INCREASING EUROPEAN PRODUCTIVITY, RESILIENCY AND DEFENCE PRODUCTION
(AND HOW TO PAY FOR IT)

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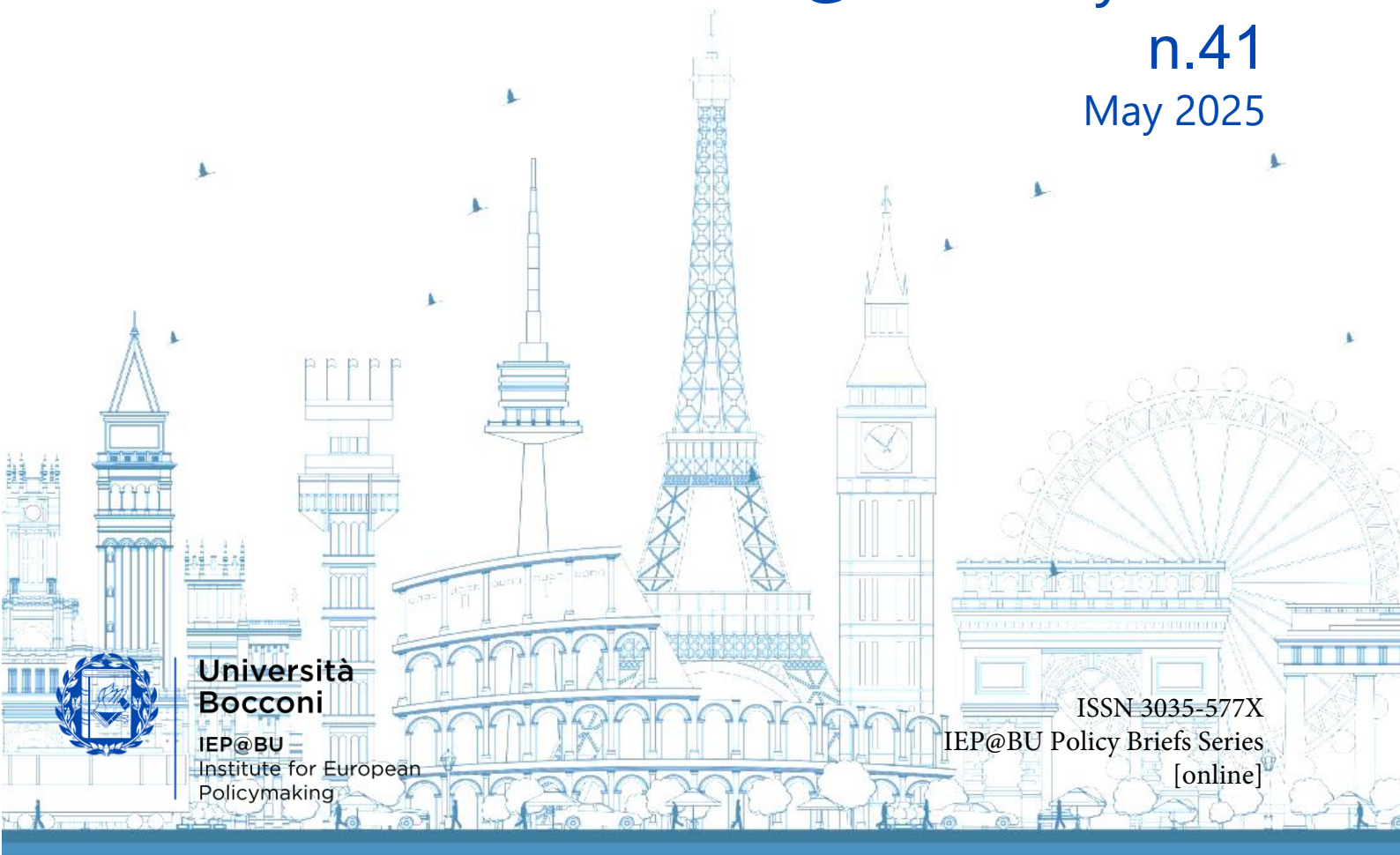

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Executive Summary

The European economy is stalling. Growth rates have settled at around 1%, making the EU overall, and the euro area in particular, the slowest growing of the major economic areas globally. Europe is near to stagnation although over the last decades Member States have undertaken many structural reforms and the level of education of the European workforce has continued to improve.

A lack of capital is unlikely to have been the root cause of lower productivity growth, given that the investment rate in the EU has been, until very recently, equal to that of the US. The real problem is that the return on capital is lower in most of the EU than in the US, suggesting that it is the composition of investment, rather than its volume, that is the problem. Moreover, the impact of structural reforms at the national level seems to have been more than offset by an increase in EU level regulation.

The challenges to the European economy are now magnified by the upheaval in the global trading system through the 'reciprocal' tariffs of the US.

