The role and capabilities of major weapons systems transferred between 1950 and 2010: empirical examinations of an arms transfer dataset

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Abstract

Arms transfers provide exporters an avenue to provide security to other states while gaining economic benefits. Arms transfers provide importers an avenue to gain security without having to rely on alliances. Past research uses aggregate measures of the monetary or security value of major weapon system transfers without accounting for strategic differences in possible use in interstate and civil conflict. This article presents a data set on interstate transfers of major weapon systems between 1950 and 2010 building upon SIPRI's Arms Trade Register with several improvements. First, it disaggregates land weapons and air weapons into categories reflecting their strategic capabilities. Second, model level characteristics (e.g. age, speed, and range) are drawn from Jane's Defence sources. Additionally, the data set covers a larger range of time and states than previous data sets categorizing arms. To demonstrate the usefulness this article first presents summary statistics of the data set and then replicates Blanton (2005) to show that the effect of human rights and regime types on United States transfers differs across the categories of arms compared to alternative measures of arms transfers.

Keywords: Arms transfers, arms trade, data set, major weapon systems, international security

Introduction

Major weapon systems provide states the ability to maintain security within and at their borders along with the possibility to take offensive actions beyond; however, most states cannot produce a full range of weapons and rely on imports. Previous quantitative research typically relies on one of two measures: the Stockholm Peach Research Institute's (SIPRI) 'trend-indicator value' (TIV) of the military value of the transfer or the financial value of the transfer published by the United States government in World Military Expenditure and Arms Transfers (WMEAT) reports, but neither measure directly accounts for what kinds of weapons are transferred. Additionally, the role that economic factors play in the decision to produce and export arms are well studied, but as arms transfers are not solely economic decisions it is necessary to account for the security role and tactical uses of specific types of weapons. This article starts where the economic literature ends in that the economic motivations and effect of arms transfers are accounted for whereas there is a lacuna in the study of the types of major weapon systems transferred.

To further examine arms transfers, a new data set of arms transfers based on the 'Arms Trade Register,' which is also from SIPRI, is created to show that the type of weapon matters in transfer decision making. To capture the variation between major weapons systems, the data set separates four of SIPRI's main categories – air defense systems, aircraft, armored vehicles, and artillery – based on the core characteristics affecting the role it fills for importers (SIPRI 2010). Beyond the SIPRI base, the data set is augmented with specific military characteristics of each model; this data is collected from Jane's Information Group online and published yearbooks.

The purpose of this article is straightforward: to illustrate that the type of arms states export should play a greater role in quantitative arms transfer research. Arms transfers are unique

and asymmetric because at their core they are transfers of power from one state to another and different types of weapons provide different types of power, yet arms transfers are rarely examined in this light. The main outcome is therefore related to confirming quantitatively what is known qualitatively, in that the specific decision to transfer arms varies by the type of weapon systems and the decision to transfer is affected by the type of arms the importer desires.

First, examinations of summary statistics for each category show there are clear differences in the pattern of transfer based on different model level factors that justify the categorizations. Second, the data are used to replicate Blanton's (2005) research on the United States' arms transfer decision making process, which focuses on how the human rights records and regime type of the importer influence the decision to export arms. The replication shows that Blanton's main independent variables of human rights violations and regime type affect arms transfers differently depending on the type of arms being transferred.

This data set makes two direct contributions to the study of arms transfers. First, the new data set has nuanced information on models of major weapon systems transferred between 1950 and 2010. Second, the results of the analysis show that the decision to transfer arms goes beyond political and economic relationships and decision makers take into account what is being transferred, not just who the arms are going to. The data set also has the possibility to assist those scholars researching international and domestic conflict. The majority of states in the international system do not have the ability to produce major weapon systems and this data set at a minimum provides an easily usable form of SIPRI's data to assess the weapons that different regimes have imported across time.

The article proceeds as follows: First, supply-side economic motivations for arms transfers are reviewed as the majority are trade and the provision of military aid also provides

economic benefits to the exporter. Then the alternative measures of arms transfers are reviewed along with previous categorizations of major weapons systems in the literature. This review is followed by classification of arms based on the role and characteristics different types of weapons possess from demand-side security considerations. The data analysis occurs next, which is followed by the replication.

Economic motivations for arms transfers

Two types of arms transfers exist: 1. Foreign military sales for cash, credit, and/or barter. 2. Military aid where the arms are free or subsidized. Separating the type of transfer is nearly impossible with the available data; thus, the term arm transfer accounts for both types, which is used by groups such as the United States Arms Control and Disarmament Agency (ACDA), within the academic literature, and here – unless otherwise stated.

Briefly, states produce, and in turn transfer, arms based on three sets of interest: wealth, power, and war (Krause 1992). In other words, the motivations are based on seeking economic, political, or strategic gains (Brauer 1991; Catrina 1988; Eikenberry 1995; Krause 1991; Smith, Hum, and Fontanel 1985). Political and strategic factors help to determine classification in later sections; thus, the current focus is on the role of economics. To begin, Dumas (2004) believes that there are no good economic reasons for states to begin to produce arms due to the long-term economic implications related to military spending and procurement once production is undertaken – few states have the demand for their domestically produced supply. Despite this assertion, states do produce and transfer arms; thus, the arms trade is a trade at heart and multiple facets of the traditional trade literature apply here. These subjects include supply and demand,

balances of payments, comparative advantage, economies of scale, and cooperative production schemes.

In a traditional marketplace, states would produce the type of arms they have a comparative advantage in and trade their wares to states with different comparative advantages in order to provide security; however, the production of arms does not operate under these conditions (Krause 1992). If traditional comparative advantage forces played a large factor, the high-fixed costs to develop arms would not be committed because similar arms could be imported for cheaper (Brzoska 1999). Instead, the major supplier states typically pursue production over a full range of arms at higher costs creating conditions where export is necessary to keep the industries economically feasible. The implication is that if strengthening the economy is the primary goal of producers then the production of arms should focus on relatively fewer, but more expensive weapons systems (Stanley and Pearton 1972); instead, economic production decisions are overridden by security concerns of the major supplier as no state wants to be dependent on another for a particular type of arms (Catrina 1988). Even in the post-Cold War era with supra-national cooperation in the European Union (EU), arms producers do not operate under comparative advantage (Martin et al. 1999).

Because states do not make use of comparative advantages in production there is a dichotomy with the supply and demand of arms – producers have too large of a supply and must export major weapon systems. The major source of demand for arms is from the developing world and the period between 1963 and 1988 saw the amount of arms transfers increased fourfold (Krause 1992). One effect of the trade is that imports in State A can create the perception of insecurity in State B, which creates additional demands for arms leading to a cycle continuous importing (Levine and Smith 2000).

Due to the necessity of export, the exporter's balance of payments with an importer is a primary economic motivator for action (Eikenberry 1995; Keller and Nolan 1997; Krause 1992; Stanley and Pearton 1972); however, the balance of payment benefits that suppliers are theorized to receive has little empirical backing. First, Stanley and Pearton (1972) find no evidence of the relationship between arms sales and the supplier's balance of payments. Second, almost thirty years later, Hartley (2000) finds a much smaller effect on the supplier's balance of payment. For example, a one-third reduction in United Kingdom arms exports would only lead to a 0.5% decrease in their balance of payments.

Despite the lack of benefits from balance of payments shifts, producers do benefit from export via economies of scale because major weapons systems require large sunk costs and have high per unit prices. Since 1950, the unit cost of arms has risen between nine and eleven percent annually, which is much higher than the growth rate of most states (Scheetz 2004). The ever increasing cost of arms means exports occur in order to lower the per unit price for the supplier country by having longer production runs and a reduction in the learning curve (Brauer 2004; Brzoska 1999; Catrina 1988; Garcia-Alonso 1999; Krause 1992; Smith, Humm, and Fonatanel 1985; Stanley and Pearton 1972). Over long production runs as the per unit price decreases the arms industries profit increases, which allows funding of next generation weapons (Keller and Nolan 1997). One negative implication is that suppliers may find their best action economically is to provide arms to both sides of a dispute (Brito and Intriligator 1999).

The alternative to pursuing comparative advantage or economies of scale in arms production and export is to engage in international cooperation with research and development and production, which is motivated due to falling defense budgets coupled with the increasing unit costs of arms (Bitzinger 1994). During the Cold War, cooperation occurred in arms

development with subcontracting and licensing of production, while joint ventures in research and development were rare; however, it became more common in the post-Cold War period (Skons and Wulf 1994). European states cooperate with development of aircraft and missiles, but too often the process is more expensive and inefficient (Hartley 2004). Part of the inefficiency comes from the lack of proper coordination and competition in component production (Btizinger 1994). The issue is while cooperation in research and development creates a benefit, there is less cooperation in production – states continue to build as many components as possible within their domestic industries instead of splitting production across states to maximize their comparative advantages.

Beyond these factors, arms exports occur under a national security exception by the World Trade Organization (WTO) that allows trade offsets to be used (Brauer and Dunne 2004). Offsets are:

> 'compensatory procurement arrangements designed to offset the cost of purchasing defense equipment from overseas by means of a reciprocal (countertrade) commitment by suppliers in support of a purchaser's domestic economy' (Markowski and Hall 2004, 44).

