AN IMPACT EVALUATION OF U.S. ARMS EXPORT CONTROLS ON THE U.S. DEFENSE INDUSTRIAL BASE: AN INTERRUPTED TIME-SERIES ANALYSIS.

by

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ABSTRACT

The United States Defense Industrial Base (USDIB) is an essential industry to both the economic prosperity of the US and its strategic control over many advanced military systems and technologies. The USDIB, which encompasses the industries of aerospace and defense, is a volatile industry – prone to many internal and external factors that cause demand to ebb and flow widely year over year. Among the factors that influence the volume of systems the USDIB delivers to its international customers are the arms export controls of the US.

These controls impose a divergence from the historical US foreign policy of furthering an open exchange of ideas and liberalized trade. These controls, imposed by the Departments of Commerce, Defense, and State rigidly control all international presence of the Industry. The overlapping controls create an inability to conform to rapidly changing realpolitiks, leaving these controls in an archaic state. This, in turn, imposes a great deal of anxiety and expense upon managers within and outside of the USDIB.

Using autoregressive integrated moving average time-series analyses, this paper confirms that the implementation of or amendment to broad arms export controls correlates to significant and near immediate declines in USDIB export volumes. In the context of the US's share of world arms exports, these controls impose up to a 20% decline in export volume.

DEDICATION

For Ashley – Thank you for your encouragement and love.

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Introduction

"One at a time, regulations can seem quite reasonable. Put together, they can be self-defeating."

Dr. Neal Lane

The United States Defense Industrial Base (USDIB) is an essential industry to both the economic prosperity of the US and its strategic control over many advanced military systems and technologies. The USDIB, which encompasses the industries of aerospace and defense, is a volatile industry – prone to many internal and external factors that cause demand to ebb and flow widely year to year. Among the factors that influence the volume of systems the USDIB delivers to its international customers are the arms export controls of the US.

These controls impose a divergence from the historical US foreign policy of furthering an open exchange of ideas and liberalized trade. These controls, imposed by the Departments of Commerce (DoC), Defense (DoD), and State (DoS), rigidly control all international presence of the Industry. Over time, the overlapping controls have created an inability to conform to changing realpolitiks and left such controls in an archaic state, in turn imposing a great deal of anxiety and expense upon managers within and outside of the USDIB (Chermside, 2005).

In this paper, I attempt to determine what financial implications are experienced by the USDIB because of the imposition of export controls that limit international deliveries of military and dual use technologies (DUTs) developed and manufactured by US firms. I begin by examining the prominent restrictions of arms exportation over the previous century, the strategic importance of the USDIB, and the theories providing an imperative for the Industry to engage in exportation. I then analyze time-series data of US arms exports. These analyses were found to

include a large deal of noise, preventing precise conclusions regarding the cost imposed upon the USDIB because of export controls. The enaction of significant controls were correlated to significant and near-immediate declines of up to 20% of the US's share of world arms exports.

Exploring The Foreign Policy of the US

The Finley-Moody Trading Corporation, a US based firm, is not a company the layman would consider to export "strategic commodities." The firm built agricultural equipment, forage harvesters and self-unloading farm wagons to be precise. In 1962, Finley-Moody attempted to export two of these harvesters and eight of these wagons to the USSR. The Export Administration Act of 1949, however, set forth protocol that required exports of strategic commodities to be reviewed and approved, with a corresponding license attached to the commodities, by the Executive branch of the US government. The Act evolved to serve as a medium through which US foreign policy could be implemented. The license for Finley-Moody to export this farm equipment was denied under the pretext that such an export could significantly add to the economic potential of a Communist State – an event that was thought to be "detrimental" to US welfare (Abrahamson, 1995). This denial was followed by economic analyses at the Central Intelligence Agency. These analyses questioned whether the export could have added to economic prosperity or would simply have generated humanitarian dividends in the way of marginally increasing agricultural efficiencies.

Occurrences of this type have been repeated countless times throughout the last century, during which US export controls of strategic importance have become increasingly codified and complex, and raises the question of what has been the general impact of these controls on US exports?

US Policy With Respect to Arms Proliferation

This paper's scope is limited to the leading US export controls regarding the exportation and corresponding proliferation of conventional weapons and DUTs, namely the Export Administration Acts and the Arms Export Control Acts. I have summarized notable introductions of and amendments to US export controls meeting the criteria of examination for this paper in Table 1.

Modern US limitations to the dissemination of weapons have their base in the 1917 Trading with the Enemy Act (TEA) and the Neutrality Acts of the 1930's (United States Department of State, 1983). TEA, initially, made trade with an enemy, or ally of an enemy, of the US during times of war illegal. "Trade" was broadly defined to include the satisfying of debts, entering into or execution of contracts, extension of credit, and any transferring of asset between any US entity and an international counterparty. TEA has been amended over time to include such things as Executive Order 6102, which forbade the hoarding of gold by US citizens (Cornell Law School). Parts of the Act are still in effect, and largely used as an embargo enforcement mechanism for both general commercial trade and the trade of armaments (Field, 2009). Of the multiple Neutrality Acts of the 1930's, the 1939 Act was unique in that it was the first legislation to specify export and import licensing protocol for armaments (US Department of State Office of the Historian). Export controls found their golden age in the Post-World War II period. With the weaponization of nuclear technologies and the formation of the Warsaw Pact, the US moved to prevent the proliferation of advanced weapons systems. For conventional weapons, such restrictions began with the Export Control Act (ECA) of 1949: the first arms control-intensive legislation passed by the US. The Act was, broadly, designed for control of the

exportation of military and DUT wares for the reasons of national security, foreign policy, and short supply situations (Federation of American Scientists, 1998). The short supply clause was novel, as it specified that US exports containing strategic inputs to which the international supply had dwindled should be curtailed to preserve US access to such inputs. The Act remained in effect from 1949-1969, was reinstated in 1979, and lapsed in 1994 (Swan, 1993).

Table 1

Major Restrictions to US Arms Exports.

Trading with the Enemy Act (TEA)	1917	Disallowed US entities to trade with entities of an enemy state during times of war.
Neutrality Act of 1939	1939	Export and import licenses first required for armaments.
Export Control Act (ECA)	1949	Introduced extraterritorial influence to arms controls, by restricting the trade of strategic military goods to nations who were furthering or supporting Communist ideology. Became a medium for incorporating the guidance of the Coordinating Committee of the Consultative Group (COCOM).
Export Administration Act (EAA)	1969	Tempered the control of trade. Required the President to be prepared to demonstrate to Congress why policy/security interest took precedent over liberalized trade.
Arms Export Control Act (AECA)	1976	Controls the export of defense articles and services which are inherently military. DoS administers the Act. Considered an enactment of the DoD's Defense Science Board "Bucy Report" recommendations. Established the Munitions Control List (MCL) to organize those categories of systems to be controlled by the International Traffic in Arms Regulations (ITAR). Established ITAR, requiring exporters to apply for and receive license to export a good/service list on the MCL.

Table 1: Continued.

Export Administration Act of 1969 Amendment	1977	Intended to be a non-facilitation of state terrorism. Extended jurisdiction of US export controls to re-exports by overseas subsidiaries of US firms.
International Economic Emergency Powers Act (IEEPA)	1977	Provides the President authorization to control international finances, exports, and imports. To activate, President must declare a national emergency that possess an "unusual and extraordinary threat" to national security, foreign policy, or the domestic economy.
Export Administration Act of 1979	1979	Limited the President's imposition of foreign policy controls such that imposed controls are to be socially efficient: cost to US entities must not exceed the benefit to the US foreign policy objectives. Made exportation to states determined by the Secretary of State to have repeatedly supported terrorism more difficult.
Export Administration Act of 1979 Amendment	1985	Increased Congress's presence in determining which countries to be blocked from receiving US arms shipments.
Omnibus Trade & Competitiveness Act	1989	Relaxed export licensing protocols to COCOM members and to states with COCOM-like policies. Encouraged the trade of DUTs by limiting when controls can be applied to these technologies.
Arms Export Control Act (AECA) Amendment	1999	Assigned ITAR licensing responsibilities to Department of State.

The importance of the ECA following 1969 has been insignificant in terms of controlling US arms exports because of the enaction of the Export Administration Act (EAA) of 1969 (the 1969 Act). The 1969 Act was a temperance of trade controls for military technologies. It was largely a continuation of the 1949 ECA, with a major revision that required the President to be

prepared to demonstrate to Congress as to why policy or security interests superseded free trade (Swan, 1993).

The 1969 Act was replaced by the 1979 Act. As amended, the 1979 Act provided the "authority to regulate exports, to improve the efficiency of export regulation, and to minimize interference with the ability to engage in commerce." The improvements in efficiency were, in part, derived by a requirement for the President to be prepared to present Congress with evidence that benefits to foreign policy did not supersede the costs incurred by the USDIB by way of decreased international sales. The 1979 Act also made the exportation of arms and DUTs to those states determined by the Secretary of State to have supported terrorism more difficult than under past controls and increased Congress's presence in export protocols (Swan, 1993).

The 1979 Act remained in effect until September of 1990. During the period between enaction and expiration, there were several amendments to the Act. A 1985 Amendment required the President to consult with several Congressional Committees before altering foreign policy, thereby further increasing Congress's role in controlling military and DUT exports. The 1988 Omnibus Trade and Competitiveness Act (OTCA), which was tagged to the 1979 EAA, established a protocol for the President to determine what national security issues could arise from foreign mergers, acquisitions, and takeovers of USDIB companies, and allowed suspect transactions to be suspended or barred. The OTCA also shortened the maximum time allowed to complete a review of a proposed international arms transaction from 120 days to 90 days, thereby expediting the licensing process (US House Select Committee on US National Security and Military/Commercial Concerns with the People's Republic of China).

The 1979 Act was kept alive by Executive Order 12730, which invoked the authority granted by the International Economic Emergency Powers Act (IEEPA). The IEEPA was enacted in 1977, and gave the President the power to control imports, exports, and international finance by declaring a national emergency because of an "unusual and extraordinary threat" arising in part or whole outside of the US. Historically, the IEEPA has been used to, among other things, freeze lending to South African entities, to embargo Libya, and to block exports to Nicaragua. Executive Order 12370 was implemented because a lapse of the EAA was believed to derail Congressional interests in the matter of revising the 1979 Act and the imminent conflict with Iraq emphasized the need to further embargo arms from those states supporting terrorism (Swan, 1993). Public Laws 103-10 and 102-277 kept the 1979 Act in force, following Executive Order 12370, until August 1994 (US House Select Committee on US National Security and Military/Commercial Concerns with the People's Republic of China).

In all, the series of Export Administration Acts were a well-balanced attempt to maximize benefits to the USDIB & US foreign policy interests. There was, however, an externality: the "Bucy Report."

The DoD's Defense Science Board released a report, the Bucy Report, in 1976 expressing concern that the US was loosing its technological advantage over Communist nations. Communist states were able to circumvent the costly and lengthy research and development phases of military technologies by acquiring advanced weapons systems through alternative procurement methods. The Board recommended that licensing authorities focus on preventing these alternative procurement channels from delivering sophisticated hardware and knowhow to

Communist states. Amendments were made to the 1969 EAA in 1977, providing the US with jurisdiction over re-exports of defense items (Swan, 1993).

