Economic Security of Poland

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ABSTRACT: The aim of this research is to create a relatively easy-to-apply, yet complex and complete model for measuring levels of economic security, one that incorporates risks in supply, finance, labor market, technology, sales, economic policy, and mobilization, thus comprehensively evaluating the economic security situation of a country and the danger of risk activation. The development of this conceptual model and the risk groupings was based on several historical and contemporary economic dysfunction and crisis studies (approximately one hundred). The applied methodology takes into account the different risk-averse or risk-tolerant preferences of various societies. It also considers the effect of economic cycles on economic indicators. Meanwhile, simple mathematical calculations ensure ease of application, making it readily adaptable not only for academics and researchers, but also for any governmental entity, or non-governmental organization. With the help of this model and thirteen selected indicators, we subjected Poland's economic security situation for the period 2010-2019 to comprehensive analysis. We then drew conclusions on how the level of risk in different subsystems changed during this relatively calm period.

KEYWORDS: economic security, Poland, supply security, financial security, technological security
JEL CLASSIFICATION: E1, E6, F4, F5, H6, J6, O4
DOI: xxxxx

Introduction

In an increasingly interconnected and dynamic global economy, the concept of economic security has gained significant prominence, due in particular to the 2008

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worldwide financial-economic crisis, the COVID-19 pandemic, and the Russo-Ukrainian war. The importance of the economic situation results from the fact that it has multi-dimensional implications for society.

Firstly, economic security is closely linked to the overall quality of life for a given population. When individuals have stable and sufficient incomes, employment opportunities, and access to basic necessities, a sense of well-being is fostered and financial stress is reduced. Moreover, economic security provides a foundation for social stability, contributing to lower crime rates and improved social cohesion (International Labour Organization, 2004). Additionally, economic security is critical to long-term economic growth and development. A secure economic environment encourages domestic and foreign investment, stimulates entrepreneurship, and facilitates innovation. It allows businesses to plan for the future, make strategic decisions, and expand their operations (Rettberg, 2010).

Secondly, economic security also has a strong impact on other dimensions of security, playing a pivotal role in shaping the overall strength and resilience of a nation across several elements, including political strength, military power (Clowes & Choroś-Mrozowska, 2015; Kennedy, 1983), and the quality of the natural environment. When a nation's economy is robust and resilient, it reduces socio-economic disparities (Shevchenko et al., 2023) and mitigates the risk of social unrest. A financially secure population is less likely to be swayed by radical ideologies or engage in activities that can undermine political stability (Gill et al., 2014). Economic security plays a crucial role in bolstering a nation's military power. A strong economy provides the necessary resources to invest in defense infrastructure, research and development, and the procurement of advanced weaponry (Samuels, 1996). It enables the recruitment and training of skilled personnel, enhances logistical capabilities, and supports the maintenance of a technologically advanced military. Additionally, economic security accelerates strategic alliances and international partnerships, contributing to the collective defense of the nation and the strengthening of its position on the global stage. It can also facilitate research and innovation in environmental science, leading to the development of solutions to address environmental challenges and ensure a healthier ecosystem. Thus, economic security fosters stability, provides resources, and promotes sustainable practices, which contributes to the advancement and well-being of a country in a variety of ways.

The security studies literature fails to offer policymakers, military leaders, analysts, scholars, and students any easily applicable yet comprehensive and holistic models. Consequently, the first goal of our research has been to provide a detailed and comprehensive economic security model, one which delves into every aspect of economic security by examining key macro-level indicators. The second aim has been the analysis of Poland's economic security situation prior to the onset of the COVID-19 pandemic (between 2010 and 2019) by presenting a holistic view of the country's economic stability and resilience, since understanding economic risks is crucial for decision-makers in order for them to develop effective strategies for the future. Consequently, our research makes two contributions to the literature. First, concerning model application, we provide an easily usable toolkit

for the comprehensive examination of economic security in any given country. Due to its simplicity, it is easily adoptable for any governmental entity (ranging from the Ministry of Finance to the military General Staff) or non-governmental organizations (civil organizations, journals, etc.), as it does not require any special statistical software or complex methodology. Second, we conduct a broad analysis of economic security trends in Poland during the relatively calm period between the 2008 financial-economic crisis and the COVID-19 pandemic – a perspective not found in existing literature.

Literature Review: The Evolution of the Economic Security Concept

The concept of economic security has evolved over time. In one of the earliest papers in this field (Cable, 1995), Cable outlines the gradual maturation of the definition. Initially, economic security was closely tied to military power, as the term "security" primarily had military and political connotations. In this context, economic security referred to elements of trade and investment that directly impacted a nation's defensive capabilities. The concept was later broadened to encompass state policy tools that could influence the military potential of other nations, such as export restrictions and investment boycotts. At the time, essential definitions emerged for concepts like security of supply, financial security, and security of economic policy leverage, recognizing the influence of economic power projection on overall security. Subsequently, intensified global economic competition and the pursuit of competitiveness expanded the definition further to include market access security and general technological security. The Copenhagen School's multidimensional security model provided an even broader interpretation of economic security, encompassing all potential risks within the economic system that could undermine political, social, military, and ecological stability (Buzan & Hansen, 2009). Today, this is the most common interpretation of security in science.

