

Military Spending in an Open Economy

Carlos Seiglie
Rutgers University
Department of Economics
seiglie@andromeda.rutgers.edu

Introduction

“In 128 BC a venturesome Chinese diplomat named Chang-k’ien traveled westward to ... Jaxartes where he discovered the easternmost fringes of the civilized Middle East. Thereafter, the Chinese maintained ... trading contacts with central Asia, until in 101 BC, Chinese armies conquered a string of oases as far as Jaxartes ... (which) led to the establishment of the caravan route between China and the Middle East-the so called “Silk Road (McNeill, 1963).” As this passage suggests, the association between the development or extent of trading relationships and of a strong military capability is a long-standing one in history. Notable examples also include the Roman, Spanish and British empires.

Similarly, Baron de Montesquieu wrote in *L Esprit des Lois*: “peace is the natural effect of trade...their union is founded on their mutual necessities.” David Hume recognized that trade could substitute for geography and also reduce conflict when he wrote “free trade is the vital principle by which nations of the earth are to become united in one harmonious whole.” In a series of seminal papers (1980, 1992), Polachek presents a model and empirical results consistent with the liberal thesis that trade reduces international conflict by inducing fear of the losses of the gains from trading with another country. Others such as Mansfield (1994), Oneal et al. (1996), and Oneal and Russett (1997, 1999) amongst others find a similar inverse association between trade and conflict of particular dyads using variously different methodologies and data sets.

There are others who have argued that trade causes conflict between dyads or that at least the relationship is ambiguous. Results supporting the former view include Barbieri (1996), Gasiorowski (1986) and Park, Abolfathi and Ward (1976) amongst

others. With the exception of Russett and O'Neil (2000), who find that not just trade between dyads, but also that aggregate trade is negatively related to dyadic conflict, all the work in this area explores the issue at the dyad level. Instead, this paper examines the effects that international trade in general has on the military spending of countries. This question is of considerable interest to social scientists since a certain amount of military capability may be a necessary condition for the development and the survival of the state, not to mention that it has been used throughout history as a means to forcefully redistribute resources through conquest.

The importance of this is that the relationship between trade and conflict may also be a natural consequence of two intermediate processes that are not being taken into account. The first is that trade leads to increases in wealth for the more open nation and therefore, this country will acquire more of all normal goods, one of which is military weapons. Stocked with a greater amount of weapons it can then induce a deterrent effect on adversaries and/or pose a threat of conquest to neighboring nations leading these to acquiesce to better relations or alternatively, results in a power transition that leads to war. Therefore, the first issue considered in this paper is how changes in trade exposure and in the terms of trade impact on the military capability of a nation through its effect on its income. Note that these improvements may come about not just exogenously, but may result from countries resorting to various economic, military or political means. Examples of some of these strategies include denying a competitor navigational access or rail transport, imposing on them higher access fees and employing preferential tariffs.

The second process is the direct effect proposed by Polachek (1980, 1992). Given that trade benefits those countries that engage in it and that the countries in question will

want to protect their gains from trade, we should expect that the greater the gains from trade the greater will be the size of the military required to protect them. Consequently, this paper also explores the direct effect that increased trade has on military expenditures and reveals that, as the above historical examples suggest, greater international trade leads to greater military expenditures. It is also found that expansion in the demand for a country's tradable commodities, i.e., an improvement in their terms of trade will initiate changes in expenditures.

Recently, Reuveny and Maxwell (1998) introduce a dynamic model that links arms races to trade. They in fact find that the demand for weapons by utility maximizing countries engaged in an adversarial relationship responds ambiguously to an opening of their economies to trade. More specifically, using a particular functional form for the countries' utility functions and assuming that production in each country is carried out by the use of Ricardian technology, they find that the response of the demand for weapons to an exogenous opening of the economy to trade hinges on the relative value the country places on weapons versus consumption goods, i.e., the results depend upon tastes. This paper continues along in their tradition of assuming rational agents, but generalizes the preferences of the decision-maker to being homothetic and allows for the technology of production to be more general. The cost of this generalization is that the model is static and not dynamic as theirs. This paper complements the work of Polachek (1980, 1992) and contributes to the literature developed by Boulding (1962), Intriligator (1967, 1975), Brito (1972), McGuire (1965), Isard (1988), Olsen and Zeckhauser (1966), Sandler, et. al (1983), Smith (1980) and others who employ economic modeling techniques to analyze issues in international relations.