In this environment of concern that proliferation of US military items would erode the US's technological and strategic advantage over the Communist states, the Arms Export Control Act of 1976 (AECA) was passed. The AECA is a three-part Act: establishing the Munitions Control List (MCL), establishing the International Traffic in Arms Regulation (ITAR), and the general provisions contained in the AECA (Van Atta et al., 2007).

The MCL is the "heart" of modern licensing protocol. It is currently broken into 13 categories of articles, series, and technical data covering everything from combat shotguns to nuclear submarines (United States Munitions List). The MCL is the codified portion of the AECA. The ITAR is the subjective portion, providing guidance to inferring from the MCL and providing the protocol to apply for a license to export a MCL listed commodity or service.

A frequent qualm regarding the AECA, ITAR, and MCL is the overreaching broadness of definitions provided in these items. The term "export" includes the shipment of a defense system, transference of ownership or license from a domestic entity to a foreign entity, the disclosure of technical data to a foreign entity, the taking of technical drawings or hard-copies of data outside of the US, and the performance of "defense services" for a foreign entity. The location of disclosure, transference, or performance for such exports does not matter, as the Act applies to all US persons with extraterritorial jurisdiction. "Technical data" includes all data carrying classification of classified or above, information with a Secrecy Order protection attached, and information directly relating to the design, manufacturing, and operation of defense articles. Technical data does not include generally know science, mathematic, and engineering

knowledge. The subjectivity and broadness of these definitions and the need for adaptation to concurrently occur with scientific advancement occasionally draws complaint from academia and industry as being inhibitive to the advancement of high-tech goods through international collaborations (Lane, 2001).

To this, the DoS reaffirms that the US policy is not to license exports to countries supporting communism, terrorism, or are in a general state of upheaval for which the benefit of issuing an export license is less than the benefit to restrict the export in accordance with US foreign policy at the time of license application (Swan, 1993).

Figure 1 shows the US share of total arms exported worldwide for the period of 1965-1994. This figure is inserted to show the US market share of arms exports before and following the introduction of the AECA, ITAR, and the MCL.

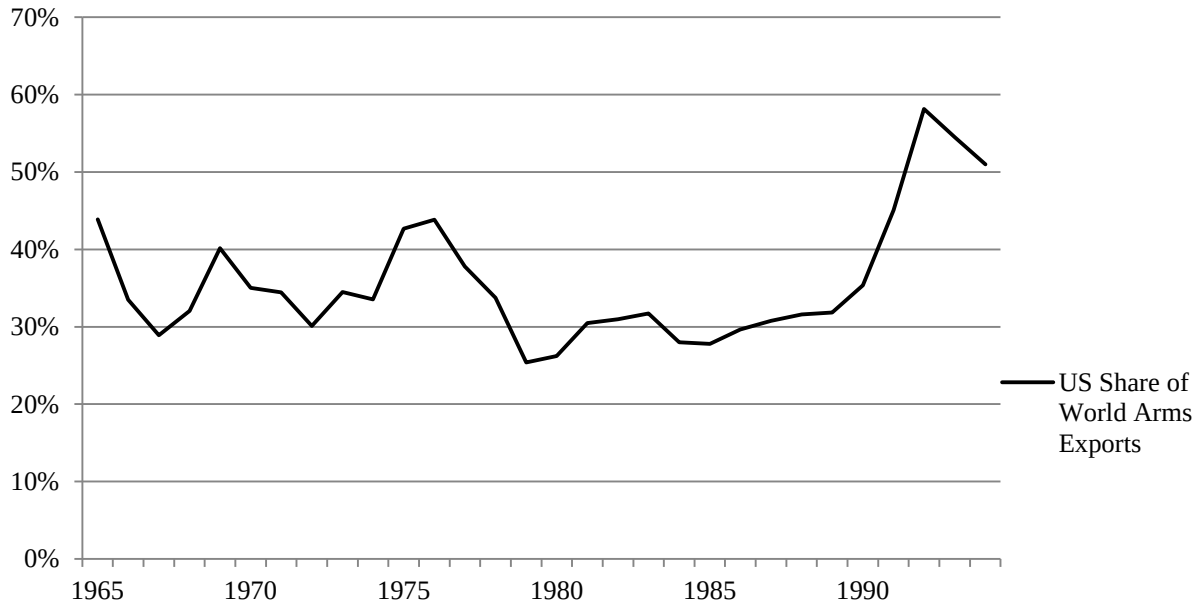
Per Figure 1, it is evident that the US share of total arms exports was at a relative high in 1976, at 44.83%. This is slightly less than what the US share was in 1965, at 44.86%. The US share fell to 37.78% in 1977, 33.75% in 1978, and bottoming out at 25.39% in 1979. The 1979 US export share was the lowest during the past sixty years of reported data. The US share did not rise above the 1976 share until 1991, at 45.09%.

Other than occasional revisions to the categorization and organization of the MCL, little has changed to the AECA since its 1976 introduction. One of the notable revisions occurred in 1999, when the responsibility of license review and approval or denial was passed from the DoC to the DoS. This came amid a series of mid 1990's controversy regarding the US satellite industry proliferating technology to Chinese interests. Politicians determined the DoS would be better suited to review and decide upon the ITAR licenses. This transfer of licensing authority greatly

increased the complexity of ITAR protocol (Bender, 2006; Waite & Schwartz, 2007). Figure 2 shows the number of consent agreements for settlement regarding a violation of AECA or ITAR each year from 1980-2010.

Figure 1

US Share of World Arms Exports, 1965-1994.



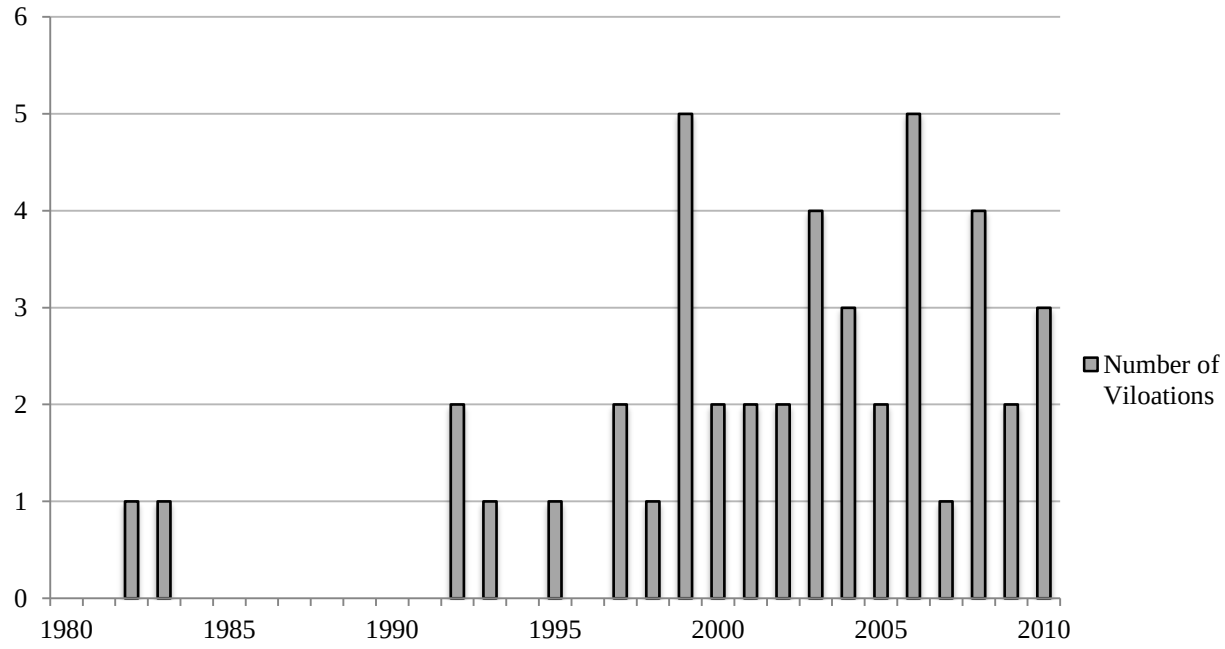
Notes: Based on SIPRI TIV Database results, period 1965-1994. For expanded periods or other nations' shares, see Appendix A.

Beginning in the mid 1990's the number of violations of AECA and ITAR began to increase, corresponding with fears that Beijing had acquired proprietary satellite technology. From the period 1980-1998, when the DoC was charged with ITAR licensing, there were 9 reported ITAR violations made by US firms. This is compared to 35 reported violations during

the period 1999-2010, when the DoS assumed responsibility for licensing. Notably, violations spiked in 1999, the year the DoS took over the licensing procedures. We can deduct that violations occur more often when political concern over the proliferation of MCL items is highest and when politicians decidedly make exportation more restrictive through changes to the Act (Hudson, 2008).

Figure 2

AECA & ITAR Violations, 1980-2010



Notes: Based on the consent agreements published by the Assistant Secretary for Political-Military Affairs, pursuant to 22 CFR §127.10, of violations of the AECA and ITAR. Consent agreements for the above violations are published on the US DoS Directorate of Defense Trade Controls webpage.

An examination of Table 2 indicates that the US is not entirely restrictive in its exportation policy of weapons and corresponding knowhow.

The US has exported to and imported from more foreign customers than any other member of the UNSC member (and any non-UNSC state) over period of 1950-2010, for which data is available. This does not nullify the complaints of excessively strict export controls. US export controls are widely seen by policy experts as being endogenous, rather than exogenous (Trefler, 1993). An endogenous variable is one that is the product of inputs. That is, it is the output of some function. An exogenous variable is the complement: the input to some function. This is to say that the US implements export controls not to influence foreign policy, but directly as foreign policy.

Table 2

Summarizing the Number of Nations Exported To, Imported From, and Total Arms Trade Partners of UN Security Council Member States, Period 1950-2010.

Nation	*Exported To*	*Imported From*	*Total Trade Partners*
China	71	12	81
France	122	15	122
Russian Federation	83	4	86
United Kingdom	117	19	118
United States	159	26	161
USSR	74	8	75

Notes: Based on SIPRI TIV Database results, period 1950-2010. *Exported To* denotes the number of states the UNSC member state exported arms to, and *Imported From* denotes the number of states the UNSC member state imported arms from. *Total Trade Partners* is the sum of the nations the UNSC member state exported to or imported from during the period without double-counting. SIPRI considers NATO and the UN as separate trade partners. SIPRI data contains a "unknown country" category that is not included in this table, as the unknown categorization can contain multiple countries that are not able to be differentiated.

Defining the Strategic and Economic Importance of the USDIB

The USDIB is a primary driver of the US economy and catalyst for the technical innovation that has allowed the US to establish and maintain its comparative advantage in advanced sciences (Voors, 2003; James A Baker III Institute for Public Policy, 2009). This advantage is beginning to wane. Central to this decline is an oversight as to the strategic and economic importance of international collaborations when policy is implemented (Lane, 2001). Included in this section is an examination of leading theories relating to international sales and diversification of the USDIB.

The USDIB and the Soviet Collapse

The Soviet Union of the mid and late 1980's was primed for dissolution. With Mikhail Gorbachev's rise to power in 1985 and the Eastern Bloc collapse of 1989, the "implosion" of the Warsaw Pact of 1991 was imminent (Thorton, 2007). The repercussions of the breakup were global. For the first time in nearly 60 years, the developed world was, largely, at peace as the US assumed the role of sole military superpower.