However, even within the Copenhagen School's framework, a unified definitive concept of economic security and its components remains elusive. Various scholars have contributed differing viewpoints. Collins identifies supply security, market access security, finance-credit security, techno-industrial capability security, socio-economic paradigm security, transborder community security, systemic security, and alliance security as economic security factors (Collins, 2022). In contrast, Gazdag highlights sustainable development, market access security, supply security, security of the built environment and infrastructure, social security, technological security, and the role of the state in a secure society (Gazdag, 2011). Mischuk clusters these factors into four groups: technological security, resource security, financial security, and social security (Mishchuk, 2023). Meanwhile, according to the International Labour Organization, "economic security is composed of basic social security, defined by access to basic needs infrastructure pertaining to health, education, dwelling, information, and social protection, as well as work-related security" (International

Labour Organization, 2004, 5). Notably, many concepts, including those mentioned above, lack a clear economic model, often blending macro, international, and global factors, and introducing areas (e.g., sustainable development and social security) whose inclusion in the economic dimension of security is questionable as they are often regarded as separated areas (Babiarz et al., 2020; Buzan & Hansen, 2009). Consequently, we are endeavoring to establish a conceptual framework that can be universally applied to the interpretation of economic security and that exclusively comprises and evaluates elements related to the operation of the economy.

Methodology

The methodology employed in this study involves two major steps. First, we develop our own conceptual model with a macroeconomic perspective to assess the economic security of any given country. We then lay out a methodology for measurement and run through our model using Poland as an example.

Model Framework

This model takes into account various factors and processes that contribute to the overall economic stability of a country. After analyzing the macroeconomic model of the economy, we studied hundreds of historical crises and economic malfunctions of varying magnitude and historical periods. Using their findings, we identify and define the significant potential risks that could have an effect on economic activity. Then, we categorize these threats according to their economic system impact. The groups presented in subchapter 4.2. became the economic security model's subsystems. To effectively measure these risks, we have put together the most appropriate indicators able to provide valuable insights and serve as reliable measurements.

The Applied Quantitative Method

To effectively communicate the need for decisive actions to decision-makers, measurements must expose whether economic risks have escalated to a concerning level. Thus, the methodology employed must demonstrate a threshold level beyond which the situation can be deemed precarious. Two challenges come into play here. Firstly, a certain degree of uncertainty is inherent in any economic system (Cable, 1995). However, the degree of uncertainty avoidance depends strongly on cultural characteristics. So, a different level of risk can be considered as the normal economic environment in risk-taking and risk-averse countries. Secondly, economic cycles influence the values of the indicators. Among these cycles, the Juglar cycle produces significant effects on economic activity, including countries with a high level of openness (de Bondt & Vermeulen, 2021; Spinola, 2023) due to the interaction between foreign or domestic consumption and investment, while its length is manageable for measurement purposes.

Consequently, to reduce the impact of cultural characteristics and economic cycles on the numbers, we propose the use of dynamic indicators spanning an 8-year timeframe because Juglar cycles are reported to have a length between 7 and 11 years (de Groot et al., 2021; Isaic et al., 2019), and research indicates that the average Juglar-cycle length is somewhere between 7.8 and 9 years today (de Groot et al., 2021). This approach entails constant comparison of current values with the averages of the previous 8-year interval. The utilization of moving averages is a commonplace practice in economic and financial analysis and within our model it proves apt in ascertaining whether risk levels surpass or fall beneath what might be deemed normal in that particular country.

Two indicators were selected for each sub-system of our economic security model in order to obtain a comprehensive understanding of the economic security landscape in Poland. These indicators were chosen based on their ability to effectively capture the essence of the respective domains and gauge fluctuations in various economic risks. There are two subsystems that serve as exceptions, namely the financial and economic mobilization subsystems. In the realm of finance, an additional indicator has been introduced specifically to measure the financial stability of the state sector. This is crucial, as inadequate fiscal resources at the government's disposal can result in a fragile state status, thereby amplifying various security risks (Dankiewicz et al., 2022; Shkolnyk et al., 2020). The measurement of the economic mobilization subsystem has not been conducted in this study due to limited access to information in this particular field. The absence of time series data in these specific datasets prevented us from establishing a precise measurement.

By employing this approach, we could effectively assess the economic security situation of Poland, taking into account both immediate and long-term perspectives. The analyzed time interval is between 2010 and 2019, as we do not want to examine the specific economic consequences of the COVID-19 pandemic in this article.

Economic Security Model

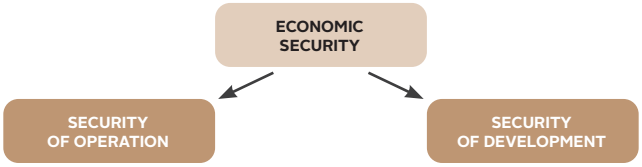
The Conceptual Model

We utilized the expanded economic security concept and a strict macroeconomic perspective when developing our intricate model. It is not intended to imply that the model disregards global processes and problems, but that all of their effects are measurable on a country-by-country basis. Which is quite useful as the ultimate objective is to be able to alert decision makers if risks exceed a dangerous threshold level.

