

Nataša Stanojević
Institute of International Politics and
Economics
Belgrade

EXPORT POTENTIAL OF SERBIA'S DEFENSE INDUSTRY*

Izvozni potencijal vojne industrije Srbije

Abstract

This paper empirically tests an augmented gravity model of international trade in order to investigate the impact of various factors on the volume and direction of export of the Serbian defense industry. The results show that military expenditure, arms import and a dummy variable referring to historical ties in arms trade have positive effects, while, on the other hand, population, distance and degree of industrial development of partner countries have negative effects on Serbia's military export. The study resulted in three empirical models, all with a high coefficient of determination but different statistical significance of variables. One of them was selected and applied to all export partners of the Serbian defense industry. Out of 61 countries, 21 were determined as target markets based on the combination of two criteria – the trade potential index, determined by the application of the gravity model, and trade dynamics.

Keywords: *defense industry, gravity model, arms trade, military expenditure, Competitive Industrial Performance Index.*

Sažetak

U ovom radu se empirijski testira prošireni gravitacioni model međunarodne trgovine kako bi se istražio uticaj različitih faktora na obim i smer izvoza srpske odbrambene industrije. Rezultati pokazuju da pozitivne efekte na srpski izvoz oružja imaju vojna potrošnja i uvoz naoružanja partnerskih zemalja, kao i *dummy* varijabla koja se odnosi na istorijske veze u trgovini oružjem. S druge strane stanovništvo, geografska razdaljina i stepen industrijskog razvoja partnerskih zemalja imaju negativne efekte. Rezultat su tri empirijska modela, svi sa visokim koeficijentom determinacije, ali različitim statističkim značajem nezavisnih varijabli. Jedan od ova tri modela je izabran i primenjen na sve zemlje uvoznice srpske odbrambene industrije. Od 61 analizirane zemlje, njih 21 su određene kao ciljna tržišta na osnovu kombinacije dva kriterijuma: indeksa trgovinskog potencijala, dobijenog primenom modela gravitacije, i trgovinske dinamike.

Ključne reči: *vojna industrija, model gravitacije, trgovina oružjem, vojna potrošnja, indeks konkurentskih industrijskih performansi.*

* This paper presents findings of a study developed as part of the research project "Serbia and Challenges in International Relations in 2020", financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia and conducted by the Institute of International Politics and Economics in Belgrade.

Introduction

The main feature of Serbia's foreign trade is the constant, rapid growth of trade deficit and a limited number of export partners. Finding new markets is of key importance for overcoming these weaknesses.

Arms production and trade, besides their geopolitical and security aspects, have a strong impact on economies of numerous countries. From the point of view of the manufacturers themselves, defense industry does not differ significantly from any other material goods production. The advantage of this industry is that it has a secure market, as production is most often realized on the basis of the previously obtained military orders.

In addition to direct sales revenues, military industry products can be an impetus for industrial development by embracing new technologies, increasing the capacity of related industries (metal processing, electronics, textile and rubber industries, etc.), engaging versatile workforce, etc. Production of arms for export is the only profitable military activity, often more profitable than many other types of production.

Military exports contribute to the development of the economy in the same way as all other types of exports: they ensure an influx of foreign currency, which pays for the import of goods or equipment for the expansion of domestic production and reproduction, or provide financial resources for services and activities that create conditions for faster economic development. Finished product exports constitute only one part of military industry's exports. There is a full range of ancillary services, which are also subject to trade: "assistance" in handling deliverables, "technical assistance" in maintaining those assets, including overhaul and delivery of spare parts, construction of military infrastructure facilities (airports, base facilities, launch ramps), as well as resource production facilities [14, p. 104].

Military industry is one of few sectors of Serbian economy that has the potential to significantly improve the placement of its products in foreign markets. As the current level of military spending in the world is, by international standards, very high with a tendency to grow further, this gives the military industry an opportunity to grow and improve.

The purpose of this study is to identify the influencing determinants of Serbian military exports. A single-country gravity model will be applied to the export of arms and military equipment. The data about the composition of trade flow is the panel data.

The coefficients obtained will be used to create an equation for the calculation of Serbian military export potential. More specifically, the second goal is to assess which export markets offer most opportunities to increase the exports, by applying the coefficients obtained in the first part of the research and the trade dynamics with individual countries.

Literature review

Ever since the gravity equation was introduced by Tinbergen [25] and Linnemann [7], it has been used in hundreds of papers for estimating the determinants of bilateral trade. For a long time, gravity equations, primarily as a macroeconomic model, were used only for the assessment of a country's overall export. As Harrigan [5, p. 41] noticed, it is "surprising how little work has been done on examining disaggregated gravity equations". Among few studies, only two analyzed the relationship between product categories and the parameters of the gravity equation. One is the study by Rauch [19] who identified that dummy variables for a common language and colonial ties had very different impacts on the selected three product categories. The other is the paper of Mohlmann et al. [15] who reported the importance of using different product categories for the parameters of the gravity equation.

Not until the 2010s did the application of the gravity model to a particular sector become a more common topic of research. Several research studies explored the determinants of exports for product-specific trade. Some of the most important are: Wei et al. [28] who used the gravity model to estimate the impact of food safety standards on China's exports of honey, Atif et al. [2] analysed Pakistan's agricultural and chemical products export, Rahman et al. [17] used the gravity model for the analysis of Bangladeshi textile and apparel industry's export, Shahriar et al. [20] analyzed the export of China's animal meat, etc.