The level of offsets required is an indicator of the amount of competition there is in the supply side of the market (Catrina 1988). Three types of offsets can occur: countertrade, local content requirement, and bundling requirements. Countertrade is when the exporter buys goods from the importer. Local content requirements insist that the exporter outsource some value of the trade in the importing country. Bundling requirements may insist on package deals that include more than just arms (Markowski and Hall 2004). The goal of trade offsets is to encourage the importation of arms through reducing the importer's balance of payments or provide additional benefits to sweeten the deal.

The discussion above accounts for the economic subjects relevant to the arms trade since the inherent nature of arms separates them from other industries because they shift the level of security and relative power throughout the system (Eikenberry 1995; Pearson 1994). Current existing data sets on transfers – reviewed next – allow for some investigation on the effects of the arms trade, but they do not allow for the direct investigation of the levels of power and capabilities transferred between states, which is the primary motivation here and the basis for the later categorizations. Thus, this endeavor builds upon the economics literature, in that the economic conditions creating the international arms market are accounted for, but the lack of discussion on the types of goods transferred and their effect leaves a lacuna to be filled.

Existing measures of arms transfers

This article categorizes arms to show that there are important differences that are not accounted for with the traditional SIPRI TIV (for previous use see Kinsella 1994, 1998, 2002) or the WMEAT measure (for previous use see Blanton 1999, 2000, 2005) that quantitative analyses use to measure arms transfers (Moore 2012 is a notable exception). The TIV does not take into account the type of arms transferred, but the aggregate military volume in the form of a dollar amount of all weapon systems transferred.[1] For example, a transfer of one tank with a military value (TIV) of $10 million will appear the same as a transfer of ten pieces of artillery with a military value of $1 million. The outcome is that the TIV has a bias towards larger major weapon systems without regard to qualitative indicators of usefulness such as age or type of weapon; thus, the TIV measure does not directly account for variance in the capabilities of different weapons systems that affect arms transfer decision-making processes. By solely using the TIV an

examination of transfer arrangements is limited to an estimate of power the importer gains overall, which is not directly fungible with the role and capabilities the importer has gained.[2]

The WMEAT measure is the financial value of all transfers highlighting the financial gain of the exporter and the financial loss of the importer where, once again, the security gain in role and capabilities to the importer is unknown. A difference from the TIV is that it includes small arms and light weapons (SALW), which are easier to transfer illicitly and their origin is more difficult to determine. This issue along with the low financial costs means the strategic decision to transfer SALW is different from major weapon systems. Another issue with WMEAT data is that some periods are simply unavailable as the U.S. State Department is not in possession of the necessary information to make a report – particularly in the early 1980s. Historically, governments other than the United States have expressed a preference for SIPRI data as they are a non-profit institution located in a neutral country, which indicates using the WMEAT data over SIPRI is not desirable (Catrina 1988).

The issues with the previous measures motivate the current endeavor of analyzing arms transfers based on the type of weapon system being transferred and to account for the strategic characteristics of transferred weapons. While the extensive qualitative and historical literature on arms transfers often accounts for the types of weapons transferred, the quantitative arms transfer literature rarely does. The exceptions are reviewed below.

Previous categorizations of arms

The oldest example of categorization reviewed is Mullins' (1987) examination of the decision-making process of newly independent states to decide whether to import arms or undertake domestic production. In order to examine the acquisition patterns of states, Mullins classifies arms into thirteen categories based on the SIPRI data: utility aircraft, transport aircraft,

attack aircraft, fighter aircraft, trainer aircraft, armored cars, armored personnel carriers, tanks, missiles, guard boast, patrol boats, corvettes, and amphibious craft. The coding scheme for classification is based on the primary role for which the class of arms was developed, though he acknowledges many arms have secondary roles (see Mullins 1987, 120-25). For the majority of similar classifications separation is made based on armaments (size of the projectile fired) and weight of the weapon system. The classifications Mullins makes are well suited for his purpose of studying newly independent states, but do not cover the full range of arms such as air defense systems and artillery.

Craft (1999) uses an intricate classification of major weapon systems. In his research, he also uses SIPRI data and applies a 'weighted effectiveness indicator' that is more common in military science and security studies than political science. This measure quantifies arms in a manner such as a MIG-23 is 'roughly twice as effective as a T-55 main battle tank, or a 1.5 rating' (Craft 1999, 100). This classification appears to be similar to the TIV and is appropriate for Craft's interest in a state's overall military power and its effect on various aspects of war onset and war outcome. However, an interest in the transfer of the different kinds of weapons and the specific amount of power transferred – combined with the implications that these arms have on other state and interstate processes – requires a different data set.

The work by Zarzecki (2002) is largely considered the state-of-the-art when it comes to arms transfers and his data ranges between 1960 and 1997 for major weapon systems. The base data he uses also comes from SIPRI and he classifies arms in a manner somewhat similar to this article. Zarzecki discusses categorizations in terms of meta-categories (tank vs. plane), categorical (bomber vs. fighter), and generational (technology changes) (2002: 78). The classifications here are similar to Zarzecki's categories, but also account for generational

differences indirectly by using the age of the model design. Another difference between this data set and Zarzecki's is that he focuses on the diffusion of arms – when states bring different types of weapon systems into their arsenal since the innovation of that type of weapon system – whereas the interest here is broader in examining the factors affecting whether or not arms transfers occur over time.

These examples show that SIPRI data provide a good foundation for arms classification because they provide the type and model of transferred arms. These examples also show that the previous classifications are not sufficient for the goals of this data set. SIPRI's breakdown of dyadic arms transfers from 1950-2010 includes both the number of units and the type/model transferred in eight categories of arms: air defense systems, aircraft, armored vehicles, artillery, engines, missiles, sensors, and ships. Engines and sensors are omitted from the analysis as these categories are components of other weapons systems related to their efficiency rather than its capability as a weapon.[3] Missiles are omitted because these are ammunition for the other major weapon systems and deserve separate study – particularly because self-contained versions have important ramifications with use by non-state actors. Ships are not included because the category ranges from a small patrol boat to an aircraft carrier and these systems have a significantly longer life span with retrofitting – neither Craft (1999) nor Zarzecki (2002) include naval vessels in their studies for similar reasons. Research will account for ships when the Jane's reports are acquired in the future; however, major weapon systems that are mountable on ships are included in the analyses.

Roles and capabilities of arms transferred between 1950 and 2010

Arms transfers are a strategic decision by both parties involved in the deal. Importers need a variety of major weapon systems to accomplish their goals regardless of what they may be; thus, importers need weapon systems to fill different roles. Exporters need to be concerned about how the weapons will be used by the receiving state as exerting ex post control is extremely difficult; thus, exporters account for the capabilities they transfer. In this section, classification begins with accounting for importer interests using the base trade register categories of air defense systems, aircraft, armored vehicles, and artillery from SIPRI. This data set provides researchers a way to evaluate supply side and demand side decisions in greater detail as it accounts for the strategic value of what is transferred.

An assumption is made that exporter action is driven by security considerations as opposed to economic considerations, which were reviewed earlier, in order to simplify the process and because the conflict literature historically places the security concerns of states being the most important factor in decision-making and this is the focus for classification. States do take both factors into account. Substitutability, which is traditionally an economic factor, is considered later in the article from a security viewpoint. Exporters' economic concerns come from the high cost of research, development, and production of arms – there is an economic push for export despite the security risk (Krause 1992; Keller and Nolan 1997; Pearson 1989; Skons and Wulf 1994). Additionally, when importers seek to acquire major weapon systems they find the funds to do so regardless of other domestic economic conditions. One reason for this assumption is that despite arms companies not being economically viable without exports, they do not have to export every kind of arm they make, thus the military characteristics of the model drives part of the decision making process.

Table 1 provides a breakdown of the base SIPRI categorizations used – what is seen is that the four basic categories of arms are too blunt as the uniqueness of systems may be lost with these groupings. The type classification, alternatively, is too narrow as many SIPRI types are only slightly different from each other, but range from eleven to forty. Thus, the SIPRI description classifications are reorganized based on the military characteristics major weapon systems possess based on importer and exporter interests with data collected from Jane's Publishing Group. While many options for categorization are possible, major weapon systems are grouped in the most parsimonious manner based on the military characteristics affecting the importer's ability to maintain security.

[Table I in here]

Defining role

To account for the role of arms, a simplified version of a Lancaster Framework on consumer demand is used to categorize major weapon systems because different weapon systems provide both offensive and defensive strategic options to states. In other words, states seek goods based on the characteristics they possess (Lancaster 1966). The result for land weapons is six categories – gun air defense systems, missile air defense systems, towed artillery, self-propelled artillery, armored vehicles, and tanks – and eight categories for aircraft – support aircraft, transport aircraft, bomber aircraft, attack aircraft, support helicopter, transport helicopter, combat helicopter, and unmanned aerial vehicles (UAV) – based on unique military features identifying their role.

The Lancaster Framework consists of three assumptions used to classify a good:

'1. The good, per se, does not give utility to the consumers; it possesses characteristics, and these characteristics give rise to utility; 2. In general, a good will possess more than

one characteristic, and many characteristics will be shared by more than one good; 3. Goods in combination may possess characteristics different from those pertaining to the goods separately' (Lancaster 1966, 134).