As a result, we define economic security as a condition in which the activation risk of factors and processes that threaten normal economic operation and growth is not higher than the normal level. In this definition, normal economic operation can be considered as the growth of production and service processes according to a trend

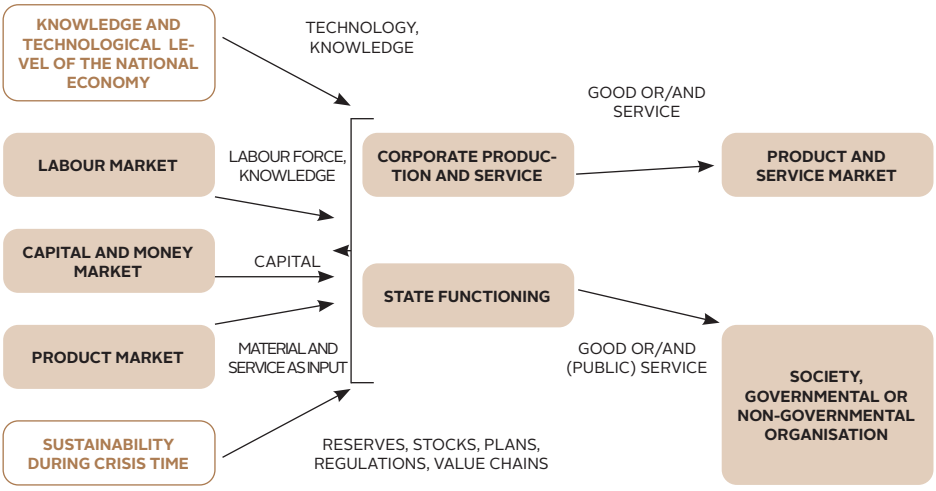
corresponding to the quantity and quality of the resources of the given economy on a long-term average, free from fluctuations greater than the degree of cyclicality arising from economic and natural laws (Taksás, 2013). Therefore, several experts (Csath et al., 2019; Shevchenko et al., 2022) divide economic security into a long term (security of development), and a short term (security of operation) understanding of it. The former examines long-term risks to a country's development by evaluating competitiveness, general economic, social, and ecological environment and measuring development factors, while the second one focuses on risks in the daily operation of the economy (Figure 1).

Figure 1. Sub-dimensions of economic security



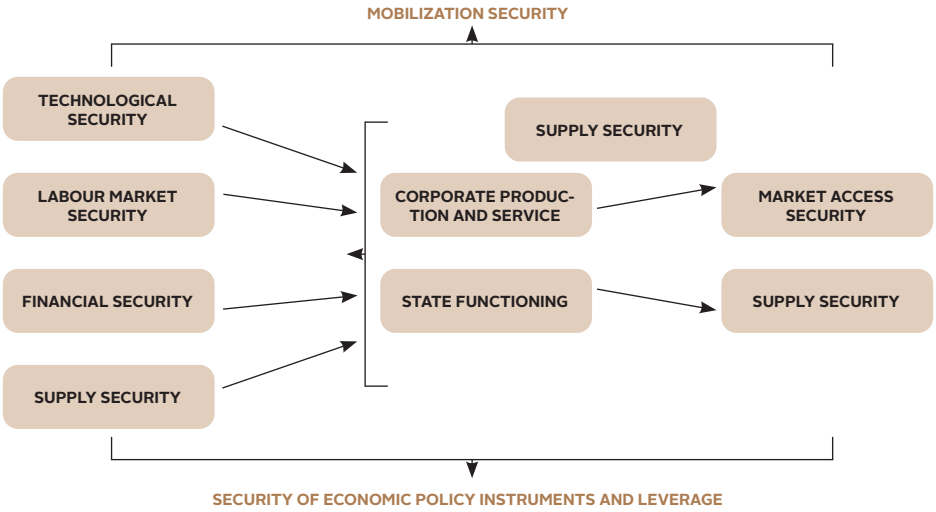
As the goal of this article is to analyze the level of operational security in Poland, the complexity of the economic activity and the subsystems of the economic security must be understood. Based on the simple and widely used macroeconomic framework of the national economic system (Mankiw, 2022), Figure 2 shows the first one, the scheme of economic operation with all the required production factors, instruments, and markets.

Figure 2. Operation scheme of the economic system



The economy requires material and service inputs, capital, labor force, knowledge and technology, physical access to markets and consumers, the ability to compete on these markets, and the capacity to operate during periods of crisis. We connected this scheme with the analysis of hundreds of economic failures and crises in countries worldwide, spanning from ancient times to the present. This research has taken several years, and our objective has been to discern the underlying factors contributing to economic malfunctions in each case. Through this thorough examination, we have identified common root causes and organized them into distinct subsystems of economic security. These are the followings: supply security, financial security, labor market security, technological security, market access security, mobilization security, and security of economic policy instruments and leverage.[5] (See Figure 3).

Figure 3. Subsystems of operational security



Economic Security Subsystems

Supply security means access to the material and service inputs (including energy and communication) necessary for corporate production and state functioning. Additionally, it refers to the delivery of produced goods and other necessary assets (e.g., cash) to their users (society, corporates, state bodies, allied forces, and foreign customers) at the appropriate time and in the appropriate manner with no greater

5 Our model does not recognize information (or cyber) security as a subsystem of economic security because we view it as an independent dimension of the multidimensional security system. We believe that information security is significantly more important, as it has a strong and direct impact on all aspects of security.

risk than normal. The most typical risks in the supply sub-system connect to the disruption or malfunction of the domestic or foreign part of the supply chain (including information flow breakdowns), as well as demand turbulence. Since governments have far fewer tools to influence the functioning of the foreign parts of the supply chains, import must be considered riskier than a domestic source. The other important aspect in analyzing supply security is the concentration level. Low diversification in any part of the supply chain refers to increased risks, as it means that any unforeseen loss of capacity can immediately result in supply problems due to the lack of substitutive capacities.