To restart growth the EU needs to focus on productivity and innovation. This does not require hundreds of billions of euro in new expenditure, but rather a sharp focus on the efficiency of existing budgets couples with innovation-friendly rulemaking. Single market rules need to be streamlined, and financial market rules need to be adjusted to encourage more investment in risk capital by both households and long-term savings institutions. ESG rules need to be adjusted to take into account that defence has become a key social goal. The increase in national defence expenditure provides an occasion to strengthen European high-tech industry. But European-wide competition in the market for weapons is key to keep costs in check.

I Introduction

This discussion paper presented at the March 2025 Martens Center Academic Council meeting has four main component.

First, a critical review of some of the proposals to increase European productivity presented in the Draghi Report, focusing on its suggestions related the technology sector and AI.

Secondly, a discussion of the EU's current and preferable strategy to ensure improved long-term supply resiliency for critical minerals.

Thirdly, an analysis of how fully integrating Ukraine into the revitalized European military industrial sector can help Europe rearm at an affordable cost.

And lastly, a proposal for a new European Defense Fund as a common European financing vehicle to resist Russian aggression. A distilled set of policy recommendations follows at the end.

II Raising European Productivity Levels by Using AI

Mario Draghi's Report, The Future of European Competitiveness, is a call to action to confront the main economic challenges facing the EU in the coming decades. Slowing economic growth especially compared to the US, compounded by the need for improved resilience against geopolitical shocks and globalisation in reverse, the need to address climate change and high fossil fuel costs, and the need for Europe to be able to defend itself, demands a comprehensive response. Not least at the EU level, as fragmentation often lies at the heart of our relative underperformance. Draghi's response is clear—up to 5% of GDP in additional annual investments in the EU in the coming years, with up to 80% coming from the private sector. Our principal future policy challenge is to incentivise the private sector in Europe to invest more, while recognising that only governments can lead in boosting our national and regional security.

The self-evidently politically determined title of Draghi's Report misses the crucial economic point that it is productivity, rather than competitiveness, that dictates living standards and should be EU policymakers' focus.

Even low productivity economies can be competitive through means like a flexible (under-valued) exchange rate or low wages. And the EU of course already runs a sizable current account surplus at around 3% of GDP, and can expect to derive a general positive future terms of trade shock as decarbonisation cuts fossil fuel import costs towards zero. The EU's crucial problem instead lies in raising low average productivity levels.

The Draghi Report has a number of important suggestions for how Europe can increase productivity, which will be discussed in the following section. The following section will focus on the particular issues relate to raising the EU's economic resiliency and defence industrial capabilities.

The EU as a fully developed economy (still) relatively close to the global productivity frontier cannot import technology to boost productivity, and the economics profession is generally poor at identifying

the long-term drivers hereof[1]. The literature[2] identifies three categories of productivity drivers; 1) boosters of innovation and experimentation of new knowledge and technologies, including R&D, especially in digital and intangible assets; 2) contributors to diffusion of existing knowledge and technologies among the largest number of economic agents, including human capital and public infrastructure; and 3) processes that facilitate the efficient allocation of resources within and/or between sectors and firms, including competitive intensity, trade intensity and globalisation, and financial deepening[3]. The EU faces critical challenges in all three categories.

The Draghi Report clearly identifies the key role of the technology sector as the principal driver of the rising productivity growth differentials between the US and EU. Largely due to its limited venture capital availability and smaller market size, the EU failed to capitalise on the initial digital revolution from the mid-1990s onwards. Europe failed both to generate new technology and internet companies, and diffuse the new digital technologies into the wider economy. First-mover advantages in most digital sectors have proven decisive, due to network and scale effects, enabling today's US technology giants to dominate global corporate R&D budget rankings[4].

Internet and technology services firms in Europe face natural language barriers to growth and a still incomplete internal market in services, and not least continued national location of sector supervisors, often providing a powerful bureaucratic obstacle to fast and seamless firm expansions across the EU.

Indeed, as illustrated by the banking union, even a common European supervisor is often not enough to facilitate cross-border expansions and M&A against entrenched domestic opposition in individual member states.

This factor of domestic supervisors principally focused on "maintaining the independence of national players" further dims the integrative prospects of Enrico Letta's and Mario Draghi's "28th regime".

A "common European 28th regime" in principle available for European companies as an alternative to national regulatory frameworks will be illusory without strong independent European level sector supervisors.

With such institutions, a "28th regime" would simply mean "opting out of national regulation", which will in practice surely not be tolerated by competitors or national regulators.