Papers on the defense industry's impact on economy are very rare. Most of them refer to the impact of military spending on the domestic economy. These are studies by: Ram [18], Yakovlev [30], Dunne et al. [4], etc. They all feature the following explanations:

- Military spending increases aggregate demand which reduces unemployment and increases capital utilization.
- Military research and development stimulates infrastructural development and spillover effects of technology for civilian use.

Some of the literature on defense spending and economic growth revealed an inverse relationship between them. Mankiw, Romer and Weil [8] argue that huge military spending causes reallocation of resources from a more productive market to less productive ventures financed with taxes. This can create welfare losses and reduce labor supply.

Even rarer are the theoretical and empirical studies of the economic aspect of arms trade. The first step in exploring this topic was made by Anderton [1] who applied international trade models to arms trade. In the study of Zubair and Wizarat [31], the effects of arms exports on economic growth are analyzed. They viewed arms exports as one of the variables of economic growth, in addition to military expenditure, GDP, labor and the dummy variable for military conflict. Their results showed that a 1% increase in arms exports (of top arms exporting countries) results in a 39% increase in GDP of the arms exporting countries [31, p. 93]. To our knowledge, there is no empirical research conducted primarily on military exports.

There are few important studies which presented the state and capacities of the military industry in Serbia and they are important for this research because of their abundance of factual data. Mirković [14] elaborated on the condition and history of the military industry of Yugoslavia, followed by that of Serbia, and presented the data on the status, capacities, volume and structure of exports and imports in the military industry. Kovačev et al. [6] provided the documentation on the capabilities of the military industry of SFRY, which predominantly preceded the modern military industry of Serbia in terms of technology, physical capabilities, and manpower. Matović

[9] discussed the business arrangements of the Yugoslav military institutions, military industry enterprises, and, in particular, the business operations of Yugoimport-SDPR, a Yugoslav and afterwards Serbian company with a monopoly on international arms trading. This monograph is particularly important for this research because it provides data on the trade relations and agreements with the importing countries, which Serbia inherited from former Yugoslavia.

Đokić [3] analyzes the recent state of Serbia's military industry, highlighting the problem of accumulated debts, unresolved ownership structures and outdated production capacities. The author points to the Government's attempts to resolve these issues through various measures, such as converting debts into creditors' shares, favorable loans and direct financial assistance. The article by Vidović et al. [27] is thematically closest to this research. The paper analyzed the export potential of this industrial branch, as well as its impact on the overall economy of Serbia and the economic activity of the country. The method used was SWOT analysis.

An overview of Serbia's military industry

Within the Socialist Federal Republic of Yugoslavia (SFRY), Serbia had an industry that was not far behind the most industrialized economies in the West in terms of quality. Military production, with the capacity of more than 550 factories, was one of the most successful manufacturing sectors. The diversified production of small arms and light weapons (SALW), tanks, armored vehicles, rocket launchers, ammunition, etc. was of high quality and sold in many regions worldwide, yielding significant revenues. The military industry employed about 57,000 workers, 27,000 of whom worked in the territory of what was then Serbia [5, p. 140]. About 80% of military production, for the needs of the armed forces at the time, was covered by the domestic military industry, including product development at domestic institutes [16, p. 437]. About 30% of the military industry capacity was manufacturing for export [16, p. 438] which amounted to \$1-2 billion per year.

During the transition period after the 1990s, all industries suffered significant damage. The production of

many was reduced, in terms of technology and product finalization. The military industry did not develop during this period either. However, it did not lose its former level of quality, while its production capacity was only slightly reduced. Currently, Serbia's military industry is growing and undergoing significant modernization. It has been generating more notable income in recent years, given the rise in armed conflicts across the world.

One of the advantages is that the state is the major owner of the defense industry. The law stipulates that the state's total share in production cannot be less than 51 percent; in fact, the defense industry is almost 80% state-owned. The Serbian government annually invests about 50 million euros in this sector, of which more than 80% is earmarked for the development of new technology. The Register of Producers of Weapon and Military Equipment records 52 companies that are licensed to produce weapons [10]. They employ 8-10 thousand workers. The largest production and export are realized by 6 companies which are under the control of the government group "Defense Industry of Serbia". As of January 2020, the group includes additional 13 companies operating in various sectors: textile, manufacturing of trucks and other vehicles, optics, tire manufacturing, civil aviation, etc. The public company Yugoimport-SDPR still has a monopoly on arms trading.