The existence of financial security means that the national economy is able to obtain sufficient savings from capital and money markets to finance potential budget deficits and national debt, in addition to sustaining the production and capital investment processes. Typical risks in the financial sub-system include an absence of savings or a lack of access to capital markets, failures in tax collection, or corporate sales problems. The best measurement of financial security includes analysis of the balance of payments (BoP), the international investment position (IIP), foreign exchange reserves, and exchange rate volatility. The financial stability of the state sector is crucial to the economy as a whole, so it is in itself worth measuring with some specific indicators, such as the government sector's gross and net financing needs as a percentage of GDP, public debt, and its currency denomination and source structure.

Labor market security, in our context, can be defined as the existence and reproduction of a skilled workforce that enables the national economy to sustain and enhance its production. Typical risks in this subsystem can be high levels of emigration, general strikes, as well as labor and skill shortages in the case of economic mobilization (including war). It is quite difficult to measure this subsystem, but some data is available, for example migration balance and its qualification structure, labor force reserves, and adult education participation rates.

Technological security relates to having the necessary technological level for economic operation and stable growth. Several major risks can arise in the technological dimension, such as insufficient research and development capacity, or slow technology diffusion, technological sanctions against a country, or high dependence on foreign technology. There are some indicators that can measure the complexity of technological security well, such as the comparison of the productivity of foreign and local enterprises, R&D expenditure, the role of foreign-owned companies in the export, and so on.

Market access security depends on a company's ability to sell its products and services domestically and internationally in order to finance its operations and provide income to economic actors and members of society. In this subsystem, the most important risks are low levels of competitiveness, economic sanctions or trade policy instruments used against the country, underdeveloped logistics infrastructure, and conflicts in the region. The best way to analyze risk here is to check indicators such as changes in real unit labor costs, export dependency rates, structural and geographical diversification of the export, exchange ratio changes, and infrastructure development level.

An economy's ability to adapt its operational structure to the demands of a crisis determines its level of mobilization security. It is the activation, concentration, and use of the resources and capabilities of the national economy in a crisis situation, and includes economic security, economic organization, resource optimization, and resource reallocation tasks (Krajncz, 2019). Economic mobilization is a very complex system; however, we can state generally that the more a country has organized its preparation in peacetime, the more material, infrastructure elements, military equipment, defense industrial components, and other important stock reserves and reserved industrial capacities it has available, the stronger its defense industrial R&D activity, the better its access to defense industrial value chains, and the higher the technology level and the quality of its human capital, the lower its risks are in terms of mobilization security. Due to the complexity of the economic mobilization system and the frequently restricted information in defense, open measurement of the level of mobilization security is difficult (Medveczky, 2004). Consequently, qualitative analyzes, which are typically conducted by domestic defense organizations alone, are generally more useful than quantitative indicators.

Economic policy leverage depends on the ability of economic policy to influence other economic security subsystems via fiscal, monetary, and other instruments (for example, communication, diplomacy, etc.). Several factors can restrict freedom in economic policy from monetary, fiscal, or its various other domains (such as international economic policy). Any traditional or newly created indicators connecting to these domains are good instruments for the measurement of risk.

Over several years spent analyzing numerous economic failures and crises worldwide, we have identified various risks that can emerge within the previously mentioned subsystems of economic security. Consequently, in Appendix A, we present an extensive collection of the major risks associated with each subsystem. Additionally, we have compiled the most useful indicators for measuring variations in these risks (see Appendix B). In our comprehensive quantitative analysis of Poland's economic security situation, we selected indicators from this compilation.

Empirical Results: Poland'S Level of Economic Security

Supply Security

In the domain of supply security, two indicators were selected from those which are listed in Appendix A, namely general import dependency and energy import dependency. The former refers to the broad range of risks associated with international supply chains, whereas the latter specifically examines the risks within the Polish energy sector. Insufficient energy supply can give rise to significant security concerns, extending beyond the economic domain to encompass a variety of security dimensions. Furthermore, it is important to point out that Poland exhibits

a significant level of external dependence in the field of energy (National Security Strategy Of The Republic Of Poland, 2020). Consequently, any fluctuations in the energy market have the potential of inducing economic turmoil, as is currently visible in the circumstances of the ongoing Russo-Ukrainian war.

Table 1. Change of risks in import dependency

Év	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Import dependency (%) (Current year – average for the previous 8 years)	3.040	4.566	3.527	2.926	3.220	2.415	3.312	4.787	4.729	2.546

Source: Own calculation using data from Statistics Poland

Table 1 shows that during the period analyzed, the country's import dependency, as indicated by the import ratio of GDP, consistently exceeded the average for the preceding eight years (illustrated by the positive numbers). In a rapid growth and semi-peripheral country undergoing a catching-up process, it is commonplace for there to be an evident manifestation of escalating risks stemming from a growing reliance on imported (both investment and consumption) goods, materials, and services necessary to sustain economic performance and growth. The observed growth rate of 3-5% in the data is relatively substantial, thereby requiring particular attention from economic policymakers.

Table 2. Change of risks in import energy dependency

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Energy import dependency (%) (Current year – average for the previous 8 years)	10.811	10.746	5.765	-1.722	0.376	-0.349	0.055	7.577	12.035	12.275

Source: Own calculation by Eurostat's data

Table 2 is interestingly informative on Poland's level of energy import dependency. During the initial and final stages of the period, there was a notable acceleration in dependency, accompanied by inherent risks. However, in the middle of the period (2013-2016), dependency levels remained relatively stable and did not exceed the average for the previous period. The analysis of the underlying factors (including energy policy, economic structure, and market behavior) necessitates a broader examination in energy studies.

