapons sales. It began in September 1996 and finished in September 1999 and has produced almost 30 papers, 4 already published and another 16 accepted for publication.

The origins of the project were in our 1994 *Defence and Peace Economics* Paper on models of the arms trade, which has become recognised as providing the standard for arms trade models, and our 1995 *Economic Journal* paper on control of the trade. The model was based on a small group of forward-looking, optimising suppliers of major weapons systems who take account of both the economic and security consequences of their sales. Demand is modelled in terms of pairs of hostile interacting recipients involved in an arms race. In the course of this project we have substantially developed this theory. In our *Journal of Economic Dynamics and Control* Paper we examine the stability and dynamics of the system and the role of price adjustment. In a forthcoming *Oxford Economic Papers* model we examine the interaction of the various ways that suppliers can cooperate: through export control, alliances and collaborative production. In a forthcoming *Defence and Peace Economics* paper we examine the consequences of the recipients having the potential to produce their own weapons at a cost. In a related *Defence and Peace Economics* paper Garcia-Alonso analyses price competition and the relationship between firm and state in a model with

heterogeneous military goods. The links of military expenditure and the arms trade to economic growth are examined in other papers.

The theoretical work has been supplemented by empirical work. In a *Defence and Peace Economics* paper we propose a new interpretation of the available data and estimate import demand functions for arms from a cross-section, another paper applies the model to a panel. The econometric issues in estimating arms races are discussed in a forthcoming *Defence and Peace Economics* paper and applied to Greece-Turkey and India-Pakistan data in another paper. There is a paper on the institutional issues in arms exports control and the results of the project have been disseminated in a policy oriented survey in *Economic Policy* and a forthcoming invited paper in a special issue of the *Journal of Conflict Resolution*. Surveys of our research were also presented at the 1998 ASSA meetings at Chicago and the Fifth World Peace Congress in Amsterdam and the work has been presented at seminars in many Universities in Europe and the US.

A major success of the project has been building up a network of researchers interested in this area. This group and the research staff at Surrey have been involved in regular workshops. Three conferences associated with the project have been held at Middlesex University organised by Professor Paul Dunne. The first in 1997 was on the Globalisation of European Military Industry and the Arms Trade; the second in 1998 was on the Economics of Military Expenditure in Developing and Emerging Countries and a conference volume edited by Dunne is forthcoming from Macmillan. The third in 1999 was on the Arms Trade, Security and Conflict and a selection of papers from it will be published in a special issue of *Defence and Peace Economics* and a conference volume edited by Levine, Sen and Smith is planned. The 1999 conference attracted speakers and delegates from the US, South Africa and half a dozen other European countries.

The election of a Labour government committed to an ethical foreign policy and the development of an EU code of conduct for arms exports increased media and policy interest in these issues. Wider dissemination has been achieved by links to organisations like the Royal United Services Institute, the Centre for Defence Studies at Kings College and the Campaign Against the Arms Trade. Smith was on the academic panel convened to advise on the UK government's Strategic Defence Review and has lectured to the Royal College of Defence Studies, the Joint Staff College and other military audiences. The project report, details of researchers, data-sets and many of the papers can be

down-loaded from a web-site dedicated to the project.

2. FULL REPORT OF RESEARCH ACTIVITIES AND RESULTS

Background.

The arms trade is interesting because it is where foreign policy concerns such as security, human rights and international order interact most directly with economic concerns such as trade, jobs and profits. Explanations of the trade which emphasise just economics or just politics must be unsatisfactory - both matter. The trade is quantitatively important and probably amounts to about \$30 billion a year. After a period of decline, total exports of arms seems to be stabilising, though the economic difficulties in East Asia, one of the main markets, may inhibit further growth in that area. Arms exports are politically controversial raising issues of proliferation and the diversion of resources from development needs and are almost always subject to national regulation. There is also a complex international regulatory regime and its evolution raises a number of important policy questions.