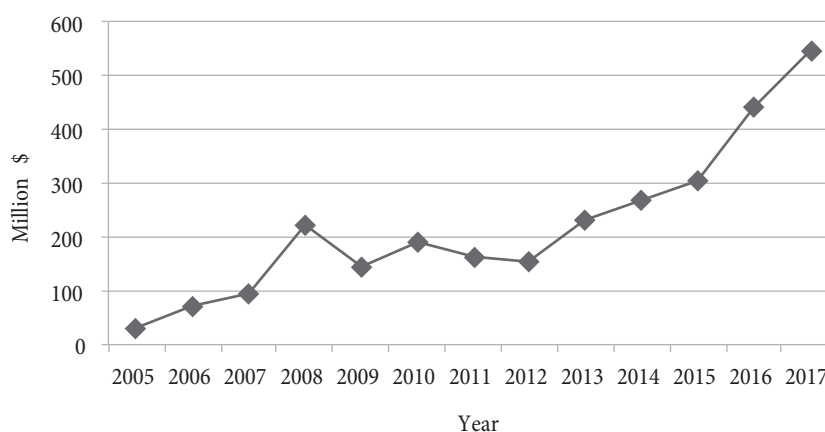
The industry produces all kinds of weapons, except for high-end armaments, such as supersonic combat aircrafts, air defense systems, long-range missiles and navy vessels. The product range is identical to the one previously produced in Yugoslavia (ammunition, small arms, rockets, grenades, explosives, armored vehicles,

etc.), yet all these product groups underwent continuous technological development and innovations. In these sectors, production exceeds the needs of the Serbian Armed Forces by far. That is why the military industry of Serbia is mainly an export-oriented industry, which contributes to a significant surplus in foreign trade.

Competition in this sector is not small. Most of the top manufacturing countries are also the top exporting countries. More than 1,000 companies from some 100 countries produce the same groups of products as Serbia. About 80 countries currently produce small arms ammunition for revolvers, pistols, rifles, carbines, and machine-guns. Only about a dozen countries produce advanced guided light weapons [21]. Zastava arms company is one of the twenty largest companies in the SALW category, along with the famous Glock, Berreta, Remington, Heckler & Koch, Smith & Wesson, etc. Zastava has positioned itself as one of the leading manufacturers of hunting and sporting rifles, assault rifles, machine-guns and grenade launchers in the world market [21].

The share of exports of Serbian weapons and ammunition in the world market is considerable, given that these goods are exported to over 65 different countries. The volume of export continues to increase by expanding into new markets and signing new contracts in the existing markets. The highest value in export sales was achieved by exporting to: the United Arab Emirates (\$138.24 million or about 25% of total military exports), the United States of America (\$112.68 million or about 21%), the Kingdom of Saudi Arabia (\$61.83 million or 11%), and the Republic of Bulgaria (\$47.03 million or about 9%) [13, p. 12]. In

Figure 1: Exports of the Serbian military industry in 2005-2017 (million \$)



Source: Serbian Ministry of Trade, Tourism and Telecommunications.

2017, total military export amounted to \$546.27 million. Compared to 2016, the value of realized export increased by \$103.76 million (by about 23%).

The predictions are in favor of the Serbian military industry. The largest increase is envisaged in the sectors of small arms and light weapons and ammunition, which are the most important strategic sectors of the Serbian military industry. The procurement analysis suggests that within a fifty-year period the world production of military assault rifles, carbines, pistols, and light and heavy machine-guns will range between 36 and 46 million units, annual production of small arms alone (firearms rather than light weapons) averaging 700,000 to 900,000 [21]. Additional growth of the military industry and an increase in its exports would be of great importance for Serbia's economy.

Data and methodology

Variables and data

The dependent variable in the gravity model is usually export. In this research, we are specifically exploring the exports of the defense industry of Serbia. The data are provided by the Ministry of Trade, Tourism and Telecommunications of the Republic of Serbia in the form of annual reports. In terms of transparency in arms trade, Serbia is the fourth exporter in the world in the SALW category, behind Switzerland, Germany and the Netherlands [25]. Therefore, the export data from annual reports can be considered reliable, which is a common problem with arms trade research. Due to large annual variations in the value of arms exports, we will use a three-year average.

The independent variables commonly included in the gravity model are the size of the economy of the importing and exporting country, most often represented by GDP, geographical distance, as an indicator of transportation costs, and a whole range of potentially important dummy variables, such as common language, border, former colonial relations, etc.

On the basis of general information on the level of armament of many small Arab and African countries, it is clear that the size of the economy does not play a

significant role in the import of weapons. The quantities that are relevant for the import of weapons as specific goods must be identified. Preliminary research using simple regression has identified several potential factors that define the export of Serbia's defense industry.

Military expenditure (Mex) includes spending on the creation, maintenance and strengthening of a state's armed forces with regard to their physical capacity, training and financing of human resources. It is expressed in monetary terms or as a share in GDP or government expenditure. Although the share in GDP is more reflective of the state's willingness to allocate funds to this social segment, the expenditure expressed in monetary terms is an indicator of both the willingness and financial capability to realize it. For this research, the data on military expenditure was obtained from the Military Expenditure Database of the Stockholm International Peace Research Institute (SIPRI) [23].

The import of weapons and military equipment (Imp) is the second variable, which is not collinear with the previous one. For the import value the data from SIPRI (2020b), that has developed a special trend-indicator value (TIV), were used. This is a unique system of measuring the volume of international transfers of major conventional weapons by using TIV as a common unit. It is "based on the known unit production costs of a core set of weapons and is intended to represent the transfer of military resources rather than the financial value of the transfer" [24]. This amount is expressed in millions of dollars, but it does not denote the sales prices for arms transfers. "They should therefore *not* be directly compared with GDP, military expenditure, sales values or the financial value of export licenses..." [24]. This is the main reason for the lack of collinearity with the previous variable.