This new peace created another void – in the demand for new advanced weapons platforms. The US cultivated a system from which its arsenal is supplied by private contractors and subcontractor, who have taken up specialization in sub-segments of the weapons' market. The decreased demand for military technologies left such contractors greatly exposed to the geopolitical repercussions of the Soviet collapse (Sapolsky & Gholz, 1999), more so than if these suppliers were diversified in other high-tech industries. Inherently, the US itself was now at risk:

if its suppliers of weapons collapsed, the US could plummet from its placement of sole superpower because of an inability to internally equip its military and security forces.

The Encouraged Consolidation

To prevent this concurrent collapse in the USDIB, the executive branch of the US government moved quickly to coordinate and subsidize consolidations of major defense players. Though politically controversial, the Clinton Administration introduced a series of incentives for contractors to attain efficiencies, primarily in the research and development of dual use technology (DUT). These subsidies, provided primarily through DoD research funding, were seen as a powerful force in staying the US weapon supply (Oden, 1999). However, the occurrence of "peace dividends," from development of DUTs, has remained inconclusive (Thorton, 2007). It has been determined, using the DIBs of small and medium sized European countries as proxies, that horizontal consolidation was essential (Struys, 2004). Notable consolidations within the USDIB following the Soviet collapse included Northrop merging Grumman Aerospace in 1994, Lockheed merging with Martin Marietta in 1995, and Boeing's acquisition of McDonnell Douglas in 1997. A recent Wall Street Journal article concluded that of the $700 billion 2009 Pentagon budget, approximately $400 billion went to "The Defense Half Dozen" – Lockheed Martin, Boeing, Northrop Grumman, General Dynamics, Raytheon, and United Technologies (Hodge, 2011), and a 2002 RAND report found "the number of defense contractors that accounted for two-thirds of all defense sales shrank by 60 percent between 1990 and 1998." (Lorell, 2002). These mergers created significant welfare losses (i.e. lost jobs), resulting from the allocative inefficiencies that accompany the merger specific efficiencies (i.e.

cost savings from economies of scale) (Blair, 2010). Using the industry's current health and the DoD's anxiety regarding future mergers reducing the department's monopsony power (Hodge, 2011) as measures of the effect of the horizontal mergers, we can deduct that the net welfare effect has been positive.

The Theory of World Politics Cycles and the USDIB

It is regarded that world politics cycles through three broad phases: bipolarity, unipolarity, and multipower (Little & Smith, 2006). During the bipolar phase, the world is widely seen as "stable." Two powerful states with equal military capabilities and opposing interests or ideology square off to test the other's abilities. Other nations align themselves with one of the two superpowers. Outright conflict is rare, but proxy wars occasionally occur. After some period, one of the two superpowers is forced to concede, typically because of an internal revolution or macroeconomic turmoil. This brings about the unipolar phase, under which one of the bipolar superpowers emerges as the dominant source of world power. This superpower possesses the means to deter or incite conflict as it sees necessary in the furtherance of its interests. Smaller wars, typically civil wars, arise in nations with little significance economically or strategically to the superpower as tensions escalate in the vacuum left by the dissolution of the former superpower of the bipolar phase. It is believed that, as long as responsible policies are implemented by the sole superpower, the unipolar phase should last approximately as long as the bipolar phase. As the unipolar player inevitably sees its geopolitical control erode, the world becomes a much more dangerous place. Coalitions develop between states with like motives and trading ties (Sweo & Gordon, 2009). As these imbalanced coalitions vie for prominence, smaller

members of a coalition will attempt to switch their alliances so to lever their importance beyond what their military and economic powers dictate. These shifting states often create the volatility that degrades to world war. These world wars cause weaker alliances to be absorbed by stronger ones. The end result is two camps of coalitions, each dominated by the strongest member state, thus renewing the cycle of world politics.

Arguably, had the US government not taken immediate actions to preserve the USDIB, the US would have broken with the "responsible policies" dictated by the Little and Smith three phase theory of world politics. Accordingly, had such policy not been taken, the US would have had its monopoly on world politics quickly eroded, resulting in what could have been the most dangerous multipower struggle the world would have experienced, as Cold War littered the world with stockpiles of both conventional and nonconventional caches that would have given the vying multipower coalitions the means to bloodily bring the world back to a bipolar phase.

The Export Imperative

Nations (like firms) intend to maintain the minimal amount of inventory to meet the demands of current geopolitical conditions. End-users of military goods are not alone in influencing the market conditions. Technological advances made by the USDIB, EDIB (European Defense Industrial Base), and other innovating parties have shortened the technological refresh cycle to the point that it is not economically efficient to hold large equipment reserves, even during times of active war (Brill, 2007). Seemingly in conflict with the technological refresh cycle is the increasingly robustness of equipment, marketed by contractors to indicate the need for less servicing and higher theater reliability (Rosenwald, 2007). Simply, the end-user of the equipment will not purchase military technologies unless it has (or anticipates) active uses for such technology within a very short time following receipt of equipment. And when the user does purchase equipment, it seeks those goods that will last the longest (Thorton, 2007). Acknowledging this, it must be noted that brining a new product to market is, at best, a capital and manpower intensive feat. This is especially true in a high-tech industry. But it is vital for such industries to maintain their technological competitive advantage. Other high-tech industries, such as the pharmaceutical industry, can more easily export their products to a wider consumer base than the USDIB can, because of export controls.

Because of these market forces, members of the USDIB are reliant upon international customers to provide supplementary cash flows when domestic demand decreases and to offset the costly research and development (Hartley, 2008). Below, I explore several financial and economic theories relating to the use of exportation as a means to stay the US's technological edge in military and DUT technologies.

The Theory of Comparative Advantage

Comparative advantage is the theory that a nation can specialize in the production of goods and services, exporting that which they specialize in and importing that which they cannot produce at a lower opportunity cost than a trading partner (Maneschi, 2008). This is the fundamental theory to understanding why international trade is a profit-producing mechanism for society (Lutz, 2008). The cornerstone to comparative advantage is laissez faire: the uninhibited flow of goods, services, and capital across international bounds. Comparative advantage is inhibited by trade controls, which make trade artificially more costly. (McConnell & Brue, 2008). This added cost reduces the incentives to international trade, which are primarily the exploration of a lower opportunity cost.

Classical economist David Ricardo is credited with much of the fundamental theory of comparative advantage. A conceptualization of his theory follows:

> Let us assume that the US and Brazil each want satellites and lumber. The US can produce a unit of orbital satellites at a cost of 100 men and an equivalent unit of lumber at a cost of 40 men. Brazil can produce satellites and lumber at a cost of 125 and 50 men, respectively. Under this arrangement, the US will produce satellites and trade for Brazilian lumber because the opportunity cost of this trade agreement is lowest: 100/50 < 125/40.

Let us further assume that each country has 250 units of cumulative labor for the production of these goods. Table 3 shows the output assuming the US and Brazil devote half of their labor force to the production of satellites and half to lumber without trade or specialization:

Table 3

Total Goods Produced without Trade or Specialization

	US	Brazil	Total
Satellites	2.5	1	3.5
Lumber	1.25	2	3.25
Total	3.75	3	6.75

Table 4 depicts the benefits generated if the US and Brazil specialize in the production of the goods they possess a comparative advantage:

Table 4

Total Goods Produced with Specialization & Trade

	US	Brazil	Total
Satellites	2.5	0	2.5
Lumber	0	5	5
Total	2.5	5	7.5

We can see that by specializing and trading, the US and Brazil can collectively generate an additional 0.75 unit of goods: 6.75 units without specialization and trade, 7.5 units with. Both the US and Brazil are in a position to capitalize by specializing and trading, as long as the lower opportunity costs holds.

If the Brazilian government imposes a tariff on foreign satellites, the Brazilian importers become increasingly indifferent to using foreign or domestic sources. This, however, eliminates the social cost savings to Brazil.

Alternatively, if the US implemented restrictive exportation policies regarding satellites, Brazil looses incentive to import from the US. The Brazilians may look to Europe or domestic suppliers for a supply of commercial jets. They may revise their strategy, and produce satellites

and import lumber. Regardless, if restrictions to the exportation of US satellites are too high, US satellite manufactures have a diminished incentive to produce.

From the above example, we can observe that restrictive trade reduces the incentive to trade. Many social economists have taken the stance that modern international trade theory should not incorporate benefits to the trading states. It is the multinational corporations (MNCs) that benefit from trade, with no inclination to benefit society (Lutz, 2008). This agreement has grown in momentum in recent years, and is frequently used as the basis for implementing mechanisms that discourage socially damaging deals from occurring. Let us bring the USDIB into the mix: as shown from the review of US arms export restrictions, the US government is heavily integrated into the international trade of the USDIB's products and services. Because every export of an MCL listed item must be applied for, reviewed by the DoS, and decided upon with respect to foreign policy, the US possesses a monopoly in allowing international export of military technologies.

One the basis of comparative advantage theory and the restrictive trade policies of the US, I submit the following hypotheses for testing:

> H1: US legislation and acts restricting US arms exportation will adversely affect the US market share of world arms exports.
>
> H2: US legislation and acts restricting US arms exportation will have no impact on the US market share of world arms exports.

The US has access to cutting-edge technology and world-renowned research labs. This access and the provisions of US government research and development dollars to develop and refine technical instruments for both military and civilian applications has established and

maintained the US's comparative advantage in the development and production of advanced systems. This advantage is waning (Lane, 2001).

The strict export controls, primarily the Arms Export Control Act of 1976 (explored in detail above), are cited as a primary reason for this fading lead in advanced sciences. In a recent interview with The Economist, Lon Rains, an editor for Space News, voiced a growing industry consensus that ITAR licensing has "sped up the inevitable proliferation of advanced technology, by forcing other countries to find other means of obtaining [dual use technologies] that had previously been manufactured only in the United States." This notion is an interesting compliment to Hypotheses1 and 2. It asserts that US exports of dual use and military technologies are negatively correlated to the exports of other nations. Inspired by Rains perception, I submit the following additional hypotheses for testing:

> H3: US export policy regarding the trade of arms causes the US share of the market to correlate to changes in the market share of fellow UNSC members.
>
> H4: US export policy regarding the trade of arms does not cause correlation between US share of the market and the market share of fellow UNSC members.

I will examine these hypotheses in detail in Methodology and Analyses section below.

Modern Portfolio Theory

Markowitz's Modern Portfolio Theory (MPT) gave added reason for multinational corporations (MNC's) to construct a diversified portfolio of income streams so to yield greater returns with less variability (Peavy & Vaughn-Rauscher, 1994). By including international markets with low or negative correlation to a MNC's domestic market to the MNC's portfolio of

income streams, the firm can move towards the theoretical efficient allocation that provides the optimum risk-return combination of assets as dictated by the firm's industry (Peavy & Vaughn-Rauscher, 1994). Per MPT, diversification is simply the combining of two or more income streams, with some variance associated with each (Swisher & Kasten, 2005). MPT predicts that a drop in total unsystematic variance, with diminishing returns to scale, will occur in the portfolio that is an MNC as more income streams (markets/international trading partners) are added. This is caused by the weighted averaging effect present in the MPT model. The diversification imperative within the USDIB comes from the fact that nations do not engage in military purchases with perfect correlation. As such, the expected variance of a DIB firm is best minimized by bringing together independent, non-interactive cash flows via the process of unrelated diversification (Lippman & Rumelt, 1982).

