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Enhancing the Preparedness and Readiness

d'Artis Kancs

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EERI
Economics and Econometrics Research Institute
Avenue Louise
1050 Brussels
Belgium

Tel: +32 2271 9482
Fax: +32 2271 9480
www.eeri.eu

Enhancing the Preparedness and Readiness[1]

d'Artis Kancs

Science Research Innovation Implementation Centre, ZPIIC, Latvian National Armed Forces

ABSTRACT

To enhance the situational awareness of strategic readiness in Europe we look through two complementary angles. First, through a situational assessment of selected strategic readiness elements that have often been overlooked in Europe. Leveraging the newly augmented strategic readiness framework of the US DoD, we examine the defence industrial readiness for a protracted conflict and war, force mobility, and a sustained whole-of-society resilience. Second, through a scenario analysis in order to future-proof the strategic decision maker options to be resilient to changing boundary conditions. We stress test Europe's readiness in view of possible future systemic shocks across threat and time horizons by simulating selected scenarios of the NATO's Strategic Foresight Analysis 2023 and Future Operating Environment 2024 and evaluate potential impacts in the EU-EMS model. Situational assessment reveals that the defence industrial mobilisation, force mobility and sustained resilience readiness are "off-track" in view of the European Defence Readiness – as a steady state of preparedness. Second, by quantifying potential costs of unpreparedness, the "Cold War 2.0" scenario analysis provides a rationale for European allies to embark on a gradual de-risking trajectory rather than waiting for a much more costly "abrupt shock" trigger dictated by geopolitical events.

Keywords: Preparedness, readiness, Europe, Cold War 2.0, CRINK

JEL: H56, H57, L11.

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1.0 INTRODUCTION

Since several years, Europe is increasingly facing multi-dimensional, complex and cross-border threats and crises. The three decades of the post-Cold War peace period in Europe has ended abruptly with the Russia's full-scale war against Ukraine. Not just this one military's aggression challenge, but multiple, security-political-economic-environmental challenges. From pandemics to infodemics, from climate change to disruptive technologies. Security threats coming from state and non-state actors abroad in the form of terrorist attacks, cyber attacks or hybrid warfare blur the lines between conventional and unconventional forms of conflict, the lines between civilian and military, state and non-state, peace and war are increasingly blurred. An environment of a simultaneous cooperation, competition and conflict now supersedes the traditional linear view of the peace-war spectrum. Strategic competition, pervasive instability and recurrent shocks define a broader security environment.

The geopolitical and security landscape in the entire world is changing dramatically. Events such as Israel's war the Middle East make today's global security environment increasingly unpredictable. According to Michta (2024), democracies around the world are facing early stages of a system-transforming war by a newly formed "axis of dictatorships." Russia and China are setting a new global agenda, while Iran and North Korea work to dismantle what's left of their regional power balances. While this informal alliance of China, Russia, Iran and North Korea (CRINK) accelerates to consolidate, the collective West – though declaring itself united – remains fractured politically, militarily and economically. European allies are often divided when it comes to their economic interests and they lack a shared threat assessment. During the Cold War, NATO's European members spent an average of about 3.8 percent of GDP on defence. For comparison, the EU's defence expenditure was 1.6% in 2023 (EDA 2024). Many political and strategic leaders in Europe are still struggling with accepting that the good old days of post-Cold War peace in Europe have passed. In reality, the threats to our freedom and security are just as big as during the Cold War – if not bigger (Rutte 2024). Peace and prosperity will have to be defended.

From a political-strategic decision-maker perspective, the nature of Europe's threat environment evolves rapidly from crisis management and response to more demanding and pervasive threats, including hybridised threats. The evolving security environment including future uncertainty is summarised in the NATO's Strategic Foresight Analysis 2023 (SFA23) and Future Operating Environment 2024 (FOE24). Also the EU is acknowledging the changing nature, scope and scale of threats Europe is facing requires an enhanced preparedness and readiness to a protracted conflict and war. As noted by Niinistö (2024), Europe must adjust for an era of a fierce geopolitical competition, where the rules-based international order is under a constant attack by autocratic revisionists. The rapid rate of technological change updates the methods employed by both state and non-state adversaries, which requires a dynamically updated preparedness and strategically prioritised a future-proof readiness.

Against the backdrop of the multiple crises widening and new emerging, the demands placed on global leaders have become ever more challenging and pressing. Europe faces a critical moment in its history, where strategic choices will set the course of history for a generation. We support strategic decision makers with an enhanced situational awareness of strategic readiness in Europe through two complementary angles. First, through a situational assessment of selected readiness elements that have often been overlooked in Europe. Leveraging the newly augmented strategic readiness framework of the US DoD (2023), we examine the defence industrial readiness for a protracted conflict and war, force mobility, and a sustained whole-of-society resilience. Second, through a scenario analysis – in order to future-proof the strategic decision maker options to be resilient to changing boundary conditions – we stress test Europe's strategic readiness in view of possible future systemic shocks across threat and time horizons by simulating selected scenarios of the NATO's SFA23 and FOE24 and evaluate potential impacts in the EU-EMS model. Our analysis contributes to a larger EU's work stream on preparedness, response capability and resilience to future crises, to enhance Europe's preparedness and readiness.

Our findings from the situational assessment reveal that the defence industrial mobilisation, force mobility resilience and sustained resilience readiness are largely "off-track" in view of the European Defence Readiness. Second, by quantifying potential costs of unpreparedness, the "Cold War 2.0" scenario analysis results imply that among the biggest challenges Europe faces today is the imperative of adaptation, and there can only be adaptation if European leaders clearly articulate what it is we need to adapt to. By quantifying the cost of unpreparedness, we provide a measurable rationale for European allies to embark on a gradual de-risking trajectory rather than waiting for a much more costly "abrupt shock" trigger dictated by geopolitical events. Comparing EU-EMS model simulation results of unanticipated "Cold War 2.0" shock versus anticipated shock suggest that exploring the key issues ex-ante – without strategic decisions being imminent at this point in time – and taking a proactive approach can help to prepare strategic decisions weigh alternative courses of action ahead of time.

Definition: "*EU Defence Readiness can be defined as a steady state of preparedness of the Union and its member states to protect the security of its citizens, the integrity of its territory and critical assets or infrastructures, and its core democratic values and processes. This includes an ability to provide military assistance to its partners, such as Ukraine.*" (JOIN 2024)

2.0 SITUATIONAL ASSESSMENT OF READINESS

Given the global uncertainties brought with the recent pandemic, the wars in Europe and middle East, the re-emergence of a system-transforming power competition globally, an urgent question arises: is Europe prepared for a major crisis and war – which may be protracted – and how do we know? Not all answers to these questions are readily found among extant readiness metrics (Galvin 2022). In the context of a protracted conflict and war, blind spots exist in assessments for example of mobilisation readiness, force mobility and sustained long-term resilience (Monaghan et al. 2024). The present study contributes toward filling these gaps; this section undertakes a situational assessment of selected strategic readiness elements. Leveraging the newly augmented strategic readiness framework of the US DoD, we examine the defence industrial readiness for a protracted conflict and war, force mobility, and a sustained whole-of-society resilience.

2.1 Strategic readiness framework

To ensure a structured alignment of Europe's strategic readiness with the continuously evolving threat environment and European Defence Readiness – defined as a steady state of preparedness, we leverage the newly augmented strategic readiness framework (SRF) of US DoD (2023). SRF conceptualises a comprehensive assessment of readiness with advanced data analytics, allowing to inform decision makers of the readiness trade-offs and impacts resulting from their strategic choices to better illuminate associated risks and opportunities. Specifically, it provides a framework for (i) evaluating readiness through a strategic lens that focuses on building capability and proficiency for future crises or conflict, while still meeting existing strategic demands; (ii) a comprehensive assessment of strategic readiness that leverages advanced data analytics, existing products, and assessments conducted.

SRF integrates pieces of existing preparedness efforts through the prism of ten dimensions of strategic readiness: sustainment, modernisation, allies and partners, business systems and organisational effectiveness, human capital, global posture, force structure, resilience, operational readiness, mobilisation. These ten strategic readiness dimensions describe the extent of a combined capability and capacity that is vital to achieving strategic objectives; they help break down the complexity of strategic readiness by organising disparate elements into more easily accessible and meaningful components (Watts et al. 2024). This guiding framework of strategic readiness is well-suited for a situational assessment in Europe, as it allows to follow the progress made toward the strategic preparedness objectives in each of the ten dimensions and across the processes that govern them, as well as to recommend levers the decision makers can use to bring Europe closer to the strategic readiness goals. The ultimate advantage of looking through the prism of SRF is to ensure the strategic choices of decision-makers are data-driven and risk-informed so decision-makers understand the trade-offs necessary to choose one course of action over another. The application of SRF allows us to augment the way Europe's strategic readiness is measured and assessed currently and improve how European allies identify vulnerabilities, evaluate their preparedness and improve their capacity.

This study, inherently limited in scope, does not take a deep dive into every individual dimension of strategic readiness. Instead, it selects three strategic readiness dimensions – defence industrial mobilisation expansibility, force mobility and long-term sustained resilience readiness – due to space constraints in this paper. Hence, our focus is on one specific aspect of each of the three selected strategic readiness dimensions. This analysis is part of a larger European Union's work stream on preparedness, response capability and resilience to future crises, where all ten dimensions of the Europe's strategic readiness is scrutinised holistically.

2.2 Mobilisation readiness

Mobilisation, in the context of strategic readiness, includes three aspects: industry, personnel and materiel. Industry – the main focus of our analysis – provides the required materiel, equipment and services that support the joint force. Industrial mobilisation entails increasing capacity in sectors that currently produce or provide defence products and services as well as developing new industrial base capabilities, when needed (Campbell 1952). Mobilisation readiness measures convertibility and expansibility, i.e., the capability and capacity to assemble and organise national resources in support of a protracted crisis or war effort. It is a measure of resources, of what would be made available and accessible to the war effort of a nation. Mobilisation readiness of civilian entities includes the capacity to nationalise and reconfigure industry, the state of the recruiting pool and access to the additional raw materials and production and distribution capacity to equip recruits. Mobilisation readiness of military entities includes accession commands, individual training centres, combined training centres and ranges, distribution of materiel stockpiles, and materiel production (US DoD 2023).

According to Campbell (1952), there are three stages in the transformation of a peace-time economy to a war-ready economy. First, there is a “rearmament” (also referred to as “mobilisation hump”). This stage covers the shifting of the economic system from steady state peace-time pursuits to the production of a greatly increased military materiel, and the expansion of productive capacity suitable to the production of military materiel. The second stage is the period of “expansion”. This stage is marked by a massive expansion of the military sector. For example, instituting a peacetime draft, mobilising its reserves and building new production facilities. At the end of this stage, a country is prepared in terms of industry, personnel and materiel, the stockpiling of critical materials, reserve capacity for the production of military goods, and basic industrial capacity to wage war on a short notice ("mobilisation readiness"). This stage corresponds to the European Defence Readiness – as a steady state of preparedness. The third stage "total mobilisation" or "total war" constitutes total economic mobilisation, with rationing and the conversion of civilian production to wartime use. When a country is at war, all efforts – economic and military – are directed toward winning it.

Our goal is a situational assessment of mobilisation readiness with a particular focus on eventual blind spots in existing assessments. Recognising that the extant metrics used to describe and quantify mobilisation readiness cover important aspects of a country's ability to respond to challenges of scale for mobilisation and major conflict, challenges of delivery, challenges of new technology, and challenges of ensuring sufficient and appropriate domestic industrial capability, as well as developing secure and resilient supply chains, we note that other parts of the question of a country's defence industrial readiness remain untouched. Often, they represent the least addressed issues such as expansibility, including the capacity to mobilise (and nationalise) industry in the event of a rapidly escalating armed aggression or other major crisis (Galvin 2022). For example, what is a nation prepared to do in the event that the defence industry's capacity is not big enough to sustain the fight, especially if it is a protracted large-scale conflict? Could the civilian sector reconfigure and retool the necessary industrial capacity to build defence system platforms?

