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SECTORAL FDI AND DESTINATION COUNTRY FUNDAMENTALS: IMPLICATIONS FOR SERBIA

Sektorske strane direktne investicije i fundamenti zemlje primaoca – iskustva za Srbiju

Abstract

This paper implements a new empirical framework for identifying the key host country drivers of FDI flows and studies the performance of Serbia with respect to the identified indicators at the disaggregated sector level. We propose a new method for estimating country scores based on the estimated model parameters. We apply the methods to Serbian data and identify the main potential constraints for stronger production and R&D-type FDI inflows in higher value-added sectors. While we observe some heterogeneity in the performance across different sectors, the results also point to several priorities on the policy agenda.

Keywords: *FDI, nonlinear panel, accumulated local effects, sector analysis, structural policies*

Sažetak

Ovaj rad koristi novu empirijsku metodologiju za identifikaciju ključnih fundamenata zemlje primaoca koji utiču na priliv stranih direktnih investicija (SDI) na sektorskom nivou i analizira trenutnu poziciju Srbije u odnosu na identifikovane indikatore. U radu je predložen novi metod za procenu pozicije zemlje za svaki od pojedinačnih fundamenata pomoću ocenjenih modelskih parametara. Metodologija je primenjena na poslednjim raspoloživim podacima za Srbiju u cilju procene oblasti koje predstavljaju potencijalna ograničenja za veći priliv proizvodnih SDI i SDI u oblasti istraživanja i razvoja u sektorima koji generišu veću dodatu vrednost u privredi. Dobijeni rezultati pokazuju određen nivo različitosti u performansama između sektora i ukazuju na potencijalne prioritete u daljim reformama.

Ključne reči: *SDI, nelinearni paneli, akumulirani lokalni efekti, sektorska analiza, strukturalne politike*

Introduction

Global foreign direct investment (FDI) flows have increased strongly over the last three decades. Although the history of FDI research dates back to the1960s, there has been a considerable rise in academic interest since the 2000s indicating that globalization has increased not only in momentum but also in its characteristics during the last two decades [27]. Despite the moderate global contraction of FDI flows in relation to the COVID-19 crisis, FDI remains a significant source of financing investment needs at the current stage of economic development in Serbia, whilst also contributing to higher economic growth through a variety of channels discussed in the literature (see, e.g., Balasubramanyam et al. [5], Popovici [28], Ramondo et al. [29], Saurav & Kuo [32]). FDIs also played an important role in maintaining the sustainable external position of Serbia and helped ease the depreciation pressures, especially in times of increased uncertainty during the pandemic and recent episodes of increased inflation pressures. Enhancing FDI flows remains one of the key priorities on the policy agenda in Serbia and other emerging and developing economies. Identifying the key host country drivers of FDI flows and implementing policies to address detected constraints for FDI are the main elements of the pro-active policy approach.

The set of potential drivers or constraints discussed both in the economic literature and in policy and business practice is overwhelmingly large (see, e.g., Blonigen & Piger [8], Eicher et al. [13], Saurav & Kuo [32]), from traditional sources of a country's comparative advantage, such as endowments (production factors in the Heckscher-Ohlin framework), extended to institutional quality, to the more recent focus of the literature on the policy-amenable drivers of business and investment climate. The latter on its own includes a large number of potential barriers: i) undeveloped infrastructure (energy, telecommunications, transport, and logistics) and business enabling services (financial sector), which can hinder production capacity and/or increase trade costs; ii) inefficient government policies, which lead to various types of distortions in the economy (product and factor market conditions, property rights protection, general rule of law, ease of firm entry and exit, the presence of tariff and non-tariff barriers, distortive tax regimes); iii) policies that affect overall macroeconomic and political stability; iv) policies targeting specific types of investment or trade promotions.

While the cross-country determinants of FDI flows have been extensively studied in the literature with a focus on a particular narrow set of drivers, only a handful of studies (e.g., Blonigen & Piger [8]; Eicher et al., [13]) examined a broad set of potential determinants arising from economic theory, yet without providing inference on the estimated parameters of the empirical model. The ability to understand which variables, among a large number of indicators, are the statistically significant forces of the effects that we observe in reality is of the utmost importance for efficient decision-making at both the firm and economic policy levels. In this paper, we build upon the recent methodology proposed by Maur et al. [24], who introduced a new method for statistical inference in empirical models for FDI with a large number of explanatory variables. Maur et al. [24] considered more than 190 potential indicators of the host country characteristics in the worldwide sample along all policy-relevant dimensions and identified a subset of statistically significant drivers of FDI flows. We extend their results and study the performance of Serbia with respect to the identified indicators at the disaggregated sector level.

We find mixed results in studying the current state of indicators for attracting production and research and development (R&D) types of FDI in 20 broad sectors in Serbia. We also observe, to a certain extent, a heterogeneity in the performance across different sectors. Serbia performs well in trade openness indicators (tariffs and non-tariff measures), labor force educational level, and the general government net lending dimensions, on average across the different sectors. It displays moderate performance with respect to different indicators of macroeconomic stability, corporate tax regime, and domestic trade policies. Labor force size, political stability, the soundness of the domestic financial system, and the existing logistics infrastructure are areas that, on average, represent a constraint for stronger FDI flows across different sectors. Institutional quality, urban depopulation, and domestic scientific and technical capacity are identified

as the areas that present the largest constraints for FDI in multiple sectors.