A central flaw to MPT, and its empirical analogue of the capital asset pricing model, is that it is designed for securities' management (Lubatkin & Chatterjee, 1994). The model's differentiation between the components of a firm's risk – systematic risk and unsystematic risk – is too rigid to readily apply to the valuation of non-securities assets. Another primary flaw regarding MPT with respect to corporate diversification is the belief that diversification will lower a firm's unsystematic risk, but not the systematic component. Lubatkin and Chatterjee's study of the dynamics of the two risk components found they are not independent of each other: rather, they are dependent and interrelated.

Unsystematic risk is better known as business specific risk, or shareholder risk. Sources of unsystematic risk are regarded as being able to be diversified away by combining low or negative correlated assets. Such sources can include the loss of a major customer to a rival, the

untimely death of an executive, and, among other things, the loss of a monopoly in critical technology know-how. Researchers estimate unsystematic risk of a firm by finding the standard deviation in the error term obtained by regressing the overall returns of the firm's stock flow to the overall returns of the stock market. Unsystematic risk has been found by Miller & Bromiley (1990) to be moderately correlated to income stream variability.

Systematic risks, or macroeconomic risks, are those sources of uncertainty affecting all firms. Such sources can include changes to monetary policy, changes to tax law, and, among other things, market demographics. Financially, systematic risk is considered to be the correlation of variability in a firm's stock returns to macroeconomic influences. Put in a more generalized manner, it is the sensitivity of a firm's return to those macroeconomic forces (Markowitz, 1952). Systematic risk is, empirically, the coefficient of market returns regressed against a firm's stock return. Shareholders will price firms with lower systematic risk with a premium, all else equal (Van Horne, 1980).

It is important to note that within these definitions of we find that central flaw to MPT with respect to corporate diversification: the risk component is a derivative of a regression of the firm's stock returns against the market's return. It is difficult, if at all possible, to isolate and examine the influence one income stream has on a MNC's stock return. As such, the analyses used below examine the macro exportation trends within the USDIB.

Returning to MPT, there is much conceptual confusion about which risk metric is the optimum one to diversify. To this, it has been suggested that the decision is, of course, relative. This is because the risks are interdependent and because a risk is specific to a firm – meaning

that firms are not equally sensitive to a risk (Moyer & Chatfield, 1983; Subrahamanyum & Thomadakis, 1980; Sullivan, 1977).

Proponents of corporate diversification advocate that firms horizontally integrate those synergistically interrelated business units (Bettis & Hall, 1982; Lubatkin & O'Neil, 1987; Chatterjee & Lubatkin, 1990). These researchers have recognized that MPT is designed for securities management, and have extended the model's core concepts to apply to firm managers contemplating risk mitigation strategies. Whereas MPT assumes management of the firm to be passive, and that cash flows cannot be altered, the theory of strategic management – supported by the underlying concepts of the MPT model – assumes that the managers of firms can influence the risk profiles of both unsystematic and systematic components by adjusting their control of the market.

To correct for this, modern practitioners of managerial sciences suggest that strategic management provides a better explanation of the risk mitigations derived from corporate diversification.

Strategic Management

This exploration of strategic management theory is intentionally brief for reasons explored below.

Strategic management, in a generalized sense, is the study of how prominent intended and emergent initiatives undertaken by a firm's management enhance the performance of the firm through the utilization of its resources (Nag, Hambrick, & Chen, 2007). By developing the strategic mission, vision, objectives, policies, and plans of the firm, often in terms of plans or

projects, and then allocating the firm's resources to execute such plans and projects, the managers proactively guide their firms on behalf of the interests of the firm's owners.

Hoskisson and Hitt (1990) theorized that the relationship between systematic and unsystematic risk were not linear, rather the relationship is curvilinear. This was proven by Markides (1992) and further explored by Lubatkin and Chatterjee (1994). Lubatkin and Chatterjee provide evidence that risk, regardless of how it is measured, can be mitigated by "midrange" diversification. By the midrange diversification, it is suggested that firms should engage in activities and markets that are included in or naturally symbiotic to their core competencies. Firms diversifying into unrelated markets or business were found to increase their unsystematic risk exposure, even though they empirically offset such risk per MPT. For USDIB players, such a symbiotic diversification would likely include the exploitation of DUT to provide for a civilian market cash flow. Defense firms have historically had great success in either licensing their technology and know how for civilian uses or for directly selling to civilian consumers (Feldman, 2008).

Further Lubatkin and Chatterjee determined that systematic risk includes a diversifiable component: by diversifying in a constrained manner, firms are able to synergize and protect from macroeconomic unknowns. The primary justification for this ability to influence systematic risk is the ability of managers to directly influence the competitive position of their firm.

Because data is not currently available regarding the international exportation details of USDIB firms for a suitable period of time, the testing of a hypothesis based in strategic management theory is not feasible.

Methodology and Analyses

Before proceeding, I must acknowledge that this data contains only that which is publically available. Thus, analyses of this data are limited. I have attempted to provide readers with an encompassing picture of US international arms trends, and only drawn conclusions on the basis of statistically significant results.

Review of the Data Source

The data my analyses draw from have has been generously provided by the Stockholm International Peace Research Institute (SIPRI). SIPRI was established by the Swedish government in 1966 and collects official government and industry data to quantify the value of "major conventional weapons" exported by states. SIPRI also monitors the individual DIB players. Having been cited by many mainstream publications, including the Economist and Foreign Policy, SIPRI has become the international authority in documenting and reporting world arms trade from 1950-present.

SIPRI has determined that one trend emerging in the trade of arms is the increase to transparency. Many NATO and EU member states have voluntarily published national reports on arms exports, typically with annual frequency (Wogau & Rapp-Jung, 2008). The first nation to begin such reports was the US, who has been legally obligated to do so since 1961, inclusive (Holtom & Bromley, 2011). Holtom & Bromley expect NATO & EU states to continue such reporting, and to increasingly provide additional details (i.e. license denials and brokering licenses). It is not anticipate that such transparent reports will be voluntarily published by other states in the near future (Weber & Bromley, 2011). Because of the US's obligation to report on

USDIB arms exports, it can be expected this data is of the highest accuracy available by public means.

SIPRI's data refers only to the actual delivery of major conventional weapons, and is expressed as trend indicator values (TIVs) in constant 1990 prices (US$ m). This adjustment for constant 1990 prices allows the analyses to be freed of biases resulting from inflation and exchange rate differentials. The TIV is not a representation of the value of the goods exported, but of the volume exported per purchasing power parity. Naturally, this allows for the measurement of trends in the flow of weapons and not in the flow of funds. Because the TIVs do not represent a financial value, they cannot be used to determine importance to economic metrics, such as gross domestic product, but do allow for market share calculations. SIPRI calculates the TIVs, through its Arms Transfer Project, from official government and industry reports. The Export TIV tables utilized are included in Appendix I. These tables provide the total Export TIV for country, group, or international body (i.e. NATO) for years 1950-2010. If a delivery is identified but the recipient is not known with "an acceptable degree of certainty," SIPRI categorizes such delivery as "unknown." (SIPRI).

Peer Nations

One of the primary determinants relating to a state's restriction of the proliferation of arms is the mastery of nuclear technologies, particularly weaponization (Struys, 2004). Initially, it was my intention to compare the US's share of world arms exports to other nuclear nations. This, however, would not have yielded a true group of peers: North Korea, Pakistan, and India possess nuclear technologies and weapons but export nowhere near the volume as states like the

US and USSR/RF. As such, this classification would not be sufficient to provide for significant comparison.

Upon examination of the SIPRI arms exports data, readers will be quick to realize the likeness of the top exporters. I have summarized the top 10 arms exporting states for the period of 1950-2010 in Table 5. Except for Italy, all top exporters currently or formerly utilized nuclear reactors for peaceful power production (World Nuclear Association). All top exporters, excluding Czechoslovakia, have or had nuclear weapons or access to nuclear weapons through a shared program (International Atomic Energy Agency). All top exporters have ratified the Nuclear Non-Proliferation Treaty (NNPT). A deciding difference that I will use for the purposes of comparisons is status as a permanent member to the UN Security Council. The permanent members include China, France, Russia, UK, US, and USSR (formerly). UNSC permanent member states all possess nuclear power programs, nuclear weapons, and have ratified the NNPT. The six states to have held the statues of a UNSC permanent member have accounted for approximately $1.4T of the $1.7T of worldwide arms exports between 1950 and 2010, or 84% of the market share. Non-UNSC members account for $266B of the arms exports over this period, approximately 16%.

From the review of the US restrictions of arms exportation and the significance of the USDIB to the US policy and economy, I have identified 4 periods of time for which segmentation is required. The first period, the pre-AECA/ITAR period, encompasses 1950-1976 and represents 27 observations. The second period, the post-AECA/ITAR enaction period, encompasses 1977-1991 and represents 15 observations. Following the collapse of the USSR, the world's second largest (at the time, the largest) exporter of arms, the US market share soared,

Table 5

Top 10 Arms Exporters & Nuclear Statuses

State	*Total Export (US$m), 1950-2010*	*Nuclear Power*	*Nuclear Weapons*	*NNPT Member*	*UNSC Permanent Member*
USA	$608,583	Yes	Yes	Ratifier	Yes
USSR[1]	$459,565	Yes	Yes	Ratifier	Yes
UK	$128,334	Yes	Yes	Ratifier	Yes
France	$108,451	Yes	Yes	Ratifier	Yes
Russia[2]	$84,221	Yes	Yes	Ratifier	Yes
Germany (FRG)	$75,018	Yes	NATO Shared	Ratifier	No
China	$44,151	Yes	Yes	Ratifier	Yes
Czechoslovakia[3]	$30,256	Yes	No	Ratifier	No
Italy	$26,352	No	NATO Shared	Ratifier	No
Netherlands	$19,854	Yes	NATO Shared	Ratifier	No

Export data provided by the Stockholm International Peace Research Institute, reflecting constant 1990 prices (US$m). Nuclear power, weapon and ratification of the Nuclear Non-Proliferation Treaty (NNPT) data provided by the International Atomic Energy Commission. United Nation Security Council Permanent Member status provided by the United Nations.
1: USSR dissolved in 1992.
2: Russia replaced USSR as a UNSC Permanent Member in 1992.
3: Czechoslovakia dissolved in 1993, becoming the Czech Republic and the Slovak Federal Republic.

abetted by the US government. However, the mid 1990's scandal and the amendments to the AECA that provided the DoS the authority to oversee ITAR licensing, this share sharply fell by the new millennium. Because of this divergence with trend, caused by changes to the US export protocols, we must segment the third period from 1992-1999 to account for the post-USSR, and accounts for 8 periods. The fourth and final period, the post-bubble period, encompasses 2000-2010 and represents 11 observations.

Methodology

The dependent variables in this study were the US annual shares of world arms exports and the US annual share of UNSC arms exports. Market share is the appropriate metric, as it adjusts for the natural geopolitical ebbs and flows of world demand for weapons. Further, an adjustment for inflation and exchange rates is required to compare the international players to US activity over the 61 periods (1950-2010) of data. This adjustment is made in the data provided by SIPRI, which reflects the 1990 US dollar purchasing power for volume of exports. The time series used begin in 1950 and end in 2010. There are 61 periods of data, with 27 annual observations constituting the pre-AECA/ITAR implementation series (1950-1976), 15 observations of the post AECA/ITAR implementation (1977-1991), 8 observations of post USSR-collapse bubble (1992-1999), and 11 periods observations of DoS ITAR licensing (2000-2010).