Population (Pop) is used in gravity models as a signifier of market size. It is not directly related to the value of arms procurement. The countries with small and large populations may have equal needs in view of the number of tanks, armored vehicles, military aircrafts or air defense systems, which depend on the size of their territory and the configuration of terrain. However, in this research the population determines the framework for the sale of ammunition and SALW, which are the most important export products of the Serbian defense

industry. In this case, the larger the population is, the larger the quantity of weapons, especially light weapons, it requires. However, for Serbia, as a small country, the size of export market is not an advantage. We expect a negative sign of the coefficient for this variable. Namely, small countries do not have the capacity to meet the needs of big armies, which is why they find other suppliers. Serbia has already had this problem with large markets in other manufacturing sectors.

Distance (D) between the trade partners represents transport costs.

Competitive Industrial Performance Index (CIP) is a performance indicator, developed by UNIDO, for the assessment of industrial competitiveness. “It captures a country’s ability to produce and export manufactured goods competitively”. It includes eight indicators, defined along three dimensions:

- 1) capacity to produce and export manufactured goods,
- 2) level of technological deepening and upgrading, and
- 3) country’s impact on global manufacturing.

Industrial competitiveness directly determines a country’s capacity for its own military production and the technological capability of its industry, including the military industry, thus defining which combat assets must be imported and of what quality, at the same time somewhat identifying its trading partners.

YU dummy variable refers to the export markets of former Yugoslavia’s defense industry. Namely, most capacities of the former Yugoslavia’s military industry, both for production and research, were located in the territory of Serbia. Further, as a successor to former Yugoslavia, in addition to debts and numerous obligations Serbia

also assumed arms delivery obligations arising from the previously concluded agreements. Most partners continued cooperating despite Yugoslavia changing its political identity. On the other hand, in terms of production, the relations with the factories located in the territories of the breakaway republics were completely terminated [16, p. 438], which is why these new states, although former members of Yugoslavia, are not included in the YU group.

GDP per capita (GDP pc) shows the capacity of countries for import in general.

Although common in gravity models, GDP as a variable had no statistical significance in the preliminary simple correlation in this study or in any variant of the gravity model. The reason for this is the fact that the degree of a country’s militarization is not related to the size of its economy. The “mass” of a traditional gravity model is represented by some of the previous variables: military expenditure, import of weapons and military equipment and population. All of them explain different aspects of the demand for defense industry products.

In order to select the variables, a test of multicollinearity between independent variables should be conducted (Table 1). The higher the multicollinearity, the more it reflects on the beta coefficients, due to which they are poor indicators of the relative influence of each independent variable. It is not easy to determine the acceptable level of multicollinearity, because it depends on the number of independent variables in the model and the number of correlated variables. The common approach is that correlation between several independent variables of up to 0.5 should not affect the regression coefficients, since the correlation coefficients over 0.7 are unacceptable.

Table 2: Sources and definitions of variables

| Variables | Description | Source | Unit of measurement |
|-----------|---|---|---|
| Exp | Export of the Serbian defense industry (dependent variable) | Serbian Ministry of Trade, Tourism and Telecommunications | Thousand \$ |
| Mex | Military expenditure | SIPRI | Million \$, at constant 2017 prices and exchange rate |
| Imp | Import of weapons and military equipment | SIPRI | Million \$, assessed on the basis of TIV |
| Pop | Number of citizens of importing countries | World Bank | Millions of citizens |
| D | Airway distance between Belgrade and the capitals of the importing countries | distance calculator | Kilometers |
| CIP | Competitive Industrial Performance Index is the indicator of industrial competitiveness | UNIDO | Index |
| YU | Dummy variable indicating the importing countries of former Yugoslav defense industry | Various sources | 1/0 dummy |

Source: Author.

Table 1: Multicollinearity test

| | Mex | Imp | Pop | D | CIP | GDP pc | YU |
|--------|------|-------|-------|-------|-------|--------|-------|
| Mex | - | 0.15 | 0.45 | 0.14 | 0.45 | 0.24 | 0.10 |
| Imp | 0.15 | - | 0.30 | 0.10 | -0.08 | -0.07 | 0.27 |
| Pop | 0.45 | 0.30 | - | 0.16 | 0.29 | -0.14 | -0.05 |
| D | 0.14 | 0.10 | 0.16 | - | -0.11 | 0.01 | 0.16 |
| CIP | 0.45 | -0.08 | 0.29 | -0.11 | - | 0.65 | -0.49 |
| GDP pc | 0.24 | -0.07 | -0.14 | 0.01 | 0.65 | - | -0.42 |
| YU | 0.10 | 0.27 | -0.05 | 0.16 | -0.49 | -0.42 | - |

Source: Author's calculations.

In the multicollinearity testing, GDP per capita and the CIP index have shown a high degree of collinearity (0.65) because both are basically related to the development of countries. These variables should not be found in the same model. In all the proposed models, the CIP index is included instead of GDP per capita. It suits the specific subject of research better because it refers specifically to the manufacturing sectors which include military production. The CIP index also showed lower p-value, that is, greater statistical significance. The other combinations of independent variables met the common criteria.