The results contribute to the literature in two principal ways. First, we extend the existing empirical work to the case of Serbia, along with proposing an alternative method for the construction of country scores based on the estimated model parameters. Second, our results contribute to the policy discussion and prioritization of measures to alleviate constraints for stronger FDI inflows in Serbia. We focused our analysis on production and R&D types of FDI flows in higher value-added sectors given their stronger expected effect on the domestic economy, especially considering the recent, post-pandemic, shift towards the nearshoring of such types of FDI. The results can be easily applied to all other types of FDI activities or other sectors.

The remainder of the paper is structured as follows: The next section outlines relevant literature. The following section sets the conceptual framework, including a short discussion of the empirical approach of Maur et al. [24]. The subsequent section presents the data. The results and their discussion are provided before the concluding section.

Literature review

The literature studying the motives for locating production abroad distinguishes between two principal types of FDI: horizontal and vertical. Horizontal FDI theory assumes that a firm may want to locate production in the destination market to save on costs of supplying the market, such as tariffs or transport costs; this type of FDI assumes building duplicate plants in a foreign location in order to supply the host country market. Horizontal FDIs are therefore primarily motivated by the size of the destination market and potential impediments to trade. In contrast to horizontal FDI, the literature has emphasized comparative advantage across countries as a motive for the foreign location of some stages of production; this mode is known as vertical FDI. In this case, intra-firm trade between parents and affiliates producing vertically linked goods is a complement of FDI. In essence, vertical FDI leverages low factor prices in host countries to reduce production costs [29]. Vertical FDIs are primarily oriented towards export and tend to be unaffected by the size of the local market [23].

The other stream of literature, the growth theory, is focused on the role of FDI in the economic growth of the host country [5], indicating that improvements in technology, efficiency, and productivity spillovers coming from FDI should contribute to growth in the host country. FDI plays a significant role in transferring advanced technology, knowhow, management practices, and expertise from developed to developing countries, enhancing productivity, stimulating innovation, and upgrading local industries in the recipient country [1]. Moreover, FDI inflows contribute to capital formation, infrastructure development, and job creation, thereby bolstering domestic investment, consumption, and economic activity [23]. In addition, FDI inflows are associated with improvements in the labor market [3], the deepening of trade linkages [32] and fostering competitive pressures and market efficiencies, prompting domestic firms to improve their performance and adopt more efficient production methods. Conversely, the literature also identifies several potential negative effects of FDI on economic growth [7]: FDI may exacerbate income inequality and distort resource allocation by favoring capital-intensive sectors and large multinational corporations over small and medium-sized enterprises (SMEs) and local businesses. Furthermore, FDI can intensify the "resource curse" phenomenon, whereby countries rich in natural resources attract FDI that fails to translate into sustainable economic development due to governance challenges, corruption, and Dutch disease effects. Additionally, FDI may crowd out domestic investment or hinder the development of indigenous technological capabilities, especially in cases where foreign affiliates operate in a siloed environment, isolated from the local economy. Overall, the mixed empirical evidence on the association of FDI for economic growth (see, e.g., survey in [23]), also underscores the importance of effective policy frameworks, institutional reforms, and regulatory safeguards to mitigate potential risks and maximize FDI's positive contributions to sustainable development [25].

Motivated by alternative FDI theories, there arises a vast empirical literature investigating the drivers of FDI indicating size [36] and growth potential of the host

country [37], economic and political stability [33], [35], the market openness [34], tax policies [35], as well as quality of institutions [9] as main potential drivers of FDI. However, the literature has not yet reached the consensus on the key determinants of FDI, and the estimated coefficients on different destination country fundamentals tend to be ambiguous and sometimes contradictory [13], [22], [23], [26]. Using systematic literature review methodology, Islam & Beloucif [17] for example showed that the size of the host market is the most robust determinant, followed by trade openness, infrastructure quality, labor cost, macroeconomic stability, human capital, and the growth prospect of the host country. Market size is highly significant in all studies in their review, indicating that most of the world's FDI are market-seeking. Conversely, Balasubramanyam et al. [5] and Sekkat & Venganzones-Varoudakis [34] find trade openness to be the main driver of FDI. The subset of important determinants of FDI may also vary depending on the level of development of the economy. For example, Popovici et al. [28] find trade openness as the main determinant of FDI, while the rest of the determinants may vary for the high-income (their prospects for growth and infrastructure development), middle-income (quality of institutions and stability of the macroeconomic environment), and low-income economies (highly educated labor force). Dollar et al. [11] use surveys from 8 countries to assess the impact of policies affecting investment climates on firm international trade integration. Blonigen & Piger [8] use Bayesian Model Averaging of 56 potential covariates with FDIs, which include measures related to GDP, labor endowments, capital, land and natural resources endowments, trade openness, FDI and investment climate, tax policy, communication infrastructure, financial infrastructure, policy environment, as well as dyadic variables commonly included in gravity models: distance, cultural proximity, and geographic proximity measures. The results find a narrower set of variables (between 7 and 16) with a high inclusion probability as a predictor of FDI, thus suggesting that a parsimonious model could explain FDI outcomes. They find little support for policy variables controlled by the host country (such as multilateral trade costs, business costs, infrastructure, or political institutions) that influence FDI, with an exception for bilateral trade and investment policies. Bergstrand & Egger [6], Head & Ries [16], and Dorakh [12] use gravity models for testing potential determinants of FDI.