The origins of the project were in our Defence and Peace Economics Paper, Levine Sen and Smith (1994). This paper was quickly recognised as providing a standard for models of the arms trade, e.g. see the comments on it by Anderton (1995) in his Survey and by Sandler and Hartley (1995) in their text book. The model was based on a small group of forward-looking, optimising suppliers of major weapons systems who take account of both the economic and security consequences of their sales. The model was further developed in an Economic Journal paper, Levine and Smith (1995). The project began in September 1996 and finished in September 1999 (a one year extension was agreed). In the course of this project we have substantially developed this theory and used the theory in a range of applied work. Output of the project is listed at the end and referred to in brackets.

Objectives

The aim of the project was to conduct empirically informed theoretical research which analyses the causes and the effects of the arms trade, explains the stylized facts and produces policy conclusions regarding the regulation of weapons sales. The other specific objectives listed in the proposal were:

- To construct and develop linked models of demand, supply and market interactions for the international trade in arms, which can be useful for the theory of political economy as well as policy formulation;
- To explain to both academics and policy makers how arms sales can be used: to help domestic industry in their effort to restructure; to protect the legitimate security interests of allies; and, to avoid the dangers of misuse by recipients who could use current purchases to threaten international security.
- To develop the interdisciplinary aspect of the subject by using game-theoretic economic models which can integrate the political and economic dimensions that characterise arms sales;
- To analyse the available data in the field of arms sales and suggest ways of improving their quality.

We feel that we have met all these objectives.

Methods

The main method used in the project was to construct and simulate various policy regimes on calibrated models which link:

- demand: developing the large arms race literature which has largely ignored trade as well as analyzing the implications of the arms trade (and military expenditure) for the economic welfare of major Third World recipients;
- supply: developing models of production and strategic trade which has largely ignored arms, and incorporating the emergence of a buyers' domestic military production when the price of imports becomes high.
- markets: the strategic interaction of buyers and suppliers through the market.

Although limited by the availability of data, we have done some econometric work which has informed the calibration of the theoretical models, revealed stylized facts for the models to explain and provided other insights in their own right. We have also carried out some institutional work.

Results

Our models are based on a small group of optimising suppliers of major weapons systems who take account of both the economic and security consequences of their sales. We model the demand side

in terms of pairs of hostile interacting recipients involved in an arms race and examine the effects of supplier cartels controlling arms exports. In our Journal of Economic Dynamics and Control Paper [A1] we examine the stability and dynamics of the system and the role of price adjustment. In our forthcoming Oxford Economic Papers model [B1] we examine the various ways that suppliers can cooperate: through export control, alliances and collaborative production. In [B6] we examine the consequences of the recipients having the potential to produce their own weapons at a cost. In a related paper [A4] Garcia-Alonso, who worked on the project, analyses price competition and the relationship between firm and state in a model with heterogeneous military goods. In a related paper [B13] she extends the analysis of export regimes to take into account the security concerns associated with the exports of state-of-the-art weapons. This approach is developed in [B4]. The links of military expenditure and the arms trade to economic growth are examined in [B14] and [C2].

In economic terms what is central to our models is that arms exports have externalities: spill-overs that are not fully taken into account in agents decision-making either because of divergent interests or co-ordination failures. Co-ordination failure is central to the arms race externality. Countries can increase their security by increasing military capability; but one country's security is its rival's insecurity. Security is a negative externality; which both countries appreciate (these are full information models) but can do nothing to avoid in the absence of a credible co-ordination mechanism. An arms control regime between regional rivals that jointly agreed on levels of military capability would internalise this externality and result in lower military expenditure and imports of arms, but given their antagonism they cannot agree such a regime.

In [A2] and [B1] the decisions of producers involving domestic military capability and the exports of arms results in a public good in the form of their common regional security. It is non-excludable (no country can be excluded from 'consuming' high regional security) and it is non-rival (its 'consumption' does not reduce the amount available for others). There is now a free-rider problem for countries producing arms. Domestic military capability increases regional security and is a positive externality between producers; exports to regions reduce regional security from the producer point of view and is a negative externality. Each acting independently has an incentive to rely on others to provide for regional security resulting in an inefficient equilibrium in which each provides too little domestic military capability and exports too many arms.