The situational assessment of industrial mobilisation in Europe attempts to answer the question what is the current ability of existing and surge production capabilities to replace weapon inventories destroyed in the event of a prolonged conflict? We follow the methodology of Cancian et al. (2020) and EC (2024), which allows to compute the defence industrial capacity for replacing existing stockpiles. The time to replace inventories is used as metric for the ability of the defence industrial base to meet the demands of a protracted conflict. The inventory replacement time, I_w^R, in years is calculated as:

$$I_w^R = \frac{I_w^O}{Y_w^R} + Y_w^L$$

where I_w^O denotes inventory objective of weapon system w, Y_w^R is the industrial production rate and Y_w^L denote production lead time. To compute the replacement time of current inventories in Europe, we need data for defence industry stockpiles and per-unit production rates. We rely on inventory data from SIPRI (2024) which are complemented with defence industry stockpiles from Polyakova et al. (2024). The defence production rates for individual weapon systems are based on U.S. production data from the industrial mobilisation database (Cancian et al. 2020), as no comparable estimates are available for European manufacturers. Note that the U.S. has been spending on defence consistently more than European allies hence the following calculations represent a lower bound (optimistic), the real inventory replacement times are likely to be considerably higher in Europe.

Table 1 reports the computed time in years necessary to replace the inventories estimated on the basis of existing production capacities at economical and maximum production rates. Economical production rate is defined as the most efficient peace time production rate for each budget year at which the weapon systems can be produced with existing plant capacity and tooling, with one shift a day running for eight hours a day and five days a week. Maximum production rate is defined as the maximum capacity rate that a manufacturer can produce with extant tooling, the number of shifts is at maximum feasible. The results summarised in Table 1 (left panel) reveal that the average replacement time for different weapon systems is rather high in Europe even for a peace time environment, and certainly so in view of a looming protracted conflict with CRINK. As expected, mission support and command, control, communications, computers and intelligence (C4I) systems have shorter replacement times, because partially they have analogues in the civilian manufacturing. In contrast, navy ship systems, space based systems, missiles and ammunitions and aircraft and related systems are characterised by long replacement times. Navy ship systems and space systems have long replacement times because aircraft carriers and satellites are not built on assembly lines but instead fabricated individually, which applies equally to the maximum production rate.

Table 1 (right panel) also reports the threshold attrition rate in percent needed to replace the inventory for different categories of weapons. The attrition rate is defined here as the percentage of the force and materiel lost because of combat attrition for each period of fighting. To compute the threshold attrition rate, we follow the methodology of Stoll (1990). In line with the definition of the European Defence Readiness – as a steady state of preparedness (section 2), the defending force (European allies) aims at a withdrawal rate of zero and can hold its position until the threshold attrition rate is exceeded. At that point, the defending force has to withdraw and the security of its citizens, the integrity of its territory and critical assets or infrastructures cannot be defended anymore. It was estimated during the Cold War 1.0 that NATO could suffer in the worst case up to 3.5 % attrition per day (Stoll 1990). For comparison, the threshold attrition rates in Table 1 are computed on annual basis. The gap between threat realities and defence industrial capacity availabilities is evident.

To identify the key problems of the defence industrial mobilisation and their drivers in a structured way, we look through the lens of the strategic readiness of US DoD (2023). Three major issues with the defence industrial readiness in Europe can be identified (see Figure 1). One of the key problems is *Limited production capacity, including constrained capacity to support Ukraine (industry tailored for peace time)*. Most of the existing national preparedness and readiness strategies (great exceptions being Finland and Sweden) are oriented on threats below the level of war – e.g. terrorism, natural disasters, cyberattacks, or loss of critical infrastructure (Galvin 2022). While these approaches address a number of capabilities that would be useful also in times of a protracted crisis and war such as mass care, security, first responders, and operational communications, a protracted conflict would require these capabilities would have to be expanded. This would inevitably lead to an intense competition over critical resources such as people, raw materials, and production and distribution capacity (Campbell 1952), which is not addressed in current readiness frameworks (Rehman 2023).

We have identified several drivers of the limited defence industrial production capacity in Europe. First, a new and challenging security environment – with war having returned to the European continent – has different needs than a peace time environment to respond adequately. The European defence industry has a constrained capacity to respond to the structural change in the deteriorating security environment, which will prevail in the medium- and long-run, but also due to the need to support Ukraine in defending itself against Russia's war of aggression in the short-run. Second, decades of underinvestment have left the European defence industry with limited production capabilities. Third, due to fragmented and uncoordinated demand, defence industry is typically tailored to the specific needs of narrow national markets. Fourth, supply chain bottlenecks affect production capacity and the possibilities to effectively expand production. Fifth, the reluctance from the European financial sector to provide financing to defence-related companies represents a significant constraint for the defence industry's capacity to undertake the necessary investments (EC 2024).

The second identified problem is *Limited exploitation of the true potential of the European defence industry*. The key driver leading to the problem of a limited exploitation of the true potential is fragmented and uncoordinated demand (Figure 1). The European defence market structure is highly imperfect. At the national level, the market reflects a mix of monopoly supply and monopsony demand, while at the European level it is a complex amalgam of oligopoly supply and oligopsony demand. Comparatively small national markets in Europe are served in isolation following the prevalence of a "systematic bias in favour of a domestic solution" and "a domestically oriented organisation of defence R&D". Defence industrial supply chains have been predominantly set up on a national basis. Access for new suppliers located in other member states remains limited, leading to low levels of cross-border engagement in the defence industry's supply chains as evidenced by the Eurostat data on intra-EU trade. Despite that defence equipment procurement expenditures of EU member states increased by approximately 65% between 2017 and 2022, the value of intra-EU trade in defence-related products has not increased. In contrast, the intra-EU defence equipment procurement ratio to the total defence equipment procurement in the EU has decreased from 22% in 2017 to 15% in 2022. For comparison, the ratio of the value of the overall intra-EU trade of goods and services to the EU GDP is around 47%. An increase in the European defence demand thus does not show up in the European cross-border trade, indicating that member states prioritise their national industries and/or those of third countries. Thus the defence fragmentation remains unsustainably high, not only at the level of downstream buyers, but also at higher tiers of the defence supply chains. The fragmented demand is mirrored by the defence industry being largely divided along national borders in Europe (EC 2024).

As the defence sector is demand-driven – governments are the only buyers of the defence products – the fragmented nature of the relatively small domestic demand is reflected also in a fragmented defence industry. Four types of the costs of non-integration (defence market fragmentation) in Europe can be identified: (i) Monetary costs due to the duplication of national efforts. Resulting duplications prevent the industry from achieving optimal production levels, because that increases costs, and by increasing costs Europe is getting less weapons, ammunition for the budgets available. (ii) Failure to capture the economies of scale needed to produce vital equipment such as ammunition and potential learning effects. The foregone economies of scale may substantial. Existing literature provides clear evidence of the expected positive impact of increased scale of production on the cost-effectiveness of the defence industry: costs reductions of 10-20% can be achieved when production is doubled or increased from minimum efficient scale to the ideal level (EC 2024). (iii) Dependencies on non-EU sources of equipment. European countries tend to direct a very large proportion of their procurement outside of Europe. From a total of EUR 75 billion spent by EU member states between June 2022 and June 2023, 78% has been procured from outside of Europe (EC 2024). (iv) Lack of common military assets affecting interoperability leading to the emergence of capability gaps. By spending limited resources to develop multiple times similar capabilities, gaps may arise in other segments, in particular regarding capabilities requiring high investments that are not affordable at a national level.

The third identified problem is *Unaddressed security of supply risks*. While the security of supply is not a major concern for most European countries during peace time, it may become a critical vulnerability in times of major crises and war, as the functioning of international markets – including intermediate inputs – generally deteriorates in such contexts (stricter export control, higher demand, transport problems, weaponisation of global supply chains, etc.) and supplies for defence production, including delivery of defence products and services, can be significantly affected, or even disrupted. For example, access to imported critical raw materials – notably from China which supplies 34% of all raw materials to the European defence sector – could be cut off during a global conflict – issues that are not addressed in current preparedness and readiness strategies. Indeed, in 2023 China imposed export restrictions on gallium, germanium and high-grade graphite (EC 2024).

Two main drivers leading to security of supply vulnerabilities can be identified in Europe (Figure 1). One is the above mentioned European defence sourcing fragmentation contributes to security of supply uncertainties particularly during major crisis and war. Further, insufficient understanding of European defence supply chains and dependencies on third countries for critical supplies and components imply significant vulnerabilities that cannot be addressed at a national level only. Although, the security of supply is a national competence in the EU, there is nonetheless an ever-stronger European dimension to the security of supply, as industrial supply chains are increasingly spanning across national markets in Europe as well as globally (Kancs 2024). With the increasing cost and complexity of state-of-the-art capabilities in defence, no single European country can afford to develop, produce, and sustain on a purely national basis the whole spectrum of defence capabilities. The growing size and complexity of supply chains both vertically (the number of tiers in the supply chain), and horizontally (the number of intertwined upstream suppliers and downstream customers connected in each node) inevitably implies a lagging knowledge and the overall understanding of supply chains and potential risks and vulnerabilities.

The consequence of the three identified problems is a substantial gap between the increasing security needs, including the necessary military support for Ukraine on the one side and European Defence Readiness – as a steady state of preparedness – on the other side. Despite an incremental progress made since the redefined strategic mobilisation priorities in the 2023 NATO Summit in Vilnius and the European Council meeting, longstanding structural issues hobbling the European defence industrial mobilisation appear not easily overcome. The situational assessment reveals gaps in the Europe's defence industrial preparedness, which can be illustrated for example by looking at the progress of transforming a peace-time economic-military fabric toward achieving a mobilisation readiness. From 2014 (when Russia started a war against Ukraine) to 2023, Russia's defence spending has increased by 300 percent and China's by 600 percent (SIPRI 2024). In that time, the combined European allies' spending on defence increased by 20 percent. While Russia and China have been arming at speed and scale, the number of combat battalions, in-service main battle tanks, infantry fighting vehicles, armoured reconnaissance vehicles, and self-propelled artillery in European armies has remained static or even fallen between 2014 and 2023 (SIPRI 2024). Russia alone will produce around three times more artillery munitions than Europe and the U.S. combined in 2024 – and at much lower cost – whereas the munitions production and rearmament is slow in Europe (SIPRI 2024). Whereas China is already commanding a military of over 2 million which continues to grow, and Russia increased its number of troops to a total of 1.5 million, forces of European allies are slow in mobilising despite the adversely evolving security environment. In summary, we can conclude that the European defence industrial expansibility is missing the speed of relevance vis-à-vis CRINK.

2.3 Force mobility

"*The nature of war is unlikely to change, but its character continues to evolve. The new reality is an unprecedented level of speed, intensity, and agility that is changing the character of conflict and threatening traditional notions of security. It is characterised by: more, faster, and everywhere*" (Lavigne 2023).

Having many more Alliance's members than during the Cold War, European allies also have much longer land border to defend. Now that NATO has a 2,601 km land border with Russia plus 1,250 km with Belarus, the ability to move large forces smoothly across national borders has become an even more significant capability. A critical element of military mobility is the transport of thousands of troops and equipment across Europe, ensuring that they are provided for and maintained. This involves a transit of troops and heavy equipment across national boarders. Within the concept of force readiness, our focus is on force mobility as an essential force element to successfully deal with dynamic external security challenges wherever they come from.

The situational assessment of force mobility suggests that the mobility of armed forces – needed to rapidly deploy forces from across Europe to repel an attack by a "near-peer adversary" such as Russia – presents acute structural problems. A swift and seamless movement of military force and their equipment – at short notice and at large scale – enabling them to react quickly to emerging threats at our external borders and beyond is not possible in Europe currently. Although detailed situational assessment results related to force mobility contain classified information and are not publicly releasable, our situational assessment implies that the movement of troops and heavy military equipment through national boarders is hindered by four major structural problems. Main obstacles to a swift force and materiel movement include inadequate infrastructure — including bridges and tunnels — to move armoured military vehicles; lengthy and fragmented bureaucratic obstacles, including national regulations and customs requirements, and administrative processes to carry military materiel across borders; a lack of transport capacity such as rail cars; and vulnerabilities and incompatibilities in communication systems (Figure 2).

Since 2023, NATO shares ca. 3,850 km land border with aggressors Russia and Belarus – longer than the U.S.-Mexico border. If Russia would attack a NATO country, allied forces would need to reach the attacked segment of the Alliance's eastern flank as fast as possible. In a war, every second matters. Indeed, during the Cold War, European allies were trained to moving military personnel and materiel around, a task that was very simple back then but has gradually become extremely complex and slow. A second key driver of the force mobility problem is that European allies have long underinvested in military mobility required for a rapid deployment of forces across Europe (JOIN 2024). As a result, closing the structural gaps and increasing the speed of force mobility requires long time – eventually too long given the rapidly evolving threat environment – which limits the force capability to respond with the necessary speed, intensity and agility.