It differs from such work as that of Gowa (1989), Gowa and Mansfield (1993) and Grieco (1988) since it does not assume that trade creates a security externality and therefore, that countries are concerned with relative gains. Economic theory is grounded in the assumption that individual consumers value a set of commodities or goods, including leisure. When individuals make the decision on the amount of commodities to consume they do so based on their self-interest and are not concerned, for example, with the national security implication of their purchasing foreign-made goods. The only way that theoretically these choices can be internalized in the decision-making calculus of the individual is through the use of tariffs and other commercial policies by their government, which then affects the relative prices of goods and therefore, the demand for, foreign versus domestically-produced goods. In other words, economic theory perceives the individual as a “price-taker” for national security consumption: each individual has no significant impact on it and therefore does not internalize the implications of their decisions on this variable, but collectively they can potentially have an effect.

In exploring the issue of trade and security, the paper is organized as follows. Section I presents a graphical exposition of the model and reviews some basic propositions of international trade theory that incorporate strategic interactions. Section II examines the effects on the military sector of opening an economy to international trade. Section III presents a modification to Polachek’s (1980) model to highlight that a country’s capital account is probably as important as its trade account and that future research should focus on the effects of capital flows on conflict. We conclude by discussing some other possible extensions in the field.

I. The Basic Model

The trade-conflict relationship can be modeled as a two-stage game of complete, but imperfect information. In the first stage, each of two adversarial nations allocate resources to the production of a stock of weapons. Next, given the level of national security and consumption of other goods established in the first stage, the countries decide whether they should engage in military conflict with the possible payoff being a reduction (by destruction) of the weapons possessed by the adversary. Recent work by Morrow (1997), using a variant of a model by Powell (1993) and Anderton, et al. (1999) explore this two-stage problem. In order to highlight how trade may operate on this process, I will focus on the allocation of resources in the first stage.

I employ a modification introduced by Komiya (1967) of the standard Heckscher-Ohlin two-factor model that depicts the general equilibrium effects on a small economy as it opens to international trade. All the usual assumptions are made, e.g., the technology is represented by constant returns to scale production functions for each of three sectors: a military sector denoted by M which produces weapons for domestic consumption (weapons are assumed to be a non-traded good) and an agricultural and industrial sector producing traded goods X (food) and Y (computers). We assume no factor intensity reversal, perfect competition in goods and factor markets and that preferences over the three commodities, national security, X and Y are represented by a homothetic utility function, U .

For tractability many authors such as Anderton, et al. (1999), Grossman and Kim (1995) and Reuveny and Maxwell (1998) assume production of commodities occurs using a Ricardian or fixed-coefficient technology employing only one factor of

production. Assuming this type of technology implies that the returns to the factor are fixed as there are no diminishing returns in production. Conversely, the use of neo-classical production functions as employed in this paper has the advantage that with the introduction of more than one factor of production and diminishing returns, the wages to labor and return to capital will vary depending upon the production levels of each commodity. Since internal conflict or domestic political support for defense spending may be mitigated or enhanced by greater equality of the income of the owners of capital and labor, then the introduction of this technology allows some of these issues to be examined. Since this is beyond the scope of this paper it will not be pursued further but it warrants future investigation.

In order to present the propositions from the model in a graphical manner, in what follows I refer to only two commodities: weapons and the traded good Y. The algebraic presentation of the results for all three commodities is straightforward and follows from the model developed by Komiya (1967) and adapted by Seiglie (1992). Suppose that there are two countries denoted by 1 and 2 with each having an adversarial relationship with the other. In this case, the utility function for the representative decision-maker in country 1 is $U_1(m_1, y_1)$, where y denotes the amount consumed of commodity Y and $m_1 = M_1 - a_1 M_2$ denotes national security. It is equal to the country's expenditures on the military, M , minus some fraction, a , of the amount spent by the opponent. This specification assumes that some proportion of an adversary's military capability spills over and **decreases** the effectiveness of the country's military defense, i.e., it reduces its national security.¹ Likewise, we assume that the adversary has preferences represented by $U_2(m_2, y_2)$ where $m_2 = M_2 - a_2 M_1$. The proportion a_i differs for each country

depending, for example, on the percentage of military spending directed towards offensive versus defensive purposes. Given this framework, the problem can be viewed as a static game in which each country chooses the level of spending on M and y given the choices of the opponent.

Let us compare the Nash equilibrium when country 1 is in autarky with the one that prevails when it opens up to trade. In other words, we analyze the effect that an expansion in trade has on the amount allocated to the military sector. For simplicity, assume that initially both countries have closed economies and then country 1 opens up to trade. If we assume that it has the comparative advantage in the production of Y , then its terms of trade increases, i.e., the price of Y increases relative to M (and X). We show the derivation and compare the effects in Figure 3. First though, in order to arrive at the Nash equilibrium we derive the reaction functions for each country under autarky (Figure 1) and free trade (Figure 2). For country 1, its reaction functions for the two cases are derived as follows.