Financial Security

As mentioned previously, three indicators were selected to measure the shift in financial risks. The first two, the relative investment position of the country and the relative value of the current account, reflect the country's overall financial position, whereas the third, the relative gross governmental financial needs, describes the financial risks of the state sector.

In the balance of payment, the current account indicates whether a country's trade and income flow resulted in a positive or negative balance for the given period. In the meantime, a country's international investment position is a financial statement that details the value and composition of its external financial assets and liabilities (IMF, 2023). A nation with a positive value is a creditor nation, while a nation with a negative value is a debtor nation.

Gross governmental financial needs is the best indicator for measuring the government sector (Csath et al., 2017) since it summarizes the amount of money a state must attract from the financial markets to cover its annual budget deficit, its property acquisitions, and its annual bond issuance. This indicator represents the risks significantly better than a straightforward state budget index, as the third amount is typically the largest. By comparing it to the GDP, we can determine the indicator's relative value.

Table 3. Change of risks in the country's financial needs

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
BoP / GDP (%) (Current year – average for the previous 8 years)	-0.7	-0.3	1.1	2.9	1.9	3.3	2.9	2.1	0.9	2.2
IIP / GDP (%) (Current year – average for the previous 8 years)	-18.33	-11.95	-12.63	-13.94	-10.52	0.60	2.94	2.83	8.82	13.57

Source: Own calculation from Polish National Bank data

Although the numbers of the two indicators appear slightly different, since the current balance demonstrates a reduction in risks since 2012 while the investment position has only improved since 2015, they both represent the same process. In the first half of the decade, the increased value of capital import weakened the international investment position as a result of the rapidly increasing liabilities to foreign investors. However, these investments quickly bore fruit and improved the current account balance by boosting exports. Despite the improvement shown in the table, it is important to note that the current balance and investment position remained negative throughout the entire period. In conclusion, the second half of the 2010s mitigated the financial risks in the Polish economy, but the country's financial dependence persisted.

Table 4. Change of risks in the government's financial needs

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Relative gross governmental financial needs (%) (Current year – average for the previous 8 years)	M.D.	-4.037	-1.877	-3.225	-3.101	-3.201	-0.365	-3.400	-3.132	-1.999

Source: Own calculation of Poland's Ministry of Finance data

As each year's value was lower than the average for the previous eight, the relative gross governmental needs demonstrate a steady improvement in the state sector's financial risks. Thus, the relative financial needs of the government sector gradually decreased as sales of Treasury securities grew slower than GDP.

Labor Market Security

The two indicators selected for analysis the labor market subsystem are the migration balance and the adult participation in education and training. The reason behind the choice is the impact of emigration, immigration, and adult participation in the education, which lies in their potential to yield immediate or short-term effects, both positive and negative, in terms of ensuring an adequate labor force for the economy.

Table 5. Change of risk in migration balance

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Migration balance (person) (Current year – average for the previous 8 years)	-42294	-82407	-19853	-11847	3672	10242	25318	45978	75529	86384

Source: Own calculation of Eurostat data

Table 5 represents a huge deterioration followed by an enormous improvement in labor market vulnerabilities. Until 2013, the migration balance was constantly worse than the average for the previous eight years. However, a significant reestablishment of balance can be observed from 2014 onwards, which is likely attributable to the starting point of the Russo-Ukrainian conflict. This resulted in a shift for Poland from a position of negative balance to that of a receiving country. During the years 2018 and 2019, there was an improvement in the balance, with approximately 80,000 individuals per year. While it is beneficial for the economy, it could give rise to challenges in some other aspects of life.

Table 6. Change of risk in adult education

Év	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Participation rate in education and training from 25 to 64 years (%) (Current year – average for the previous 8 years)	0.488	-0.438	-0.338	-0.475	-0.700	-1.113	-0.712	-0.288	1.500	0.538

Source: Own calculation of Eurostat data

The enrolment rate in tertiary education in Poland has consistently ranked among the highest in the European Union (EU) over a sustained period, contributing significantly to the country's economic growth. However, it is important to see that adult education in Poland has historically been characterized by low participation rates. The data presented in Table 6 indicates a decline in adult education during the middle of the analyzed period. This represents a significant weakness within the economy. The absence of a mindset that prioritizes continuous learning, exhibited by both employers and employees, contributes to heightened risks within labor markets. This issue is particularly significant during the current era of the fourth industrial revolution, where ongoing adaptation is crucial for both companies and workers.

Technological Security

Lack of technology or restricted access to technology is typically a barrier to medium- or long-term development, but not to the short-term functioning of the economy. However, a rapid and massive exodus of technology-intensive foreign-owned firms can disrupt economic functioning even in the short term, as was the case in certain Russian economic sectors following the outbreak of the Russo-Ukrainian war. Even though Russian decision-makers had anticipated this exodus, it caused severe problems in certain industries (such as automotive and vehicle production, etc.). In a nation more integrated into the global economic system than Russia, such an exodus could pose a greater threat. Consequently, the best method for evaluating short-term technological risks is to assess the significance of foreign companies in economic activity, which reflects the technological dependence on them. Comparing the productivity rate of foreign and domestic companies and measuring the proportion of foreign-owned firms in a country's exports are useful indicators for this purpose. By measuring their technological role in the economy, such data can be used to evaluate risks and predict the consequences of a potential exodus of foreign-owned companies. The greater the productivity gap and the greater their export role, the greater the economy's dependence on their knowledge and technology. Since only the latter of these two indicators has sufficient long-term

data for Poland, a second indicator must be selected. Productivity and relative R&D expenditure are both potential solutions for the role of a second indicator in this field. Although, these indices represent long-term technological development, the variation in their values also reflects some short-term issues. In the end, research and development expenditure was selected because the value of productivity growth indirectly appears in the market access security subsystem.