Since the Cold War, moving forces across Europe has become entangled in a web of national regulations and customs requirements (Allen et al. 2021). In the short-run, improving pan-European military mobility is challenging, because transport and customs rules are largely a national prerogative. Further, the physical infrastructure needed, such as resilient rail systems and bridges strong enough to bear the weight of tank transporters, has largely been neglected during the decades of the post-Cold War peace period in Europe. Also common standards are often absent across European allies (Allen et al. 2021). For example, the rail gauge in Finland and the Baltic states is wider than in the other Nordic countries. This means that Norwegian and Swedish trains cannot run directly on Finnish and Baltic rails. Instead, they must stop near the border to unload and then transfer onto wider-platform train to continue into Finland or Baltics (Ottosson et al. 2024). Such unresolved technicalities reduce the speed of military mobility considerably. Apart from the absence of a fit-for-purpose physical infrastructure and a not aligned legal and regulatory framework, European rail operators do not have enough rail cars to transport heavy military equipment. According to the largest rail network operator in Europe Deutsche Bahn, it has less than 10% of the rail cars that would be needed for military transport in the case of an armed aggression or war against European allies (Hartmann 2024).

Our situational assessment – the force mobility is “off-track” in view of the European Defence Readiness as a steady state of preparedness – is broadly in line with the overall force readiness assessment of Monaghan et al. (2024). They find that, although, NATO outguns Russia several times over, European allies face a significant conversion challenge in translating their potential and power into required combat capabilities with the necessary speed, intensity and agility. European forces face significant readiness gaps and mobility challenges in air force, army and navy, which undermine the conventional deterrence.

2.4 Resilience

Resilience refers to the ability to maintain the capability and capacity to perform essential functions and services, without time delay, regardless of threats or conditions, and taking into account that adequate warning of a threat might not be available. Sustained resilience readiness requires stockpiles, facilities and infrastructure associated with mobilising forces, systems of production and distribution, and organisational flexibility to shift or extend supplies to meet ever-changing demands in a protracted conflict and war. These capabilities become particularly important when the nation's crisis or war effort extends across all segments of society; generating capacity shift to regenerating capacity as casualties are brought back from the battlefields, equipment is damaged beyond repair, and lines of communication are disrupted with shipment of supplies lost or captured. The civilians then need to pull deeper into its resources to keep supporting its military while also continuing to develop other capabilities that might provide the decisive edge (NATO 2024).

The objective of the sustained resilience assessment is to describe the ability of Europe to sustain a major crisis or war over a protracted period of time beyond the effects of the initially mobilised resources. A particular attention is eventual blind spots in existing resilience assessments. Typically, conventional readiness metrics measure the extent to which armed forces are prepared, trained and resourced in a snapshot of time. Similarly, civilian readiness captures the current state of having the right number of people with the right set of skills, competencies, resources, and experiences in the right jobs at the right time to support a military capability. However, most assessment frameworks that are used in Europe do not provide insights about sustained resilience (Nederveen et al. 2024). Neglecting the sustainability dimension of resilience implies that conventional readiness metrics in many cases reveal only part of the resilience readiness. There are a whole spectrum of medium- and long-term readiness considerations left unmeasured, no matter how comprehensive short-term readiness metrics would become (Watts et al. 2024). Further, beyond the conventional military and civil resilience, the psychological resilience and economic resilience are rarely (Finland and Sweden as successful examples) being assessed in Europe (Lucas et al. 2023).

Indeed, the lessons learned from the third-year Russia's war of attrition on Ukraine suggest a need to reformulate the question from 'Is Europe ready for war?' to 'Is Europe ready for protracted war?' Any permutation of a serious Russia-NATO conflict that does not end quickly, will likely become a clash of not just military forces, but societies – a competition in resilience and preparedness, industrial capacity and supply chains, logistics, mass, resources, and especially the "will to fight". Also the two-decades war in Afghanistan and its conclusion visibly demonstrates the importance of rethinking what it means to be prepared. Despite the qualitative superiority and greater capacity of allies, the opponents showed patience and waited out the situation (Rehman 2023). These examples suggest that in the security environment Europe faces today, a sustained whole-of-society resilience requires the full range of military and civilian capabilities, which includes an active cooperation across governments, the private sector and civil society.

Several approaches of measuring resilience readiness have been developed in the literature (Nederveen et al. 2024). We follow the approach proposed by E-ARC (2024) – Enhanced Analytic Resilience Index (EARI) – which consists of five components: prerequisites of resilience, preparedness, shock resistance, crisis recovery, and risk exposure. EARI framework introduces a dynamic evaluation and weighting measurements of risks and stresses against each state while differentiating between endogenous and exogenous uncertainties. The resilience readiness scores are normalised on 0 to 10 (highly resilient) scale.

The prerequisites of resilience (column 2 in Table 2) comprise a set of nine variables covering areas like corruption perception, socio-economic development, inclusion, research, and education. For Europe, we calculate the prerequisites of resilience at 6.7, which provides an indication of social cohesion and apart from the risk exposure is the lowest resilience readiness score estimated. The preparedness component composes sixteen variables selected to assess the general state of preparedness in case of shocks, covering the most relevant aspects evaluated by NATO civil preparedness criteria. The preparedness component is estimated at 7.2. The shock resistance and coping with shocks component reunites three indicators measuring general features contributing to shock resistance and coping with shocks and three groups corresponding to NATO's criteria (continuity of government, resilient food and water resources, ability to deal with mass casualties) and a mix pillar for the rest of four criteria. We estimate the Europe's shock resistance at 7.9, which is the highest resilience readiness score in EARI. The crisis recovery, adaptation, and post-shock thriving component contains three indicators: lack of adaptive capacities, commitment to improve health resilience, and recent societal shocks. For Europe, we calculate the preparedness component at 7.5. The exogenous risk exposure (last column in Table 2) contains ten variables assessing general and specific risks, including climate-driven hazard & exposure, seismic and climate risk exposure. Although we quantify risk exposure, the rapidly changing global environment vis-a-vis the time lag required to collect and process data to derive robust insights for decision makers should be kept in mind when interpreting these results.

3.0 SFA23/FOE24 SCENARIO SIMULATION

The primary aim of scenario analysis is to future-proof the strategic decision maker options to be resilient to changing boundary conditions. To stress-test the Europe's strategic readiness, we leverage the EU-EMS model (2024)[2] and undertake a simulation analysis of selected NATO's SFA23 and FOE24 scenarios.

3.1 The model

To study how systemic shocks are transmitted to countries' prices, production, consumption, trade and welfare in presence of global cross-border multi-stage production networks, we rely on an empirically parameterised and validated model of Kancs (2024) that is adopted to capture general equilibrium effects of global value chains as in Antras and Chor (2022). Sectoral heterogeneity is an important dimension in our analysis as impacts of bilateral trade cost changes differ across countries depending on the sectoral composition of their economies and the relative dependency on different foreign markets. This modelling framework allows us to explore the impacts of trade policy changes on prices, production, consumption and welfare of countries through the reorganisation of the GSCs they are involved in.

The world economy we consider is perfectly competitive consisting of J countries, indexed $j = 1, \dots, J$ and S sectors, indexed $s = 1, \dots, S$. Country j's consumers and firms source sector s's final and intermediate goods from the lowest price supplier across all countries. Consumer preferences in country j are characterised by the utility function:

[2] https://web.jrc.ec.europa.eu/policy-model-inventory/explore/models/model-eu-ems/

$$u(C_j) = \prod_{s=1}^{S} \left(C_j^s\right)^{\propto_j^s}$$

where C_j^s is the consumption of good j supplied by sector s and $\propto_j^s$ is the sector's share in expenditure with $\sum_{s=1}^{S} \propto_j^s = 1$. In sector s of country j, good ω^s is produced according to the Cobb-Douglas production function:

$$y_j^s(\omega^s) = z_j^s(\omega^s)\left(l_j^s(\omega^s)\right)^{1-\sum_{r=1}^{S}\gamma_j^{rs}} \prod_{r=1}^{S}\left(M_j^{rs}(\omega^s)\right)^{\gamma_j^{rs}}$$

Where $y_j^s(\omega^s)$ is output, $z_j^s(\omega^s)$ is total factor productivity capturing firm technology, $l_j^s(\omega^s)$ is labour input, and $M_j^{rs}(\omega^s)$ is a Cobb-Douglas composite of intermediate inputs from all sectors with shares γ_j^{rs} for $r = 1, \ldots, M$ such that $\sum_{r=1}^{S}\gamma_j^{rs} = 1$. Technology $z_j^s(\omega^s)$ is an i.i.d. draw from a Frechet distribution with cumulative density function $exp\left(-T_j^s z^{-\theta^s}\right)$. In this distribution $-T_j^s$ governs the state of technology of country j in sector s, while $\theta^s > 1$ is an inverse measure of the dispersion of productivity in sector s across producers, thereby shaping comparative advantage. This randomness makes consumers' and firms' optimal sourcing decisions the solutions to the discrete choice problem with random parameters of choosing the lowest price source country.

Sector s's composite product Q_j^s is a CES aggregate of its goods over the unit interval:

$$Q_j^s = \left(\int_0^1 q_j^s(\omega^s)^{1-1/\sigma^s} d\omega^s\right)^{\sigma^s/(\sigma^s-1)}$$

where σ^s is the elasticity of substitution between sector s's goods and $q_j^s(\omega^s)$ denotes the quantity of product ω^s that is ultimately purchased from the lowest price source country. The equilibrium of the model can be found by maximising utility subject to the unit cost function, c_j^s, associated with 1:

$$c_j^s = \Upsilon_j^s w_j^{1-\sum_{r=1}^{S}\gamma_j^{rs}} \prod_{r=1}^{S}\left(P_j^{rs}\right)^{\gamma_j^{rs}}$$

Where Υ is a constant that depends only on γ_j^{rs} for $r = 1, \ldots, M$, w_j is the wage rate of labour, and P_j^{rs} is the price index of intermediate inputs:

$$P_j^{rs} = A^r \left[\sum_{i=1}^{J} T_j^r \left(\gamma_i^r \tau_{ij}^{rs}\right)^{-\theta^r}\right]^{-1/\theta^r}$$

Analogously, the price index of final goods can be expressed as:

$$P_j^{rF} = \prod_{s=1}^{S} \frac{1}{\propto_j^s} A^r \left[\sum_{i=1}^{J} T_i^r \left(c_i^r \tau_{ij}^{rF}\right)^{-\theta^r}\right]^{-\propto_j^s/\theta^r}$$

These price indices depend on technologies, T_j^s, unit costs, c_i^r, and trade costs τ_{ij}^{rs} between origin country i and destination country j. Trade costs are of the iceberg type with $\tau_{ij}^{rs} \geq 1$ measuring the number of units of a good produced by sector r for use in sector s that have to be shipped from country i to country j for one unit to arrive in destination. Fraction $\tau_{ij}^{rs} - 1$ of the transported good is used to pay for transportation. The price indices also depend on sector-specific productivity dispersion parameter, θ^r.

In equilibrium, the shares of intermediate goods sector s in country j sources from sector r in country i are given by:

$$\pi_{ij}^{rs} = \frac{T_i^r\left(c_i^r\tau_{ij}^{rs}\right)^{-\theta^r}}{\sum_{k=1}^{J} T_i^r\left(c_r^k\tau_{kj}^{rs}\right)^{-\theta^r}}$$

and the corresponding shares of final products sector F in country j sources from sector r in country i are given by:

$$\pi_{ij}^{rF} = \frac{T_i^r\left(c_i^r\tau_{ij}^{rF}\right)^{-\theta^r}}{\sum_{k=1}^{J} T_i^r\left(c_r^k\tau_{kj}^{rF}\right)^{-\theta^r}}$$

which themselves depend on technologies, T_j^s, unit costs, c_j^s, and trade costs, trade costs τ_{ij}^{rs} between countries i and j. They also depend on the productivity dispersion, θ^r. These parameters can be interpreted as sector-specific trade elasticities as they measure (in absolute value) the percentage fall in a sector's bilateral trade due to a 1% increase in the bilateral iceberg trade cost.