The Closed Economy Case

The derivation of each country's reaction functions and the Nash equilibrium level of military spending are shown in Figure 1 and follows Seiglie (1988). Suppose country 2 does not have any military capability, then $M_2 = 0$ and country 1 faced with the production possibility curve XX is in an autarkic equilibrium at A , consuming $m_1 = M_1$. This provides the intercept for the reaction function of country 1. Now suppose that country 2 produces M_2^1 units of military capability, then this causes the national security of country 1 to fall by $a_1 M_2^1$. To determine the consumption possibility locus we subtract

$a_1 M_2^1$ vertically from XX giving the curve DD. The new equilibrium under autarky is A' . At this equilibrium, the consumption of national security is m_1^1 but the amount of military spending is given by M_1^1 . This gives us our second point for the reaction function of country 1. As can be seen, the representative individual is made worse off since national security has fallen. The loss in welfare is measured by $(U_1^{1A} - U_1^{2A})$. By choosing different levels of military spending for country 2, we can derive country 1's reaction function, $R_1^{Autarky}$. Similarly, by choosing different expenditure levels for country 1 and deriving the optimal choices for country 2 yields its reaction function under autarky, $R_2^{Autarky}$. The Nash equilibrium for this game is given by point E. Given the size of the opponent's military sector, the other country cannot be made better off by choosing a different level.

The Free Trade Case

The Nash equilibrium under free trade is derived similarly in Figure 2. For simplicity, assume that these countries do not trade with each other but instead only with the rest of the world. Having them trade with each other does not affect the results so long as they are price-takers, which is the standard small-country assumption used in international trade theory. The equilibrium is again derived by finding the optimal amounts of production and consumption for each country given the amounts chosen by the opponent. To find the intercept of country 1's reaction function, we find the optimal level of M chosen given the terms of trade established by world prices. Starting from a situation where country 2 has no military, we assume that country 1 maximizes utility by producing and consuming at point A, i.e., it does not engage in international trade. The

amount of national security consumed is equal to the production of the military sector and is given by M_1 . Next, when country 2 has M_2^1 units of military capability the optimal amount country 1 decides to produce remains the same, but the amount consumed or demanded is larger as indicated by the point, M_1^1 . This country can consume the difference by reducing its production of X and increasing the production and exports of commodity Y, as indicated by the trade triangle in Figure 2. To determine the budget constraint faced by this country, we subtract $a_1 M_2^1$ vertically from line p, the country's terms of trade given by the relative price of Y to M. The amounts consumed of national security and the traded good Y is given by the coordinates of point A' . Since preferences are homothetic, the level of utility is given by U_1^{2T} . Note that in this case welfare declines by $U_1^{1T} - U_1^{2T}$, so individuals are made worse off by the adversary's increased spending. Continuing to find the optimal amount of M_1 chosen for the different levels of M_2 , we derive country 1's reaction function under free trade. Note that in this case it is given by the line R_1^{Trade} . Similarly, we could derive the reaction function for country 2 assuming it chooses the optimal amount of military capability given the amounts chosen by country 1. It is also a line, which we label R_2^{Trade} . The Nash equilibrium under a free trade regime is given by point E* in Figure 2.

II. Some Comparative Statics

In Figure 3, we compare the autarky and free trade equilibria. The first proposition that we derive is that although for any given level of the opponent's military capability welfare is reduced by less under free trade, the Nash equilibrium level of armaments is larger under free trade (indicated by E* as compared to that given by E).

Restated differently, trade increases wealth but part of the increase is used to purchase national security. It is the reaction of the opponent to a country arming that leads to the final result of both spending more on weapons in equilibrium. Since the level of military spending is higher for both, we could conjecture that this may also increase the likelihood of war in the second stage (see Seiglie, 1988).

Finally, in Figure 4 we depict the situation when country 1 experiences an increase in its terms of trade while that of country 2 remains unchanged. This effect occurs when the prices of a country's exported commodities rise relative to its imported goods. An example of this would be when the price of oil rises relative to other imported goods for an oil-exporting country. As a consequence, country 1's reaction function shifts upward leading to an increase in the military spending of both countries. Note that the effects of an improvement in the terms of trade for country 1 is for its level of welfare to increase, whereas that of country 2 to decrease because of the decline in its national security.