Increasing availability of firm level data has motivated more recent research on the firm-level determinants of FDI. Key firm-specific dimensions include research and development (R&D) potential and investment, human capital, differences in input costs, market costs and financial policies. However, similar to macro-level research, the literature has not yet reached consensus on the subset of key determinants. Sarker & Serieux [31] found that FDI depends on both firm- and country-level factors in the host countries, the set of firm level data is narrowed to communication, finance, and corporate governance quality, while Lee [21] distinguished innovation capabilities measured by R&D intensity and marketing capabilities measured by selling, general, and administrative intensity.

The recognized potential positive growth effects of FDI has motivated growing literature on the analysis of specific determinants of FDIs in the region of Western Balkans and Serbia [30]. The importance of government in stimulating the inflow of FDI is recognized by Arandjelovic & Petrovic-Randjelovic [4] and Jirasavetakul & Rahman [18], while the positive impact of tax incentives on the choice of a country as an investment destination is shown in Domazet et al. [10]. Analyses of FDI determinants in Visegrad Group and Serbia [20] indicate that external factors such as the overall business environment, economic crisis, political risks, positions in relevant institutions, and shocks such as pandemics determine the overall volume of FDI as well. Kastratovic & Loncar [19] analyze the effectiveness of bilateral investment treaties in promoting FDI outflows using a gravity model based on panel data for Serbia and 147 partner economies. The results show that bilateral investment treaties as well as unilateral liberalization of the FDI regime in the host country are positively affecting outflows of foreign direct investment from Serbia.

In this paper, we contribute to the literature by analyzing the position of Serbia based on the subsample of statistically significant indicators of FDI, which is chosen among more than 190 potential indicators of the host country's characteristics, relying on and extending the methodology proposed in Maur et al. [24].

Conceptual framework

The decision to undertake foreign direct investment, therefore, is a result of the complex analysis of the company's internal and external environment. The external environment includes both push (global/source country level) and pull (host country level) fundamentals. The empirical literature that studies country-level drivers of FDI flows surveyed above typically focuses on one or a small subset of potential FDI drivers and tests whether the estimated empirical relations corroborate with theoretical models. From the host country's policymaker's perspective, such approaches are relevant for the goal of testing how concrete policy measures are expected to impact future FDI inflows. However, empirical approaches that include a subset of potential FDI drivers are of limited policy use if the goal of the policymaker is to identify all areas in the domestic economy that may constitute a constraint for FDI inflows.

An alternative, quick-win policy approach has been different benchmarking indicators, such as the Global Competitiveness Indicator (GCI) series prepared annually by the World Economic Forum, the Distance to Frontier (DtF) approach of the now-infamous Doing Business indicators, or global or regional enterprise and investment climate surveys. The benchmarking indicators offer a readily available and comprehensive set of data that maps the country's performance in a particular indicator dimension vis-à-vis its global peers. However, the indicators do not enable formal assessment of whether they are actually important for FDI flows in a given sector, which value of the indicator constitutes the alarm for policymakers, and how the indicators interact with each other, limiting their usage for policymaking.

Maur et al. [24] proposed a new empirical approach targeted at addressing the shortcomings of both strands of literature. The approach starts with a large set of potential host country indicators of FDI inflows and, using recent advancements in econometric and machine learning literature, provides a new inference procedure for high-dimensional nonlinear panel data models typically employed in the analysis of FDI inflows. In this way, a manageable subset of statistically significant indicators can be obtained without restricting the set of potential indicators a priori.

In particular, nonlinear panel data models with individual effects ($i = 1, 2,..., j = 1, 2,..., N$) have the following representation:

$$Y_{i,j} = g\{\alpha_i + \gamma_j + \Sigma_{p=1}^{K} \beta_p W_{i,j}^{p} \geq \varepsilon_{i,j}\}, \varepsilon_{i,j} \mid W_{i,j}, \alpha, \gamma \sim F_{\varepsilon} \quad (1)$$

where function $g()$ is typically the indicator function, and error distribution is typically a logistic cumulative distribution function (CDF) or a standard normal CDF (in which cases the dependent variable $Y_{i,j}$ is binary). Other choices are also possible. Parameters α_i and γ_j are individual effects, and we are interested in estimating and conducting inference on the parameters β_p for a potentially large number K of explanatory variables $W_{i,j}^{p}$. The proposed algorithm estimates the unknown parameters and provides a method for inference on the estimated coefficients, building upon recent work on estimation and inference in nonlinear panel data models [15] and inference in high dimensional models [14]. The algorithm is as follows:

1) Split randomly the data (with no replacement) with respect one panel dimensions (say, N_1 and N_2) while maintaining the panel structure along the second dimension.
2) Use XGB algorithm (or alternative machine learning algorithms) to find the subset W^Q of the Q best predictors of $Y_{i,j}$ in the first subsample (keeping the fixed effects among the predictors).
3) Run separate nonlinear panel regression models for each explanatory variable on the second subsample using W^Q from step 2 as the additional regressors in these estimations.
4) Use analytic bias correction proposed in Fernandez-Val and Weidner [15] on the coefficient estimates from step 3.
5) Repeat the steps 1-4 M times.
6) Take the empirical mean from M random splits to get the final estimate $\widehat{\beta_p}$.

$$\widehat{\beta_p} = \Sigma_{m=1}^{M} \widehat{\beta_{p,m}} \quad (2)$$

7) Obtain the standard errors and the confidence intervals using nonparametric delta method (Efron, 2014) from the empirical distribution of $\widehat{\beta_{p,m}}$.

The algorithm efficiently controls for three types of bias which may be present in the estimated parameters, for more discussion please refer to the paper.

Applying the algorithm to 190 potential destination country drivers of FDI flows for 116 countries and 245 sectors over the 2010-19 period, Maur et al. [24] identified a subset of statistically significant drivers of global FDI flows. The drivers included destination country characteristics in all dimensions that foreign investors could potentially explore in their analysis. The indicators include variables that are policy-amenable over the short or medium run, as well as country fundamentals such as GDP growth or population size. The latter indicators may not be under the direct influence of policymakers in the short run; however, they sublime the effects of multiple policy initiatives and are also relevant preconditions for maximizing the effect of more focused policy initiatives. The empirical model displays strong forecasting performance, reaching an area under the ROC curve value of 0.92 in prediction of future FDI inflows over the five-year span.

In this paper, we extend the estimated model to Serbian data. Based on the estimated parameters and available data, our goal is to understand how Serbia performs along each statistically significant indicator of the country's attractiveness for FDI. Hence, we want to define a traffic light system that will map the actual value of the indicator for Serbia over the most recent period to the score on the scale between one and five, taking into account the estimated parameters from the global model sample and all interdependencies between the variables. In this way, we can obtain a transparent and easy-to-use identification of areas where Serbia performs well (score values of the indicator equal to four or five), where it has moderate performance (the score equals three), and where the constraint for stronger FDI inflows is present (the score equals one or two).

For calculating the scores at the sector level, we need to define four sector-specific boundary values for each statistically significant variable. These boundary values should be defined in the way that projects the space of all possible values the variable can take into five regions, which are: i) similar enough within the region and ii) dissimilar enough between the regions with respect to the estimated probability of receiving FDI in the sector. In addition, we need that the measure of probability is monotonically increasing going from the first to the last region and that it is a function of all model parameters.

To satisfy the required conditions, we combine a measure of nonparametric accumulated local effects (ALE) introduced by Apley and Zhu [2] with the K-means clustering algorithm to arrive at estimates of sector-specific boundary values for each variable. Using simulation methods, ALE produces a monotonically increasing estimate of the model probability of receiving FDI for any potential value ("local value") of the variable of interest, integrating out the effects of other variables on probability. Once we have the estimated ALE for all potential values of variables, we apply the K-means clustering approach to obtain the boundaries of the relevant regions. The algorithm is the following:

1) Load estimated model parameters.
2) Load data for all countries, and for each variable, calculate the worldwide minimum and maximum.
3) For each variable and sector, estimate ALE using 1,000 simulations on the range of values defined in step 2.
4) Apply K-means clustering on ALE realizations to get the boundary values for regions.
5) Repeat steps 3-4 for each variable and sector.

The result of the algorithm is the set of boundary values for each variable and sector pair, which we use later to obtain the scores for Serbia.

Table 1 provides an example of the estimated boundary values for one selected variable (GDP growth: five-year ahead average forecast) and for production and R&D types of FDI inflows in three sectors each. Depending on the estimated model parameters and sector characteristics, the boundary points may differ, as we see in the table. The boundary points are used to assign scores. For example, a country with a 5-year GDP growth forecast of 3.5% will receive a score of 3 for FDI flows in auto components (the actual value is higher than the second boundary point but lower than the third), but a score of 2 for FDI flows into biotech R&D. The heterogeneity in the boundary point values reflects the estimated differences in importance of

each variable for FDI inflows in a particular sector in the global sample.

Data

The data for country-level indicators over the 2018-2023 period primarily comes from the World Bank's TCdata360. The unique source of the data is used for data consistency purposes. Data for several macroeconomic indicators that were incomplete in the TCdata360 database is obtained from the IMF's World Economic Outlook (WEO) database. In line with the econometric approach used in Maur et al. [24] the raw annual indicator data is transformed into five-year averages over the most recent available period to mitigate the effects of cyclical fluctuations and pandemic-related potential outliers, thereby focusing on more structural changes in the indicators.