The model is closed by two sets of market clearing conditions and a trade balance condition. The first requires that for each country j the total expenditure, X_j^s, satisfies:

$$X_j^s = \sum_{r=1}^{S} \gamma_j^{sr}\, Y_j^r + \propto_j^s \left(w_j L_j + D_j\right)$$

where D_j denotes the trade deficit so that the two terms on the right hand side correspond to total expenditures on the country's intermediate and final products respectively. The second market clearing condition requires that the total output, Y_j^r, satisfies:

$$Y_j^s = \sum_{r=1}^{S}\sum_{k=1}^{J} \pi_{jk}^{sr}\gamma_k^{sr}\, Y_k^r + \sum_{k=1}^{J} \pi_{jk}^{sF} \propto_k^s (w_k L_k + D_k)$$

where the two terms on the right hand side correspond to the country's total output levels of intermediate and final products respectively.

The trade balance condition requires that country j's aggregate imports equal the aggregate exports plus it's trade deficit, D_j:

$$\sum_{i=1}^{J}\sum_{r=1}^{S}\sum_{s=1}^{S} \pi_{ij}^{sr}\gamma_j^{sr}\, Y_j^r + w_j L_j = \sum_{i=1}^{J}\sum_{r=1}^{S}\sum_{s=1}^{S} \pi_{ji}^{sr}\gamma_i^{sr}\, Y_i^r + \sum_{s=1}^{J}\sum_{i=1}^{J} \pi_{ji}^{sF} \propto_i^s (w_i L_i + D_i)$$

Finally, the equilibrium is defined by the following system of equations: $J \times S$ equations of the unit cost function, $c_j^s, J \times (J-1) \times S$ equations of the price index of intermediate inputs, P_j^{rs}, $J \times S$ equations of the price index of final demand goods, P_j^{rF}, $J \times (J-1) \times S \times S$ equations of the shares of intermediate inputs, π_{ij}^{rs}, $J \times (J-1) \times S$ equations of the shares of final demand goods, π_{ij}^{rF}, $J \times S - 1$ equations of the total output, Y_j^r, and J equations of the trade balance condition. In this system of equations we seek to solve for the following unknown variables: $J \times (J-1) \times S \times S$ independent intermediate goods trade shares, π_{ij}^{sr}, J × (J − 1) × S independent final goods trade shares, π_{ij}^{rF}, $J \times S$ unit production costs, c_j^s, $J \times S \times S$ intermediate goods price indices, P_j^{rs}, $J \times S$ final goods price indices, P_j^{rF}, $J-1$ wage levels, w_j, (one is a numeraire), and $J \times S$ gross output levels, Y_j^s.

The high dimensionality of the model – $[J \times S] + [J \times (J-1) \times S] + [J \times S] + [J \times (J-1) \times S \times S] + [J \times (J-1) \times S] + [J \times S - 1] + [J]$ equilibrium equations need to be solved simultaneously – implies that solving the model is computationally demanding. To reduce the computational burden, we solve the system of equilibrium equations for the effects of a change in trade costs on wages, output and prices in differences. By applying goods market-clearing and trade balance conditions, allows us deriving results for changes in the variables of interest, without knowing the initial levels of the target variables. In this "hat algebra" approach we only need data on the intermediate input and final demand goods trade shares, π_{ij}^{rs} and π_{ij}^{rF}, and the intermediate input and final demand goods expenditure shares, γ_j^{rs} and α_j^s. Further, for parameterising the model, we need values for trade elasticities, θ^r, and for operationalising the trade policy shock in the model, information on changes in trade costs is required.

The intermediate input and final demand goods trade shares, π_{ij}^{rs} and π_{ij}^{rF}, and the intermediate input and final demand goods expenditure shares, γ_j^{rs} and α_j^s, are computed from the World Input-Output Tables (WIOT) and Inter-Country Input–Output (ICIO) data. Each entry of the World Input-Output matrix represents a country-sector pair, e.g. how much each sector in Italy spends on intermediate input and final demand goods from each sector in China. To illustrate the type of bilateral trade data detailed in the model, we can think of an input-output table of a simplified world economy. The table consists of two panels for intermediate inputs and final goods. This distinction is crucial for both (i) computing the actual trade costs including tariffs and (ii) mapping the observed input-output linkages into the model. This richness of the World Input-Output trade data allows us to determine the impact of systemic shocks on each sector within each country.

The most influential parameter in this model (like most trade models) is the trade elasticity, θ^r, that determines substitution within each sector across goods from different origin countries. Therefore, elasticity estimates are drawn from the econometric literature (Imbs and Mejean 2017). In line with the importance of this elasticity in the trade literature, assumptions about the trade elasticity have the largest impact on the underlying model estimates. The elasticity of substitution of traded goods from different origin determines the ease and speed with which trade can be reorganised, for example, away from countries which have increased import tariffs. If trade elasticity is low, it is hard to find alternatives for existing imported goods and the welfare loss of cutting the trade link is high. If the elasticity is higher, substitution is easier and welfare costs are much lower. In line with literature estimates (Figure 3), it seems plausible to assume, however, that the relevant trade elasticities, are larger in the medium and long run, and smaller in the very short run. This time-dependency of trade elasticities implies that the size of economic losses stemming from a sharp increase in trade costs with certain trading partners and the following reduction in trade flows depends crucially on the time frame over which adjustments take place and is the key why our model predicts smaller economic costs in the long run than in the short run.

3.2 Scenario construction

To assess the impact of systemic shocks on the European defence readiness, we rely on scenarios generated in the NATO's Strategic Foresight Analysis 2023 (SFA23) and Future Operating Environment 2024 (FOE24) exercises. We acknowledge that the future is also defined by random shocks that can confound strategic decision makers and lead to abrupt changes in policy direction. Examples of systemic shocks with a particular relevance to defence in the last few years include the Covid-19 pandemic and Russia's started full-scale war. Further, the transition from one conflict to another through time can also be considered as a sequence of shocks on a smaller scale. To model future uncertainty formally, the approach of Ilut and Schneider (2023) or Kancs (2024) who explicitly model risk and ambiguity could be considered – a promising avenue for future research.

Aligned with the SFA23 and FOE24 systemic shock scenarios, we examine likely future boundary conditions by selecting a subset of representative scenarios that we investigate deeper in the European context. In this study, which is inherently limited in scope, we do not analyse every potential strategic shock identified in SFA23 and FOE24. Instead, we select few distinct potential shocks that are scoring high on both likelihood and potential impacts and illustrate how mobilisation readiness, force mobility and resilience readiness perform in these scenarios of systemic shocks. Due to space constraints, we present simulations of one compound systemic shock scenario – "Cold War 2.0" – that assembles changing boundary conditions from several SFA23/FOE24 scenarios: '*Isolated states conducting disruptive strikes against digital and economic global systems causing global shock in telecommunication, supply flows and industrial activity*'; '*Confrontation over limited resources (`resource wars') expanding to regional and global levels, attracting major powers or security coalitions*'; '*Major supply chain shock resulting from regional conflict, denied access to resource nodes, or severe trade prohibitions*'; and '*Formation of a military alliance, openly adversarial to NATO'*.

To operationalise Cold War 2.0 scenario in the model, we simulate a complete cessation of trade between the "Alliance" (32 member countries plus 37 NATO partners) and CRINK (China, Russia, Iran, North Korea). The rest of the world ("ROW" consisting of all other countries) is modelled as 'neutral'. All trade flows in final demand goods, intermediate goods as well as raw materials with CRINK is disrupted in the Cold War 2.0 scenario. In the model, we implement prohibitively high trade costs between members of the Alliance and partners and CRINK, so that all trade flows between the two 'blocks' drop to zero. Other bilateral trade costs (e.g. between the Alliance members and with the rest of the world countries) are left unaltered and trade flows between all these trading partners will endogenously adjust.

We are aware of the hypothetical and extreme nature of SFA23/FOE24 scenarios. However, the insights gained from this analysis offer valuable perspectives on the whole-of-society resilience, including civil, military, public and private forces at play. Moreover, by examining such extreme scenarios, we aim to delineate the boundaries of possible outcomes and provide a worst-case perspective on the issue. We do not speculate on what events might trigger such scenarios happening, nor do we take a stance that this is a likely or desirable outcome.

3.3 Simulation results

First, our focus is on the economic costs to the Alliance measured by the fall in Gross National Expenditure (GNE), as they have a direct impact on the defence preparedness. GNE is the welfare-relevant quantity in many macroeconomic and trade models including the EU-EMS model. GNE, also known as "domestic absorption," is the economy's total expenditure defined as the sum of household expenditure, government expenditure and investment. In contrast, in the GDP accounting identity also imports and exports are accounted for, and hence it may not account for terms-of-trade effects that arise following an extreme trade shock like the decoupling scenario we model. Note however while GNE differs conceptually from GDP, its total value is similar to the more familiar GDP measure.

Our key result is that in the event of an abrupt decoupling as in the Cold War 2.0 scenario, the Alliance is likely to experience a GNE loss of 5.8-6.9% in the first few years and approximately 4.4-5.7% over the horizon of five years (Figure 4). Note that the EU-EMS model does not incorporate standard short run business cycle amplification effects, implying that in this sense, our results represent conservative estimates. With more time to adjust, for instance over a time horizon of six to eight years during which trade and production are reorganised, the decoupling cost would drop to 1.0-4.7%. In the long-run, the Alliance's welfare loss from no longer being able to trade with CRINK would be up to 2.2% of GNE. From a macroeconomic standpoint, these are severe costs, reflecting particularly China's importance in the Alliance's and global trade. In the short run, they compare to the GDP falls witnessed in the global financial crisis and during the Covid pandemic. Moreover, part of the costs would be permanent, i.e. the Alliance's welfare would be lower in every single year going forward. At the same time, while severe, these costs are not devastating and could be managed with appropriate policy, and crises of similar magnitudes have successfully been managed in the past.

Regarding robustness of these simulation results, they depend crucially on the ease and speed with which imports of intermediate goods and raw materials used in defence production can be reorganised away from CRINK to partner countries and within the Alliance. In the EU-EMS model, this substitutability is governed by the 'trade elasticity' that determines substitution within each economic sector (including defence) across intermediate inputs and raw materials from different origins. In Figures 4 and 5 we report two substitutability scenarios: rapid trade diversion from CRINK (dashed line) and moderate trade diversion (solid line). Our results are of the same order of magnitude as model-based simulation results of Baqaee et al. (2024). Simulating a Cold War 2.0 scenario of a complete cessation of trade between the West and East blocks the authors find that the annual GDP loss in Germany would amount to 5.0-5.8% in the short-run.

Next, Figure 5 reports simulation results of an abrupt trade decoupling from CRINK on the aggregated European defence production. Results are reported as a percentage change compared to baseline. These simulation results imply that, in the short-run (3-4 years), the defence industrial production in Europe would suffer sizeable losses amounting to 7.3–7.4% per year (Figure 5). In the medium- to longer term, international trade will be reoriented toward trade within the Alliance and partners, and the adverse impact of decoupling from CRINK on the European defence industrial production will be dampened (2.4-5.2%).

The main impact on the defence industrial production in the EU-EMS model channels through supply chains of intermediate goods and raw materials from China, as the manufacturing of weapon systems and equipment in the Alliance uses imported intermediate goods as well as raw materials as inputs (Kancs 2024). For example, sensors to precision-guided missile makers, infrared lenses for night-vision goggles, nitrocellulose for gunpowder and bulletproof fibre for body armour. China also supplies over one-third of all raw materials to European defence manufacturers, including rare earths (91%), tungsten (83%), magnesium (81%), germanium (76%), gallium (63%), indium (57%), lead (54%) and vanadium (52%) (EC 2016). The plane's engines and flight control systems use critical high-performance magnets, made of rare earth materials such as neodymium, dysprosium and praseodymium. For example, Gallium is used to produce high-performance microchips that power some of the Alliance's most advanced military technologies. Disrupting these intermediate goods and raw materials supplies to European defence manufacturers abruptly would result in a negative output shock.

4.0 EUROPEAN DEFENCE READINESS UNDER COLD WAR 2.0

4.1 Defence industrial readiness

To evaluate the defence industrial readiness in the Cold War 2.0 scenario, we relate the simulated 'post-shock' realities of intermediate input and raw material supplies to the European defence industrial capacity, as simulated in section 3.1. Specifically, we use the maximum production rate per weapon system and re-compute the replacement rates of current inventories with the reduced defence industrial production due to a complete cessation of supplies from CRINK (Figure 5).

While these results are informative about the channels of adjustment linking the European defence industry to global supply chains, when interpreting these results it has to be kept in mind that the actual magnitude of defence production effects will be specific to each manufacturer, weapon system and plant location. We use the simulated average impacts in calculations to circumvent the absence of such detailed information.[3] Results from the situational assessment of defence industrial readiness in Europe (section 2) serve as a benchmark against which to measure results of scenario analysis.