This study's analyses implement autoregressive, integrated moving average (ARIMA) models. ARIMA is well suited for assessing the impact of intervention, such as the enaction of regulations and restrictions, on a time series (Cook & Campbell, 1979). The first phase of an ARIMA analysis is the estimation of a univariate model that is independent of any regulation and restriction. This is referred to as the "noise model." The second phase of an ARIMA model is the estimation of the restrictions on the time series through a transfer function. This is the intervention model. The statistical fit of the intervention model is then tested with several analytical metrics. If these metrics determine the intervention model to be inadequate, a new model is estimated until the most statistically significant model is found (Monforton & Windsor,

2010; Novoa et al, 2010; Pridemore & Snowden, 2009; Wagenaar, Maldonado-Molina, Wagennaar, 2009).

For the analyses of this paper, all computations were performed by PASW Statistics (SPSS) Version 18.

Results

In the testing of the time series data to determine whether the US restrictions on arms exportation aversely effects the US share of world exports, it was determined that the ARIMA predicted model deviated significantly from the observations: details of this deviation are included in Appendix 4. The fraction of the sample variance explained, or predicted by, the dependent variable (R-square) allows for the determination of how well the regression line predicted by the ARIMA model fits the ex post observations. Both R-square and stationary R-square were found to be 0.004, with a standard error of 0.002, and a 95% confidence metric of 0.006. The mean root mean square error (RMSE), the measure representative of a "typical" error, was found to be 9.499, with a standard error of 11.812, and a 95% confidence metric of 17.851. The mean absolute percentage error (MAPE), which is useful for the purpose of reporting the generic percentage terms of an error for values that are strictly positive (for which all observations of this study are), was found to be 29.583, with a standard error of 40.688, and a 95% confidence level of 58.308. It is important to note that RMSE is sensitive to large errors because of the squaring, which gives disproportionate weight to such errors. Given the nature of the volatility of the data, RMSE is not ideal for this analysis. MAPE, however, is more relevant, as the error is expressed in a percentage term and all dependent variables are positive. The

Ljung-Box statistic exhibits a significance measure of 0.000. The Ljung-Box statistic, shown in Appendix B, is key, as the lack of significance questions the importance of any deviation between the predicted model and the observed results (Ljung & Box, 1994).

After reviewing the observed data, it has been determined that the bubble occurring in Period 3 is the source of a large amount of noise within the model, which drives the lack of significance found in the Ljung-Box statistics. This absence of significance forces inconclusive conclusions with respect to the initial hypotheses (H1 and H2). I submit the following replacement hypotheses:

> H5: US legislation and acts restricting US arms trade adversely affect the US market share of world arms exports during the Cold War.
>
> H6: US legislation and acts liberalizing US arms exportation have no impact on the US market share of world arms exports during the Cold War.
>
> H7: US legislation and acts restricting US arms trade adversely affect the US market share of world arms exports during the Post Cold War period.
>
> H8: US legislation and acts liberalizing US arms exportation have no impact on the US market share of world arms exports during the Post Cold War period.

To test these revised hypotheses, I will conduct two independent ARIMA analyses: the first testing Periods 1 and 2, and the second testing Periods 3 and 4. This will adjust for the marked changes to both the US and world landscapes of arms exportation that followed the collapse of the Warsaw Pact.

In testing H5 and H6, the ARIMA model, again, exhibited significant deviation from the observations. Both R-square and stationary R-square were found to be 0.078, with a standard error of 0.067, and a 95% confidence metric of 0.126. The mean RMSE was found to be 6.344,

with a standard error of 8.2323, and a 95% confidence metric of 12.229. The MAPE was found to be 15.322, with a standard error of 20.949, and a 95% confidence level of 30.135. The Ljung-Box statistic exhibits a significance metric of 0.000. The Expert Modeling feature of PAWS determined there to be no outliers. Results are shown in greater detail in Appendix 5.

The final analysis of this group of hypotheses (H7 and H8) also exhibited significant deviation between the predicted ARIMA model and the observations. Both R-square and stationary R-square were found to be 0.820, with a standard error of 0.083, and a 95% confidence metric of 0.878. The mean RMSE was found to be 1.507, with a standard error of 1.874, and a 95% confidence metric of 2.832. The MAPE was found to be 5.241, with a standard error of 7.258, and a 95% confidence level of 10.373. The Ljung-Box statistic exhibits a significance metric of 0.948. The Expert Modeling feature of PAWS determined there to be no outliers. Results are shown in greater detail in Appendix 6.

For the testing of the time series data to determine whether the US share of arms exportation exhibited low or negative correlation to fellow UNSC nations, the ARIMA predicted models, again, exhibited significant deviation from the observed. Both R-square and stationary R-square were found to be 0.162, with a standard error of 0.022, and a 95% confidence metric of 0.151. The mean RMSE was found to be 8.628, with a standard error of 10.695, and a 95% confidence metric of 1.065. The MAPE was found to be 26.512, with a standard error of 36.537, and a 95% confidence level of 0.677. The Ljung-Box statistic exhibits a significance metric of 0.000. The Expert Modeling feature of PAWS determined there to be no outliers. Results are shown in greater detail in Appendix 7.

This analysis exhibits the same high degree of noise that the first ARIMA analysis did. To correct for this, I have revised H3 and H4:

> H9: US export policy regarding the trade of arms causes the US share of the market to correlate to changes in the market share of fellow UNSC members during the Cold War.
>
> H10: US export policy regarding the trade of arms does not causes correlation between US share of the market and the market share of fellow UNSC members during the Cold War.
>
> H11: US export policy regarding the trade of arms causes the US share of the market to correlate to changes in the market share of fellow UNSC members following the Cold War.
>
> H12: US export policy regarding the trade of arms does not causes correlation between US share of the market and the market share of fellow UNSC members following the Cold War.

These hypotheses are revised in the same way as H5, H6, H7, and H8. I will conduct two independent ARIMA analyses: the first testing Periods 1 and 2, and the second testing Periods 3 and 4.

In testing H9 and H10, the ARIMA model, again, exhibited less deviation from the observations as the analysis for H3 and H4. Both R-square and stationary R-square were found to be 0.012, with a standard error of 0.001, and a 95% confidence metric of 0.13. The mean RMSE was found to be 6.421, with a standard error of 8.390, and a 95% confidence metric of 12.354. The MAPE was found to be 17.267, with a standard error of 23.664, and a 95% confidence level of 33.999. The Ljung-Box statistic exhibits a significance metric of 0.000. The Expert Modeling feature of PAWS determined there to be no outliers. Results are shown in greater detail in Appendix B.

The analysis of H11 and H12 provides evidence of significant deviation between the predicted ARIMA model and the observations. Both R-square and stationary R-square were found to be 0.760, with a standard error of 0.130, and a 95% confidence metric of 0.853. The mean RMSE was found to be 1.767, with a standard error of 2.216, and a 95% confidence metric of 3.334. The MAPE was found to be 5.960, with a standard error of 8.242, and a 95% confidence level of 11.788. The Ljung-Box statistic exhibits a significance metric of 0.947. The Expert Modeling feature of PAWS determined there to be no outliers. Results are shown in greater detail in Appendix B.

Discussion

Test of US Share of World Arms Exports

A large source of the noise occurring within the analyses results from the third segmentation: the post-USSR bubble. For this period, the average US share of world arms exports soared from 31.7% in Period 2 to 51.8% on Period 3, before falling back to 31.3% in Period 4. This is shown in Figure 3 and Table 6. This bubble causes the predicted model to violently deviate from the observed. Because of this, the analysis is inconclusive in determining whether US arms restrictions have a significant effect on the US's share of world arms exports.

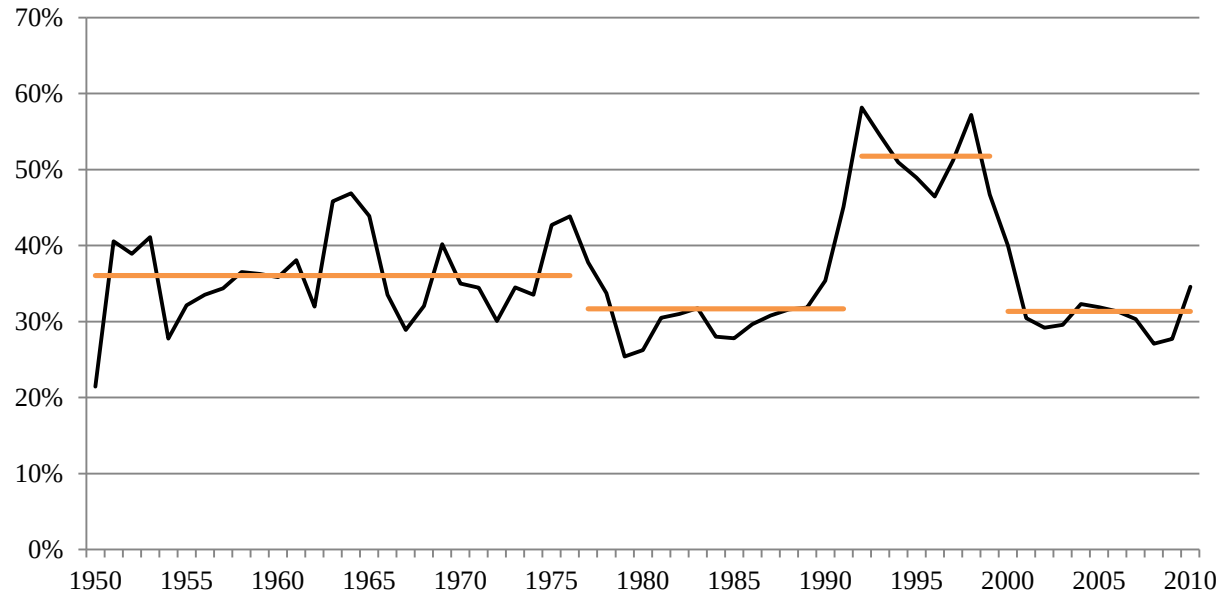
The analysis for Periods 1 and 2 suggests the predicted deviates from the observed, however these measures do not exhibit a significant correlation between a shift in period and a shift in the moving average of the US's share of world arms exports. As such, there is no justification to reject H6 and accept H5. It is important to note that the shift between Periods 1 and 2 is in close proximity to the end of the Vietnam War and the election of Jimmy Carter. The end to the Vietnam War reduced the need of American allies to purchase military hardware that was compatible with the hardware US forces fought with (Maraniss, 2003). Jimmy Carter implemented a passive foreign policy, with respect to previous administrations (Carleton & Stohl, 1985). Together, these forces serve to skew the volume of deliveries to international customers.

The analysis for Periods 3 and 4 provides markedly different significance. The ARIMA model found there to be significant correlation between the shift in period, occurring in 2000 when the DoS began administering ITAR licenses, and the US's share of world arms exports. Because of the significance of the Ljung-Box statistics, there is justification to accept H7 and to

reject H8, concluding that arms export controls impose up to a 20% decline in US share of the market.