Our definition of sectors for FDI inflows is close to definition of sectors used by the Financial Times. We look at 35 granular sectors and also distinguish between potential types of FDI activities (production, research and development, customer service, retail, logistics, and others).. We focus our analysis on a subset of high-value-added sectors and on production and R&D types of FDI activities, given their relevance for achieving sustainable high economic growth rates through positive productivity spillovers, technology transfers, and deepening of trade linkages [32]. The results for other sectors and types of FDI activities are available from the authors.

Results and discussion

This section presents the estimated scores for each sector, FDI activity, and destination country indicator. Please recall that scores equal to one or two indicate that Serbia is performing relatively poorly in this dimension, constituting a potential constraint for higher FDI inflows. A score equal to three indicates moderate performance with some potential for improvement, while scores equal to four or five imply good performance with a small margin for further improvement. To ease interpretation, the scores are also reported in different colors. We first present the results for production-oriented FDIs and later for R&D FDI types.

We consider the indicators which are identified as statistically significant drivers of global FDI flows in Maur et al. [24]. The indicators, presented in Table 2, are grouped into nine types, reflecting their underlying characteristics and potential effects or motives for foreign investors: domestic demand size, production factor capacity, production support, taxes and regulatory barriers, rule of law, foreign trade contestability, home market contestability, macroeconomic and political stability, and past FDI performance. Higher values of some indicators may increase the likelihood of FDI inflows (such as, for example, domestic demand size for FDIs aimed at primarily serving the domestic market or production factor capacity variables for any types of FDI).

On the other hand, higher values of some indicators indicate potentially higher costs and/or uncertainty for investment and will have a negative effect on the FDI probability (for example, cost to import or export, tax rates, inflation). To avoid ambiguity, all values of the indicators are scaled in such a way that the higher assigned scores indicate more favorable conditions for investment.

Figures 1-2 present the results for production-type FDIs. Although for most indicators we observe some heterogeneity in the estimated scores across the sector,

Table 1: Example of estimated boundary points for selected sectors and one variable

Variable: GDP growth 5Y forecast (percentage)	FDI inflows					
	Production type			R&D type		
Boundary point	Auto components	Auto OEM (manufacturers)	Consumer products	Biotech	Communications	Industrial equipment
One	2.023	2.600	1.916	3.163	2.600	1.440
Two	3.371	4.159	4.000	4.000	3.706	2.600
Third	4.260	5.544	5.059	5.131	4.711	3.706
Four	6.303	6.940	6.669	6.452	6.117	5.317

Source: Authors' calculations

Note: The table reports estimated boundary points (rows) for sectors defined in columns for two types of FDI inflows and selected variable.

the results, on average, provide some guidance on areas which require policy attention.

The achieved trade openness does not represent a constraint for FDI inflows across the sectors, as the score for foreign trade contestability and past FDIs is generally above 4 (or even 5) for all indicators in this group, with some exceptions in the case of tariff rates, for which the estimated score is 3. Serbia also scores relatively strongly on taxes and regulatory barriers related to registering property, with an average score close to 4. The labor tax and contributions are areas within this dimension which could benefit from some improvements to further increase the attractiveness of FDI in the majority of sectors, as the obtained score is largely equal to 3.

We observe some heterogeneity in the scores for macroeconomic and political stability indicators. While

Table 2: The list of statistically significant destination country indicators

Type	Indicators
Domestic demand size	GDP growth (5Y forecast, %); Final consumption expenditure (% of GDP)
Production factors capacity	Labor force size (total); Tertiary education enrollment (gross %); Urban population (% growth); Industry value added (% growth); Scientific and technical journal articles (total)
Production support	Logistics performance index (1-5); Soundness of banks index (1-7)
Taxes and regulatory barriers	Labor tax and contributions (% of profit); Profit tax (% of commercial profits); Total tax & contribution rate (% of commercial profits); Time to pay taxes (hrs/year); Cost of registering property (% of property values)
Institutions: rule of law	Judicial independence index (1-7); Commencement of proceedings to resolve insolvency index (0-3)
Institutions: foreign trade contestability	Cost to Import: Documentary Compliance (USD); Cost to Export: Border Compliance (USD); Cost to Export: Documentary Compliance (USD); Tariff rate, most favored nation (simple mean all products, %)
Institutions: home market contestability	Prevalence of trade barriers (1-7); General government final consumption expenditure (% of GDP)
Macroeconomic and political stability	Inflation, consumer prices (annual %); General government gross debt (% of GDP); General government net lending/borrowing (% of GDP); Political Stability No Violence index (-3 to 3)
Past FDI	Foreign Direct Investment: Inward stock (USD per capita)

Source: Authors' calculations based on [25]

Figure 1: Estimated scores for production type FDIs (first part)