Given the oligopolistic structure of supply, producers charge a price above the marginal cost and reduce supply below that of a competitive market. In addition R&D expenditure has part of the characteristic of a public good in that it is also non-rival though it is at least partly excludable. These characteristics on the supply side mean that there are three potential gains to producer countries from co-operation. First they could co-operate on the retail side and jointly regulate exports; as they do to some extent through restrictions on the sale of Weapons of Mass Destruction. Compared with the oligopolistic equilibrium this will reduce exports because countries would be able to increase profits (or reduce losses) by charging a higher price and, in addition, the negative externality linking exports to regional security (proliferation) would fall. Second they could co-operate in deciding on domestic military capability internalising the positive externality from military capability to regional security; this is the standard alliance externality. Finally they could co-operate on the production side by pooling R&D costs through collaborative ventures. Collaborative production is common within the EU and the EU issues are discussed in [A2] and [B9]. The choice to co-operate or not along each of these three dimensions gives eight possible regimes, combinations of co-operation, and the four most important of these are analysed in detail in [B1].

Since arms exports are a “bad” within our framework, monopoly is good, since it restricts supply and raises prices. This has two effects on the buyers. The first is a terms of trade effect which clearly reduces the buyers welfare, they pay more for their arms and have less for other uses. The second effect is for the higher price of arms to cause a switch from military expenditure into consumption. This reduction in arms stocks in response to the price rise shifts the reaction functions in the arms race. This moves the Nash equilibrium closer to the efficient consumption-military expenditure mix that pairs of buyers would choose if they could co-operate through some process of arms control. This effect could outweigh the terms of trade loss making the buyers better off as a result of the formation of the cartel and the higher prices. These results suggest that the optimal market structure for the arms industry could be a producer monopoly, or equivalently, a cartel of co-operating producer countries. Arms suppliers clearly have a common interest in forming a cartel. Our results indicate that this could also be beneficial for recipients, particularly if combined with a tax on arms exports redistributed to recipients, and constitutes an alternative to banning trade as do current arms export cartels.

Of course the proposal for a supplier cartel plus transfers to recipients is both dependent on the specification of the model and subject to obvious practical difficulties. Any proposal for co-operation must inevitably address the problem of sustaining such a regime given the incentive of any participant to renege. Other practical problems are that suppliers have different interests and recipients are very heterogeneous. While transfers of major weapons systems can usually be detected there is less information on the price paid, and monitoring prices would be crucial to the scheme. In addition, once one allows for the possibility of domestic production by buyers, the position changes. A cartel which drives up the price increases the incentive for domestic production and the proliferation of arms supply capability as analysed in [B6]. [B8] provides a model of the effects of arms export controls in which the suppliers can also use foreign aid, either military or civil, as an additional instrument.

The use of aid conditionality, both as sanctions and incentives, is increasingly being considered as a policy tool within the framework of ethical foreign policy. The economic and political impact on developing countries is important in this context. Although not central to our objectives, we have analysed the theoretical and institutional basis of such alternative policy instruments in regulating the arms trade and arms races in developing countries. The role of income and substitution effects in regulating security-related expenditures within developing countries is an interesting extension to the core models.

In most of our models we have regarded demand as being generated by a peaceful arms-race between antagonistic nations and we have not considered war as such. This seems sensible because inter-state wars are rare while arms races are common. However in [B5] and [C3] we do look at conflict directly. In the research of Moraiz, a PhD student financed by the project, data on conflict has been gathered and used to construct some of the stylised facts. Some of these are explained in a bargaining model with asymmetric information and the optimal allocation of resources in preparation for possible war. In this set-up wars, although inefficient, are consistent with rational behaviour.