When considering the characteristics of major weapon systems it is assumed that they are an 'intrinsic commodity group' where goods in the group can be 'intrinsic perfect substitutes,' 'close substitutes,' and 'intrinsic total complements' depending on how the categories put forth are compared; additionally, arms can share multiple of these classifications when they are partly complementary and partly substitutable (Lancaster 1966, 144).

The application of this framework to arms is appropriate due to arms being traded goods and due to the utility the importer receives from different types of weapon systems based on the characteristics they have, which are separated below initially based on land versus air.

Land Weapons

Land weapons are classified into four groups based on role – air support, ground support, front-line transport, and front-line offensive – or air defense system, artillery, armored vehicles, and tanks, respectively. Using the Lancaster Framework additional separations are made within air defense systems and artillery by separating the former as missile or gun based and the latter as towed or self-propelled because these characteristics are inherently different with limited substitutability and utility for the importer.

The primary role of air defense systems (ADS) is obvious: defense against air weapons. SIPRI's ADS category includes multiple varieties of anti-aircraft guns and surface-to-air (SAM) missile systems that can be stationary, mobile, or self-propelled. Demand for ADS is driven by a desire for security from external threat as states are rarely attacked by domestic forces with aircraft. ADS are separated by the primary weapon – gun or missile – because of the inherent

differences; gun ADS are typically line-of-sight weapons, whereas missiles have a longer range. Additionally, missile systems cost more than gun systems and require significantly more training for operation. ADS are not separated as being self-propelled or not because many towed and stationary systems are mountable on trucks after import.

Artillery in SIPRI's category includes has seventeen types of mortars, rocket launchers, missile launchers, and traditional large guns. The demand for artillery is similar to ADS as it provides strategic options for the state with the difference being the focus on ground support, which allows for both defensive and offensive interactions with front-line units whereas ADS only defend against air strikes. For this data set, the primary role distinguishing artillery is how they are transported: self-propelled and towed. The reason for this is that self-propelled artillery is typically more expensive than towed artillery and often larger. Another reason for this separation is that a supermajority of towed artillery is guns and the remaining are all multiple rocket launchers. The primary use for artillery is for support from behind-the-line; however, this support can take multiple forms like softening the front for an advance or to provide cover for a retreat. Generally, artillery is useful in interstate conflicts, yet can play an important role in domestic crises that develop into full-fledged conflicts or civil wars.

The third SIPRI land category is armored vehicles, which are denoted here as 'offensive armored vehicles' (OAV); tanks are removed and placed in their own category. From a demand perspective, armored vehicles are front-line weapons that have the potential to carry small and medium sized weapons – and potentially troops – that makes them useful for both interstate and civil conflict due to their versatility. Internationally, armored vehicles are used to move troops into position and across long distances when air maneuvers are not feasible. Domestically, armored vehicles can be used for crowd control and to move troops into position with protection

from small arms, which make them essential for oppression of a domestic population. In both cases, after deploying troops the armored vehicles' weapons can still be used to provide support for troops on the ground. Armored vehicles are arguably the backbone on the ground for modern militaries; for example, both the United States and British militaries had to redesign some of their armored vehicles for protection from IEDs in Iraq and Afghanistan during the 2000s as these vehicles were necessary to establish control on the ground and transport troops safely. Due to the potential presence of weapons on armored vehicles all types are considered with one another at the same time due to the use of identical frames and armor.

Tanks are the last land-based system, which are separated from SIPRI's armored vehicles categories because tanks cannot transport troops and have heavier armor.[4] The role of tanks could be considered similar to artillery – large projectiles shot from a long distance – but, the heavy armor and robust treads allow for these weapon systems to be used in rough terrain and at the front-line. This versatility and prestige from ownership creates the demand for tanks. Tanks, however, are reliant on the sub-systems they possess when facing other tanks – as Iraqi's T-72 tanks found out when confronted with American M-1 tanks as the latter was able to accurately fire while moving and at night.

Aircraft

Support aircraft include patrol, air-borne early warning and control (AEW&C), and electronic warfare aircraft. The role of these aircraft is to support ground and air units from behind-the-line during interstate conflict and have similar use during civil conflict. The demand for support aircraft is limited compared to other types of weapon systems due to the clear support role. The general difference between support aircraft and transport aircraft has to do with the electronics and other devices installed in the planes; this difference means support aircraft can be

quite expensive so states with lower military budgets may not seek to acquire this type of aircraft with a focus instead on weapon systems that have direct military capabilities. Even the British have suffered setbacks with support aircraft, for example, having to borrow P-3 Orions from the United States to use in operating against Libya during the Arab Spring due to retirement of their Nimrod aircraft, which caused public backlash after being reported on by the media (Drury 2011).

Transport aircraft are able to move weapons and troops – as well as airdrop – into front-line combat areas. These aircraft can be used in combat as well – recently, Sudanese forces have been hand-dropping bombs out of old transport aircraft to blockade towns (The Economist 2012). Alternatively, states involved in conflict have alternatives and can use the flag-carrier airlines or private groups to help transport goods and troops. For example, the United States used Viktor Bouts' fleet of transport aircraft to get supplies into Iraq – even if the United States did not realize it (Farah 2008). These alternatives for transporting people and goods mean that the demand for transport aircraft is no too high, especially for states that are not too large where goods and troops can be transferred by truck or rail.

The other large aircraft, bombers, are rarely transferred according to SIPRI (2010). The capability gained with bombers is the ability for long-range offensives and punishment, which appears to be a capability most states would desire; however, bombers have largely been retired in favor of fighter jets with bombing capabilities, greatly reducing demand. Due to the decreased demand for large bombers with the development of dual-use aircraft, the states that still produce them keep them for their own forces.

The attack aircraft category includes all fighter, fighter/ground attack, and fighter/bomber aircraft – as well as their various derivatives. These aircraft have a primarily offensive role, but

can be used to defend against an onslaught of enemy forces. Furthermore, though these aircraft are commonly used for interstate conflict, they can also be employed in civil conflict including domestic oppression, but this is not their primary role. The demand for attack aircraft comes from the power gained from being able to conduct attacks from the air at long distances and the reputation for possessing them. The reputational benefits for possession of attack aircraft – particularly supersonic ones – began with the third wave of decolonization when leaders of newly independent states sought the arms in an attempt to show their states are modernizing.

The roles that the previously described aircraft – support, transport, and attack – also apply to helicopters. Helicopters are separated from fixed wing aircraft due to the different utility they provide the state possessing them. First, helicopters have shorter ranges than fixed wing aircraft that limits power projection. Second, helicopters need fewer infrastructures to operate, such as runways. The versatility of helicopters create their demand, particularly because of the multiple roles a single helicopter can take; for example, some transport helicopters have the capability to carry different combinations of gun and missile pods, which means they could provide air support after dropping off troops. These key differences mean that even though they serve the same purposes as aircraft they do not serve the same role; for example, Iraq's use of helicopters to put down the 1991 uprisings because they were banned from flying fixed-wing aircraft in the north and south (Gordon 2012).

The last aircraft category, unmanned aerial vehicles (UAV), are a relatively new hybrid arms classification possessing both attack and support aircraft characteristics. UAVs gained prominence at the beginning of the United States' invasion of Afghanistan in 2001, but their use dates back to the mid-1980s, with Israel being one of the largest and earliest developers. The demand for UAVs stems from multiple factors with the primary motivation being costs – drones

cost significantly less than support and attack aircraft. Additionally, these arms are multipurpose; their long ranges and ability to remain at high altitudes allow circling UAVs to survey borders, serve as backup for an offensive force, or serve as an emergency defensive measure against an attacking force.

Measuring capabilities with military characteristics

'Military characteristic' is defined as a capability of a weapons system directly affecting the military power it has. Seven broad groups of characteristics are presented: firepower, weapon range, number of tubes, troop capacity, age of design, range (driving distance/flight time), and speed (aircraft cruising/vehicle max speed).[5]

The military characteristics are coded using publications by Jane's Information Group, which includes online databases and yearbooks dating back to 1949 and are taken from the online reports and yearbook specifications table for each individual model of weapon system, which appears at the end of each report and yearbook entry.[6] Reports on each model of weapon system in the SIPRI trade registers are downloaded from Jane's covering 1950 to 2010. Reports are removed from the database when the model is no longer used by any state; thus, data for retired weapon systems are taken from yearbooks published by Jane's when the arms were still in use.[7]

[Table II in here]

Specific definitions of the factors drawn from the specification tables are presented in Table 2 and the summary statistics of each military characteristic by category are presented in Table 3.[8] Table 2 show the seven groups of characteristics and their measurement for the relevant categories of major weapon systems. Firepower includes armament size, warhead weight, and pylon weight where armaments and warhead weight are used for land weapons and pylon weight

is used for aircraft. Weapon range is used for land weapons along with the number of tubes the system can fire from. Troop capacity is relevant for transport systems. Age of model design at transfer date applies to all categories. Range and speed represent power projections capabilities of mobile weapon systems.