Figure 3

Segmented Moving Average of US Market Share of Arms Exports, 1950-2010



Notes: Based on SIPRI TIV Database results, period 1950-2010. For expanded periods or other nations' shares, see Appendix A.

Table 6

Segmented Moving Average Synopsis, US Share of World Arms Exports

	Period	*Average Market Share*
Period 1	1950 - 1976	36.1%
Period 2	1977 - 1991	31.7%
Period 3	1992 - 1999	51.8%
Period 4	2000 - 2010	31.3%

Test of US Share of UNSC Arms Exports

The second initial ARIMA analysis yielded results close to that of the first analysis. The Ljung-Box statistic of significance (0.000) again suggested a large amount of noise. This is not surprising, as this analysis seeks to determine the correlation between US and peer UNSC nations. As such, the noise of the USSR collapse bubble is magnified: shown in Figure 4 and Table 6. Because of the insignificance of this analysis, the results are inconclusive in determining the correlation between the US and UNSC states.

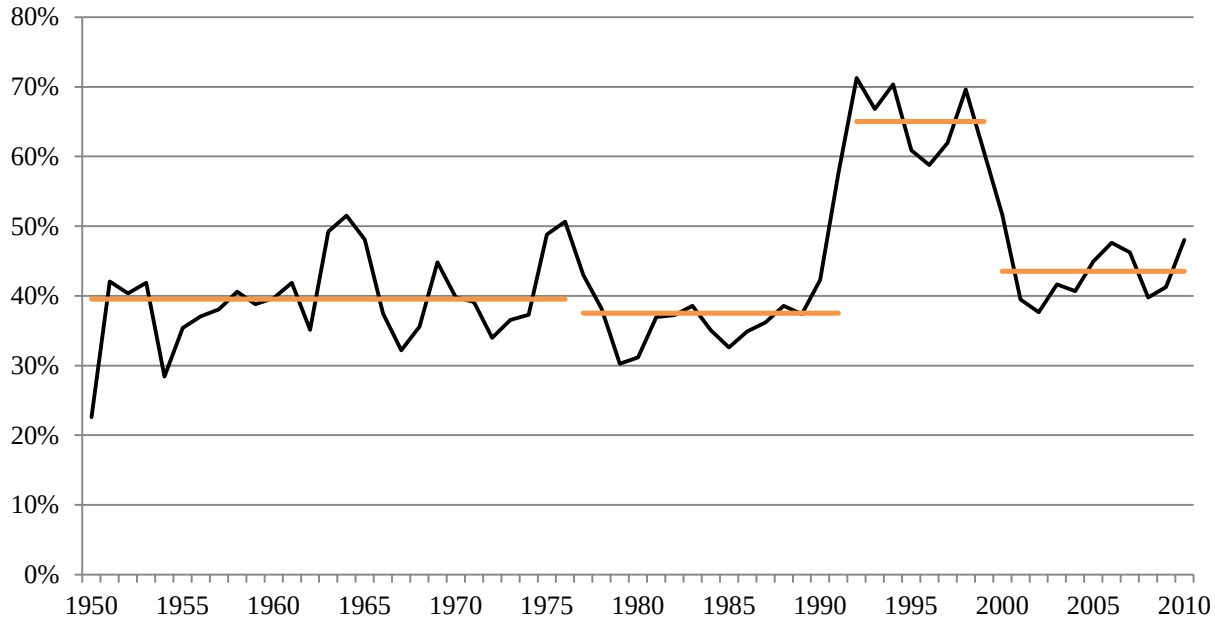
After making similar adjustments to this test, as were done with the test of US share of world arms exports, there was no justification to accept H9 and reject H10. Again, this test is prone to the skew caused by the election of Jimmy Carter and the end to America's presence (at least its overt presence) in Southeast Asia. However, in testing H11 and H12, there was a high degree of significance in the correlation between the shift of periods, occurring in 2000, and the shift in moving average of the US share of UNSC arms exports. To more clearly determine the correlation between the US and peer UNSC states in the exportation of arms, I have inserted Table 7.

As shown above, the correlations of other UNSC states' arms export shares frequently move inversely with the US's share. It is not surprising that the USSR/US correlation is as significantly negative as -60% and -89% for Periods 1 and 2, respectively. But the negative correlations of France, Russia, and UK suggest that these states are willing to fill voids in demand the US cannot supply because of export restrictions. This holds with Rains's (2008) remarks regarding ITAR as a restriction to US exports that serves as a catalyst to the

proliferation of advanced technologies. This correlation matrix, however, is not scientific and cannot be used to draw conclusions from. It does, however, suggest areas for further study.

Figure 4

Segmented Moving Average of US Market Share of UNSC Arms Exports, 1950-2010



Notes: Based on SIPRI TIV Database results, period 1950-2010. For expanded periods or other nations' shares, see Appendix A.

Table 6

Segmented Moving Average Synopsis, US Share of UNSC Arms Exports

	Period	*Average Market Share*
Period 1	1950 - 1976	39.5%
Period 2	1977 - 1991	37.5%
Period 3	1992 - 1999	65.0%
Period 4	2000 - 2010	43.6%

Table 7

Segmented Correlation to US Share of UNSC Arms Exports

	Period 1	*Period 2*	*Period 3*	*Period 4*
China	2.74%	10.19%	34.26%	0.20%
France	31.58%	-66.39%	-12.74%	-38.20%
Russia			-87.71%	-93.28%
UK	-48.56%	18.57%	-69.33%	15.40%
USSR	-60.31%	-88.59%		

Study Limitations

Though the data provided by SIPRI is of incredible quality, it is annual in frequency. Further, data is only available from 1950-present. The number of periods does not support time series analyses the likes of ARIMA. This deficiency and the dramatic shifts in arms exportation trends that has occurred over the last 50 years causes a large deal of noise in the ARIMA models that cannot be readily adjusted for at present.

It needs to be acknowledged that the proliferation of armaments has illicit themes that cannot be accounted for at the present time (Koorey et al., 2008; Wezeman, 2010). Further, SIPRI has frequently noted that the TIVs for China are suspect (Jakobson & Knox, 2010). China's importation and exportation of armaments is kept very quiet within Beijing. At present, this lack of transparency can be seen as a further source of noise within the ARIMA analyses.

Again, I have attempted to provide readers with an encompassing picture of US international arms trends within the scope of this study, and only drawn conclusions on the basis of statistically significant results.

Topics for Future Research

A logical step for future research would be an examination of procurement policies and the strategic dynamics between the USDIB and the DoD. The USDIB is regarded as exhibiting strong oligopoly traits per Stigler's 1964 theory and the US government is believed to hold a monopsony position in procuring weapons (Rogerson, 1999). Solmirano & Wezemen (2010) have examined the procurement policies of Gulf States, and the extension of such an examination to the US and USDIB would provide understanding into what can be called an industrial anomaly: an oligopoly supplying a monopsony. Such an assessment would draw heavily from the field of strategic management to determine whether firms are exploiting a competitive advantage within the industry and how the Executive Branch counters such an advantage through regulations that skew bargaining power, such as the Truth in Negotiations Act (Riemer, 1997).

A secondary study for future research would by an analysis to determine how the DIBs of other nations interact with their domestic governments and how this interaction affects their international presence. It has been determined that other DIBs experienced similar market conditions following the cession of Cold War tensions (Struys, 2004). In determining the dynamics at play between foreign DIBs and their governments, it would likely be shown as to how these policies evolved and if considerations were made to allow for eased exports following the collapse of the Bloc.

Should data be made publically available that exhibits greater detail, transparency, and accuracy, I would like to reexamine this subject and to explore the implications of restricted DUT exportation. With such increased detail, future analyses will be able to reduce the presence

of noise within time-series models and provide greater certainty in concluding the financial implications of arms export restrictions.

Conclusions

The USDIB is a vital component to the US economy. Through the evolution of federal regulations, it has become a pawn in the game of foreign policy. The ethics of this positioning, brought on by the US federal government, can be debated. However, it is not within the contexts of this paper to debate this. What is within the context of this paper is the realization that the US export controls, primarily the Arms Export Control Act of 1976, is a significant external factor affecting the USDIB's ability to engage in international sales.

The ARIMA analyses presented in this paper have shown that the imposition of or amendment to leading export controls affecting the USDIB significantly correlates with up to a 20% decline of the US's share of world arms exports. This finding provides for the justification of concluding that export restrictions impose significant financial burdens upon the USDIB because of decreased international sales.

Further, it should be acknowledged that the US's peers (China, France, Russia, and UK) exhibit frequent inverse correlations to the US's arms export trends. Though this correlation was not scientifically concluded, it is foolish to ignore, as it provides for evidence that export restrictions do not slow the proliferation of weapons systems. Rather, they serve to speed up such proliferation by providing other states with the economic justification to undertake costly R&D projects to replicate technology already mastered by the US, to refine technology initially mastered by the US, or to surpass the US in technological capabilities.

Appendix A: Stockholm International Peace Research Institute Data

World Arms Exports, Constant 1990 Prices (US$m)

Year	*China*	*France*	*Russia*	*US*	*USSR*	*UK*	*Ex-UNSC*	*World Total*
1950		13		1,644	3,241	2,381	396	**7,675**
1951		56		4,625	3,117	3,199	407	**11,404**
1952	8	36		6,322	6,157	3,132	596	**16,251**
1953	16	294		9,223	8,466	4,018	428	**22,445**
1954	19	332		5,604	9,473	4,285	478	**20,191**
1955	16	465		6,739	6,842	4,974	1,929	**20,965**
1956	51	860		8,343	7,117	6,155	2,356	**24,882**
1957	30	665		8,328	7,661	5,205	2,357	**24,246**
1958	478	695		9,686	9,102	3,901	2,667	**26,529**
1959	376	778		7,719	8,014	3,009	1,405	**21,301**
1960	305	1,171		6,096	5,843	1,942	1,658	**17,015**
1961	37	1,084		6,679	7,064	1,083	1,606	**17,553**
1962	54	1,523		5,742	7,868	1,167	1,614	**17,968**
1963	11	1,695		9,364	6,960	986	1,421	**20,437**
1964	61	1,896		12,570	8,601	1,270	2,410	**26,808**
1965	450	1,699		11,467	8,819	1,425	2,285	**26,145**
1966	675	1,731		8,528	10,476	1,357	2,690	**25,457**
1967	439	1,596		7,435	11,395	2,225	2,638	**25,728**
1968	725	1,873		8,385	11,001	1,582	2,602	**26,168**
1969	639	1,326		11,589	10,408	1,893	2,992	**28,847**
1970	866	1,777		9,069	10,158	908	3,127	**25,905**
1971	1,271	2,348		11,156	11,498	2,247	3,870	**32,390**
1972	1,168	2,533		10,199	13,751	2,378	3,868	**33,897**
1973	698	2,839		12,288	15,085	2,714	2,018	**35,642**
1974	611	2,122		11,968	14,995	2,388	3,607	**35,691**
1975	654	2,388		15,950	11,483	2,191	4,690	**37,356**
1976	608	2,110		15,819	10,330	2,360	4,868	**36,095**
1977	226	2,800		15,726	15,616	2,232	5,026	**41,626**
1978	638	3,207		14,896	18,282	2,028	5,091	**44,142**
1979	599	2,968		10,081	18,226	1,427	6,402	**39,703**

World Arms Exports, Constant 1990 Prices (US$m): Continued.