Model specifications

In this research, we use the gravity model to calculate the possibility of increasing the export of the Serbian defense industry. We suspect the gravity model will produce much better results when applied to a particular sector or product than to total exports determined by the coefficients that are the same for all exported products. The empirical analysis is based on an ordinary least squares (OLS) regression used to estimate the parameters of linear equations. The parameters of equations were defined by minimizing the residual sum of squares.

We will determine the coefficients for the export of Serbian weapons using a panel dataset for all 61 countries – the destinations of Serbian military exports. In most countries, the volume of arms procurement is very uneven by nature. That is why the average volume of exports for three years (2015, 2016 and 2017) is used, which is the latest data on arms exports. Since there were no exports to some countries in certain years, our sample includes 173 observations.

The variables described above will be included in the analysis by applying the stepwise selection method to the model. This is why the model specification and results cannot be clearly separated.

All the relevant variables are included in the first model. The extended gravity equation takes the following form:

$$Exp_{sjt} = \beta_0 + \beta_1 Mex_{jt} + \beta_2 Imp_{jt} + \beta_3 Pop_{jt} + \beta_4 D_{sj} + \beta_5 YU_j + \beta_6 CIP + e_i \quad (1)$$

In this combination, the D and CIP variables had high p-values (Table 3), which is why they were excluded from the following equation:

$$Exp_{sjt} = \beta_0 + \beta_1 Mex_{jt} + \beta_2 Imp_{jt} + \beta_3 Pop_{jt} + \beta_4 YU_j + e_i \quad (2)$$

The model with no dummy variables is also tested:

$$Exp_{sjt} = \beta_0 + \beta_1 Mex_{jt} + \beta_2 Imp_{jt} + \beta_3 Pop_{jt} + \beta_4 D_{sj} + \beta_5 CIP_{jt} + e_i \quad (3)$$

The subscripts *s*, *j* and *t* stand for Serbia, the trade partner of Serbia and the time period, respectively. *Exp_{sjt}* denotes military exports of Serbia to country *j* in year *t*, *Mex* is military expenditure of country *j* in year *t*, *Imp_{ij}* is the military import value of country *j* in year *t*, calculated according to the SIPRI TIV methodology, *Pop_{jt}* denotes the population of country *j* in year *t*, *D* is the distance between Serbia and the partner country, *YU_j* is the dummy variable whose value is 1 for former Yugoslavia's military export partner *j*, and *CIP_{jt}* is the Competitive Industrial Performance Index signifying the level of industrial production of country *j* in year *t*.

Empirical results

The testing of the gravity model resulted in three empirical models, all with the high coefficient of determination but different statistical significances of variables.

As already mentioned, Model 1 contains two variables, CIP and D, that are not statistically significant, CIP also having a high standard error. In Models 2 and 3, p-value of all variables is under 0.01 (Table 3); they encompass the same variables referring to military

expenditures, arms imports and population, since they have high statistical significance. Model 2 has a very strong YU dummy variable indicating complex political and diplomatic relations, which had been developed for decades. Without this dummy variable, Model 3 has a smaller determination coefficient and a slightly larger statistical error (Table 3).

Table 3: Results of the estimated gravity model

| Variables | (1) | (2) | (3) |
|----------------|-----------------------|-----------------------|-----------------------|
| Mex | 0.13*** (0.01) | 0.12*** (0.01) | 0.14*** (0.01) |
| Imp | 5.84*** (1.25) | 5.79*** (1.25) | 7.37*** (1.24) |
| Pop | -23.18*** (4.25) | -24.08*** (4.22) | -25.72*** (4.38) |
| YU | 7763.6*** (1955.4) | 8640.5*** (1732.5) | - |
| D | -0.30 (0.19) | - | -0.37* (0.20) |
| CIP | -8018.8 (8066.5) | - | -23004*** (7437.4) |
| R ² | 0.60 | 0.60 | 0.57 |
| Standard error | 9606 | 9631 | 9834 |
| F | 42.01 | 61.97 | 43.42 |
| Significance F | 0.00 | 0.00 | 0.00 |
| Observations | 173 | 173 | 173 |

Notes: ***p<0.01; **p<0.05; *p<0.1. Standard error is given in parentheses.
Source: Author's calculations.

Nonetheless, Model 3 is chosen for the estimation of export potentials. This model has more variables than Model 2, with the additional CIP index of import countries and the distance. In addition, the YU dummy is less reliable because it is actually an approximation of "important export markets". Namely, the importance of some trading partners of former Yugoslavia is not a fixed category, having changed to some extent over the decades.

Since the values of variables are not in logarithmic form, the values of coefficients show their impact on Serbian military exports expressed in thousands of dollars. An increase of \$1 million in military expenditure induces an increase of \$140 in Serbian military export. An increase of \$1 million in military import, assessed on the basis of TIV, results in an increase of \$7,370 in Serbian military export. As a variable in Serbia's export model, population indicates the potential scope of arms purchase and, as expected, has reverse causality with military exports in all three models. In the chosen third model,

population growth of 1 million results in the reduction of \$25,720 in Serbian arms exports. Distance, as usual, has a negative effect on export. Every additional kilometer of distance between the export market and Belgrade leads to a reduction of \$370 in military exports. The CIP index is also in inverse proportion to Serbian arms exports. Industrialized countries mainly produce weapons for their own use or import them from other countries that are industrially more developed than Serbia. With the growth of the CIP index of the export market, Serbian exports fall by \$23 million.