Table 3 shows the summary statistics of the characteristics in Table 2. The ordered and received columns show that the mean size is highest for OAVs and tanks while the other land weapons' orders are generally larger than aircraft orders (other than attack aircraft). The firepower, warhead weight, weapon range, and tube columns show there are variations across the land weapons in what is being transferred. For aircraft, troops and pylon weight are only available for a few systems – the relevant characteristics available for most air systems are speed and range. Age is discussed in detail later.

[Table III in here]

Examination of the data

Using the categorizations and characteristics described above summary statistics are presented to show that what is transferred is as important as other measures of arms transfers. Four examinations of these states take place: 1. Substitutability of major weapon systems; 2. Rate of retransfer within each category; 3. Age of transferred weapons systems; 4. Total number and size of orders per model-dyad-year.[9]

Substitutability

The categorizations are made on an earlier assumption that security drives decision making of importers and exporters, but that does not mean that economic factors are irrelevant.[10] Economic conditions within producers create the push to export while threat perception and

prestige considerations of the importer drive demand; the push for export exists across the industry as a whole, while the demand for import is category specific.

A key component of the Lancaster Framework is substitutability. On one level substitutability is present within categories, while on another level substitutability is also present across categories. In relation to the former, substitutability is more apparent – importers can shift between suppliers for similar weapons or import a large number of units with few armaments versus fewer units with greater armaments. In relation to the latter, an example across categories is the separation of gun ADS/missile ADS and towed artillery/self-propelled artillery that was made earlier – both types are fundamentally different yet used for the same purpose and thus substitutable. Hence, the effect of substitutability is potentially great on the demand side, but only when there are alternative suppliers and/or models, which depends on the supply side of the arms market.

Figure 1: Number of producer-exporters of major weapon systems

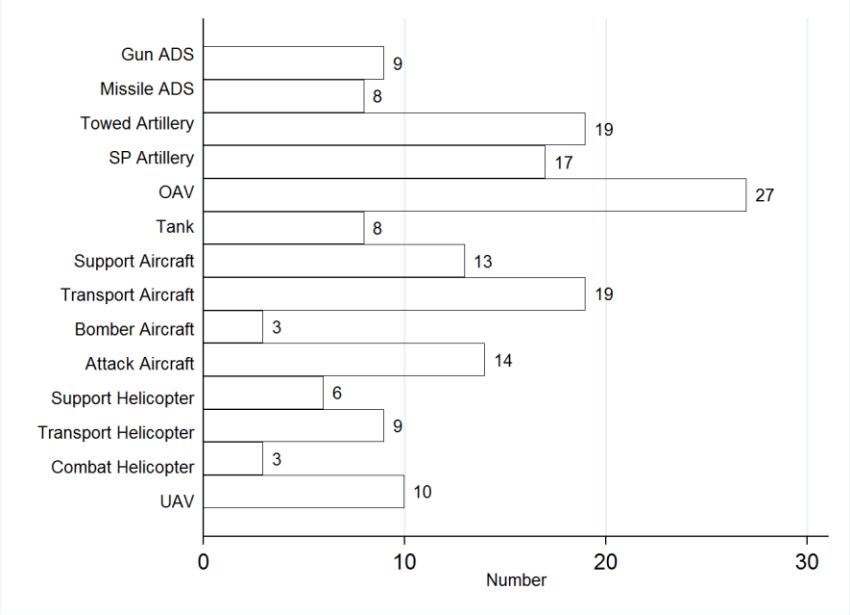


Figure 1 shows the number of states producing each category of major weapon system, which includes licensed production.[11] Gun ADS and missile ADS have nine and eight producer-

exporters, respectively, where seven overlap. For artillery, there are 19 producer-exporters of towed models and 17 of self-propelled models, but less than half of these states overlap. The difference in overlap shows that substitutability of artillery is much greater than for ADS – if a state is trying to import the former and is rejected by all of the self-propelled artillery producers there are still eleven producers of towed artillery producers to approach. For ADS, however, importers are limited to Czechoslovakia, the Netherlands, and Norway if states producing both types exclude the importer from consideration. OAV has the greatest level of substitutability with 27 producer-exporters and in terms of training this category is easiest to switch between as most models are built with simple chassis and transmissions similar to large trucks. Tanks are the least substitutable of the land weapons with only eight producer-exporters, which means that states that desire to import tanks must maintain good relationships with at least one of these states.

The aircraft categories in Figure 1 show that there is more substitutability in fixed-wing aircraft than helicopters. Combat helicopters and bomber aircraft are the least substitutable aircraft with three producer-exporters while transport aircraft are the most substitutable with 19 and 14 producer-exporters, respectively. Unlike the land weapons, these aircraft are far less substitutable across categories – transport aircraft and attack aircraft provide clearly different utility. With few notable exceptions, the producers of aircraft are all European or North American.[12]

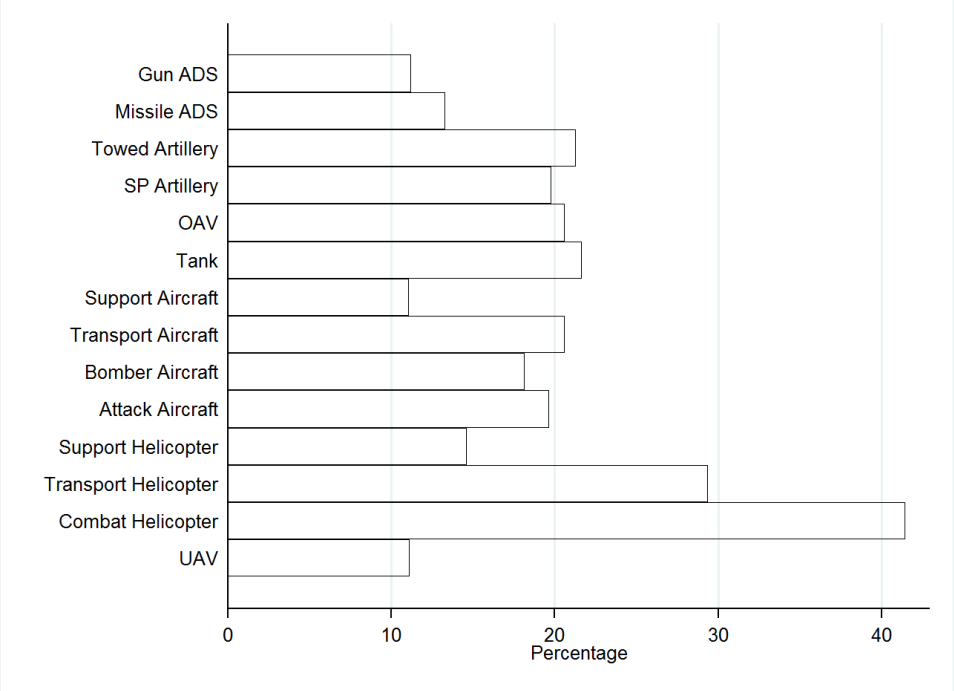
The varying levels of substitutability provide justification for looking at these categories separately despite the two ADS and two artillery categories being close to one another. The next issue to consider is whether or not these transferred arms were designed by the state exporting

them as they may be transferring arms purchased from a different state when purchasing new arms.

Retransfer

Figure 2 shows the total percentage of major weapon system exports by all states not produced by them – higher percentages indicate greater retransfers.[13] Retransfers are important because states have the opportunity to export used weapons whereas few states produce a full range of major weapon systems, which can affect balances of power and conflict processes.

Figure 2: Percentage of retransfers by category



In 12 of the 14 categories, retransfers occur in 21% or less of orders – in the transport helicopters and combat helicopters categories retransfers occur in 29.4% and 41.4%, respectively. The highest level of retransfer occurs because there are only three producers of combat helicopters and these are desirable arms. In the land weapon categories, the retransfer rates of the gun and missile ADS systems are 11.2% and 13.3% whereas for both artillery types, OAV, and tanks the retransfer rate hovers around 20%. One explanation is that the used value of

ADS is uncertain; thus, states desire these systems directly from the producer, whereas preowned artillery, OAV, and tanks are easier to value and importers feel comfortable receiving retransfers.