Table 7. Change of risk in the role of foreign-owned companies in export

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Rate of foreign-owned firms in export (%) (Current year – average for the previous 8 years)	0.950	-0.400	-2.363	-3.425	-3.475	-3.263	-3.919	-2.118	-1.947	2.554

Source: Own calculation of Eurostat and Zysk (Zysk, 2014) data

The proportion of foreign-owned firms engaged in export activities remained relatively stable throughout the observed period, with figures hovering around 60-61% at both the beginning and end of the timeframe. However, it can be observed on Table 7 that prior to the rebound in 2019, the Polish economy successfully mitigated technological risks and enhanced the participation of domestic companies in exports compared to previous years. Although, the aforementioned trend is evidently visible from the available data, a more comprehensive analysis is required to ascertain the underlying mechanisms that facilitated this risk reduction and the factors that contributed to the subsequent bounce back in 2019.

Table 8. Change of risk in relative R&D expenditures

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Relative R&D expenditures (%) (Current year – average for the previous 8 years)	0.153	0.158	0.269	0.222	0.247	0.251	0.160	0.183	0.304	0.362

Source: Own calculation of Statistics Poland data

The value of relative R&D expenditures (R&D expenditures/GDP) was consistently higher than the average for the previous eight years, demonstrating relatively stable growth. It indicates that no short-term risks emerged in this area during this time period. The issue, however, is that despite this continuous growth the absolute value

of the indicator is still very low, indeed among the lowest in the EU, which raises risks to the sustainability of the country's long-term development, and is crucial in avoiding the middle development trap.

Market Access Security

We have selected two crucial risks that can arise in the market access subsystem from the numerous possibilities: the potential for deterioration in competitiveness and the vulnerability of export markets. These two risks adequately characterize the area, and their measurement can provide a reasonably accurate picture of the market access risks.

The most common indices for measuring shifts in competitiveness is the analysis of the change in real unit labor costs (Lipská et al., 2005), while the export dependency indicator can be used to describe shifts in export risks. Unit labor costs show the proportion of labor costs in the value of GDP. While in the short term, it can be favorable for workers when unit labor costs increase faster than GDP, in the middle and long term, this can hinder the country's position in the international competitiveness competition (Artner, 2011). When we compare unit labor costs with the value of inflation, we obtain real unit labor costs. In cases where inflation is higher than the growth in unit labor costs, it means that real labor productivity is growing faster than real labor costs per workforce. This indicates that the preconditions for the emergence of price pressure on competitiveness do not exist in the given economy. However, in cases where inflation is lower than the growth in unit labor costs, it means that real unit labor costs are increasing, and we can speak of an accumulation of wage growth unabsorbed by price development, which subsequently indicates the emergence of inflationary pressures in market competition (Lipská et al., 2005).

Table 9. Change of risk in competitiveness position

Év	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Change of real unit labor costs (%) (Current year – average for the previous 8 years)	-3.375	2.329	1.286	-0.157	-0.429	-0.914	-4.171	0.314	-0.543	-1.457

Source: Own calculation from Eurostat (unit labor costs) and World Bank (inflation) data

Export dependency is another typical indicator for measuring market access risks, as exports are generally considered riskier than domestic sales. Certainly, in the case of Poland, the question of whether intra-EU exports should be considered real exports or not is reasonable, as there is almost no probability that any legal action would restrict the export of Polish goods and services to EU countries. However, the

lower level of knowledge of local market conditions, cultural differences, possible indirect import restrictions, and the influence of local economic policies make export markets riskier in comparison to the domestic market, even in the case of regional economic integration. This indicator is therefore still appropriate in measuring market access risks in the case of Poland, too.

The change in the real unit labor costs is calculated by subtracting any change in it from the inflation rate and then comparing that value with the average over previous eight years. Thus, in the table, positive values present an improving price competitiveness position while negative values indicate a deteriorating position comparing the previous interval. Despite the fluctuation of the two indicators, there was a discernible trend in the second part of the examined period in which the increase in unit labor costs generally exceeded the inflation rate, generating an environment of price pressure on producers and service providers.

Table 10. Change of risk in export dependency

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Export dependency (%) (Current year – average for the previous 8 years)	4.705	5.514	5.554	6.850	6.562	6.452	6.910	6.590	5.104	3.696

Source: Own calculation of Statistics Poland data

During the whole period analyzed, the Polish economy's reliance on exports increased annually relative to the average for the previous eight years, indicating a rise in market access risks because the likelihood of losing export markets (due to political, geopolitical, economic, social, or even natural disaster reasons) is much greater than losing domestic markets.

Mobilization Security

As mentioned in the introduction to this subchapter, the information and data required for measuring mobilization security (such as defense production, defense R&D, product and material reserves, production line reserves, etc.) are not typically publicly available, so we are unable to include them in this paper. However, it is imperative for decision-makers to gather and monitor these indicators as well to gain a comprehensive understanding of the evolution of mobilization risks.