The theoretical work has been supplemented by empirical work. In [A3] we propose a new interpretation of the available data and estimate import demand functions for arms from a cross-section. Demand for arms imports is made a function of price, military expenditure (a proxy for threat and arms race type variables) and GDP (a proxy for the capability to produce the

weapons domestically, the alternative to importing). Estimation of this specification faces the fundamental difficulty that data on prices of arms imports are very poor. The basic idea in our empirical work is that we can exploit the different methods of construction of the SIPRI and ACDA series to circumvent this problem. By construction, the SIPRI measure is a constant price volume index, while the ACDA measure is a constant price value index. The ratio of the ACDA to SIPRI series thus provides an implicit price index. This price index shows the qualitative movements one would expect, e.g. falling during the 1990s with the large drop in demand. [A3] discuss the indexes in more detail and present some preliminary estimates of the demand function for imported arms based on cross-section data on total imports by countries over a number of years. Measurement error is a major problem (e.g. the SIPRI and ACDA measures cover different categories of weapons). However the experiments in [A3] suggest that the evidence for a negative price elasticity of demand is robust to the treatment of measurement error. [D3] extends the estimates using panel data for eight major regions over a ten-year period. Again, using a model in which quantity of arms demanded depends on price, military expenditure and GDP, the price elasticity proves to be significantly negative. The econometric issues in estimating arms races are discussed in [B10] and [B11] applying the approach suggested to Greece-Turkey and India-Pakistan data. The institutional issues in arms exports controls are analysed in [B9]. The role of arms exports for the defence industry are examined in [D1]. Industrial restructuring of the European defence industry has been a major issue throughout the project. However we have not given it a high priority in our work because it is being covered elsewhere particularly by the work of Keith Hartley and his co-authors at York.

Activities

A major success of the project has been building up a network of researchers interested in this area. These include Prof Paul Dunne of Middlesex University, Dr Mary Carmen Garcia-Alonso (who worked on this project visiting Sen at Birmingham and Levine at Surrey), Dr Saadet Deger and Prof Berthelemy (OECD), and Prof Bernard Udis (Colorado). This group and the research staff at Surrey Dr Mouzakis and Francisco Moraiz have been involved in regular workshops. Three conferences associated with the project have been held at Middlesex University organised by Prof Dunne. The first in 1997 was on the Globalisation of European Military Industry and the Arms Trade; the second in 1998 was on the Economics of Military Expenditure in Developing and Emerging Countries and a conference volume edited by Dunne is forthcoming from Macmillan. The

third in 1999 was on the Arms Trade, Security and Conflict. We were invited to edit a special issue of Defence and Peace Economics on the Arms Trade and Arms production which will contain a selection of the papers from the conference including [B4], [B6] and [B8]. A conference volume edited by Levine, Sen and Smith [B7] is also planned. The 1999 conference attracted speakers and delegates from the US, South Africa and half a dozen other European countries.

The results of the project have been disseminated in a policy oriented survey in Economic Policy [A2] and a forthcoming invited paper in a special issue of the Journal of Conflict Resolution [B12] which surveys the whole output of the project. Surveys of our research were also presented at the Fifth World Peace Congress in Amsterdam [C1] and [C2] and the 1998 ASSA meetings at Chicago [C4] and the work has been presented at seminars in many Universities in Europe and the US.

Outputs

The main outputs are the 4 published papers, 17 completed papers which are forthcoming in journals or books and 7 conference or discussion papers. A total of 28 papers is, we feel, an impressive output for a project with a budget of £64,000. Other future papers, which will use the research from the project, are in preparation.