III. Importance of the Capital Account

Polachek (1980, 1992) developed a framework to analyze the trade-conflict nexus. In his model, a country's preferences can be represented by a utility function over the consumption, C , of m -goods that are produced in a k -country world. Furthermore, each of these countries can initiate conflict or cooperation on any of the $k-1$ countries towards which the level of intensity is denoted by a $1 \times (k-1)$ vector Z . Preferences for the level of conflict generate a derived demand for it, although the primitive for conflict may be to redistribute wealth from neighbors either voluntarily or involuntarily by threat or

use of force. Furthermore, conflict has effects on the terms of trade or prices in the world markets.

Formally, a country seeks to maximize:

$$U = u(C, Z), \quad (1)$$

$$\text{with } C = \{c_1, c_2, \dots, c_m\} \text{ and } Z = \{z_1, z_2, \dots, z_{k-1}\}.$$

A country's balance-of-payments is composed of the current and capital accounts with the capital account taking on a greater importance in current times. To account for this, a modification of the country's budget constraint to account for the importance of international capital flows requires that the total dollar amount they export of each of the k goods, x_{ij} sold at prices, p_{ij}^x is equal to the value of imports m_{ij} at prices p_{ij}^m and any net borrowing from the rest of the world denoted by K . This is the country's capital account. Formally,

$$\sum_i^m \sum_j^k p_{ij}^x x_{ij} - \sum_i^m \sum_j^k p_{ij}^m m_{ij} = K \quad (2)$$

with $K = \sum_i^k [l_{ij}(r_{ij}) - b_{ij}(r_{ji})]$ where l_{ij} denotes lending by country i to j at an interest rate of r_{ij} and similarly b_{ij} denotes the amount borrowed by country i from j at an interest rate of r_{ji} .

It should now be clear that conflict should affect bilateral prices and interest rates in a symmetric manner. Namely,

$$p_{ij}^x = p_{ij}^x(z_j, z_j^*), \quad p_{ij}^m = p_{ij}^m(z_j, z_j^*), \quad r_{ij} = r_{ij}(z_j, z_j^*), \quad r_{ji} = r_{ji}(z_j, z_j^*)$$

where z_j is the intensity of conflict or aggression of country i targeted at country j and z_j^* is the level of aggression of country j towards i. Thus conflict affects prices in the following manner:

$$\text{a) } \frac{\partial p_{ij}^x}{\partial z_j} < 0, \text{ b) } \frac{\partial p_{ij}^m}{\partial z_j} > 0, \text{ c) } \frac{\partial p_{ij}^x}{\partial z_j^*} > 0, \text{ d) } \frac{\partial p_{ij}^m}{\partial z_j^*} < 0, \text{ e) } \frac{\partial r_{ij}}{\partial z_j} < 0, \text{ f) } \frac{\partial r_{ij}}{\partial z_j^*} > 0, \text{ g) } \frac{\partial r_{ji}}{\partial z_j} > 0, \text{ and}$$

$$\text{h) } \frac{\partial r_{ji}}{\partial z_j^*} < 0.$$

The interpretation of a), d) and h) is that greater conflict by the actor towards the target requires the actor to reduce the price of their exports (or the lending rate) to induce them to purchase the good (or borrow). Yet strategically, if you are in conflict with country j, the acting country may instead want to use price as a mechanism to punish j (a complementary instrument) and therefore, may want to raise their export prices or the lending rate. Furthermore, if we assumed that the price of one's exports had to be reduced when a conflict occurs, since the adversary's welfare would be increased accordingly when export prices are reduced, this implies that conflict could be Pareto improving for them. By allowing the prices charged to be an instrument complementing more direct methods of conflict, we would reduce the likelihood of this results. The interpretation of b), c) and e) is that greater conflict by the actor leads to either them being charged a higher price for the imports from the target country or a higher borrowing rate (see Polachek, Seigle, Xiang for greater details).

The problem for the target country is two-staged. First, it chooses the amount of consumption of the m goods to maximize (1) subject to the budget constraint given by equation (2). Then it chooses the level of conflict to initiate against the target country given the prevailing prices being charged to them in the first stage. One could think of

individual consumers solving the first decision, i.e., the composition of imports and exports and the government or politicians deciding the level of conflict, Z . In order to derive a perfect subgame Nash equilibrium, we solve the system backwards by solving for the second stage's optimal level of conflict Z against each country conditional on the first-stage being solved optimally, and then use these results to solve the first stage problem. The solution is a perfect Nash equilibrium level of international conflict or cooperation directed by each country towards another in the international system. Comparative static results could be derived by varying a country's endowments (for example, the development of a new industry or the discovery of oil or some other natural resource) and investigating how the distribution of conflict and cooperation evolves.