Our results suggest that, if all made-in-China parts and other CRINK components were excluded from European weapon system manufacturing, on average, the replacement time of current inventories of weapon systems would increase significantly (Table 3). The negative effects on the defence industrial readiness are further dampened, when the shock can be anticipated, i.e. government announces the trade policy measures one year in advance.

The expansibility of the defence industrial capacity is dependent on strategic competitors, which will be challenging to substitute in the short-run (Kancs 2024). Our simulation results suggest that the current structure and capacities of the European defence industry cannot respond effectively and agile to challenges implied by a major geopolitical conflict, as simulated in the Cold War 2.0 scenario. In the case of a complete cessation of intermediate goods and raw material supplies from China, the European defence industrial base could not replace most weapon system inventories with the speed of relevance. Even at maximum production rates, replacement would take many years, though weapon systems with civilian analogues are at less risk.

To identify bottlenecks in the Alliance's defence industrial preparedness, we use simulation results from section 3.1 and compute the Foreign Input Reliance (FIR), which measures the sourcing-side exposure of a sector or the entire economy, and the Foreign Market Reliance (FMR) index, which measures countries' reliance on foreign markets on the sales side (see Kancs 2024 for methodology). We use the Inter-Country Input-Output data from the OECD complemented with WIOD data to compute the defence sector's FIR and FMR for the "Alliance" consisting of 32 member countries and 37 NATO partners, CRINK consisting of China, Russia, Iran and North Korea, and the rest of the world (ROW) consisting of all other countries. Table 4 reports an extract of intermediate goods supply interdependencies in the defence sector for four largest European economies and the strategic challenger China in 2023. The computed bilateral FIR corresponds to the share of foreign sources used as intermediate inputs into defence industrial production.

Table 4, top-left panel *fir2023* reports row nations' reliance on inputs from column nation for the defence industrial production, whereas top-right panel (*fmr2023*) reports row nations' total input sales to column nations' defence industries. Cell shades are indexed to share sizes; darker shades indicate higher foreign input dependency. The Alliance's defence industrial dependency on China can be seen in columns *CHN*, suggesting that 13.4-15.7% of intermediate goods in the defence sector are sourced from China, whereas 5.7-8.3% of defence intermediate goods are supplies to China. Next, we assess the defence industrial preparedness after the Cold War 2.0 (CW) shock. The post-shock trade in intermediate goods between countries is reported in the two bottom panels of Table 4 (*fir_CW* and *fmr_CW*). Following a complete cessation of intermediate goods trade with China (zeros in columns and rows *CHN*), part of international trade will be reoriented towards trade within the Alliance and with ROW.

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[3] To validate the simulated impacts of an abrupt a complete cessation of trade with China on the European defence industrial preparedness, we rely on expert judgement and a global sensitivity analysis.

Global supply chains are all about dependence – who depends on whom and for what. Can Europe that has to rely on its potential adversary for critical supplies hope to persevere and achieve a strategic advantage against it? As noted by Secretary General Stoltenberg in September 2024: "*Russia used gas as a weapon to try to coerce us. We must not make the same mistake with China.*" Our findings imply that significant investments are necessary to ramp-up a supply-chain-shock-robust production capacity, reduce lead-in time, prepare capacities that can be easily mobilised in case of need and more generally build a defence industry that possesses the levels of readiness fit for the new geopolitical environment. Our results are also consistent with findings of Monaghan et al. (2024), who conclude that despite clear demand signals, problems persist, including production acceleration barriers, delivery delays, and NATO-EU coordination.

4.2 Force mobility

The ideal future force is one that is able to cope with a world in which both trends and shocks shape the future (Moffat et al. 2011). The fundamental problem of developing an effective and capable future force structure is one that is constrained by the lack of knowledge of the future environment in which the force is going to have to operate (FOE24). We stress-test force mobility in the Cold War 2.0 scenario simulated in section 3.1. The scenario analysis of force mobility follows the same steps and methodology as explained in Section 3.2 (scenario analysis of industrial mobilisation), therefore we will be concise here and in section 3.4.

To stress-test the force mobility and evaluate the military mobility in Europe, we zoom in on individual force elements. Following Gauthier and Archambault (2016), force elements are defined as organisational entities consisting of individual force components (personnel, resource, equipment, infrastructure, etc.). Force elements represent the smallest force entities that can be employed individually and independently. For example, a frigate (including its crew and some basic equipment) is a force element. A naval task group, on the other hand, is not a force element since the ships that compose it can be deployed individually. Similarly, the crew of a ship is only a component of a force element, since it generally cannot be employed in isolation. Individual force elements are unambiguous, they can be identified, counted, costed and employed in theatre. Force elements are tangible outputs of the force generation process. Force generation tasks are associated with individual shock scenarios, they are explicit about what force elements can generate (or not) to meet force readiness requirements. An example of a force generation task is: "generate forces able to provide initial response to a major air disaster in a specific area followed by a sustained rescue effort". The level of responsiveness (normal, high, or immediate response) and Notice to Move (NTM) (in minutes, hours, days) are integral parts of each force generation task.

The mobility of every force element to conduct the assigned tasks in specific location is assessed using the methodology of Gauthier and Archambault (2016): ready, ready with concurrency risk, ready with caveats, and not ready. Ready corresponds to a force readiness level 'The force element exists, is trained and equipped to task requirements, ready at the required NTM, and its employment will not affect readiness for other tasks'; Ready with concurrency risk – 'The force element exists, is trained and equipped to task requirements, ready at the required NTM, however its employment will affect readiness for other tasks'; Ready with caveats – 'The force element may lack personnel, equipment, training, or may not be ready at specified NTM, however its employment remain possible given additional time, resource, and acceptance of risk'; and Not ready – 'The force element does not exist, or is not trained/equipped to task requirements, or cannot meet the specified NTM, or is currently committed/employed and therefore is unavailable'. The following force elements are reported: Naval ships (up to Frigates), Brigades, Fighter jets and Military helicopters.

After decoupling from CRINK – as simulated in the Cold War 2.0 scenario – we compute how individual force elements are affected by the shock. The force elements assigned to a task (package) represent what is necessary to meet the essential requirements of the task. Accordingly, if one force element is not ready after the shock, some essential requirements are presumably not met and this information is cascaded up the chain of force elements. We then aggregate the readiness of individual force elements to the joint force mobility. Although the data and quantitative scenario analysis results related to force readiness contain classified information and are not publicly releasable, stress-test results reveal that the force mobility in Europe would even further be "off-track" in view of the European Defence Readiness – as a steady state of preparedness.

4.3 Sustained resilience

As above, sustained resilience is stress-tested in the Cold War 2.0 scenario simulated in section 3.1, and the impact evaluated in scenario analysis. Here, we use the simulation results of losses in the European Gross National Expenditure following an abrupt decoupling from CRINK (reported in Figure 4). In addition to long lasting effects on Europe's economy, such as supply shortages and inflation, increased unemployment and reduced purchasing power, war also has important indirect negative consequences on infrastructure, public health provision, and social order. All these factors affect a sustained whole-of-society resilience.

Following Bruneau and Reinhorn (2006); Alloush and Carter (2024), the loss of resilience, L_i, after a systemic shock, F, can be measured by the size of the expected degradation, d, (probability of failure), over time (that is, time to recovery t_r) (Figure 6). Formally, the impact for every resilience component *i* is defined by:

$$L_i = \int_{t_0}^{t_r} (1 - q_i(t)dt)$$

where t_0 is the time of the systemic shock realisation and t_r is the time when the full system's resilience is restored, i.e. $q_i = 1$. The total impact for the aggregate resilience, L_T, is a weighted *w* sum of individual components:

$$L_T = \sum_i w_i L_i$$

Table 5 reports the computed post-shock EARI along with resilience loss. Faced with a severe welfare loss in the Cold War 2.0 scenario, the prerequisites of resilience index decreases from 6.7 to 3.7, as the socio-economic development, societal disparities, economic inequality, inclusion and social cohesion will aggravate. The preparedness component deceases moderately from 7.2 to 6.1 in the simulated scenario, as several variables such as civic space, investment capacities, group grievance, human flight and brain drain, labour force participation rate & female participation are affected. The shock resistance and coping with shocks component drops from 7.9 to 4.3, as global supply chains including energy supplies would be significantly affected. If no policy measures would be undertaken, several NATO resilience criteria would not be fulfilled. The crisis recovery, adaptation, and post-shock thriving component would decrease from 7.5 to 6.0, as variables such as adaptive capacities and societal shocks would decline in the simulated Cold War 2.0 scenario. The exogenous risk exposure (last column in Table 5) contains ten variables assessing general and specific risks. It is likely that the drivers of general and specific risks, including climate-driven hazard & exposure, seismic and climate risk exposure will accelerate in the years to come, these are not modelled in the underlying EU-EMS model therefore they are not affected in the simulated Cold War 2.0 scenario.

Our stress-test results suggest that the sustained resilience readiness would be "off-track" in view of the European Defence Readiness, if no policies enhancing a sustained whole-of-society resilience are implemented. Our illustrative analysis results are consistent with what we are seeing in Ukraine – we know what a protracted war looks like. While Russia's war on Ukraine has underscored Europe's humbling dependence on Russia for energy, energy resilience is not solely a matter of reducing dependence on Russian hydrocarbons and Chinese critical minerals, it is also restated to the industrial transformation and the transition to net zero. As detailed in section 3.1, Europe reveals vulnerabilities over input and output market dependencies of China: intermediate goods and raw materials on the import side and sales of European manufacturers on the export side. Apart from the visible threats – which however are not necessarily the important ones – non-traditional challenges to environmental, technological and economic security present an increasing source of uncertainties to a sustained resilience. Critical European infrastructure (energy, finance, data and telecoms, transportation networks) is not just a business continuity issue, it also reveals vulnerabilities that affect individual European allies and that have cross-border implications (Polyakova et al. 2024). Broadly, our results on resilience readiness are in line with findings of Monaghan et al. (2024), who conclude that, above all, NATO allies will need find the "will to fight," which cannot be taken for granted.

5.0 FEEDBACK FOR STRATEGIC DECISION MAKERS

Based on our findings, we derive a number of policy recommendations specific to the three strategic readiness dimensions for enhancing European preparedness and readiness: (i) Develop a wartime preparedness instead of peacetime preparedness, inspiring by the examples of Finland and Sweden. *Si vis pacem, para bellum*. To preserve peace, Europe and its democratic allies need to be prepared for a protracted conflict and war. If for no other reason than the fact that the axis of dictatorships have already done so. (ii) Starting with a preparedness strategy for the EU, use a whole-of-society approach and work toward a Preparedness Union. (iii) Establish the EU host nation support arrangement, following a comparable NATO mechanism; this could be used in a crisis, for example to organise cross-border rescue transports. (iv) Strengthen strategic EU-NATO cooperation. (v) Synchronise civil-military cooperation, e.g. by supporting businesses working on critical infrastructure and the defence industry; promote the involvement of the private sector in preparedness cooperation to establish a structured cooperation. (vi) Harmonise resilience, preparedness and readiness concepts, priorities and targets between the EU, NATO, and member states.

5.1 Potential for improvement and best practices: industrial mobilisation

It is widely agreed that Europe possesses sufficient resources which, if mobilised, would ensure a credible deterrence and successful defence. However, in order to mobilise these resources – industry, personnel and materiel – structural problems including Europe's dependency on strategic competitors via global supply chains in critical sectors and raw materials, chronic force shortages and divergent national economic interests in defence industrial mobilisation need to be addressed. To mobilise for uncertainties coming, Europe needs a culture change in how the socio-economic-political fabric is organised and how civilians and military relate to each other. To ensure a whole-of-society approach, citizens need honesty from policy makers about an unavoidable competition over critical resources than can be expected during a protracted conflict and war.

For example, to reduce supply-chain dependencies on strategic competitors – particularly in strategic and critical sectors – it is imperative to re-shore manufacturing to Europe and decouple from China. Further, there is a need to significantly reforming the European defence procurement system, to overcome nationally divided economic interests. Although, the EU's increasing role in Europe's defence may raise NATO concerns, strategically considering, it could positively transform the transatlantic defence industrial base, contingent on the EU funding capacity. By effectively leveraging European collective investments and building production capacity, both the EU and NATO would benefit from greater defence industrial integration and consolidation. In order to ensure a strategic autonomy, the mobilisation of industry, personnel and materiel should primarily be based on Europe's internal resources. The initiatives proposed within the EDIP are steps in the right direction, but a transformative impact requires significantly more funding.