Trade potential of Serbian military exports

The trade potential index of Serbia's exports to partner countries is calculated on the basis of the third equation of Serbian bilateral exports. Model 3 includes the following variables: Mex, Imp, Pop, CIP and D. The obtained coefficients have been applied to all trading partners. The goal is to determine the existence and extent of the potential for additional military exports to these countries. The data included in the formula are: average military expenditure and SIPRI TIV imports in the three-year period, due to large annual variations, Pop derived from the population data for 2019, and the CIP index for 2018, which are the latest available data.

We will calculate the trade potential index by dividing the actual observed value for all 61 import countries by the value of the obtained research results. If the index is below 1.00, the potential for export to a trading partner is high. A lower value signifies more "room" for Serbia's export to this partner. If the trade potential index is above 1.00, Serbia's potential for military export to this partner has been fully developed. As a rule, this means that there is no potential for further improvement, at least not until significant changes occur in some of the variables. In arms exports, these changes occur in case of destabilization of security conditions, due to which countries tend to significantly increase their military spending and imports, and in case of wars which, as a rule, extremely raise these two variables.

In practice, however, the largest importers generally increase their imports much more than others, even

when there are no extraordinary circumstances, as their continued increase in the level of armament is a part of their long-term policy. Thus, the countries with seemingly fulfilled import potential import even more year by year. By contrast, the values of export potential close to zero can signify that there are some specific constraints not covered by the gravity models. Those might be the sanctions against and bans on the import of weapons imposed on a specific country, like Iran for example, or the domination of another exporter which is more competitive (China's military exports) or politically more influential (USA exports). These are not the factors that are commonly included in the model as variables, but present an insurmountable obstacle to increasing export in specific bilateral trade.

Due to all these irregularities, the export potential cannot be precisely determined this way. The obtained data on potential increase in exports to individual countries should be combined with the data on the export trends to those countries. Contrary to the theory of application of the gravity model, insights into the dynamics of military exports indicate that the countries with "too much room", i.e., with the trade potential index close to zero, should not be considered potential export markets. If exports, which are far below their potential, have stagnated or fallen over the years, the fulfilment of the statistically determined potential cannot be expected. On the other hand, if exports show an upward trend, an increase can be expected and supported, even if the index is well above 1.00. An increase in exports to the countries where exports meet both criteria, can be expected with relative security.

The results of this research show that the trade potential index is lower than 1.00 in 49 out of 61 countries, it being higher than 1.00 in the remaining countries. For the reasons stated above, in further assessment of export potential we will not include all 49 countries from the first group, nor will we eliminate the 12 countries from the second group.

We will make a small digression to illustrate the reasons for:

- 1) Elimination of a large number of markets, which statistically show high export potential (<1.00), and

- 2) Inclusion of countries that statistically show that the potential is fulfilled, that there is no more "room" to increase exports (>1.00).

The first group includes China and Russia, which produce all groups of weapons by themselves, have sufficient capacity to meet domestic demand from domestic resources and are oriented towards achieving that goal. This group also includes many countries that are predominantly importing weapons from China, such as African and Latin American countries which used to be Serbia's important export markets, and from Russia, the former USSR republics to which Serbia's exports have never been significant. It also comprises a lot of European countries with stagnant imports that can be explained by different reasons. Many European countries are also increasing the volume of arms imports from Serbia; this phenomenon is not related to the level of development, membership in NATO or the European Union. Otherwise, these countries would be included in the model as separate variables. In these countries, arms imports from Serbia cannot be expected to increase.

The second group, with theoretically "unjustifiably" large exports, includes: Germany, Bulgaria, Singapore and the United Arab Emirates. Bearing in mind the remarkable growth of military imports from Serbia in 2016 and 2017, they should be considered potential export markets, despite the fact that the export to these countries is significantly higher than the potential.

The results of further research show that in only 14 out of 49 cases with the estimated index below 1.00, there is also an increase in exports. In these 14 countries, a slight increase in exports can be expected or encouraged. We do not consider the remaining 35 countries to be potential export markets. Of course, they may become that in the future, but in certain considerably different circumstances, which Serbia cannot influence by its economic policy, diplomacy or price adjustments.

In the group of countries with the trade potential index higher than 1.00, 7 out of 12 show an upward export trend. These 7 countries will not be eliminated as potential markets, despite their high index (above 2.00, even reaching 4.00). Table 4 shows the countries that, according to these criteria, are considered significant as markets, which can be expected to increase Serbia's

**Table 4: Potential and realized Serbian military export
(million \$, according to the trade potential index)**

| Trade potential index: < 1.00 | | | | | |
|-------------------------------|------------------|-----------------|-------------|------------------|-----------------|
| Country | Potential export | Realized export | Country | Potential export | Realized export |
| Egypt | 20.0 | 18.3 | Slovakia | 6.4 | 4.8 |
| Iraq | 19.2 | 10.7 | Italy | 9.6 | 2.3 |
| S. Arabia | 41.6 | 31.7 | Poland | 7.2 | 2.9 |
| Hungary | 6.5 | 4.8 | Oman | 12.9 | 1.5 |
| Nigeria | 3.2 | 3.1 | Netherlands | 4.2 | 0.5 |
| USA | 80.4 | 81.7 | Jordan | 10.7 | 3.1 |
| Vietnam | 9.5 | 7.7 | Romania | 8.0 | 7.5 |
| Trade potential index: > 1.00 | | | | | |
| Country | Potential export | Realized export | Country | Potential export | Realized export |
| Canada | 6.6 | 7.9 | Bulgaria | 8.6 | 35.2 |
| Malaysia | 3.7 | 3.8 | Singapore | 4.4 | 6.2 |
| Myanmar | 7.3 | 8.7 | Germany | 1.6 | 3.4 |
| UAE | 15.6 | 67.5 | | | |

Source: Author's calculations.

exports. This group encompasses 21 out of 61 analyzed countries, which register an increase in imports from Serbia and have different trade potential indices (Table 4).