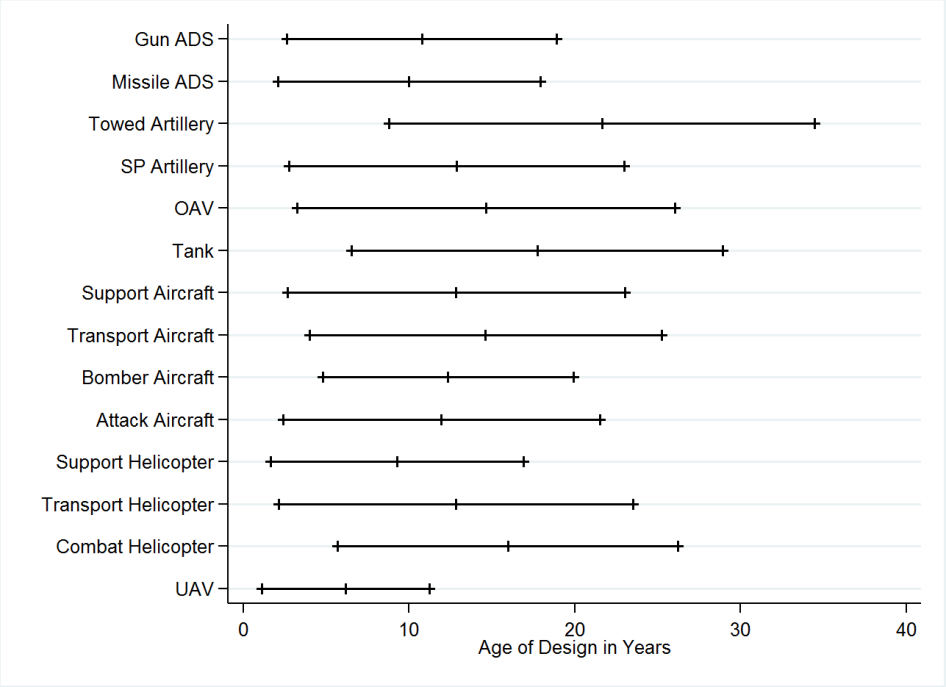
Within the aircraft categories both support aircraft and support helicopters are largely dependent on the systems and software installed, which mean there are fewer producers and importers may seek to acquire these arms directly from producers as used models may be out of date. The UAV retransfer level of 11.1% could actually be considered high due to few states producing this relatively new type of system. Within the other aircraft categories – except those already discussed – the rates hover around 20%, which is similar to many land weapons. The consistent 20% level suggests that there is a subset of states that regularly import weapons that allows for the retransfer of weapons that there is still demand for; in other words, there are states with enough of a perceived or actual security threat along with the funds to regularly modernize their military.

Thus, Table 3 and Figure 2 show that the TIV values, and indirectly, WMEAT values, do not fully account for the intricacies of arms transfers because they do not account for what major weapon systems are being transferred and if those weapons were built by the supplier – the latter part being a novel addition to the SIPRI arms trade register using reports from Jane's Publishing Group. What has yet to be accounted for is an assessment of the capabilities being transferred in a single measure, which is done using the age of the design of the transferred weapons that are calculated from the Jane's reports. The use of this measure is a simple way of summing up the other military characteristics of arms shown in Table 2 if an assumption is made that newer designed weapon systems represent upgrades from older designs or else there was no motivation for the upgrade.

Age

Figure 3 shows the average age of model design for all states' exports. The effectiveness of major weapon systems' subsystems – such as arms and armor – vary with how old the model is and many models have different generations with little difference in the model name, which needs to be accounted for. In order to account for these distinctions, each model's original design date is used. Older models are assumed to have less effective subsystems than newer models; a new design process or upgrades would not have been undertaken otherwise.

Figure 3: Age and standard deviation of model design



The mean age of all transfers is 13.09 years. Land weapons design age ranges from 10.01 years to 21.64 years, with the youngest being gun ADS and the oldest being towed artillery. For aircraft, the youngest designs transferred are UAV at 6.17 years and 9.28 years for support helicopters; the oldest design is combat helicopters at 15.96 years. One prime difference is the oldest transferred land weapon – towed artillery – is highly substitutable and the oldest transferred aircraft – combat helicopter – is the least substitutable, which is indicative of ever increasing advances of air weapons and the long-term robustness of some land weapons.

Similarly, bomber aircraft and tanks are also less substitutable relative to the other categories, but the means and standard deviations of design age at transfer are of similar levels to that of the other weapon systems.

The standard deviations around the mean age of model design show that there is indeed great variation within categories of the transferred arms. For most systems, one standard deviation is greater than ten years, which means 66.8% of weapons transferred per category have design ages from a few years old to around twenty years of age or more. Arguably it is the transfers of older weapons providing funds for new purchases along with research and development.

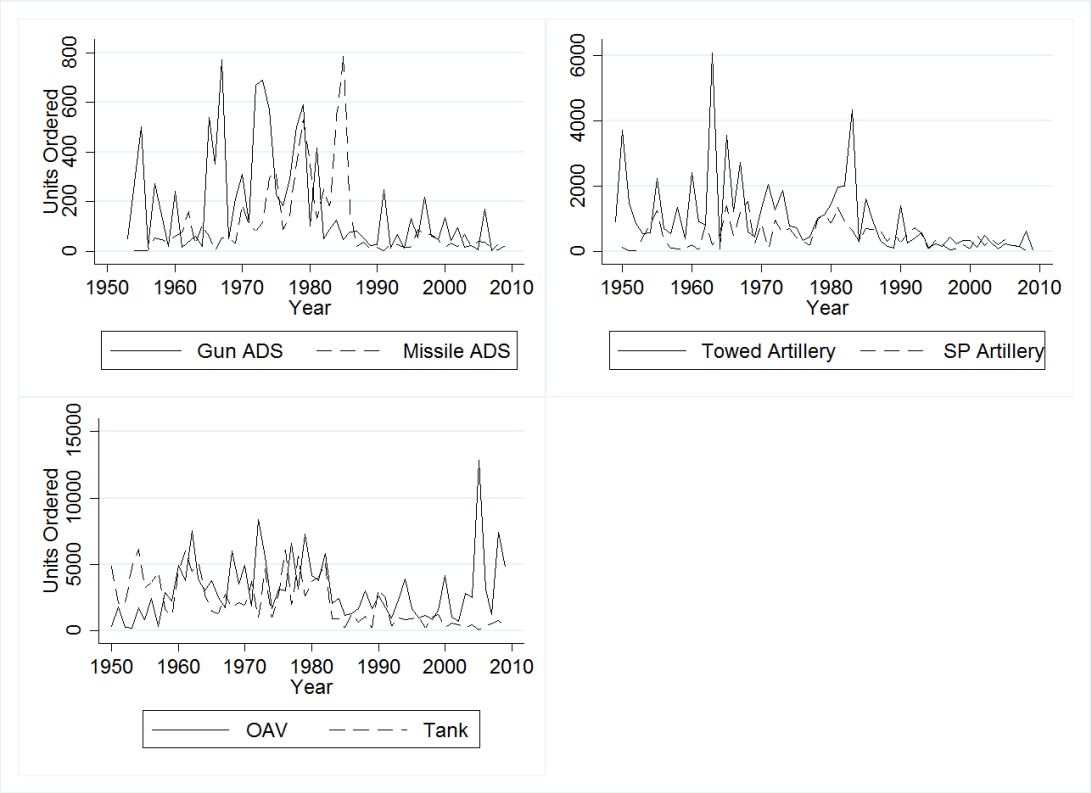
Patterns of orders across time

Figure 4 shows orders of land weapon across time. Examination of the figure shows decreases in the number of units ordered after the Cold War ends. Despite the decrease, the graphs also show that few years see no orders of land weapons and large variation on the y-axis – 800 for the ADS systems, 6000 for the artillery, and 15,000 for OAV and tank. These differences in the y-axis provide support for the earlier assertions regarding the demand for different types of land weapons – arms that provide greater strategic options are ordered in larger numbers. Additionally, the three graphs show that it is the less complicated weapon systems being ordered compared to the immediately substitutable counterpart. This phenomenon indicates that either exporters are restrictive in what they transfer or that importers choose to import higher numbers of lower capability weapon systems.

Specifically, in the top left graph for the two ADS categories, the peaks and valleys of ordered units largely match with a couple obvious exceptions in the late-60s and the mid-80s, but gun ADS is generally ordered and, in turn, delivered in greater numbers than missile ADS. A

similar pattern exists in the artillery graph on the right where towed artillery is ordered in greater numbers than self-propelled artillery with a few small exceptions. In the last land graph, tanks are initially ordered in larger numbers than OAVs until the end of the Cold War when OAVs take the lead.

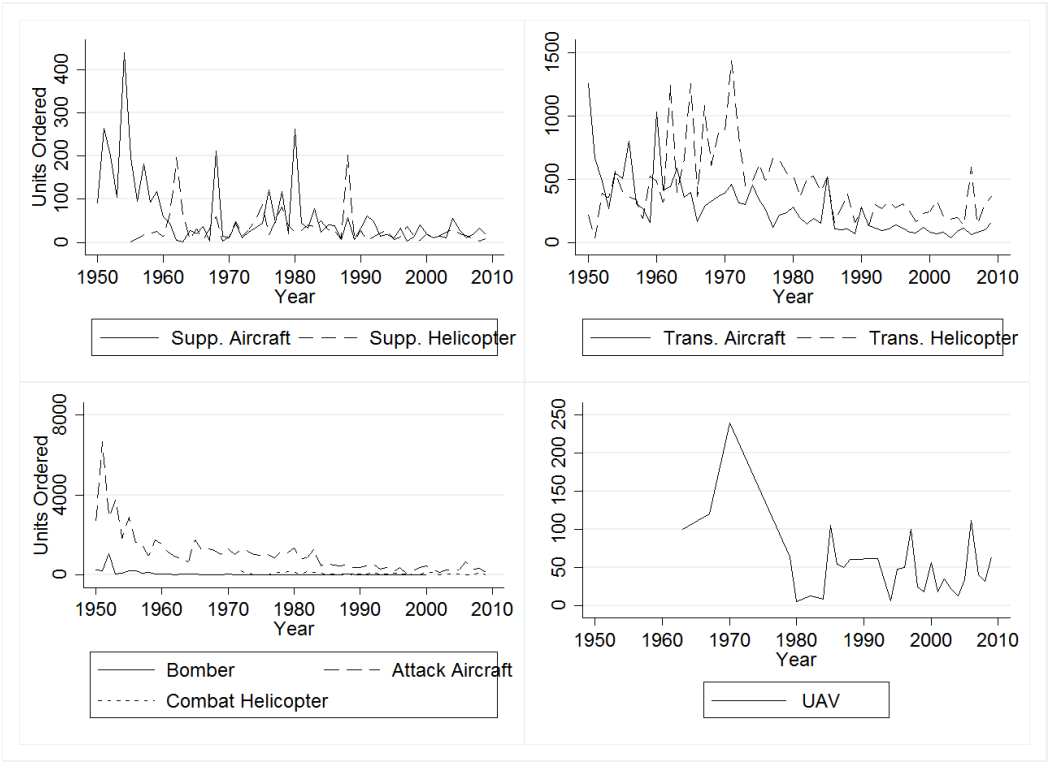
Figure 4: Number of units ordered yearly in international system – land weapons