	Sectors									
Indicator	Auto components	Auto manufacturers	Beverages	Biotech	Building materials	Business equipment	Chemicals	Communications	Consumer electronics	Consumer products
GDP growth: 5Y forecast	3	2	3	4	2	4	2	4	3	3
Final consumption expenditure	3	3	3	4	3	4	3	4	4	3
Labor force, total	3	3	2	1	2	2	3	2	3	3
Tertiary education enrollment	4	4	4	4	4	4	5	4	3	4
Labor tax and contributions	3	3	3	3	3	3	3	3	4	3
Urban population growth	1	1	1	1	1	1	1	1	1	1
Industry, value added growth	3	3	3	3	3	3	3	3	3	3
Scientific and technical journal articles	2	2	2	3	2	2	3	2	3	3
Logistics performance index	3	3	2	2	3	2	3	2	3	3
Soundness of banks	2	3	3	2	2	2	3	3	3	2
Profit tax	4	3	3	4	3	4	4	3	3	3
Total tax and contribution rate	3	3	4	4	3	3	3	4	4	3
Time to pay taxes	3	3	4	3	4	3	4	3	4	4
Registering property: Cost	4	4	4	3	4	4	4	4	4	4
Commencement of proceedings to resolve insolvency	3	3	2	3	2	1	2	3	4	3
Judicial independence	2	2	2	2	2	2	2	2	2	2
Cost to Import: Documentary Compliance	5	5	5	5	5	5	5	5	5	5
Cost to Export: Border Compliance	5	5	5	5	5	5	5	5	5	5
Cost to Export: Documentary Compliance	5	5	5	5	5	5	5	5	5	5
Prevalence of trade barriers	3	3	4	2	3	2	3	2	2	3
Tariff rate, most favored nation	4	3	4	3	4	4	3	4	4	4
General gov. final consumption expenditure	3	4	3	2	3	3	3	3	3	3
Inflation, consumer prices	4	3	3	4	3	3	4	3	3	3
General government net lending/borrowing	4	4	4	4	4	5	4	4	4	4
General government gross debt	2	3	2	3	2	3	2	3	3	2
Political Stability: No Violence	3	3	3	2	3	2	3	2	2	3
Foreign Direct Investment: Inward stock	4	4	4	4	4	4	4	4	4	4

Source: Authors' calculations

the achieved fiscal prudence has positive effects on FDI inflows with a high score across the sectors, general government gross debt (as a percentage of GDP), despite recent contractions, is still at levels suggesting a potential small constraint for future production FDI flows, which should be monitored further. The estimated scores for the home country's political environment indicator also imply some room for improvement.

Analogously, production factors and capacity indicators display different behaviors. Serbia scores highly along tertiary education enrollment and relatively moderately with respect to domestic industry value-added growth, indicating a certain capacity to attract high-value-added FDIs. On the other hand, it scores below average with respect to the measure of scientific advancements (scientific and technical journal articles), which received a score of two for multiple sectors. The current size of the labor force presents a potential moderate constraint for FDI flows, receiving an average score between two and three, yet future labor dynamics, approximated by urban population growth, indicate a potential significant constraint for FDI, receiving the lowest score consistently across the sectors.

Serbia scores moderately with respect to the production support dimension, with the logistics quality and the soundness of the domestic financial system receiving mixed scores between two and three. The latter may be of less importance in the case of large FDIs, as foreign companies, given their significant exposure to the international financial system, are in a position to internalize the presence of these types of constraints. Conversely, despite some progress in insolvency regulation and de facto procedures, the institutional quality of the rule of law still represents a constraint for FDI inflows, receiving a score equal to two for the judicial independence index proxy. Domestic demand size, on average, does not represent a significant constraint for this type of FDI inflow, which is primarily export oriented.

Figures 3-4 present the results for R&D-type FDIs. The results are broadly qualitatively similar to the results for production-type FDIs. The indicators related to export and import costs, fiscal stability, and tertiary education enrollment still receive high scores, with slightly higher variation across the sectors. The labor force dynamics and the rule of law indicators remain the most important identified constraints for FDI inflows. In addition, the scores

Figure 2: Estimated scores for production type FDIs (second part)