Conclusions

The Serbian military industry is one of the few sectors that has the potential to significantly increase the sale of its products in foreign markets. As the current level of military spending in the world is, by international standards, very high with a tendency to grow, this gives the military industry an opportunity to grow and improve. This research has identified the determinants of Serbian military exports. These are: military expenditure, import of weapons and military equipment, population, geographical distance and the CIP index as an indicator of industrial competitiveness; all of them were individually identified for the importing countries. In addition to these, the dummy variable for the most important military export markets of former Yugoslavia, which Serbia largely inherited, showed great statistical significance. These variables were applied in three different models with the high coefficient of determination, two of which showed statistical significance for all variables.

The obtained coefficients were used to assess which export markets offer most opportunities for increasing exports. The model which includes five of these variables, without the YU dummy, was applied to all the trading

partners. Based on the results of the model application, as well as the dynamics of trade with each individual country, 21 countries were identified as having real potential for the military export of Serbia. These are all its current trading partners in the Arab world, followed by some neighboring countries and countries in Eastern Europe (Bulgaria, Hungary, Romania, Poland, Slovakia), but also some of the most developed countries that have their own weapons production (USA, Germany, Italy). Most of these countries, specifically the developed countries and the Arab countries, experience continuous growth in arms imports, in general and from Serbia. Their import of arms and military equipment from Serbia will spontaneously continue the upward trend. By contrast, the neighboring countries and the countries of Eastern Europe do not have a balanced supply or a well-established import partner. Economic diplomacy, additional enhancement of Serbia's military industry and possible price adjustments or favorable terms of supply would significantly contribute to the acquisition of permanent export markets.

References

1. Anderton, Ch. H. (1995). Economics of arms trade. In Hartley, K. & Sandler, T (Eds), *Handbook of defense economics* (pp. 523-561). Amsterdam: Elsevier. Retrieved from [https://doi.org/10.1016/S1574-0013\(05\)80020-1](https://doi.org/10.1016/S1574-0013(05)80020-1).
2. Atif, R. M., Mahmood, H., Haiyun L., & Mao, H. (2019). Determinants and efficiency of Pakistan's chemical products' exports: An application of stochastic frontier gravity model.