IV. Further Observations and Conclusion

It is quite possible that conflict may impact on trade in a less than obvious manner. The more direct approach would have conflict reducing trade. Yet, I propose that conflict may actually lead to greater trade, or more specifically countries opening their economies to international trade. The process would work as follows. Conflict requires resources to successfully defend and perpetuate it. As a result a country will attempt to change institutions, including opening their economy to trade, to expand their economy. Since trade allows for gains from specialization in productions, as well as improving the terms of trade, countries will enact such a policy.

Let me give a current example where I believe such a process has occurred. When the Soviet Union collapsed, Cuba lost an enormous source of foreign aid that helped sustain the current system. Cuba almost immediately opened its economy to trade

and more impressively to direct foreign investment. It has aggressively sought joint ventures with other countries and has gone so far as to adopt the US dollar as the unit of account. Similar opening to trade and investment and radical changes to institutions have been undertaken by India, Brazil and Argentina possibly motivated by similar reasons. There are many more historical examples that come to mind.

In conclusion, studies have examined the determinants of international trade and more recently, the impact that trade has on economic growth and the size of nations. Yet, if international trade is beneficial to a country, then a country may want to protect these gains from trade. More precisely, this paper shows that world trade has implications for the size of the military sector of a country. Furthermore, since political institutions seem to play a prominent role in economic development, then one must account for not only the effects that trade has on economic growth, but also on the extent that resources are diverted to the military sector. Yet, much more research has to be conducted not only on the trade account, but also the capital account that up until now has been largely neglected. Given the degree of development in the world capital markets and the extent that nations in the international system are integrated in it, we cannot fail to neglect the impact of the capital account in our future research.

References

- Alesina, Alberto; Spolaore, E. and Wacziarg, R. "Economic Integration and Political Disintegration." American Economic Review, December 2000: 1276-1296.
- Anderton, Charles H. 1999, "Economic Activity in the Shadow of Conflict." **Economic Inquiry** 37:166-179.
- Azar, E.E. "The Code Book of the Conflict and Peace Data (COPDAB): A Computer Assisted Approach to Monitoring and Analyzing International and Domestic Events." University of North Carolina, Chapel Hill (mimeo) (1980a).
- Azar, E.E. "The Conflict and Peace Data Bank (COPDAB) Project." **Journal of Conflict Resolution**, 24 (1980b): 142-152.
- Barbieri, K. 1996. "Economic Interdependence: A Path to Peace Or a Source of Interstate Conflict?" **Journal of Peace Research** 33:29-49.
- Boulding, Kenneth E. *Conflict and Defense*. Boston : Harper and Row, 1961.
- Brito, D.L. "A Dynamic Model of an Armament Race." **International Economic Review** 13 (1972): 359-375.
- Brito, D.L. and Intriligator, M.D. "Conflict, War, and Redistribution." **American Political Science Review** 79 (1985): 943-957.
- Connolly, Michael. "Public goods, Externalities and International Relations." **Journal of Political Economy** 78 (April 1970): 23-49.
- Gasiorowski, M. J. 1986. "Economic Interdependence and International Conflict: Some Cross-National Evidence." **International Studies Quarterly** 30:23-38.

Gowa, J. 1989. "Bipolarity, Multipolarity, and Free Trade." **American Political Science Review** 83:1245-56.

Gowa, J., and E. D. Mansfield. 1993. "Power Politics and International Trade."
American Political Science Review 87:408-20.

Grieco, J. 1988. "Anarchy and the Limits of International Cooperation." **International Organization** 42:485-507.

Grossman, Herschel I., and Minseong Kim. "Swords or Plowshares? A Theory of the Security of Claims to Property." **Journal of Political Economy**, December 1995, 1, 275-88.

Intriligator, Michael, D. "Strategy in a Missile War: Targets and Rates of Fire." Los Angeles: UCLA Security Studies Project, (1967).

Intriligator, Michael, D. "Strategic Considerations in the Richardson Model of Arms Races." **Journal of Political Economy** 83 (1975): 339-353.

Isard, Walter. **Arms Races, Arms Control, and Conflict Analysis**. New York: Cambridge University Press, 1988.

Komiya, R. "Non-Traded Goods and the Pure Theory of International Trade."
International Economic Review, 8: 132-152, 1967.

Mansfield, Edward D. **Power, Trade, and War**. Princeton, NJ: Princeton University Press: 1994.

McGuire, Martin C. **Secrecy and the Arms Race**. Cambridge: Harvard University Press, 1965.