	Sectors									
Indicator	Electronic compo-nents	Engines & turbines	Industrial equipm	Medical devices	Pharma-ceuticals	Plastics	Renewable energy	Rubber	Semi-conductors	Wood products
GDP growth: 5Y forecast	2	4	2	3	2	3	4	3	4	4
Final consumption expenditure	3	5	3	4	3	3	4	4	5	4
Labor force, total	3	2	3	2	3	2	3	2	2	2
Tertiary education enrollment	4	4	4	4	4	4	4	4	3	4
Labor tax and contributions	3	3	3	3	3	3	4	3	4	3
Urban population growth	1	2	1	1	1	1	2	1	1	2
Industry, value added growth	3	3	3	3	3	3	3	3	3	3
Scientific and technical journal articles	3	4	3	2	3	2	2	3	2	2
Logistics performance index	3	2	2	2	3	2	2	3	2	2
Soundness of banks	3	3	2	2	2	2	2	3	2	3
Profit tax	4	4	3	3	4	4	4	3	4	3
Total tax and contribution rate	3	4	3	4	3	4	4	4	4	3
Time to pay taxes	4	3	3	3	3	4	3	4	3	4
Registering property: Cost	4	4	4	4	4	5	4	4	4	4
Commencement of proceedings to resolve insolvency	3	4	2	3	3	3	3	2	4	3
Judicial independence	2	2	2	2	2	3	2	2	2	2
Cost to Import: Documentary Compliance	5	5	5	5	5	5	5	5	5	5
Cost to Export: Border Compliance	5	4	5	5	5	5	5	5	5	5
Cost to Export: Documentary Compliance	5	5	4	5	5	5	5	5	5	5
Prevalence of trade barriers	3	3	3	3	3	3	2	2	2	3
Tariff rate, most favored nation	4	3	4	4	4	4	4	4	4	4
General gov. final consumption expenditure	4	3	3	3	3	3	3	3	4	2
Inflation, consumer prices	3	2	4	4	4	4	3	4	3	3
General government net lending/borrowing	4	3	4	4	4	4	5	4	4	4
General government gross debt	2	3	2	3	2	2	3	2	3	3
Political Stability: No Violence	3	2	4	3	4	3	3	3	2	3
Foreign Direct Investment: Inward stock	4	4	4	4	4	4	4	4	4	4

Source: Authors' calculations

for the logistics performance index decreased, implying stronger constraints in multiple sectors.

The presented results convey several important policy implications. First, the obtained estimates suggest that FDI investors may give different importance to particular dimensions of the host economy depending on the sector in which they invest and the type of FDI. Therefore, while improving general investment and institutional climate is expected to be beneficial for the entire economy, the sequencing of the reforms may have disproportional effects on individual sectors, depending also on their importance for the economy. Second, and in line with the recent reform focus, trade openness, macroeconomic fundamentals, and regulatory barriers related to property registration contribute positively to FDI dynamics across the sectors. Third, the labor force dynamics already constitute a potential barrier to higher FDI inflows, with even stronger negative effects expected in the future. The weak performance in the scientific work points to an additional dimension of the constraint. The policymakers can address these constraints through a combination of policies yielding short-term wins and long-term sustainable progress, including a more open immigration regime for highly skilled workers to address skills shortages, additional reforms to support scientific and technical research through different incentive schemes for researchers, and further support for partnership programs between the companies (both domestic and foreign) and research institutions. Moreover, relatively low scores for logistics performance indicate a potentially negative effect of high logistics costs on FDI. Such developments call for short-term initiatives which policymakers can consider to overcome shortcomings in this area, such as spatial solutions to reduce transport costs and disadvantages related to remote locations. Fourth, institutional quality, especially with respect to the rule of law, remains one of the largest constraints for FDI flows. The improvements and changes in the de jure and de facto institutional strength, in addition to strengthening the domestic economy, are also expected to have strong positive effects on future FDI flows.

Conclusions

The role of FDI as an important factor contributing to the economic growth, employment, and sustainable external position of developing economies has been largely recognized by the literature. Over the past several decades, emerging and developing economies have been making increasing efforts to position themselves as attractive host

Figure 3: Estimated scores for R&D type FDIs (first part)

	Sectors								
Indicator	Auto components	Auto manu-facturers	Biotech	Business equipment	Business services	Chemicals	Commu-nications	Consumer electronics	Consumer products
GDP growth: 5Y forecast	3	3	3	4	3	3	3	3	3
Final consumption expenditure	5	4	5	5	4	4	3	4	4
Labor force, total	2	3	2	3	3	2	3	2	3
Tertiary education enrollment	3	4	4	4	5	4	4	4	4
Labor tax and contributions	3	3	3	3	3	3	3	3	4
Urban population growth	1	1	1	1	1	1	2	1	1
Industry, value added growth	3	3	3	3	3	3	3	3	3
Scientific and technical journal articles	4	3	2	3	2	3	2	4	3
Logistics performance index	2	2	2	1	3	2	2	2	2
Soundness of banks	3	3	2	2	2	3	2	2	3
Profit tax	3	3	2	4	3	3	3	4	2
Total tax and contribution rate	4	4	3	4	3	4	4	4	5
Time to pay taxes	3	3	3	3	3	4	3	3	3
Registering property: Cost	3	3	5	5	4	5	5	3	5
Commencement of proceedings to resolve insolvency	3	3	4	4	3	3	3	3	3
Judicial independence	2	2	2	2	2	2	3	2	2
Cost to Import: Documentary Compliance	4	4	5	5	5	5	5	5	5
Cost to Export: Border Compliance	5	5	5	5	5	5	5	5	5
Cost to Export: Documentary Compliance	5	5	5	5	5	5	4	5	5
Prevalence of trade barriers	2	3	2	2	3	2	2	3	2
Tariff rate, most favored nation	4	3	4	4	4	4	4	3	4
General gov. final consumption expenditure	3	2	4	4	3	2	3	3	3
Inflation, consumer prices	3	3	3	3	4	3	3	2	2
General government net lending/borrowing	4	4	4	4	4	4	4	5	5
General government gross debt	2	3	3	3	2	3	3	3	3
Political Stability: No Violence	2	3	2	3	3	2	3	2	2
Foreign Direct Investment: Inward stock	4	4	4	4	4	4	4	4	4

Source: Authors' calculations

countries for foreign investments. The countries used a variety of different policies, including different types of subsidy schemes, to attract foreign investors. The state of destination country fundamentals, however, remains the key determinant of average FDI inflows and should represent the focus for policymakers considering policies to maximize the positive effects of FDI flows.