The graphs in Figure 5 are divided by roles – support, transport, and attack – with UAVs in their own graph. Similar to land weapons, the y-axis on the aircraft category graphs vary greatly with attack categories having the largest range, followed by transport and then support categories. In the top-left graph, the y-axis for support aircraft and support helicopter goes to slightly above 400 showing these aircraft are not ordered in large numbers, which is not necessarily surprising as these are expensive systems that provide no direct military capabilities to the possessor. Transport aircraft and helicopters are transferred in larger amounts than their

support counterparts where transport helicopters are ordered in larger numbers than aircraft from the early-60s on. This difference may be due to private transport options when a longer range is needed. The third graph essentially shows that only attack aircraft are really transferred since bomber and combat helicopter numbers hover around zero – but, the y-axis in this graph is the largest and, thus, the actual variation in levels are muted. However, combat helicopters and bomber aircraft have fewer producers compared to all other categories – three. Additionally, there is a general decrease across time of the number of attack aircraft ordered. Lastly, UAVs have the smallest range on the y-axis and shows spikes and valleys across time, which is not surprising due to the low number of producers and time that these systems have been transferred.

Figure 5: Number of units ordered yearly in international system – air weapons



Replication of Blanton (2005)

The replication is of Blanton's (2005) Heckman model on the determinants of United States' arms transfers to developing states that focuses on the importer's human rights abuses and regime type between 1982 and 2000. Using data provided by Blanton, the replication shows that there are significant differences in the results when using this data set's measures of delivered units evenly divided over the range of years delivered.

This research is chosen for replication due to the United States being the largest exporter of arms and the human rights conditions of importers being a current real world concern. Additionally, different types of weapons provide capabilities to importers that allow for more efficient oppression by the state. For example, ADS, artillery, support aircraft, attack aircraft, and combat helicopters provide no direct benefit to the importer to oppress their population without mass casualties. OAV and tanks can be used for crowd control and visual statements while transport aircraft and helicopters can help get government forces into position. Lastly, Blanton uses WMEAT data, which means the TIV is included with the new data set in the replication. Thus, the original model is compared to another using the TIV while an additional model is ran for each category of major weapon systems.

Blanton finds that during the Cold War negative human right records are negatively associated with the likelihood of arms transfers in the interaction model – where the main variables are interacted with a Cold War dummy variable – and the effect increases in the post-Cold War era. Additionally, Blanton finds that democracy has a positive effect in the selection stage for arms transfers and a negative effect in the amount stage, while the democracy/post-Cold War interaction term is not statistically significant.

[Table IV in here]

Table 4 and Table 5 present the results for the transfer stage and amount stage, respectively, using the data set for United States' arms exports to developing states. The transfer stage dependent variables are whether or not a transfer occurred and the amount stage dependent variables are the WMEAT value, TIV, and the number of units delivered. Support helicopters and UAV are not included because the low N in the amount stage prevents convergence due to a degree of freedom issue; for the same reasons, the ADS and artillery categories are combined. Put simply, the results presented suggest that more information can be gained by disaggregating arms categories by type rather than using the existing data. While the full results are presented in Table 4 and Table 5, only the results in relation to human rights and democracy are discussed below as they are Blanton's two variables of interest.

The human rights variable in the transfer stage provides different results from Blanton (2005) in many categories of major weapon systems. In the original model, Blanton finds a negative relationship between human rights abuse and the likelihood of transfers whereas the replication results show a positive relationship in the transport aircraft, transport helicopter, and combat helicopter models – only the offensive armored vehicle category coefficient matches Blanton, the other are insignificant. These findings show a difference from the assertion made at the beginning of the section – OAV are useful for oppression and match the WMEAT coefficient; but, the transport aircraft and helicopter coefficients are positive. An explanation is without OAV importing transport aircraft and helicopters are less useful. In addition, the TIV coefficient has the opposite and significant sign from Blanton's use of the WMEAT measure – the fact that the two most common indicators of arms transfers disagree on the effect of human rights abuse is of importance to both scholars of human rights and conflict meriting further study.

The human rights/post-Cold War interaction term is insignificant in Blanton's model, whereas the coefficients in the artillery, transport helicopter, and combat helicopter models are negative, while a positive coefficient is present in the offensive armored vehicle category. The blunt interpretation is that compared to the Cold War period human rights violators are more likely to get OAVs and less likely to get the other significant categories, which makes little sense – why would violators of human rights be more likely to get OAVs? The TIV model, though, is as expected – in the post-Cold War period human rights violators are less likely to receive arms.

In the amount stage, shown in Table 5, the significant results for the human rights abuse variable are similar to Blanton with positive coefficients, which occur in the artillery, transport aircraft, and attack aircraft models. However, the signs on the coefficients similar to Blanton suggest human rights violators will statistically receive more arms in these categories than states that do not; the TIV measure is insignificant. The amount stage interaction of human rights abuse is negative and statistically significant in the transport aircraft and attack aircraft models, while Blanton finds null results suggesting that in the post-Cold War period the United States reduces the size of transfers of transport and attack aircraft to the abusers that made it past the gate-keeping.

[Table V in here]

Democracy is positive and significant in the transfer stage and negative and significant in the amount stage in Blanton's model. The replication results differ in the transfer stage where the land weapons, support aircraft, and combat helicopter models have insignificant coefficients. In transport aircraft, attack aircraft, and transport helicopter the coefficients are positive and significant, which supports Blanton's findings. Thus, in regards to United States exports, a more democratic importer increases the likelihood they make it past the gate-keeping stage for the

aircraft listed above, but for the other weapon systems regime type does not play a role in decision making. The interaction term of democracy and post-Cold War has no statistical significance in Blanton's model transfer stage. The majority of post-Cold War interaction terms in replications are insignificant with the exception of offensive armored vehicles, support aircraft, and transport helicopters, but support aircraft has a low number of non-zeros affecting the test in both stages.

In the amount stage for democracy, only ADS and artillery are significant and signed in the same direction as Blanton's coefficient. The other coefficients for democracy are statistically insignificant, which suggests that democracy only plays a role in the gate-keeping stage. For the interaction term, the results are similar to the transfer stage where most coefficients are statistically insignificant except for offensive armored vehicle's coefficient that is positive and support aircraft that is negative.

The implications of this replication is that the type of arms being transferred needs to be considered in part because of the uncomfortable thought that states that are human rights violators during the Cold War were more likely to receive transport planes and helicopters and combat helicopters – efficient systems to transfer forces and oppress a population. In addition, showing that these patterns for transport and combat helicopters in the post-Cold War era shift – whereas Blanton's results are insignificant – to being less likely to be transferred is in line with expectations that states account more for human rights into the 1990s.

Conclusion

This article presents an argument that the study of arms transfers – particularly major weapon systems – should account for what type of weapons are being transferred between states.

The motivation for the argument is different security roles are filled with different categories of arms and that the military capabilities being transferred are an issue for both the exporter and importer.

The primary contribution of this article is a data set on new categorizations of major weapon systems based on their military characteristics revealing important disparities overlooked by the current quantitative arms transfer literature. Additionally, the replication showed that political factors affect the likelihood of an arms transfer and the size of the transfer differently across the categories of arms. Thus, this article provides base ground for future research on arms transfers. While the use of previous measures are useful for some questions, a focus on the type of weapons being transferred allows for a more detailed examination of the capabilities that importers gain and the exporter distributes into the international system.

For example, these data can be used to examine what political and economic factors drive arms transfer decision making across all states or a subset of them. Similarly, since different categories of arms provide different capabilities, it may be prudent to look at the types of arms transferred to alliance partners versus other states. Beyond the use of the data as the dependent variable there is great potential for using arms transfers as an independent variable – few studies exist on the relationship between arms transfers and international conflict, yet states cannot fight without arms. Due to different security threats requiring different types of arms the types of arms transferred to states before, during, and after conflict can affect the outcome. Another possibility is to look at arms transfers and areas of international political economy, such as foreign aid, to determine if imported arms have an effect on other interstate relationships.