McNeill, William. **The Rise of the West: A History of the Human Community**. Chicago: University of Chicago Press, 1963.

- Morrow, J. D. 1997. "When Do "Relative Gains" Impede Trade?" **Journal of Conflict Resolution** 41:12-37.
- Oneal, J. R., F. H. Oneal, Z. Maoz, and B.M. Russett. 1996. "The Liberal Peace: Interdependence, Democracy, and International Conflict, 1950-1985." **Journal of Peace Research** 33:11-28
- Oneal, J. R. and B. M. Russett. 1997. "The Classical Liberals Were Right: Democracy, Interdependence, and Conflict, 1950-1985." **International Studies Quarterly** 41:267-94.
- Park, T., F. Abolfathi, and M. Ward. 1976. "Resource Nationalism in Foreign Policy Behavior of Oil Exporting Countries." **International Interactions** 2:247-62.
- Polachek, Solomon. "Conflict and Trade." **Journal of Conflict Resolution**, 24, 1980.
- Polachek, Solomon. "Conflict and Trade: An Economic Approach to Political International Interactions," in **Economics of Arms Reduction and the Peace Process**, edited by Walter Isard and C. Anderton. Amsterdam: North-Holland, 1992.
- Polachek, Solomon, C. Seiglie and J. Xiang. 2007. "The Impact of Foreign Direct Investment on International Conflict," *Defense and Peace Economics*, 18(2):415-429.
- Powell, R. 1993. "Guns, Butter, and Anarchy." **American Political Science Review**. 87:114-32.
- Reuveny, Rafael, and Maxwell, John, "Free Trade and Arms Races." **Journal of Conflict Resolution**, 42 No. 6, December 1998 771-803.
- Sandler, Todd, Tschirhart, John, and Cauley, Jon, 1983. "A Theoretical Analysis of Transnational Terrorism," **American Political Science Review**, 77(1), 36-54.