The increasing availability of large volumes of economic, financial, and various other types of data (the "big data" paradigm) has allowed policymakers to advance their understanding of many relevant questions. However, the proliferation of data made the interpretation of the uncovered economic relations more complicated. The "black box" character of modern artificial intelligence (AI) and machine learning (ML) models, while particularly suitable for improving the predictions of economic relations of interest, has posed a significant obstacle to utilizing these models in effective economic policy.

In this paper, we implemented a new empirical framework for identifying the key host country drivers of FDI flows and studied the performance of Serbia with respect to the identified indicators at the disaggregated sector level. The framework bridges the gap between the typical focus on one or several policy dimensions in the empirical FDI literature and the lack of statistical rigor in the big data policy benchmarking literature, enabling the identification and analysis of multiple policy-relevant dimensions.

We focused our analysis on the production and R&D types of FDI inflows in twenty high-value-added sectors in Serbia. Building upon the estimates from the global sample of countries and sectors, we outlined a method for identifying whether individual policy dimensions constitute a potential constraint for FDI inflows in a given sector.

The results reveal a certain level of heterogeneity in the current performance of specific policy dimensions across the sectors. Aggregating the results, we obtained that trade openness, labor force educational level, and fiscal policy are policy dimensions in which Serbia performs well and does not represent a constraint for FDI inflows in the majority of considered sectors. Moreover, the results imply that Serbia displays moderate performance with respect to different indicators of macroeconomic stability, corporate tax regime, and domestic trade policies, with some room for potential improvements. Current labor force size, political stability, and the existing logistics infrastructure are areas that tend to present constraints for stronger FDI flows in multiple sectors. Institutional quality, depopulation trends, and domestic scientific and technical capacity are identified as the areas that present

Figure 4: Estimated scores for R&D type FDIs (second part)

	Sectors								
Indicator	Electronic components	Engines & turbines	Industrial equipment	Medical devices	Pharmaceutic ls	Plastics	Rubber	Semi-conductors	Software & IT services
GDP growth: 5Y forecast	3	5	4	4	4	4	4	4	3
Final consumption expenditure	5	5	4	5	5	4	5	4	3
Labor force, total	2	3	2	2	4	3	3	2	3
Tertiary education enrollment	4	4	4	5	4	4	4	4	5
Labor tax and contributions	3	3	3	4	3	3	4	3	3
Urban population growth	1	1	1	1	1	1	1	1	1
Industry, value added growth	3	4	3	4	3	3	3	3	3
Scientific and technical journal articles	3	2	3	2	2	2	4	3	3
Logistics performance index	2	1	2	1	2	1	1	1	3
Soundness of banks	3	1	3	2	2	2	3	3	2
Profit tax	3	4	3	2	4	4	2	3	3
Total tax and contribution rate	4	4	4	4	4	4	4	4	3
Time to pay taxes	3	3	3	3	2	4	3	3	4
Registering property: Cost	5	4	4	5	5	5	5	4	4
Commencement of proceedings to resolve insolvency	3	3	3	3	3	3	4	4	3
Judicial independence	2	1	2	2	2	2	2	2	3
Cost to Import: Documentary Compliance	4	5	5	5	5	5	5	5	5
Cost to Export: Border Compliance	5	5	5	5	5	5	5	5	5
Cost to Export: Documentary Compliance	5	5	5	5	5	5	5	5	5
Prevalence of trade barriers	2	2	2	2	2	2	2	2	4
Tariff rate, most favored nation	3	4	4	3	4	4	3	4	4
General gov. final consumption expenditure	3	4	3	4	4	3	2	3	3
Inflation, consumer prices	3	2	3	3	2	2	3	4	4
General government net lending/borrowing	4	4	4	4	4	4	4	4	4
General government gross debt	3	3	2	4	3	3	4	3	2
Political Stability: No Violence	3	3	3	3	2	3	2	2	3
Foreign Direct Investment: Inward stock	4	4	4	4	4	4	4	4	4

Source: Authors' calculations

the largest constraint for FDI in multiple sectors and call for policymakers' attention.

Our results can be extended to multiple areas. We focused our analysis on production and R&D types of FDI flows in high-value-added sectors, given their stronger expected effect on the domestic economy. This is especially important considering the post-pandemic shift towards the nearshoring of such types of FDI, which puts Serbia in a better pole position for attracting higher value-added FDIs. The results can be easily applied to all other types of FDI activities or other sectors, providing a comprehensive assessment of potential constraints for higher FDI inflows. Moreover, the proposed empirical approach can be applied to study other policy-relevant questions of interest: identification of constraints for export performance across sectors, identification of constraints for nearshoring, and many more.

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