Security of Economic Policy Instruments and Leverage

The extent of economic policy leverage is determined by a combination of circumstances and environmental factors. In this study, we have chosen to examine two of the most significant factors. The first is the level of relative state debt, which strongly influences leverage of fiscal policy by allowing for fiscal expansion in times of economic difficulties. The second is the inflation rate, which determines the leverage of monetary policy by enabling monetary expansion in the face of an economic downturn or financial market turmoil.

Table 11. Change of risks in relative public debt

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Relative state debt (%) (Current year – average for the previous 8 years)	8.0	7.5	6.2	7.2	0.2	-0.4	2.0	-2.7	-4.9	-7.3

Source: Own calculation of Eurostat data

Up until 2013, the state's debt was considerably higher than what had been considered normal in the previous period, which entailed increased risks and constrained fiscal policy leverage. Over the following three to four years, the state debt level stabilized, meaning it did not experience significant increases and remained at the previously established level. Towards the end of this interval, the state debt began to decline rapidly, thereby expanding flexibility in fiscal policy for potential interventions in the event of any economic security subsystem issues.

Table 12. Change of risks in inflation

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Inflation rate (%) (Current year – average for the previous 8 years)	0.1	1.613	0.575	-2.05	-2.8	-3.65	-3.025	0.388	0.3	0.8

Source: Own calculation of World Bank data

Unlike the earlier table, Table 12 demonstrates that monetary policy became more flexible in the mid-2010s due to a declining inflation rate. Between 2013 and 2016, the inflation rate was significantly lower than it had been in the previous decade. These substantial reductions in inflation risks led to the expansion of the Polish monetary policy toolkit during the latter half of the period analyzed, despite a gradual increase in values over the final three years.

Conclusions

The primary objective of this paper was to demonstrate the applicability of our model for conducting in-depth assessments of a country's economic security. We presented this applicability through the second objective, which was to provide a comprehensive picture of the changes in Poland's economic security situation for the period 2010-2019.This analysis of the indicators of the economic security subsystems has resulted in the following conclusions.

In the field of supply security (subchapter 5.1), risk generally increased as the import dependency of the economy each year was greater than that for the preceding eight. The energy supply risks also grew throughout the decade, except in the middle of the 2013-2016 period, when dependency levels remained relatively stable.

Regarding the financial subsystem (5.2.), although the current balance and investment position remained negative throughout the entire period, the financial risks started to ease from the middle of the period as both the current balance and the international investment position started to improve compared to the previous situation. In parallel, the financial risks in the state sector continuously decreased as the government's relative gross financial needs were lower each year than the average for the preceding eight, which indicated decreasing dependency in the sector on the domestic and foreign financial markets.

In terms of labor market security (5.3), there was a significant shift in trend in 2014 (probably due to the outbreak of the Russo-Ukrainian conflict), when the previously continually negative national migration balance suddenly became positive, decreasing the national labor market risks. However, adult education in Poland remained at historically low levels (and even deteriorated for most of the period), which sustains risks related to the general quality of the labor force in the country during the fourth industrial revolution.

In the technological security subsystem (5.4.), the country's dependency on knowledge from foreign-owned companies slowly decreased until 2018, while relative R+D expenditure was higher each year than the average for the preceding eight. Despite the mitigating risks, it has to be stated that this dependency is still quite high, and this expenditure remains relatively low when compared to what is needed to truly support the economy in the long term.

In the field of market access security (5.5), there was significant fluctuation in real unit labor costs. However, there was a discernible trend in the second part of the period, whereby the increase in unit labor costs exceeded the inflation rate, gradually generating price pressure on companies. Meanwhile, the general export dependency of the economy was higher each year than the average for the previous eight. This is normal for a capital-attractive economy like Poland, but nevertheless increases the market access risks.

Finally, in the subsystem of economic policy instruments and leverage (5.7.), the change in the relative public debt increased in the first half of the analyzed period, while in the second half, it started to decrease with increasing momentum, which improved fiscal leverage. Simultaneously, monetary policy became more flexible in

the middle of the 2010s as a result of the declining inflation rate. The inflation rate was significantly lower between 2013 and 2016 than it had been during the previous decade, which expanded the Polish monetary policy toolkit despite the gradual increase in values over the following three years.

Overall, in the analyzed interval, Poland experienced its brightest economic development in the country's modern history. However, it can be said that, despite being among the three fastest-growing economies in Europe during the analyzed decade (Eurostat, 2023), indicating a healthy economic structure, this growth did not necessarily lead to a reduction in economic security risks across all areas. In certain domains (e.g., supply security, market access security, financing security of the public sector), risks increased, partly as a consequence of the growing openness resulting from this economic expansion (Zysk, 2014), while in other areas (e.g., the qualification level of the workforce, reliance on foreign technology), risks remained at the same level. Nevertheless, economic growth has significantly mitigated risks in several crucial areas (e.g., financing situation and labor supply, leverage of economic policy), thereby creating a more stable and predictable environment for economic actors.

Limitation and Possible Further Development

In our analysis of Poland, we deliberately limited both the number of indicators employed and the time frame under examination while refraining from using restricted data. The presented approach leaves room to expand both the scope and duration of the analysis. Incorporating additional indicators, including non-public data, would enable effective monitoring of shifting risks and give a deeper understanding of the security landscape within each subsystem. Extending the period under scrutiny could also provide enhanced insight into the various processes influencing the level of economic risk. Furthermore, it would be valuable to examine data from the turbulent years of the COVID-19 pandemic and the Russo-Ukrainian war to identify the most affected areas.