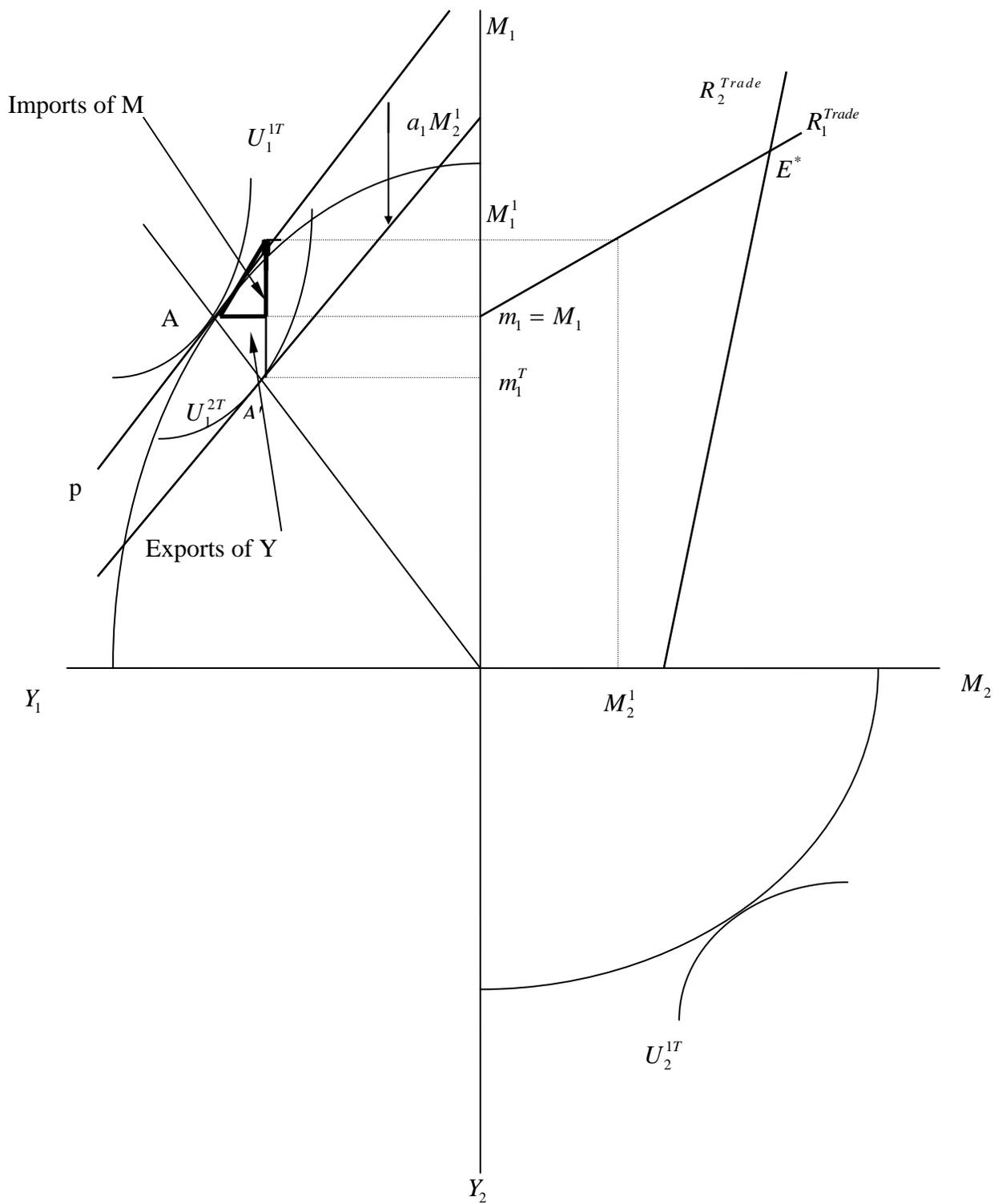


Figure 2: Free Trade Case

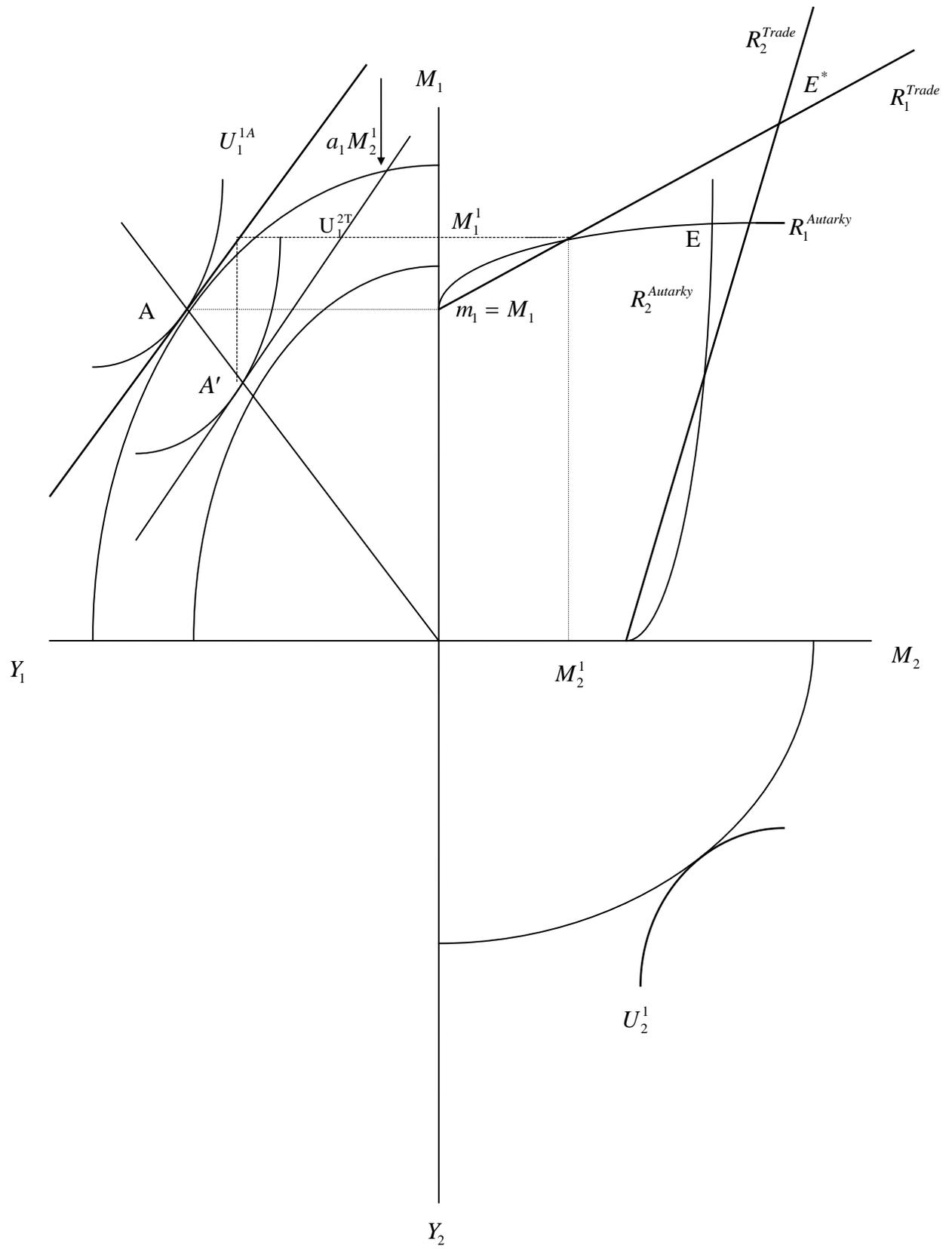


Figure 3: Autarky versus Free Trade Nash Equilibrium