Impacts

The election of a Labour government committed to an ethical foreign policy and the development of an EU code of conduct for arms exports increased media and policy interest in these issues. Wider dissemination has been achieved by links to organisations like the Royal United Services Institute, the Centre for Defence Studies at Kings College and the Campaign Against the Arms Trade. Smith was on the academic panel convened to advise on the UK Ministry of Defense Strategic Defence Review and has lectured to the Royal College of Defence Studies, the Joint Staff College the Royal Military College of Science and other military audiences. Smith has also worked as a consultant for the National Audit Office on defence related Value for Money Studies. These links with the military, the Ministry of Defence, etc. have been valuable in disseminating the results of the project. The project report, details of researchers, data-sets and many of the papers can be down-loaded from a web-site dedicated to the project.

Future Research Priorities:

We intend to retain the network of researchers and to continue research on the arms trade in the context of wider issues of defence economics. There are various empirical and theoretical issues that may repay investigation.

In the empirical work on the demand for arms imports we either averaged over years for particular country as in [A3] or over countries for a particular year as in [D3]. This is necessary because of the very lumpy nature of the data on arms imports for a particular country: most observations are zero and in a few years there are large values of imports. Dealing with this lumpiness of the data is an important issue in empirical research on the arms trade. While zeros can in principle be dealt with by Tobit type models, the appropriate specification will depend on the cause of the discrete jumps. The lumpiness can be explained either by the discrete nature of the major weapons systems themselves, by large fixed costs of adjustment, or because imports act as a jump variable moving the system to a stable saddle path as in [B8]. Each of these explanations would imply a different specification. This is something that may be worth further research.

Regulating the arms trade has many differences from, but some similarities with other forms of economic regulation. Some members of the network have developed a research interest in regulation theory at a general level with active groups at Surrey and LBS. There may be scope for applying this work to the arms trade.

A. Published Papers

[1] Levine, P. and R.P. Smith (1997a), 'The Arms Trade and the Stability of Regional Arms Races', *Journal of Economic Dynamics and Control*, vol. 21, 631-654.

[2] Levine, P. and R.P. Smith (1997b), 'The Arms Trade', *Economic Policy*, October, 336-370.

[3] Levine, P., Mouzakis, F. and R. Smith (1998), 'Prices and Quantities in the Arms Trade', *Defence and Peace Economics*, vol. 9, 223-236.

[4] Garcia-Alonso, M. (1999), 'Price Competition in a Model of the Arms Trade', *Defence and Peace Economics*, 10, 273-303.

B. Forthcoming Publications

[1] Levine, P. and R.P. Smith (1998), 'The Arms Trade Game: From Laissez-Faire to a Common Defence Policy', presented to the conference: The Globalisation of European Military Industry and the Arms Trade on September 19-20th, 1997 at Middlesex University Business School and forthcoming *Oxford Economic Papers*.

[2] Mouzakis, F. (1998), 'Domestic Production as an Alternative to Importing Arms', presented to the conference: The Economics of Military Expenditure in Developing and Emerging Countries on March 13-14th, 1998 at Middlesex University Business School and forthcoming in *The Economics of Military Expenditure in Developing and Emerging Countries*, (ed) Jurgen Brauer and Paul Dunne, Macmillan.

[3] Sen, S. (1999), 'What does the New Trade Theory tell us about the Arms Trade?', forthcoming in *The Economics of Military Expenditure in Developing and Emerging Countries*, (ed) Jurgen Brauer and Paul Dunne, Macmillan.

[4] Garcia-Alonso, M.C. and Keith Hartley (1999), 'Dual Use Export Controls, Market Structure and International Co-ordination', *Defence and Peace Economics*, forthcoming.

[5] Levine, P. and F. Moraiz (1999), 'Rational Wars with Incomplete Information', forthcoming in Levine, Sen and Smith (1999).

[6] Levine, P., Mouzakis, F. and R. P. Smith (1999), 'Arms Export Controls and Emerging Domestic Producers', *Defense and Peace Economics*, forthcoming.

[7] Levine P., S. Sen and R.P. Smith (1999), editors, *The Arms Trade, Security and Conflict*, forthcoming.

[8] Sen S. (1999), 'Arms Export Controls: Can Economics Succeed where Politics fails?' , *Defence and Peace Economics*, forthcoming.