This model holds immense potential for governments with an expanded toolkit and enhanced access to more intricate indicators. It facilitates ongoing evaluations of economic security risks within a nation, allowing for timely interventions in areas requiring attention. However, the structure of the model, while empowering analysts and experts to obtain a holistic overview of a country's economic situation, also provides researchers and academics with a robust framework with which to delve into the economic security of any given nation in greater depth and create a complex examination of it. Finally, due to its simplicity, the method is suitable for use by all governmental and non-governmental actors who do not employ highly complex statistical methodologies in their daily tasks but do have an interest in analyzing the economic security situation of their country.

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Appendix A: The most important potential risks in different subsystems of economic security

Supply security	Financial security	Labor market security	Technological security
– Engineering problems – Logistical and energy transmission problems or deficiency/fault in the information technological infrastructure – Lack of information – Natural or industrial disasters – Deficiency of state functioning or failed state status – Demand turbulence – Political or diplomatic causes (sanctions, embargoes) – Disorders in other sub-systems of economic security – Factors and processes originating from other dimensions of security	– Insufficient savings on the capital market – Rapid increase in financial source costs – Sudden disappearance or inaccessibility of external sources – Sudden increase in financial needs of domestic sectors – Corporate sales problems – Tax collection failures	– High level of emigration (both in normal and crisis period) – General level or economic branch level strike (both in normal and crisis period) – Labor and skill shortage in case of economic mobilization in crisis time – Labor and skill shortage in wartime	– Insufficient in research and development capacities or slow speed of technology diffusion – Technological sanctions against the country – Unattractiveness to technology-intensive investments – High technological dependence on foreign-owned companies

Market access security	Mobilization security	Security of economic policy instruments and leverage	
– Low level of competitiveness – Trade or other economic sanctions against the country – Use of different trade policy instruments against the country's goods and services – Lack of trade network and relationships – Underdeveloped logistic infrastructure – Political, economic, or military conflicts in the region – Other difficulties for export sale	– Lack of practice and preparation in peacetime (including the creation of the legal background) – Lack of availability of material, infrastructure element, military equipment, and other important stock reserves – Lack of availability of reserved industrial capacities – Lack of availability of labor force reserves – Lack of availability of defense industrial value chains – Weakness of defense industrial R&D activity – Low general knowledge and technology level – Low quality of human capital (skills, knowledge, innovation talent, morality, commitment to home defense etc.)	– Unsustainable public debt – Intolerable inflation – Unstable exchange rate – Lack of affordable financial sources – Large budget deficit – Unbalanced BoP, huge deficit in net international investment position – Low foreign exchange reserves – Dysfunctional tax collection – Poorly planned state budget or monetary policy – Intolerable level of corruption – Lack of exportable goods and services – Low investment attractiveness – Economic policy unpredictability (high uncertainty in market regulations) – Lack of international aid	

Appendix B: The most usable indicators for measuring the security level in different subsystems of economic security

Supply security	Financial security	Labor market security	Technological security
Measuring import dependency of supply chains: – Import as a proportion of the total quantity of goods consumed (service) – Domestic economy's ability for import replacement – Import diversification – Political risks related to countries involved in the external part of supply chains **Measuring concentration-diversification level in supply chains:** – Number of producer/service provider per 1000 habitants – Proportion of key producers or service providers (rate of those corporates, which one's role in the total production is above a given threshold) – Proportion of total production value from outputs of these key producers	**On national level:** – Balance of payment as a percentage of GDP – Net international investment position (IIP) as a percentage of GDP – Gross external debt of the national economy as a percentage of GDP – Foreign exchange reserves relative to foreign debts with maturity < 1 year or 1-year import value – Net foreign direct investment inflow – Investment rate as a percentage of GDP – Exchange rate volatility **In the state sector:** – Government sector's net financing position as a percentage of GDP – Government sector's gross financing needs as a percentage of GDP – Gross public debt as a percentage of GDP – Interest paid on public debt as a percentage of GDP – Structure of public debt by currency denomination – Structure of public debt by source – Average maturity of public debt	– Migration balance of the country – Size of emigration comparing to total population – Structure (qualification background by level and economic sector) of migration balance – Structure (qualification background by level and economic sector) of labor force (in economically active population) – Reserves in labor force (economically inactive population) and its structure – Adult participation in learning	– General productivity level in the national economy – R&D expenditures as a percentage of GDP, and its distribution among economic branches and the share of foreign actors – Number of patent applications at the national level – Speed of technology diffusion – Foreign vs. local enterprise productivity comparison – Role of foreign-owned companies in the export – Number and economic structure of technology sanctions against the country – Frequency and severity rates of industrial disasters (accidents)

Market access security	Mobilization security	Security of economic policy instruments and leverage
– Change in competitiveness level: change in real unit labor cost – Change in different global competitiveness rank list position – Export dependency rate – Existence of economic sanctions and their extent (participant countries, affected branches and products etc.), – Structural and geographical diversification of export – Exchange ratio change (change in the ratio of value of exports to value of imports) – Infrastructure development level	– Numbers of economic mobilization exercises – Level of material reserves – Availability of production line reserves – Length of domestic value chains – Defense R+D expenditures	– Balance in international payments – Foreign exchange reserve value – Exchange rate volatility – Inflation rate – Gross public debt as a percentage of GDP – Government deficit as a percentage of GDP – Government cash reserves – Internal and external economic actors' trust in the economic policy (credibility) – Frequency of market regulation or taxation changes – Size and strength of the international network of the economic policy