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Table I: Number of weapon system types and models

Weapon System	Number of Types	Number of Models
Air Defense Systems	11	76
Aircraft	40	871
Armored Vehicles	24	366
Artillery	17	232

Source: SIPRI (2010)

Table II: Military Characteristics of Major Weapon Systems

Characteristic	Measurement	Categories of Arms
Firepower	Armament – diameter of shell/projectile in millimeters	Gun ADS, Towed Artillery, Self-Propelled Artillery
	Warhead Weight – weight of high explosives (shell and missiles) in kilograms	Gun ADS, Missile ADS, Towed Artillery, Self-Propelled Artillery
	Pylon Weight – maximum weight of gun pods, missiles, rockets, and bombs carried in kilograms	Bomber Aircraft, Attack Aircraft
Weapon Range	Maximum distance the primary weapon is effective in meters	Gun ADS, Missile ADS, Towed Artillery, Self-Propelled Artillery
Tubes	Number of gun barrels, missile tubes, or rockets	Gun ADS, Missile ADS, Towed Artillery, Self-Propelled Artillery
Troop Capacity	Number of troops weapon system can carry in additional to crew	OAV, Transport Aircraft, Transport Helicopter
Age	Number of years the model has been in use at year of order	All categories
Range	Maximum distance the system can travel without refuelling Land = kilometers Air = hundreds of kilometers without extra tanks	Self-Propelled Artillery, OAV, Tank, All Aircraft
Speed	Land = maximum speed in kilometers per hour Air = hundreds of kilometers	Self-Propelled Artillery, OAV, Tank, All Aircraft

Note: For combat helicopters Jane's does not systematically report the amount of arms that can be held on the pylons, but data is available for the fixed armaments and number of rounds the helicopter can carry. The Jane's data also systematically excludes warhead weight and weapon range for tanks from virtually all models due to the large variation in the type of shells that can be red from tanks, which affects a weapon range.

Table III: Summary Statistics of Means and (Standard Deviations) for Arms Exports

	Ordered	Received	Armament	Warhead Weight	Weapon Range	Tubes	Troops	Pylon Weight	Age	Speed	Range	Transfers
Gun ADS	47.43	47.03	30.61	18.07	4039.90	2.54			10.79			205
	(68.26)	(68.58)	(11.52)	(36.67)	(2199.45)	(1.91)			(8.14)			
Missile ADS	19.28	19.22		76.11	43130.23	3.70			10.01			346
	(40.02)	(40.34)		(110.17)	(50490.30)	(2.07)			(7.93)			
Towed Artillery	84.01	85.08	133.52	50.64	14793.10	1.70			21.64			746
	(204.41)	(205.70)	(123.74)	(146.43)	(7259.08)	(2.91)			(12.84)			
Self-Propelled Artillery	55.02	54.55	181.08	171.45	26604.38	10.75			12.86	62.56	534.45	480
	(83.89)	(83.10)	(102.45)	(270.37)	(41189.40)	(15.90)			(10.12)	(9.29)	(313.46)	
OAV	129.82	126.11	24.14				10.07		14.63	82.48	576.38	1412
	(390.26)	(378.72)	(25.78)				(4.40)		(11.40)	(19.26)	(250.25)	
Tank	171.76	171.21	96.77						17.74	54.60	401.09	755
	(310.56)	(311.75)	(15.86)						(11.18)	(11.60)	(131.54)	
Support Aircraft	10.22	10.45							12.85	684.57	3088.23	370
	(16.03)	(16.37)							(10.16)	(439.76)	(1998.39)	
Transport Aircraft	7.18	18.32					47.53		14.62	422.95	2848.25	2322
	(18.32)	(18.43)					(66.15)		(10.62)	(210.39)	(2556.15)	
Bomber Aircraft	18.65	18.65						4145.32	12.36	1006.10	2896.18	163
	(47.75)	(47.75)						(3958.93)	(7.56)	(443.07)	(1659.79)	
Attack Aircraft	38.29	36.90						4072.96	11.96	1640.57	1832.75	2017
	(96.87)	(84.21)						(9204.38)	(9.55)	(710.42)	(952.90)	
Support Helicopter	10.04	9.79							9.28	223.44	836.27	164
	(19.49)	(19.25)							(7.64)	(41.22)	(409.31)	
Transport Helicopter	13.63	13.40					13.72		12.84	222.33	615.19	1953
	(33.66)	(33.12)					(13.47)		(10.70)	(48.34)	(326.86)	
Combat Helicopter	15	14.67	16.03						15.96	292.57	455.07	180
	(20.40)	(20.78)	(6.39)						(10.26)	(39.15)	(35.16)	
UAV	15.51	16.42							6.17	296.14	1543.78	100
	(25.43)	(26.01)							(5.07)	(230.27)	(4239.48)	

Table IV: Heckman Model Transfer Stage Replication of Blanton (2005)

Transfer Stage	Blanton	TIV	ADS	Artillery	OAV	Tank	Supp. AC	Trans. AC	Attack AC	Trans. Hel.	Combat Hel.
Human Rights Abuse	-0.14*	0.24**	0.02	0.10	-0.26**	0.16	0.08	0.16*	0.08	0.47**	0.28*
	(0.06)	(0.07)	(0.25)	(0.08)	(0.08)	(0.13)	(0.12)	(0.07)	(0.08)	(0.08)	(0.14)
Human Rights Abuse PCW	-0.12	-0.20*	-0.03	-0.33*	0.59**	-0.22	-0.08	-0.01	0.02	-0.29**	-0.40*
	(0.08)	(0.08)	(0.40)	(0.14)	(0.14)	(0.16)	(0.14)	(0.09)	(0.12)	(0.10)	(0.20)
Democracy	0.05**	0.05**	-0.01	0.01	-0.01	-0.04	0.02	0.05**	0.04**	0.06**	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Democracy PCW	-0.001	-0.02*	0.00		0.06**	0.01	0.06**	0.02	-0.01	0.03*	-0.02
	(0.01)	(0.01)	(0.02)		(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)
U.S. Troops	1.00**	1.50**		1.02**	1.34**	1.57**	1.03**	0.59**	1.50**	1.09**	1.00**
	(0.17)	(0.17)		(0.16)	(0.15)	(0.20)	(0.22)	(0.15)	(0.15)	(0.14)	(0.25)
U.S. Troops PCW	0.04	-0.20		0.57*	0.95**	0.19	-0.65*	-0.16	0.36	-0.14	0.54
	(0.17)	(0.21)		(0.25)	(0.24)	(0.25)	(0.30)	(0.21)	(0.21)	(0.19)	(0.34)
Ext. Conflict (War)	-1.15**	-0.99**	-4.69**	-6.17**	-5.35**	-5.53**	-4.80**	-0.62*	-5.98**	-0.66**	-4.87**
	(0.22)	(0.23)	(0.15)	(0.26)	(0.16)	(0.22)	(0.22)	(0.27)	(0.15)	(0.24)	(0.32)
Ext. Conflict (War) PCW	1.13**	0.74*	-0.60**	0.65*	5.80**	5.88**	0.33	0.07	5.80**	0.17	0.02
	(0.31)	(0.34)	(0.22)	(0.30)	(0.45)	(0.37)	(0.27)	(0.53)	(0.38)	(0.56)	(0.35)
Ext. Conflict (Minor)	-0.41*	-0.75**	0.07	0.35	-0.09	0.15	-4.85**	-0.58*	-0.47	-0.51*	0.20
	(0.21)	(0.22)	(0.48)	(0.26)	(0.35)	(0.28)	(0.21)	(0.26)	(0.36)	(0.24)	(0.50)
Ext. Conflict (Minor) PCW	0.11	1.07**	-4.02**	0.01	1.07*	-4.17**	5.38**	-5.47**	-6.88**	-4.83**	-5.02**
	(0.22)	(0.30)	(0.52)	(0.52)	(0.44)	(0.30)	(0.44)	(0.29)	(0.43)	(0.28)	(0.57)
Int. Conflict (War)	-0.36*	-0.46**	-4.33**	-0.39	0.62**	-0.72	-0.07	-0.18	-0.42	-0.28	-4.75**
	(0.15)	(0.17)	(0.43)	(0.26)	(0.21)	(0.43)	(0.36)	(0.17)	(0.26)	(0.16)	(0.26)
Int. Conflict (War) PCW	0.11	0.37	4.46**	0.61	-1.06**	0.87	0.35	-0.03	0.79*	0.25	5.81**
	(0.22)	(0.23)	(0.55)	(0.44)	(0.32)	(0.51)	(0.45)	(0.25)	(0.34)	(0.24)	(0.39)
Int. Conflict (Minor)	0.35*	0.32**	-0.64	-0.03	0.42**	-0.45	-0.13	-0.12	0.15	0.21	-0.52
	(0.14)	(0.14)	(0.38)	(0.22)	(0.15)	(0.32)	(0.30)	(0.16)	(0.19)	(0.15)	(0.34)
Int. Conflict (Minor) PCW	-0.24	-0.26	0.47	0.80*	-0.10	0.72*	-0.07	0.17	0.15	-0.25	1.27**
	(0.18)	(0.19)	(0.36)	(0.35)	(0.28)	(0.32)	(0.42)	(0.22)	(0.26)	(0.21)	(0.42)
Post-Cold War	-0.09	-0.11	-0.67	-0.15	-2.52**	0.46	0.08	-0.62*	-0.91*	0.34	0.61
	(0.23)	(0.23)	(1.06)	(0.44)	(0.44)	(0.50)	(0.42)	(0.27)	(0.35)	(0.32)	(0.63)
Constant	0.84**	-0.77**	-2.07**	-1.84**	-1.06**	-2.66**	-2.37**	-1.25**	-1.57**	-2.38**	-3.01**
	(0.17)	(0.17)	(0.56)	(0.21)	(0.21)	(0.39)	(0.33)	(0.18)	(0.20)	(0.23)	(0.40)
Log Sigma		0.43**	0.76*	-0.09	0.33*	0.15	-0.76*	-0.33**	-0.42**	-0.28**	-0.68**
		(0.05)	(0.31)	(0.28)	(0.16)	(0.52)	(0.33)	(0.05)	(0.08)	(0.04)	(0.19)
Observations	1923	1957	1967	1976	2005	1975	1965	2019	1987	2047	1965

Note: Standard Errors in parentheses

*p<0.05, ** p<0.01

Entries with . indicate collinearity and are dropped from the model.