[9] Smith R.P. and B. Udis, (1999), 'New Challenges to Arms Export Control, Whither Wassenaar?' , forthcoming in Levine, Sen and Smith (1999).

[10] Smith R.P., J.P. Dunne and E. Nikolaidou (1999), 'The Econometrics of Arms Races', *Defence and Peace Economics* tenth anniversary issue, forthcoming.

[11] Dunne J.P., E. Nikolaidou and R.P. Smith (1999), 'Arms Race Models and Econometric Applications', forthcoming in Levine, Sen and Smith (1999).

[12] Levine P. and R.P. Smith (1999), 'The Economics of the Arms Trade', *Journal of Conflict Resolution*, forthcoming.

[13] Garcia-Alonso, M. (1999), 'The Role of Technology Security in a Model of Trade with

Horizontal Differentiation', International Journal of Industrial Organisation, forthcoming.

[14] Berthelemy, J-C, Herera, R. and S. Sen (1999), 'Defence Spending, Fiscal Federalism and Economic Growth', Defence and Peace Economics, forthcoming.

[15] Garcia, M. C. and P. Levine (1997), 'Domestic Procurement, Subsidies and the Arms Trade', SCIES Discussion Paper, University of Surrey and forthcoming in *The Economics of Military Expenditure in Developing and Emerging Countries*, (ed) Jurgen Brauer and Paul Dunne, Macmillan.

[16] Smith, R. (1999), 'Defence Expenditure and Economic Growth', in *Armament, Disarmament and Conversion: A Bibliography*, (ed) I. De Soysa, N. Mouhlebe and N. P. Gleditsch.

[17] Deger, S. and S. Sen (1999), 'Economic Development and Military Security: India and Pakistan', Defence and Peace Economics, forthcoming.

C. Other Conference Papers

[1] Levine, P., Mouzakis, F. and R. Smith (1996), 'The Arms Trade: Some Theory and Econometrics', SCIES Discussion Paper, University of Surrey; presented to the Fifth World Peace Science Congress, June 1996.

[2] Berthelemy, J-C and S. Sen (1996), 'Military Expenditure, Arms Races and Growth: Some Evidence from India and Pakistan', mimeo, University of Birmingham; presented to the Fifth World Peace Science Congress, June 1996.

[3] Moraiz, F. (1998), 'Bargaining and Conflict', presented to the conference: The Economics of Military Expenditure in Developing and Emerging Countries on March 13-14th, 1998 at Middlesex University Business School and forthcoming in *The Economics of Military Expenditure in Developing and Emerging Countries*, (ed) Jurgen Brauer and Paul Dunne, Macmillan.

[4] Levine, P. and R. Smith (1998), 'Models of the Arms Trade: A Survey and Evaluation', presented to the ECAAR-Peace Science Society session, ASSA meeting Chicago, January 1998.

D. Other working papers

[1] Dunne, P. and R. Smith (1996), 'The Arms Trade and Employment in the UK', mimeo, University of Middlesex.

[2] Mouzakis F. (1999), 'Regional Variations of the Demand for Arms: an Empirical Study of Global Panel Data', University of Surrey Discussion Paper in Economics No 2/99.

[3] Garcia-Alonso, M. (1999), 'Security and Price Arbitrage', mimeo, University of Kent.

Other References

Anderton, C.H.(1995), 'Economics of Arms Trade', in *Handbook of Defense Economics*, Vol 1, edited by Keith Hartley and Todd Sandler, North-Holland, Amsterdam.

Levine, P., S. Sen and R.P. Smith (1994), 'A Model of the International Arms Market', *Defence and Peace Economics*, 5, p1-18.

Levine, P. and R.P. Smith (1995), 'The Arms Trade and Arms Control', *Economic Journal*, 105 (March) p471-484.

Sandler T. and K. Hartley (1995), *The Economics of Defence*, Cambridge University Press.