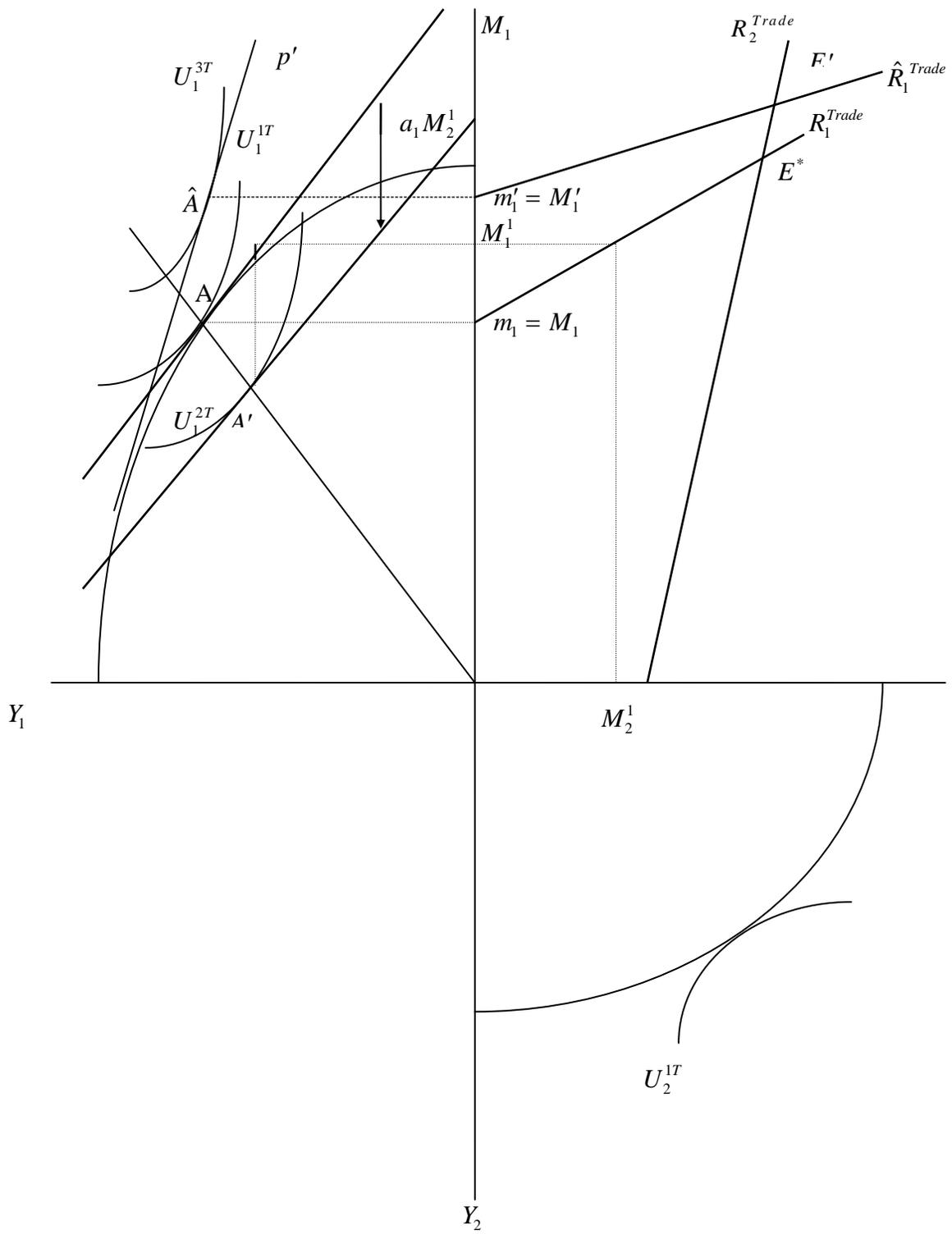


Figure 4: An Increase in the Terms of Trade

¹ For members of an alliance, the sign of the a's would be reversed.