Blank entries indicate small variation in the variable and are not included in the model to achieve convergence.

Table V: Heckman Model Amount Stage Replication of Blanton (2005)

Amount Stage	Blanton	TIV	ADS	Artillery	OAV	Tank	Supp. AC	Trans. AC	Attack AC	Trans. Hel.	Combat Hel.
Human Rights Abuse	0.39*	0.20	0.29	0.65**	0.18	0.78	0.21	0.20**	0.36**	0.08	0.19
	(0.18)	(0.11)	(0.28)	(0.17)	(0.14)	(0.75)	(0.28)	(0.07)	(0.11)	(0.11)	(0.30)
Human Rights Abuse PCW	-0.13	-0.17		-0.50	0.26	-0.59	-0.46	-0.37**	-0.35*	0.09	-0.19
	(0.23)	(0.15)		(0.33)	(0.23)	(0.78)	(0.39)	(0.12)	(0.16)	(0.14)	(0.34)
Democracy	-0.12**	-0.02	-0.07*	-0.05**	-0.04	-0.03	0.03	0.00	0.00	-0.00	-0.05
	(0.03)	(0.01)	(0.03)	(0.02)	(0.02)	(0.03)	(0.03)	(0.01)	(0.01)	(0.01)	(0.05)
Democracy PCW	-0.02	0.03		-0.02	0.13**	0.03	-0.11**	-0.01	0.00	-0.00	-0.03
	(0.02)	(0.02)		(0.04)	(0.05)	(0.07)	(0.03)	(0.02)	(0.02)	(0.02)	(0.05)
U.S. Troops	2.04**	2.02**		0.71	1.59**	2.18*	-0.08	-0.16	0.17	0.29	0.45
	(0.41)	(0.25)		(0.38)	(0.35)	(1.09)	(0.21)	(0.17)	(0.15)	(0.18)	(0.74)
U.S. Troops PCW	0.17	0.80*		0.09	0.33	-0.47		0.25	0.52*	0.30	-0.19
	(0.37)	(0.32)		(0.47)	(0.46)	(0.61)		(0.26)	(0.22)	(0.20)	(0.80)
Ext. Conflict (War)	2.01**	-1.20**	.	.	1.10	0.47	.	-0.14	0.44*	1.25**	.
	(0.41)	(0.37)	.	.	(0.64)	(0.59)	.	(0.49)	(0.20)	(0.25)	.
Ext. Conflict (War) PCW	-1.34	0.62	.	.	.	.	.	-0.42	.	-2.97**	.
	(0.77)	(0.64)	.	.	.	.	.	(0.54)	.	(0.40)	.
Ext. Conflict (Minor)	-0.12	0.14	-0.01	0.16	0.34	-0.49	0.15	0.52	0.02	0.42	-0.79
	(0.98)	(0.56)	(1.07)	(0.30)	(0.48)	(0.38)	(0.47)	(0.35)	(0.32)	(0.32)	(0.47)
Ext. Conflict (Minor) PCW	-0.61	-0.52	.	0.93	1.23	.	.	.	.	.	.
	(1.44)	(0.74)	.	(0.80)	(0.68)	.	.	.	.	.	.
Int. Conflict (War)	0.59	-0.82**		-0.88**	-0.45	-2.62*	-0.01	-0.08	-1.22**	0.15	0.31
	(0.52)	(0.28)		(0.30)	(0.38)	(1.27)	(0.51)	(0.20)	(0.24)	(0.22)	(0.22)
Int. Conflict (War) PCW	0.73	1.08		1.40*	3.12**	-0.05	0.09	1.54**	0.04	.	
	(0.81)	(0.42)		(0.61)	(1.07)	(0.81)	(0.36)	(0.33)	(0.34)	.	
Int. Conflict (Minor)	-0.53	0.10		-0.57*		0.11	-0.13	-0.21	-0.09	0.04	
	(0.39)	(0.22)		(0.27)		(0.30)	(0.33)	(0.15)	(0.19)	(0.15)	
Int. Conflict (Minor) PCW	0.56	-0.04					-0.77	0.19	0.04	-0.01	
	(0.50)	(0.32)					(0.65)	(0.28)	(0.30)	(0.26)	
GDP (Log)	0.48**	0.29**		0.10	0.16	0.08	0.02	0.04	0.25**	0.10	-0.10
	(0.07)	(0.05)		(0.07)	(0.09)	(0.13)	(0.09)	(0.03)	(0.04)	(0.05)	(0.38)
GDP PCW (Log)	0.34**	0.09		0.33	-0.44**	-0.05	0.32*	0.13*	-0.17*	-0.06	0.41
	(0.09)	(0.08)		(0.21)	(0.15)	(0.31)	(0.13)	(0.06)	(0.07)	(0.08)	(0.39)
Saudi Arabia	1.40**	1.31**		-0.45*	1.45**	-1.00	0.26	0.32	0.16	-0.35	-0.30
	(0.40)	(0.38)		(0.21)	(0.23)	(0.79)	(0.37)	(0.27)	(0.35)	(0.20)	(0.29)
Saudi Arabia PCW	-0.71	-0.43		-1.38*	0.55	1.51	.	-0.90*	0.07	-0.07	.
	(0.56)	(0.70)		(0.60)	(0.52)	(1.37)	.	(0.44)	(0.45)	(0.34)	.
Post-Cold War	-3.41**	-1.39	1.12	-2.36	3.02	2.59	-1.75	-0.37	2.39*	0.10	-4.16
	(0.56)	(0.83)	(0.61)	(2.30)	(1.76)	(4.47)	(1.72)	(0.60)	(0.97)	(1.01)	(4.07)
Constant	-1.20	-1.05	-4.38*	-1.38	-2.39	0.82	-0.10	-1.87**	0.11	2.06	
	(1.25)	(0.58)	(2.09)	(1.19)	(4.10)	(1.16)	(0.35)	(0.52)	(0.71)	(4.12)	
Log Sigma		0.76*	0.43**	-0.09	0.33*	0.15	-0.76*	-0.33**	-0.42**	-0.28**	-0.68**
		(0.31)	(0.05)	(0.28)	(0.16)	(0.52)	(0.33)	(0.05)	(0.08)	(0.04)	(0.19)
Observations	1074	676	37	99	160	92	45	284	188	301	46

Note: Standard Errors in parentheses
*p<0.05, ** p<0.01

Entries with . indicate collinearity and are dropped from the model.

Blank entries indicate small variation in the variable and are not included in the model to achieve convergence.

[1] Attempts to get the TIV values of individual models from SIPRI were unsuccessful due to the internal structure of their database.
[2] This critique is based on the assumption that the exporter is not losing power as they are transferring goods their own military does not need as a form of surplus.
[3] However, the efficiency of weapon systems is important for the sophistication of weapon systems and is accounted for in an alternate way by using the age of the weapon system design.
[4] Support vehicles built on tank chassis' such as armored bridge layers and heavy recovery vehicles are also left out as they are rarely transferred and support vehicles.
[5] The primary role of arms as offensive or defensive is an important factor exporters consider when deciding to transfer. While all arms possess defensive capabilities, some arms – such as air defense systems – are designed purely for defense. However, defensive arms can be used to allow states to take offensive actions (Buzan and Herring 1998).
[6] The one exception is age of model design that is calculated by subtracting the year of model introduction from the year ordered.
[7] Additional characteristics other than those stated were collected – and are described in the codebook in the appendix – but the characteristics used are consistently available for the largest number of models in the Jane's literature.
[8] If one wanted to update the data set access to Jane's Information group databases are required. If one wanted to replicate the data set they would also need access to hard copies of the yearbook, which may be available used online – during data collection inter-library loan systems were of limited use.
[9] There is a correlation of at least 0.99 between the number of units ordered and the number of units delivered except for attack aircraft at a level of 0.89; the variation occurs between year ordered and year(s) delivered.
[10] Some demand side economic factors – such as cost of the major weapon system – do little to drive decision making as states find funds for military expenditures regardless of needs in other sectors of society.
[11] States also have the opportunity to export used arms depending on the terms of the end user license agreement – these considerations are accounted for in the next section.
[12] Exceptions are Japan, China, Brazil, and Argentina.
[13] This percentage accounts for individual orders as opposed to the number of units per order.