Year	*China*	*France*	*Russia*	*US*	*USSR*	*UK*	*Ex-UNSC*	*World Total*
1980	979	3,697		11,083	18,120	1,659	6,707	**42,245**
1981	707	3,650		13,895	16,997	2,351	7,976	**45,576**
1982	1,590	3,641		14,209	16,245	2,453	7,720	**45,858**
1983	1,924	3,130		13,726	14,374	2,411	7,688	**43,253**
1984	2,189	2,807		11,497	13,830	2,464	8,260	**41,047**
1985	1,440	3,773		10,493	14,407	2,090	5,539	**37,742**
1986	2,099	2,944		11,544	14,571	1,929	5,842	**38,929**
1987	3,337	1,732		12,310	13,313	3,327	5,977	**39,996**
1988	1,960	1,827		11,811	12,688	2,339	6,773	**37,398**
1989	1,033	2,115		11,320	12,495	3,325	5,280	**35,568**
1990	930	1,673		10,647	10,017	1,900	4,944	**30,111**
1991	1,317	1,029		12,632	5,459	1,495	6,085	**28,017**
1992	735	1,056	2,700	14,113		1,203	4,467	**24,274**
1993	1,438	791	3,477	14,456		1,469	4,899	**26,530**
1994	1,136	764	1,552	11,781		1,516	6,364	**23,113**
1995	1,050	942	3,812	11,400		1,520	4,574	**23,298**
1996	803	1,899	3,508	11,197		1,636	5,057	**24,100**
1997	452	3,149	2,966	14,612		2,411	4,964	**28,554**
1998	362	3,362	1,966	16,176		1,374	5,038	**28,278**
1999	336	1,813	4,043	11,599		1,331	5,721	**24,843**
2000	301	1,056	3,960	7,398		1,606	4,182	**18,503**
2001	499	1,297	5,896	5,908		1,368	4,434	**19,402**
2002	509	1,368	5,705	5,229		1,068	4,027	**17,906**
2003	665	1,345	5,236	5,698		741	5,584	**19,269**
2004	292	2,219	6,178	6,866		1,316	4,381	**21,252**
2005	303	1,724	5,134	6,700		1,039	6,119	**21,019**
2006	597	1,643	5,095	7,453		855	8,144	**23,787**
2007	430	2,432	5,426	8,003		1,018	9,075	**26,384**
2008	586	1,994	5,953	6,288		982	7,433	**23,236**
2009	1,000	1,865	5,575	6,658		1,022	7,900	**24,020**
2010	1,423	834	6,039	8,641		1,054	6,996	**24,987**
Total	**44,151**	**108,451**	**84,221**	**608,583**	**459,565**	**128,334**	**265,652**	**1,698,957**

Market Share of World Arms Exports

Year	*China*	*France*	*Russia*	*US*	*USSR*	*UK*	*Ex-UNSC*	*World Total*
1950	0%	0%	0%	21%	42%	31%	5%	**100%**
1951	0%	0%	0%	41%	27%	28%	4%	**100%**
1952	0%	0%	0%	39%	38%	19%	4%	**100%**
1953	0%	1%	0%	41%	38%	18%	2%	**100%**
1954	0%	2%	0%	28%	47%	21%	2%	**100%**
1955	0%	2%	0%	32%	33%	24%	9%	**100%**
1956	0%	3%	0%	34%	29%	25%	9%	**100%**
1957	0%	3%	0%	34%	32%	21%	10%	**100%**
1958	2%	3%	0%	37%	34%	15%	10%	**100%**
1959	2%	4%	0%	36%	38%	14%	7%	**100%**
1960	2%	7%	0%	36%	34%	11%	10%	**100%**
1961	0%	6%	0%	38%	40%	6%	9%	**100%**
1962	0%	8%	0%	32%	44%	6%	9%	**100%**
1963	0%	8%	0%	46%	34%	5%	7%	**100%**
1964	0%	7%	0%	47%	32%	5%	9%	**100%**
1965	2%	6%	0%	44%	34%	5%	9%	**100%**
1966	3%	7%	0%	33%	41%	5%	11%	**100%**
1967	2%	6%	0%	29%	44%	9%	10%	**100%**
1968	3%	7%	0%	32%	42%	6%	10%	**100%**
1969	2%	5%	0%	40%	36%	7%	10%	**100%**
1970	3%	7%	0%	35%	39%	4%	12%	**100%**
1971	4%	7%	0%	34%	35%	7%	12%	**100%**
1972	3%	7%	0%	30%	41%	7%	11%	**100%**
1973	2%	8%	0%	34%	42%	8%	6%	**100%**
1974	2%	6%	0%	34%	42%	7%	10%	**100%**
1975	2%	6%	0%	43%	31%	6%	13%	**100%**
1976	2%	6%	0%	44%	29%	7%	13%	**100%**
1977	1%	7%	0%	38%	38%	5%	12%	**100%**
1978	1%	7%	0%	34%	41%	5%	12%	**100%**
1979	2%	7%	0%	25%	46%	4%	16%	**100%**
1980	2%	9%	0%	26%	43%	4%	16%	**100%**
1981	2%	8%	0%	30%	37%	5%	18%	**100%**
1982	3%	8%	0%	31%	35%	5%	17%	**100%**
1983	4%	7%	0%	32%	33%	6%	18%	**100%**

Market Share of World Arms Exports: Continued.

Year	*China*	*France*	*Russian*	*US*	*USSR*	*UK*	*Ex-UNSC*	*World Total*
1984	5%	7%	0%	28%	34%	6%	20%	**100%**
1985	4%	10%	0%	28%	38%	6%	15%	**100%**
1986	5%	8%	0%	30%	37%	5%	15%	**100%**
1987	8%	4%	0%	31%	33%	8%	15%	**100%**
1988	5%	5%	0%	32%	34%	6%	18%	**100%**
1989	3%	6%	0%	32%	35%	9%	15%	**100%**
1990	3%	6%	0%	35%	33%	6%	16%	**100%**
1991	5%	4%	0%	45%	19%	5%	22%	**100%**
1992	3%	4%	11%	58%	0%	5%	18%	**100%**
1993	5%	3%	13%	54%	0%	6%	18%	**100%**
1994	5%	3%	7%	51%	0%	7%	28%	**100%**
1995	5%	4%	16%	49%	0%	7%	20%	**100%**
1996	3%	8%	15%	46%	0%	7%	21%	**100%**
1997	2%	11%	10%	51%	0%	8%	17%	**100%**
1998	1%	12%	7%	57%	0%	5%	18%	**100%**
1999	1%	7%	16%	47%	0%	5%	23%	**100%**
2000	2%	6%	21%	40%	0%	9%	23%	**100%**
2001	3%	7%	30%	30%	0%	7%	23%	**100%**
2002	3%	8%	32%	29%	0%	6%	22%	**100%**
2003	3%	7%	27%	30%	0%	4%	29%	**100%**
2004	1%	10%	29%	32%	0%	6%	21%	**100%**
2005	1%	8%	24%	32%	0%	5%	29%	**100%**
2006	3%	7%	21%	31%	0%	4%	34%	**100%**
2007	2%	9%	21%	30%	0%	4%	34%	**100%**
2008	3%	9%	26%	27%	0%	4%	32%	**100%**
2009	4%	8%	23%	28%	0%	4%	33%	**100%**
2010	6%	3%	24%	35%	0%	4%	28%	**100%**
Total	**3%**	**6%**	**5%**	**36%**	**27%**	**8%**	**16%**	**100%**

Market Share of UNSC Arms Exports

Year	*China*	*France*	*Russia*	*US*	*USSR*	*UK*	*World Total*
1950	0%	0%	0%	23%	45%	33%	**100%**
1951	0%	1%	0%	42%	28%	29%	**100%**
1952	0%	0%	0%	40%	39%	20%	**100%**
1953	0%	1%	0%	42%	38%	18%	**100%**
1954	0%	2%	0%	28%	48%	22%	**100%**
1955	0%	2%	0%	35%	36%	26%	**100%**
1956	0%	4%	0%	37%	32%	27%	**100%**
1957	0%	3%	0%	38%	35%	24%	**100%**
1958	2%	3%	0%	41%	38%	16%	**100%**
1959	2%	4%	0%	39%	40%	15%	**100%**
1960	2%	8%	0%	40%	38%	13%	**100%**
1961	0%	7%	0%	42%	44%	7%	**100%**
1962	0%	9%	0%	35%	48%	7%	**100%**
1963	0%	9%	0%	49%	37%	5%	**100%**
1964	0%	8%	0%	52%	35%	5%	**100%**
1965	2%	7%	0%	48%	37%	6%	**100%**
1966	3%	8%	0%	37%	46%	6%	**100%**
1967	2%	7%	0%	32%	49%	10%	**100%**
1968	3%	8%	0%	36%	47%	7%	**100%**
1969	2%	5%	0%	45%	40%	7%	**100%**
1970	4%	8%	0%	40%	45%	4%	**100%**
1971	4%	8%	0%	39%	40%	8%	**100%**
1972	4%	8%	0%	34%	46%	8%	**100%**
1973	2%	8%	0%	37%	45%	8%	**100%**
1974	2%	7%	0%	37%	47%	7%	**100%**
1975	2%	7%	0%	49%	35%	7%	**100%**
1976	2%	7%	0%	51%	33%	8%	**100%**
1977	1%	8%	0%	43%	43%	6%	**100%**
1978	2%	8%	0%	38%	47%	5%	**100%**
1979	2%	9%	0%	30%	55%	4%	**100%**
1980	3%	10%	0%	31%	51%	5%	**100%**
1981	2%	10%	0%	37%	45%	6%	**100%**
1982	4%	10%	0%	37%	43%	6%	**100%**

Market Share of UNSC Arms Exports: Continued.