Looking at best practices and EU's strengths, its role in enhancing Europe's preparedness and readiness could focus on where the EU can make a legitimate difference: defence procurement. Creating a single market, especially for industry, is something the EU is particularly good at, and it is urgently needed in a fragmented European defence industry. There are however several unresolved issues that will have to be overcome before creating a single European market for defence. The first issue is legal. Article 346 of the Treaty on the Functioning of the European Union (EU 2016) explicitly exempts national defence industries from the European single market's remit. Either changing the treaty, or changing the list of goods which the exemption applies to, requires unanimity in the EU Council. Although, there are issues that can be addressed outside of treaty changes, e.g. leaning on voluntary and add-on mechanisms, the result so far has been a variety of agencies and initiatives designed partly to manoeuvre around this constraint – rather ineffective in enhancing the industry's mobilisation though. Another issue to be addressed relates to a shared understanding of the threat environment. After finding a workaround for the legal constraint, the EU has to agree on strategic priorities. In the past, the debate among member states has revolved a lot around different regions: what would work in eastern Europe versus the Mediterranean, and so on. With the full scale war started in 2022 Russia seems to have answered that question, at least for now. There is still, however, a trade-off between short-run and long-run defence investments. Using increased defence budgets and a joint buying to procure more USA equipment, or work to build up a European defence-industrial base will take time. Finally, the UK's role in European security from outside the EU needs to be worked out – how to legislatively frame the EU-UK defence-industrial integration. At the 2024 summit of the European Political Community at Blenheim Castle, the UK has made clear that it will play a major role in strengthening the European security. However, fitting a non-EU member into a defence-industrial integration of the EU makes already challenging legislative framework even more complicated and will require some sort of extra-EU legislative vehicle.

5.2 Potential for improvement and best practices: force mobility

In line with strategic priorities both the EU and NATO are increasingly recognising the importance of force readiness being aligned with the dynamically evolving threat environment. With war having returned to the European continent and the spectre of potentially fighting from and on European soil loomed; an increasing number of European allies are looking toward dispersed and mobile forces. To achieve force agility through dispersion and mobility, forces have to be well prepared to move at short or no notice, with reduced, more agile footprints, as well as deploying multi-skilled support personnel (Stringer 2023). Strategic priorities regarding the force structure are being identified across all three key force components: air force, army and navy.

The NATO's air arms strategy – Agile Combat Employment (ACE) – is becoming increasingly heard around in the Alliance. The ACE doctrine is designed to enhance the 'resilience and survivability' of allied air operations; the ACE operational scheme of manoeuvre combines ‘enduring’ and ‘contingency’ forward operating bases to posture capabilities (Stringer 2023). This increases the flexibility of operations while creating ‘operational dilemmas’ for adversaries, complicating their targeting processes through dispersal. ACE’s agility comes from generating maximum combat effect with the minimum footprint, using ‘multi-capable airmen’ who fulfil a variety of roles beyond their specific trade to achieve this. Perhaps, though, the most important facet centres on the employment of dispersed operations. This capability appeared validated during the opening attack by Russia on Ukraine in 2022: the air force aircraft that had dispersed away from the main bases survived the opening rounds to provide a stout defence against further attacks, but those that stayed put suffered hits (Mozharovskyi and Hodz 2024). The recent Ukraine’s experience is spurring allies into pursuing the agility concept more structurally.

Similarly, an enhanced army’s agility through an improved military mobility in Europe is becoming a major priority for both the EU and NATO on the background of lessons learned from the full-scale Russia's war of aggression against Ukraine. Among others, military mobility has been included in the "joint declaration" of the EU and NATO, outlining how the two organisations should work together in a complementary way.

Acknowledging the role of agile manoeuvring in navy operations, targeted exercises like Baltic Operations 2024 (BALTOPS 2024) that have taken place in June 2024 demonstrate NATO agility in a dynamic security environment. With nineteen NATO Allies, more than 50 ships, four Amphibious Task Groups and Multinational Task Units taking part, BALTOPS 2024 was the largest assembled coalition of amphibious forces in the Baltic Sea, as well as the largest assembled coalition of Mine Countermeasure forces in NATO. Such naval and multi-domain operations will be prioritised in future to enhance agility in operating as a cohesive team to ensure appropriate collective posture of deterrence and defence in a dynamically evolving security environment. However, it requires time before force agility benefits can be reaped tangibly and moreover is associated with a sizeable degree of uncertainty what the future of warfare will require.

The ability of dispersed forces to move with the speed of relevance at a time of major crisis and war is a crucial force element of the Alliance’s military deterrence doctrine. The ability of forces to move troops and materiel quickly across Europe should be visible to the enemy and deter them from attacking in the first place. For deterrence to be serious, Europe needs to show that it can shift forces faster to the front line than the aggressor can. For example, allies’ forces must be able to move personnel and materiel from the Rotterdam port to the Polish border in a matter of few days. Indeed, Ukraine has demonstrated just how vital trains are in getting munitions, tanks and armoured vehicles to the front line. As identified during this year’s large-scale NATO exercise Steadfast Defender 24, a lot still needs to be done to enable a frictionless movement of sufficiently large forces across national boundaries in Europe in the event of a major conflict or war.

Being able to react rapidly in times of crisis requires joint efforts on various fronts, i.e., between civil-military stakeholders as well as between allies on the EU and NATO level. To improve military mobility, as first, European allies need to fix the transportation infrastructure, reduce bureaucratic obstacles, address capacity issues, and create resilient communication systems. Fixing transportation infrastructure should start with a comprehensive database for military transportation, including military load classifications for bridges, roads, and tunnels. Renovation of transportation infrastructure should prioritise routes that can be used as military corridors. Reducing bureaucratic obstacles should start with a harmonisation of cross-border permits for military transports across Europe. The EU and NATO should implement simplified and standardised customs procedures eliminating the duplication of paperwork, as for instance with NATO’s Form 302 for customs exemption, which has to be used in addition to the EU’s Form 302. To address military transportation capacity issues, European allies have to invest substantially more into ailing transport equipment, as the example of Deutsche Bahn's rail cars shows. To create resilient communication systems across Europe, member states' legislators should reinforce provisions on securing critical infrastructure facilities in the national implementation of the EU's Critical Entities Resilience Directive.

Keeping forces in a state of high readiness and establishing the force structures to react agile to an armed attack wherever it comes from is a Europe's challenge to be addressed in the coming months and years. The Sweden's and Finland's experience with agility built into the force structure on the background of selected Ukraine's success against Russia's attacks suggests that agile manoeuvring (as anchored in the ACE doctrine) will be a critical NATO's ability to respond to newly emerging / evolving security threats originating from abroad. To further implement agile manoeuvring, ACE principles must be acknowledged throughout all stages of capability and doctrine development, ensuring that capabilities are best suited to contribute to operations with a minimum footprint and sufficient reactivity and flexibility.

Searching for best practices in agile air manoeuvring, European allies could learn from and build on the experience of Sweden. The new NATO member enjoys a reputation as the world leader in dispersed air operations; they have evolved into complex "war base" operations with a disused military airfield or regional civil airport acting as the central hub for a network of highway strips. Sweden employs road-based operations serving as a routine element of air force training (ainonline.com). The dispersed operations take advantage of advances in communications technology, which allow a very fluid form of warfare that is difficult to detect and disrupt. That mobility and fluidity is the key to survivability. If you operate from anywhere for long enough, a bomb will eventually find you. You have to keep on the move. Each "base" consists of numerous highway strips of a nominal 800-meter length and 17-meter width. The strips serve as everyday roads but with some treatment to the surface applied to prevent them breaking up and causing foreign object damage. Discreet hard standings are built alongside the roads in the general vicinity, not only to provide parking stands for aircraft but to accommodate trucks and fuel bowsers when not required for combat (ainonline.com). Everything is kept small to minimise detectability and enhance survivability. A single strip might only be activated for a short time, the support personnel retreating to the safety of the woods some way away when they are not needed. Local police shuts down the highway for only as long as required. Typically, a Swedish Gripen will stay on the ground for around 15 minutes between sorties – time for it to be serviced, refuelled, and rearmed by a team of just three trained conscripts and one full-timer.

The other new NATO member Finland fly slightly larger aircraft from somewhat longer road runways, but the basic concept of agile manoeuvring remain the same. Also in Finland highway operations are designed using public roads as runways. Convinced by the Finnish approach to force agility, NATO allies have already started to enhance agile combat employment on Finnish highways. In September 2024, two Allied nations joined Finland's annual road base exercise BAANA 24 to conduct historic landings on highways.

Looking for best practices in improving army's agility in Europe, the so-called 'military Schengen' agreement (MSA) – a new European initiative aimed at streamlining troop mobility among participating states – could become an activity toward strategic mobility priorities. In 2024, the Netherlands, Germany and Poland have launched a trilateral initiative to develop a military corridor for the movement of forces from Europe's North Sea ports to the eastern flank. Aimed to move military personnel and materiel more quickly and efficiently across national borders, the MSA is tackling military transport choke points, such as low or weak bridges (tanks weigh a lot more than they used to) and the bureaucracy that requires permits to move munitions across borders. The MSA will also give priority when needed to military rail requirements over civilian traffic. If implemented at the speed of relevance, the 'military Schengen' initiative could become a good example for other NATO and EU member countries as well as the unification of military mobility procedures throughout the EU and NATO.

5.3 Potential for improvement and best practices: sustained resilience

Resilience is an essential basis for a credible deterrence and defence. Deterrence is not just about showing what military power one can muster. An all-encompassing deterrence strategy, which is the new defence doctrine of the Alliance, is linked to the extent to which a country has both military capacity and a civil society that is robust enough to withstand major trials. Strengthening national and Europe-wide preparedness for deterrence and defence requires a whole of government approach, public-private cooperation, and societal resilience considerations. Strong states and strong societies are daunting targets for aggressors. Therefore, European allies should be reiterating the importance of boosting civil preparedness as part of military defence and deterrence. The same approach is necessary to resist and recover from natural disasters, infrastructure failures and hybrid attacks.

Enhancing resilience is a complex society-wide task that demands persistence, investment, and cooperation, requiring a coordinated and collective approach. Enhancing national resilience through military is not enough; each member state must confront the societal challenge of a protracted conflict and war based on its own preparedness strategy. Above all, European allies must find the “will to fight” against aggressor which – as Ukraine has shown – remains the foundation of defence. The war in Ukraine has demonstrated that size of a country is not destiny. A state with scarce resources but an active civil society and strong civic cohesion can collectively respond effectively to the devastating impact of a prolonged war caused by an external hostile force and put society back on the path of normality. There is much to learn from how the Ukrainian capacity for self-reliance and sustained resilience has enabled individual citizens, local communities, private sector, and the nation as a whole to bounce back from the massive systemic shock of a prolonged armed conflict.

Searching for best practices in enhancing a sustained resilience, European allies could learn from and build on the experience of the new NATO allies Finland and Sweden (Hanaholmen 2024). Finland offers a unique expertise in Europe based on its advanced approaches to the whole-of-society resilience and civil preparedness. Further coordinated work streams should be explored, particularly looking at interdependencies between civil authorities, military and the private sector. Leveraging synergies of interdependencies – that range from the reliance of the military on civilian logistical and telecommunication capabilities to the reliance of civil authorities on military capabilities for handling disruptive events – will be a key challenge. The cooperation model of Finnish preparedness is named ‘comprehensive security’ (kokonaisturvallisuus),[4] where vital societal functions are handled together by government authorities, businesses, NGOs and citizens. The sever vital societal functions include leadership, international and EU activities, defence capability, internal security, economy, infrastructure and security of supply, functional capacity of the population and services, and psychological resilience

[4] https://turvallisuuskomitea.fi/en/comprehensive-security/

In Sweden, the whole-of-society-resilience is referred to as 'total defence'.[5] The total defence concept involves the whole of society and contains a range of activities required to prepare Sweden for war. The total defence consists of two areas of activity – military defence and civil defence – and involved not only of the conventional military and civil resilience, but also psychological resilience and economic resilience. Both physical and psychological resilience are key to the nation's will to keep fighting and a successful defence. Physical elements of sustained resilience include energy security: access to diverse sources of power and fuel, abundant storage, and flexible demand; emergency stockpiles: ability to source food, drinking water, healthcare resources, and spare parts; hardened infrastructure: public transportation, power grids, natural gas networks, automotive fuel distribution, mobile and fixed-line telephone service, broadcasting, shelters for civilian population. Psychological elements of sustained resilience include information security: an educated and resilient population that can distinguish between truth and falsehood, sceptical of hoaxes and scare stories; social cohesion: high levels of societal trust, willingness of a population to make sacrifices and accept inconvenience in pursuit of common goals; leaders' expertise: well-trained, well-networked decision-makers used to working outside their professional silos and across the public-private, civil-military, and classified-unclassified divides; culture with institutionalised processes: ability to switch smoothly and speedily from a "peace-time" to "major crisis/war" context; threat awareness: society's understanding of the nature and extent of current and future threats.