- PLoS ONE*, 14(5), e0217210. Retrieved from <https://doi.org/10.1371/journal.pone.0217210>.
3. Đokić, K. (2018). *Defence industrial policy in Serbia: Drivers and influence*. The Armament Industry European Research Group (Ares Group), Policy Paper 31.
 4. Dunne, J., Ron, P., Smith, P., & Willenbockel, D. (2005). Models of military expenditure and growth: A critical review. *Defense and Peace Economics*, 16(6), 449–461.
 5. Harrigan, J. (2001). *Specialization and the volume of trade: Do the data obey the laws?*. NBER Working Paper, w8675. Retrieved August 24, 2020, from <https://ssrn.com/abstract=294724>.
 6. Kovačev, S., Matijašević, Z., & Petrović, J. (2006). SFRY military industrial complex. *Polemos*, 9(1), 127–203.
 7. Linnemann, H. (1966). *An econometric study of international trade flows*. Amsterdam: North-Holland Publishing Company.
 8. Mankiw, G. N., Romer, D., & Weil, D. N. (1992). A contribution to the empirics of economic growth. *The Quarterly Journal of Economics*, 107(2), 407–437. Retrieved from <https://doi.org/10.2307/2118477>.
 9. Matović, J. (2003). *Yugoslavia's military affairs and the world of the 20th century*. Belgrade: Tetra GM.
 10. Ministry of Defence of the Republic of Serbia. (2020). *Register of Producers of Weapon and Military Equipment*. Retrieved from <http://www.mod.gov.rs/lat/13582/registar-proizvodjaca-nvo-13582>.
 11. Ministry of Trade, Tourism and Telecommunications of the Republic of Serbia. (2015). *2015 Annual Report on Realization of Exports, Imports, Brokerage Services and Technical Assistance in the Field of Arms and Military Equipment*. Retrieved from https://mtt.gov.rs/download/GIZV_NVO_2015.pdf.
 12. Ministry of Trade, Tourism and Telecommunications of the Republic of Serbia. (2016). *2016 Annual Report on Realization of Exports, Imports, Brokerage Services and Technical Assistance in the Field of Arms and Military Equipment*. Retrieved from https://mtt.gov.rs/download/GIZV_NVO_2016.pdf.
 13. Ministry of Trade, Tourism and Telecommunications of the Republic of Serbia. (2017). *2017 Annual Report on Realization of Exports, Imports, Brokerage Services and Technical Assistance in the Field of Arms and Military Equipment*. Retrieved from https://mtt.gov.rs/download/GIZV_NVO_2017.pdf.
 14. Mirković, T. (2007). *Armaments and development – The impact of military consumption and military production on economic development and technical progress*. European Center for Peace and Development (ECPD).
 15. Mohlmann, J. L., Ederveen, S., De Groot, H. L. F., & Linders, G.-J. (2009). Intangible barriers to international trade: A sectoral approach. *Tinbergen Institute Discussion Paper*, 09-021/3. Retrieved from <http://dx.doi.org/10.2139/ssrn.1352265>.
 16. Radić, V. (2002). Military industry in the Federal Republic of Yugoslavia. *Military Technical Courier* 50(4-5), 430–452.
 17. Rahman, R., Shahriar, S., & Kea, S. (2019). Determinants of exports: A gravity model analysis of the Bangladeshi textile and clothing industries. *FIIB Business Review*, 8(3), 229–244. Retrieved from <https://doi.org/10.1177/2319714519872643>.
 18. Ram, R. (1995). Defense expenditure and economic growth. In Hartley, K. & Sandler, T. (Eds.). *Handbook of defense economics* (pp. 251–273). Amsterdam: Elsevier.
 19. Rauch, J. E. (1999). Networks versus markets in international trade. *Journal of International Economics*, 48(1), 7–35. Retrieved from <http://dx.doi.org/10.2139/ssrn.921392>.
 20. Shahriar, S., Qian, L., & Kea, S. (2019). Determinants of exports in China's meat industry: A gravity model analysis. *Emerging Markets Finance and Trade*, 55(11), 2544–2565.
 21. Small Arms Survey. (2020a). *Industrial production*. Retrieved from <http://www.smallarmssurvey.org/weapons-and-markets/producers/industrial-production.html>.
 22. Small Arms Survey. (2020b). *Transparency Barometer*. Retrieved from www.smallarmssurvey.org.
 23. Stockholm International Peace Research Institute – SIPRI. (2020a). *SIPRI Military Expenditure Database*. Retrieved from <https://www.sipri.org/databases/milex>.
 24. Stockholm International Peace Research Institute – SIPRI. (2020b). *The SIPRI Arms Transfers Database: Importer/Exporter TIV Tables*. Retrieved from <http://armstrade.sipri.org/armstrade/page/values.php>.
 25. Tinbergen, J. (1962). *Shaping the world economy*. New York: The Twentieth Century Fund.
 26. United Nations Industrial Development Organization – UNIDO. (2017). *Demand for manufacturing: Driving inclusive and sustainable industrial development*. Industrial Development Report 2018, Vienna.
 27. Vidović, N., Dželetović, M., & Beriša, H. (2019). Export potential of the defence industry of Serbia and the perspective of further and sustainable development. *Knowledge International Journal*, 30(6), 1599 - 1605. Retrieved from <https://doi.org/10.35120/kij30061599v>.
 28. Wei, G. X., Huang, J. K., & Yang, J. (2012). Honey safety standards and its impacts on China's honey export. *Journal of Integrative Agriculture*, 11(4), 684–693. Retrieved from [https://doi.org/10.1016/S2095-3119\(12\)60056-2](https://doi.org/10.1016/S2095-3119(12)60056-2).
 29. World Bank Indicators. (2019). *Population*. Retrieved from <https://data.worldbank.org/indicator/sp.pop.totl>.
 30. Yakovlev, P. (2007). Arms trade, military spending, and economic growth. *Defence and Peace Economics*, 18(4), 317–338. Retrieved from <https://doi.org/10.1080/10242690601099679>.
 31. Zubair, M., & Wizarat, S. (2016). *Arm export and economic growth nexus*. In International Conference on History, Politics and Global Economic Issues (HPGEI-16). London, UK. Retrieved from <https://doi.org/10.15242/ICEHM.ED1116056>.

**Nataša Stanojević**

has been working at the Center for Neighboring and Mediterranean countries of the Institute of International Politics and Economics since 2019. The most important area of her research is international economics (foreign trade, foreign investment and international economic relations) with a particular interest in the international position and challenges of transition economies in East and Southeast Europe, Russia and the post-Soviet space. Also, an important place in her research belongs to the region of the Middle East and North Africa, which is a central topic of her doctoral dissertation, numerous scientific papers and conferences and the region with which she has achieved intensive international cooperation.

She graduated in 1995 from the Faculty of Political Sciences, University of Belgrade, where she also earned her MA degree in 2003. She holds a PhD from the Faculty of International Economics in Belgrade (2007). Ms. Stanojević authored six books and monographs and 30 articles in top-ranking scientific journals and participated in international conferences in the country and abroad, among which the conferences in Tehran, Tenerife, New Delhi, Yinchuan and Belgorod stand out. Her career was previously mainly related to higher education: Faculty of International Economics, Faculty of Philology, University of Belgrade (Department of Oriental Languages, Literatures and Cultures), British Academy for Business in Belgrade. At the Faculty of International Economics, she was the coordinator of the Sector for the Middle East and North Africa and founder and first coordinator of the Iranian Center. She is a member of the Belgrade Society of Economists.