Year	*China*	*France*	*Russia*	*US*	*USSR*	*UK*	*World Total*
1983	5%	9%	0%	39%	40%	7%	**100%**
1984	7%	9%	0%	35%	42%	8%	**100%**
1985	4%	12%	0%	33%	45%	6%	**100%**
1986	6%	9%	0%	35%	44%	6%	**100%**
1987	10%	5%	0%	36%	39%	10%	**100%**
1988	6%	6%	0%	39%	41%	8%	**100%**
1989	3%	7%	0%	37%	41%	11%	**100%**
1990	4%	7%	0%	42%	40%	8%	**100%**
1991	6%	5%	0%	58%	25%	7%	**100%**
1992	4%	5%	14%	71%	0%	6%	**100%**
1993	7%	4%	16%	67%	0%	7%	**100%**
1994	7%	5%	9%	70%	0%	9%	**100%**
1995	6%	5%	20%	61%	0%	8%	**100%**
1996	4%	10%	18%	59%	0%	9%	**100%**
1997	2%	13%	13%	62%	0%	10%	**100%**
1998	2%	14%	8%	70%	0%	6%	**100%**
1999	2%	9%	21%	61%	0%	7%	**100%**
2000	2%	7%	28%	52%	0%	11%	**100%**
2001	3%	9%	39%	39%	0%	9%	**100%**
2002	4%	10%	41%	38%	0%	8%	**100%**
2003	5%	10%	38%	42%	0%	5%	**100%**
2004	2%	13%	37%	41%	0%	8%	**100%**
2005	2%	12%	34%	45%	0%	7%	**100%**
2006	4%	11%	33%	48%	0%	5%	**100%**
2007	2%	14%	31%	46%	0%	6%	**100%**
2008	4%	13%	38%	40%	0%	6%	**100%**
2009	6%	12%	35%	41%	0%	6%	**100%**
2010	8%	5%	34%	48%	0%	6%	**100%**
Total	**3%**	**8%**	**6%**	**42%**	**32%**	**9%**	**100%**

Appendix B: Autoregressive Integrated Moving Average (ARIMA) Analyses

ARIMA Model Outputs, US Share of World Arms Exports – H1 & H2

Model Fit

Fit Statistic	Mean	SE	Minimum	Maximum	Percentile		
					5	10	25
Stationary R-squared	.004	.002	.003	.006	.003	.003	.003
R-squared	.004	.002	.003	.006	.003	.003	.003
RMSE	9.499	11.812	1.146	17.851	1.146	1.146	1.146
MAPE	29.538	40.688	.767	58.308	.767	.767	.767
MaxAPE	57.820	79.616	1.523	114.117	1.523	1.523	1.523
MAE	8.057	10.083	.927	15.187	.927	.927	.927
MaxAE	16.198	20.080	1.999	30.396	1.999	1.999	1.999
Normalized BIC	3.153	3.883	.408	5.899	.408	.408	.408

Model Fit

Fit Statistic	Percentile			
	50	75	90	95
Stationary R-squared	.004	.006	.006	.006
R-squared	.004	.006	.006	.006
RMSE	9.499	17.851	17.851	17.851
MAPE	29.538	58.308	58.308	58.308
MaxAPE	57.820	114.117	114.117	114.117
MAE	8.057	15.187	15.187	15.187
MaxAE	16.198	30.396	30.396	30.396
Normalized BIC	3.153	5.899	5.899	5.899

Model Statistics

Model	Number of Predictors	Model Fit statistics	Ljung-Box Q(18)	
		Stationary R-squared	Statistics	DF
YEAR, not periodic-Model_1	1	.006	432.510	18
Period-Model_2	1	.003	404.314	18

ARIMA Model Outputs, US Share of World Arms Exports – H1 & H2: Continued.

Model Statistics

Model	Ljung-Box Q(18) Sig.	Number of Outliers
YEAR, not periodic-Model_1	.000	0
Period-Model_2	.000	0

ARIMA Model Outputs, US Share of UNSC Arms Exports – H3 & H4

Model Fit

Fit Statistic	Mean	SE	Minimum	Maximum	Percentile		
					5	10	25
Stationary R-squared	.166	.022	.151	.182	.151	.151	.151
R-squared	.166	.022	.151	.182	.151	.151	.151
RMSE	8.628	10.695	1.065	16.191	1.065	1.065	1.065
MAPE	26.512	36.537	.677	52.348	.677	.677	.677
MaxAPE	70.708	97.851	1.517	139.899	1.517	1.517	1.517
MAE	7.115	8.882	.834	13.396	.834	.834	.834
MaxAE	16.323	19.994	2.184	30.461	2.184	2.184	2.184
Normalized BIC	2.983	3.848	.262	5.704	.262	.262	.262

Model Fit

Fit Statistic	Percentile			
	50	75	90	95
Stationary R-squared	.166	.182	.182	.182
R-squared	.166	.182	.182	.182
RMSE	8.628	16.191	16.191	16.191
MAPE	26.512	52.348	52.348	52.348
MaxAPE	70.708	139.899	139.899	139.899
MAE	7.115	13.396	13.396	13.396
MaxAE	16.323	30.461	30.461	30.461
Normalized BIC	2.983	5.704	5.704	5.704

Model Statistics

Model	Number of Predictors	Model Fit statistics	Ljung-Box Q(18)	
		Stationary R-squared	Statistics	DF
YEAR, not periodic-Model_1	1	.182	269.726	18
Period-Model_2	1	.151	250.949	18

ARIMA Model Outputs, US Share of UNSC Arms Exports – H3 & H4: Continued.

Model Statistics

Model	Ljung-Box Q(18) Sig.	Number of Outliers
YEAR, not periodic-Model_1	.000	0
Period-Model_2	.000	0

ARIMA Model Outputs, US Share of World Arms Exports – H5 & H6

Model Fit

Fit Statistic	Mean	SE	Minimum	Maximum	Percentile		
					5	10	25
Stationary R-squared	.078	.067	.031	.126	.031	.031	.031
R-squared	.078	.067	.031	.126	.031	.031	.031
RMSE	6.344	8.323	.459	12.229	.459	.459	.459
MAPE	15.322	20.949	.509	30.135	.509	.509	.509
MaxAPE	37.661	51.428	1.296	74.026	1.296	1.296	1.296
MAE	5.211	6.801	.402	10.020	.402	.402	.402
MaxAE	13.116	17.203	.952	25.280	.952	.952	.952
Normalized BIC	1.903	4.642	-1.379	5.186	-1.379	-1.379	-1.379

Model Fit

Fit Statistic	Percentile			
	50	75	90	95
Stationary R-squared	.078	.126	.126	.126
R-squared	.078	.126	.126	.126
RMSE	6.344	12.229	12.229	12.229
MAPE	15.322	30.135	30.135	30.135
MaxAPE	37.661	74.026	74.026	74.026
MAE	5.211	10.020	10.020	10.020
MaxAE	13.116	25.280	25.280	25.280
Normalized BIC	1.903	5.186	5.186	5.186

Model Statistics

Model	Number of Predictors	Model Fit statistics	Ljung-Box Q(18)	
		Stationary R-squared	Statistics	DF
YEAR, not periodic-Model_1	1	.031	181.832	18
Period-Model_2	1	.126	134.798	18

ARIMA Model Outputs, US Share of World Arms Exports – H5 & H6: Continued.

Model Statistics

Model	Ljung-Box Q(18) Sig.	Number of Outliers
YEAR, not periodic-Model_1	.000	0
Period-Model_2	.000	0

ARIMA Model Outputs, US Share of World Arms Exports – H7 & H8

Model Fit

Fit Statistic	Mean	SE	Minimum	Maximum	Percentile		
					5	10	25
Stationary R-squared	.820	.083	.761	.878	.761	.761	.761
R-squared	.820	.083	.761	.878	.761	.761	.761
RMSE	1.507	1.874	.182	2.832	.182	.182	.182
MAPE	5.241	7.258	.108	10.373	.108	.108	.108
MaxAPE	15.062	20.834	.330	29.793	.330	.330	.330
MAE	1.149	1.435	.134	2.163	.134	.134	.134
MaxAE	3.528	4.390	.424	6.632	.424	.424	.424
Normalized BIC	-.353	3.882	-3.098	2.392	-3.098	-3.098	-3.098

Model Fit

Fit Statistic	Percentile			
	50	75	90	95
Stationary R-squared	.820	.878	.878	.878
R-squared	.820	.878	.878	.878
RMSE	1.507	2.832	2.832	2.832
MAPE	5.241	10.373	10.373	10.373
MaxAPE	15.062	29.793	29.793	29.793
MAE	1.149	2.163	2.163	2.163
MaxAE	3.528	6.632	6.632	6.632
Normalized BIC	-.353	2.392	2.392	2.392

Model Statistics

Model	Number of Predictors	Model Fit statistics	Ljung-Box Q(18)	
		Stationary R-squared	Statistics	DF
YEAR, not periodic-Model_1	1	.761	24.911	18
Period-Model_2	1	.878	9.479	18

ARIMA Model Outputs, US Share of World Arms Exports – H7 & H8: Continued.

Model Statistics

Model	Ljung-Box Q(18) Sig.	Number of Outliers
YEAR, not periodic-Model_1	.127	0
Period-Model_2	.948	0

ARIMA Model Outputs, US Share of UNSC Arms Exports – H9 & H10

Model Fit

Fit Statistic	Mean	SE	Minimum	Maximum	Percentile		
					5	10	25
Stationary R-squared	.012	.001	.011	.013	.011	.011	.011
R-squared	.012	.001	.011	.013	.011	.011	.011
RMSE	6.421	8.390	.488	12.354	.488	.488	.488
MAPE	17.267	23.664	.534	33.999	.534	.534	.534
MaxAPE	25.239	34.237	1.030	49.448	1.030	1.030	1.030
MAE	5.486	7.118	.453	10.520	.453	.453	.453
MaxAE	10.448	13.647	.799	20.098	.799	.799	.799
Normalized BIC	1.974	4.570	-1.258	5.206	-1.258	-1.258	-1.258

Model Fit

Fit Statistic	Percentile			
	50	75	90	95
Stationary R-squared	.012	.013	.013	.013
R-squared	.012	.013	.013	.013
RMSE	6.421	12.354	12.354	12.354
MAPE	17.267	33.999	33.999	33.999
MaxAPE	25.239	49.448	49.448	49.448
MAE	5.486	10.520	10.520	10.520
MaxAE	10.448	20.098	20.098	20.098
Normalized BIC	1.974	5.206	5.206	5.206

Model Statistics

Model	Number of Predictors	Model Fit statistics	Ljung-Box Q(18)	
		Stationary R-squared	Statistics	DF
YEAR, not periodic-Model_1	1	.011	219.579	18
Period-Model_2	1	.013	185.177	18

ARIMA Model Outputs, US Share of UNSC Arms Exports – H9 & H10: Continued.

Model Statistics

Model	Ljung-Box Q(18) Sig.	Number of Outliers
YEAR, not periodic-Model_1	.000	0
Period-Model_2	.000	0

ARIMA Model Outputs, US Share of UNSC Arms Exports – H11 & H12

Model Fit

Fit Statistic	Mean	SE	Minimum	Maximum	Percentile		
					5	10	25
Stationary R-squared	.760	.130	.668	.853	.668	.668	.668
R-squared	.760	.130	.668	.853	.668	.668	.668
RMSE	1.767	2.216	.200	3.334	.200	.200	.200
MAPE	5.960	8.242	.132	11.788	.132	.132	.132
MaxAPE	16.829	23.292	.359	33.299	.359	.359	.359
MAE	1.406	1.763	.160	2.653	.160	.160	.160
MaxAE	3.801	4.833	.384	7.218	.384	.384	.384
Normalized BIC	-.093	3.976	-2.905	2.718	-2.905	-2.905	-2.905

Model Fit

Fit Statistic	Percentile			
	50	75	90	95
Stationary R-squared	.760	.853	.853	.853
R-squared	.760	.853	.853	.853
RMSE	1.767	3.334	3.334	3.334
MAPE	5.960	11.788	11.788	11.788
MaxAPE	16.829	33.299	33.299	33.299
MAE	1.406	2.653	2.653	2.653
MaxAE	3.801	7.218	7.218	7.218
Normalized BIC	-.093	2.718	2.718	2.718

Model Statistics

Model	Number of Predictors	Model Fit statistics	Ljung-Box Q(18)	
		Stationary R-squared	Statistics	DF
YEAR, not periodic-Model_1	1	.668	26.410	18
Period-Model_2	1	.853	9.501	18

ARIMA Model Outputs, US Share of UNSC Arms Exports – H11 & H12: Continued.

Model Statistics

Model	Ljung-Box Q(18) Sig.	Number of Outliers
YEAR, not periodic-Model_1	.091	0
Period-Model_2	.947	0

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