6.0 CONCLUSIONS

The evolving landscape of multi-dimensional, complex and cross-border threats and crises have the potential to profoundly affect and disrupt society in Europe in the years ahead. The existing approaches to preparedness and readiness – valid during the decades of the post-Cold War peace period in Europe – reveal a number of deficiencies that limit their applicability in a protracted crisis and war. To overcome this gap, we enhance the situational awareness of strategic readiness through two complementary angles. First, through a situational assessment of selected readiness elements that have often been overlooked in Europe. Leveraging the newly augmented strategic readiness framework of the US DoD, we examine the defence industrial readiness for a protracted conflict and war, force mobility, and a sustained whole-of-society resilience. Second, through a scenario analysis – in order to future-proof the strategic decision maker options to be resilient to changing boundary conditions – we stress test Europe's readiness in view of possible future systemic shocks across threat and time horizons by simulating selected scenarios and evaluate potential impacts in the EU-EMS model.

We provide an analytical foundation for the debate on the European preparedness and readiness repercussions of geopolitical and security policy choices if they arise, for instance, in the context of a widening conflict with CRINK. Our findings from the situational assessment reveal that the defence industrial mobilisation, force mobility resilience and sustained resilience readiness are largely "off-track“ in view of the European Defence Readiness. Second, by quantifying the potential costs of unpreparedness, the Cold War 2.0 scenario analysis results imply that among the biggest challenges Europe faces today is the imperative of adaptation, and there can only be adaptation if European leaders clearly articulate what it is we need to adapt to. By quantifying the

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5 government.se/government-policy/total-defence/ & msb.se/siteassets/dokument/amnesomraden/krisberedskap-och-civilt-forsvar/stod-till-kommuner/krisberedskapsveckan/if-crisis-or-war-comes.pptx

cost of unpreparedness, we provide a measurable rationale for European allies to embark on a gradual de-risking trajectory rather than waiting for a much more costly "abrupt shock" trigger dictated by geopolitical events. Comparing EU-EMS model simulation results of unanticipated Cold War 2.0 shock versus anticipated shock suggest that exploring the key issues ex-ante – without strategic decisions being imminent at this point in time – and taking a proactive approach can help to prepare strategic decisions weigh alternative courses of action ahead of time. Our results suggest that the socio-economic costs may ultimately be lower if policy makers start taking systematic actions toward enhancing preparedness and readiness now and do so in a targeted way.

REFERENCES

Allen, J.R., F.B. Hodges and J. Lindley, (2021) 'Future War and the Defence of Europe', Oxford Press.

Alloush M. and M. Carter (2024). "On the Definition and Estimation of Economic Resilience using Counterfactuals," NBER Working Papers 33290, National Bureau of Economic Research, Cambrudge, MA.

Baqaee, D.J. Hinz, B. Moll, M. Schularick, F.A. Teti, J. Wanner and S. Yang. (2024) 'What if? The Effects of a Hard Decoupling from China on the German Economy', CEPR Press, London.

Bruneau, M. and A. Reinhorn (2006) Overview of the Resilience Concept, San Francisco, CA.

Campbell, W.G (1952), Economics or Mobilization and War. Homewood, II.: Richard D. Irwin.

Cancian, M.F., A. Saxton, L.A. Bryan and O. Helman (2020) Industrial Mobilization: Assessing Surge Capabilities, Wartime Risk, and System Brittleness, Naval Engineers Journal, 132:2, 39-49.

E-ARC (2024), Enhanced Analytic Resilience Index, Euro-Atlantic Resilience Centre, Bucharest.

EDA (2023) The 2023 EU Capability Development Priorities, European Defence Agency, Brussels.

EC (2016) Raw materials in the European defence industry, JRC98333, European Commission, Publications Office of the European Union, Luxembourg.

EC (2024) European Defence Industry Programme and a framework of measures to ensure the timely availability and supply of defence products. Staff Working Document No C(2024) 4822 final, European Commission, Publications Office of the European Union, Luxembourg.

Galvin, T. (2022) "A Framework for National Preparedness and Military Readiness," U.S. Army War College, War Room, Carlisle, PA.

Gauthier, Y. and P. Archambault. (2016). Informing Strategic Decision-Making on Force Posture and Readiness Defence Research and Development Canada.

Hanaholmen (2024), The Finnish and Swedish cross-sectoral concepts as inspiration for the development of crisis preparedness and resilience in the EU' presented at the 'Preparedness Union – Harnessing the Whole-of-Society Approach at EU Level', Swedish-Finnish Cultural Foundation.

Hartmann, J. (2024). "Military Mobility." DGAP Brief 10, German Council on Foreign Relations. Berlin.

Ilut, C. and Schneider, M. (2023). Ambiguity. Ch. 24. In R. Bachmann, G. Topa, & W. Van der Klaauw (Eds.), Handbook of economic expectations, 749–777. Academic Press.

JOIN(2024) Joint Communication to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, {JOIN(2024) 10 final}, EUR-Lex 52024JC0010.

Kancs, D. (2024), Enhancing Resilience: Model-based Simulations, Journal of Defense Analytics and Logistics, 8(1): 105-120.

Kancs, D. (2024), Uncertainty of supply chains: Risk and ambiguity, World Economy, 47(5), 2009-2033.

Kancs, D. (2024), Enhancing the Preparedness and Readiness: Towards an EU Preparedness Strategy, Publications Office of the European Union, Luxembourg. doi:10.2760/92995.

Lucas, E., C. Sendak, C. Collen, J. Kallberg and K. Viksnins (2023), The New Security Architecture in the Nordic-Baltic: Assessing the Russian Response, Center for European Policy Analysis, Washington, DC.

Michta, A.A. (2024) Phase Zero of the Coming War, Scowcroft Center for Strategy and Security, Atlantic Council, Washington, DC.

Moffat, J., T. Scales, S. Taylor and J. Medhurst (2011) "Quantifying the Need for Force Agility," International C2 Journal, 5:1.

Monaghan, S., E. Jakobsen, S. Martinez, M. Droin, G. Sanders, N. Velazquez, C. Cook, A. Dowd, and M. Sockwell (2024) Is NATO Ready for War?, Center for Strategic and International Studies, Washington, DC.

Nederveen, F., S. Hoorens, E.J. Frinking and H.v. Soest, (2024) Resilience quantified: A method for understanding resilience to threats to national security. Santa Monica, CA: RAND Corporation.

Niinistö, S. (2024) Strengthening Europe's Civilian and Military Preparedness and Readiness, Brussels.

Ottosson, B., A. Engström, E. Sjökvist and E. Thorburn (2024) Western Military Capability in Northern Europe 2024 - Part II: The Evolving European Security Landscape: Political Tensions and Strategic Challenges toward 2030. Swedish Defence Research Agency, FOI 5623, Stockholm.

Polyakova, A., Lucas, E., Boulegue, M., Sendak, C., Kindsvater, S., Kuz, I., Stone, S. (2024). A New Vision for the Transatlantic Alliance: The Future of European Security, Journal of Strategic Analysis, 8(1), 91-92.

Rehman, I. (2023), Planning for Protraction. Routledge.

Sellevåg, S.R., T. Apalvik and S. Dahl (2024) War in Norway: Scenario-Based Analysis of Humanitarian Needs, Nordic Defence Review.

SIPRI (2024), SIPRI Yearbook: Armaments, Disarmament and International Security, Stockholm Peace Research Institute, Stockholm, Oxford University Press, Oxford.

Rutte, M. (2024), To Prevent War, NATO Must Spend More. Carnegie Europe, Brussels. https://www.nato.int/cps/en/natohq/opinions_231348.htm

U. S. Department of Defence (2023), "Strategic Readiness," DoDI 3000.18, Washington Headquarters Services, Washington, DC.

Watts, S., Rhoades, A.L., Linick, M.E., Best, K.L. and J. Fleming (2024) Rethinking Readiness: A Framework for a Strategic Readiness Assessment, Santa Monica, CA: RAND Corporation.

Production	Replacement time, years		Threshold attrition rate, %	
	Economic	Maximum	Economic	Maximum
Aircraft & Related Syster	14.3	7.6	7.0	13.2
C4I Systems	7.7	4.6	12.9	21.6
Ground Systems	11.0	6.6	9.1	15.1
Missiles & Munitions	13.0	8.7	7.7	11.5
Mission Support Activitie	4.2	2.5	24.1	40.3
Navy Ship Systems	27.8	16.0	3.6	6.3
Space Based Systems	13.1	7.9	7.6	12.6

Table 1: Average replacement time (years) of current (2023) inventories in Europe and threshold attrition rate (percent); Source: Authors' computations based on data from Cancian et al. (2020); Polyakova et al. (2024) and SIPRI (2024)

	Prerequisites of resilience	Preparedness for resilience	Shock resistance	Crisis recovery	Risk exposure
Mean	6.69	7.20	7.95	7.47	2.25
Median	6.56	7.26	7.97	7.47	2.20
STD	0.92	0.75	0.68	0.72	0.91
Min	4.91	5.21	5.83	5.87	0.40
Max	8.21	8.52	9.18	8.99	4.20

Table 2: Enhanced Analytic Resilience Index for Europe, 2023
Source: Author’s computations based on E-ARC (2024) data

Shock	Agile trade diversion		Moderate trade diversion	
	Unanticipated	Anticipated	Unanticipated	Anticipated
Aircraft and Related Systems	10.0(+32%)	9.8(+29%)	11.3(+49%)	9.9(+30%)
C4I Systems	5.7(+23%)	5.6(+21%)	6.1(+32%)	5.6(+21%)
Ground Systems	8.6(+30%)	8.5(+28%)	9.5(+43%)	8.6(+30%)
Missiles & Munitions	11.7(+34%)	11.2(+28%)	13.5(+55%)	11.5(+32%)
Mission Support Activities	2.9(+16%)	2.7(+8%)	2.9(+16%)	2.7(+8%)
Navy Ship Systems	24.6(+53%)	19.5(+22%)	31.0(+94%)	22.3(+39%)
Space Based Systems	10.5(+32%)	10.2(+29%)	11.9(+50%)	10.4(+31%)

Table 3: Average replacement time in years (% change) of inventories in Europe following a complete cessation of trade with CRINK; Source: Authors' computations based on data from Cancian et al. (2020); Polyakova et al. (2024) and EU-EMS model simulations

FIR2023	GER	GBR	FRA	ITA	CHN	ROW
GER		6.4	9.0	7.2	14.3	40.3
GBR	6.7		7.9	5.2	15.6	28.9
FRA	9.7	3.7		9.3	13.4	33.6
ITA	8.6	2.6	5.8		15.7	38.0
CHN	1.7	0.5	0.7	0.5		24.3

FMR2023	GER	GBR	FRA	ITA	CHN	ROW
GER		3.7	5.0	4.1	8.2	38.9
GBR	4.5		2.8	2.0	5.7	24.7
FRA	8.2	3.7		5.1	8.3	33.7
ITA	6.6	2.6	4.5		5.7	31.5
CHN	1.2	0.9	0.7	0.7		15.4

FIR_CW	GER	GBR	FRA	ITA	CHN	ROW
GER		11.2	16.0	11.9	0.0	53.9
GBR	15.7		14.2	8.2	0.0	49.6
FRA	21.2	13.1		15.6	0.0	46.6
ITA	19.7	8.3	18.7		0.0	50.8
CHN	0.0	0.0	0.0	0.0		31.5

FMR_CW	GER	GBR	FRA	ITA	CHN	ROW
GER		13.0	16.0	13.3	0.0	54.1
GBR	14.9		9.6	7.1	0.0	45.3
FRA	18.7	12.5		16.2	0.0	44.8
ITA	14.8	8.8	15.7		0.0	40.9
CHN	0.0	0.0	0.0	0.0		22.2

Table 4: Foreign Input Reliance in 2023 (FIR, %); Foreign Market Reliance in 2023 (FMR, %); simulated FIR and FMR in Cold War 2.0 scenario (CW). Source: Authors' computations based on Kancs (2024) and EU-EMS model simulations. Notes: Rest of the World (ROW).

	Prerequisites of resilience	Preparedness for resilience	Shock resistance	Crisis recovery	Risk exposure
Mean	3.73(-44%)	6.05(-15%)	4.32(-45%)	6.01(-19%)	2.25(0%)
Median	3.59	6.22	4.29	5.98	2.20
STD	0.74	0.66	0.47	0.60	0.91
Min	2.50	4.58	3.38	4.79	0.40
Max	5.00	7.50	5.05	7.37	4.20

Table 5: Enhanced Analytic Resilience Index (resilience loss) for Europe, Cold War 2.0 scenario; Source: Author's computations based on E-ARC (2024) data

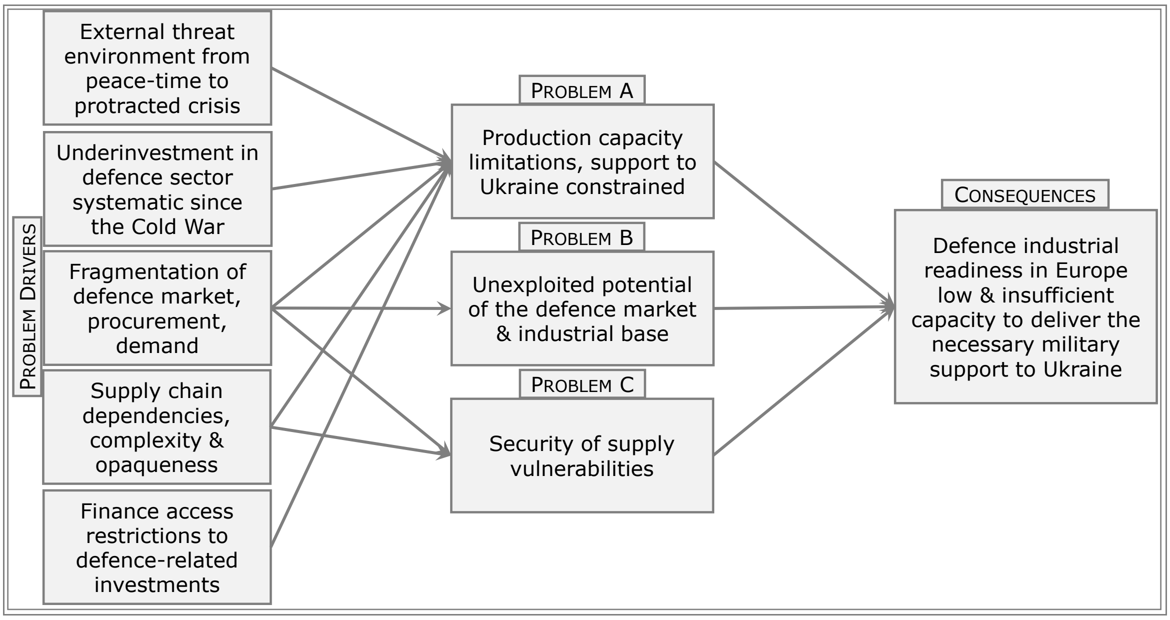


Figure 1: Situational assessment of defence industrial readiness in Europe; Source: Authors

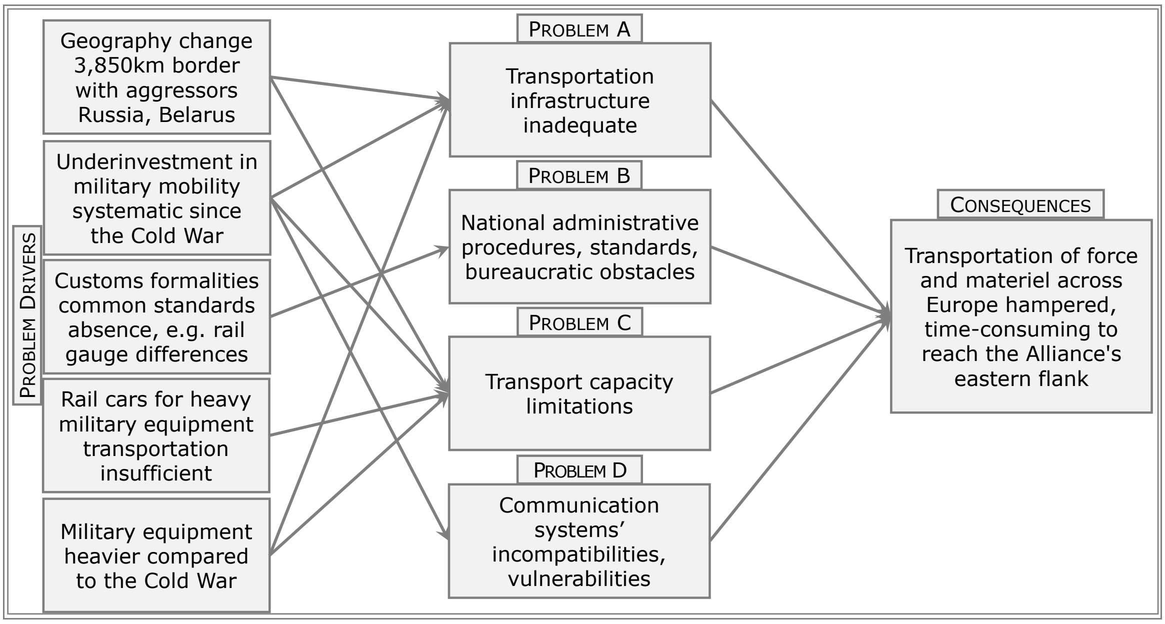


Figure 2: Situational assessment of force mobility in Europe; Source: Authors

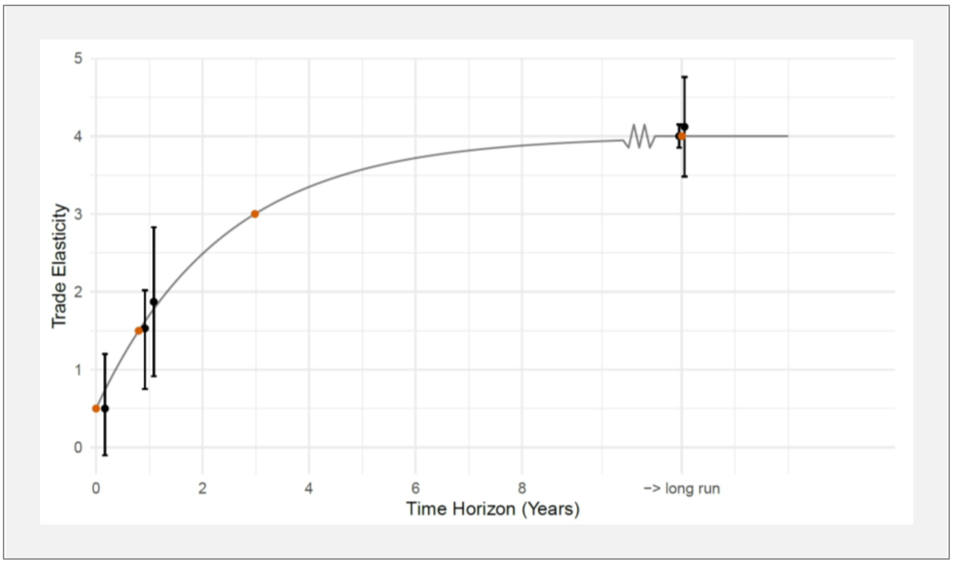


Figure 3: Estimates of the elasticity of substitution of traded goods from different origin for different time horizons; Source: Based on Baqaee et al. (2024)

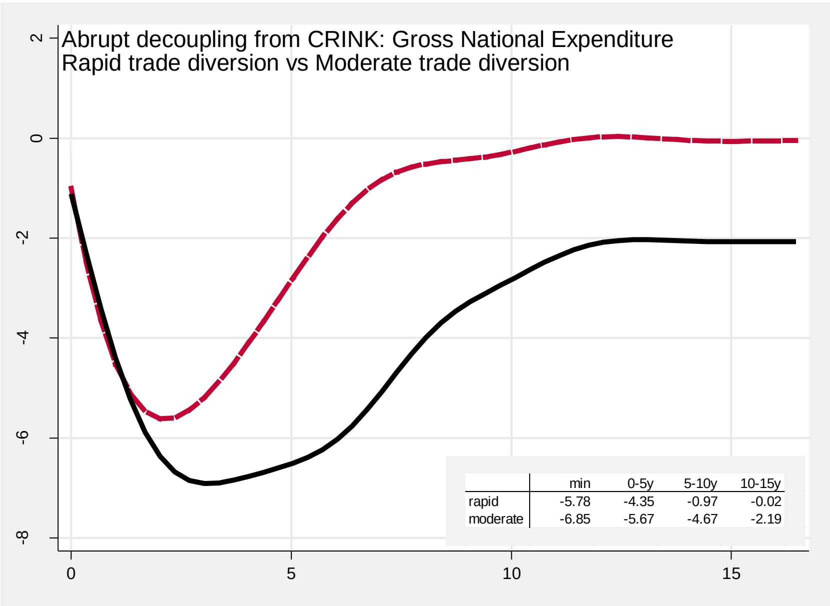
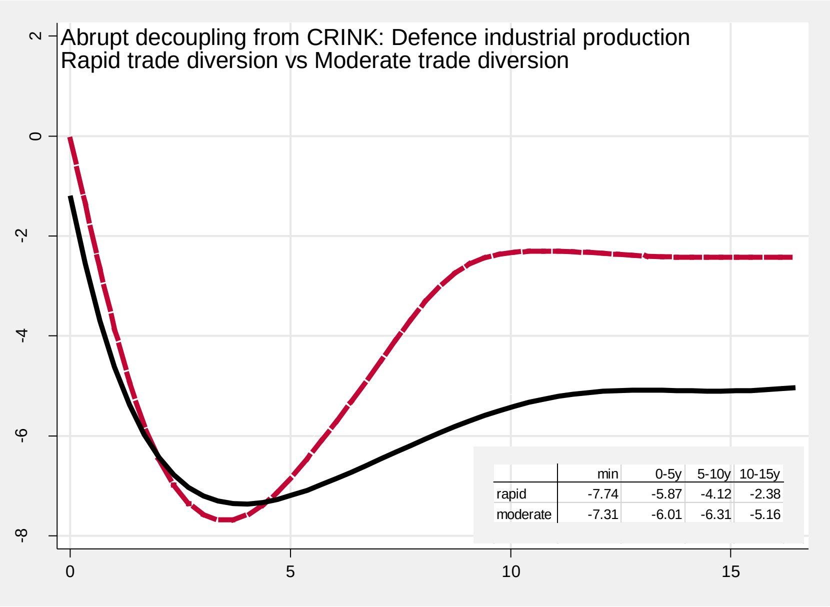


Figure 4: European Gross National Expenditure (% change) following an abrupt decoupling from CRINK; Source: Author's simulations based on the EU-EMS model



	min	0-5y	5-10y	10-15y
rapid	-7.74	-5.87	-4.12	-2.38
moderate	-7.31	-6.01	-6.31	-5.16

Figure 5: European defence industrial production (% change) following an abrupt decoupling from CRINK; Source: Author's simulations based on the EU-EMS model

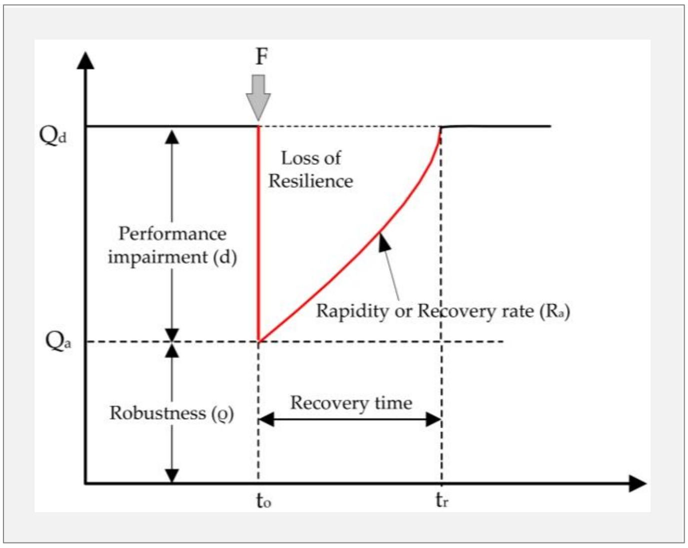


Figure 6: Quantification of the loss of resilience after a systemic shock: Source: Authors