For a 28th regime to be a viable alternative, it must be preceded by what will in virtually all European services sectors be unprecedented integration of day-to-day supervisory institutions (in addition to the existing European level rulemaking). To date, the political will for such institutional integration has not been present among EU member states, though it is possible that genuine common European supervisory institutions can be created in innovative new economic sectors, before national regulatory institutions are created and invariably establishes national barriers to entry and

[1] Total or multi-factor productivity is in fact a 'residual category' in economic models, capturing simply the additional output produced, once all relevant input factors have been accounted for.
[2] See for instance Identifying the Main Drivers of Productivity Growth – A Literature Review, OECD (2022).
[3] Things like the rule of law, resilient, transparent and legitimate institutions and associated good governance are increasingly frequently also included as affecting outcomes across the entirety of an economy.
[4] Amazon, Alphabet, Meta, Apple and Microsoft top the global corporate R&D budgets, well ahead of firms in the global auto or pharmaceutical sectors. See fDiIntelligence at https://www.fdiintelligence.com/content/feature/global-innovation-leaders-2022-edition-82527

obstacles for pan-European expansion by EU companies.

Member states will, however, for this to work in new sectors have to willingly handover such "supervisory first-mover advantage" to the EU level, and refrain from establishing any national supervisory functions. This will prove a challenging political task, as it must at all times be weighted against consumer protection and for instance other environmental concerns.

Divergent and size dependent national labour market regulations pose another regulatory obstacle to rapid pan-European growth of technology (and any other) sector firms in Europe. But as naturally with national languages, integrating or reducing such regulations for all but the smallest of European firms is likely to prove politically impossible. Widespread labor market deregulation has always proven politically contentious in EU member states.

On top of such growth obstacles to entrepreneurial and fast growth technology, the sector face potentially important policy trade-offs with regards to the benefits of scale and efficiency.

The issue resides with EU competition policy, which is guided by market structure analysis and the desire to prevent firms from acquiring market dominance either through M&A, and/or for instance the network and scale effects at play in the digital sectors.

In the US, the competition policy litmus test is instead consumer prices, and firms' prospective M&A and market position are less relevant if the company can show that efficiency gains lead to lower prices[5].

In technology sectors in which network effects are very powerful and a key driver of efficiency and productivity gains, this competition policy framework risks putting European firms at a disadvantage. As Blanchard and Ubide (2024) succinctly asked: Would Amazon have been able and allowed to grow and develop in the EU?

All told, and despite the lengthy list of recommendations laid out by Mario Draghi[6], it seems unlikely that the EU can become the home of the next generation of globally competitive technology firms, including in producing new AI and other related sectors.

This recognition will have obvious national security implications, as global technological leadership bestows the opportunity to impose extraterritorial sanctions and technology restrictions on other actors.

This is a valid, though essentially political and national security related, concern. The likely failure of the EU to generate the next generation of global technology and AI champions is however not in a broader economic sense tantamount to condemning the EU to the "slow agony" discussed by Mario Draghi.

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[5] Remedial measures can be applied ex-post to any merger, following an intervention by US authorities and approval by the court system.

[6] These include reforming and integrating at the EU levels, public sector R&D support, promoting more universities and research institutions to the top global level, promoting innovation clusters of venture capitalists, universities and start-ups, integrating the often costly and complex national procedures for filing for IPR and patents and facilitate that 'inventors become investors', increase the availability of risk capital for disruptive innovation, making available publicly funded high performance computers for AI development, and facilitate the consolidation of the telecoms sectors in Europe to promote investments in connectivity.

It is important in an era increasingly defined by geopolitical rivalry to distinguish between the political desire for technological leadership rooted in "great power status" and the economic goal of sustaining productivity growth and improving economic conditions.

The former, as captured in the work of historians like Paul Kennedy in his 1987 capstone *The Rise and Fall of the Great Powers: Economic Change and Military Conflict from 1500 to 2000* posits that differentials in growth rates and technological change, leads to shifts in the global economic balances, which in turn gradually impinge upon the political and military balances among the great powers.

Others like Daniel Drezner (2001) argue that great powers and hegemons tend to derive their status through a near-monopoly on innovation in certain leading economic sectors.

Economists like Walt Rostow and William Thomson have argued for leading sector sequencing from cotton to steel to chemicals to automotives to computers to now (allegedly) AI or advanced biotechnology, and Raymond Vernon created a model of societal technological change adapted from the product life cycle theory. According to this type of "Leading Sector" (LS) technological analysis, the EU would likely be doomed to also economic "slow agony" unless it managed to generate its domestic versions of globally competitive AI and other related technology firms.

Yet, as argued by Jeffrey Ding (2021) another paradigm exists of potentially more importance, when it comes to harnessing the economic benefits of what Bresnahan and Trajtenberg (1995) dubbed particular disruptive "general purpose technologies" (GPTs).

These are characterized by their wide and pervasive applicability across many economic sectors, potential for continuing technical improvements and synergies with other innovations.

GPTs historically include technologies like the steam engine, electricity, semiconductors, the internet, and probably today AI. Deriving the full economic benefits of GPTs is not immediately related to inventing them, or even producing them, but rather ensuring the fastest and widest diffusion of use of these technologies throughout the economy.

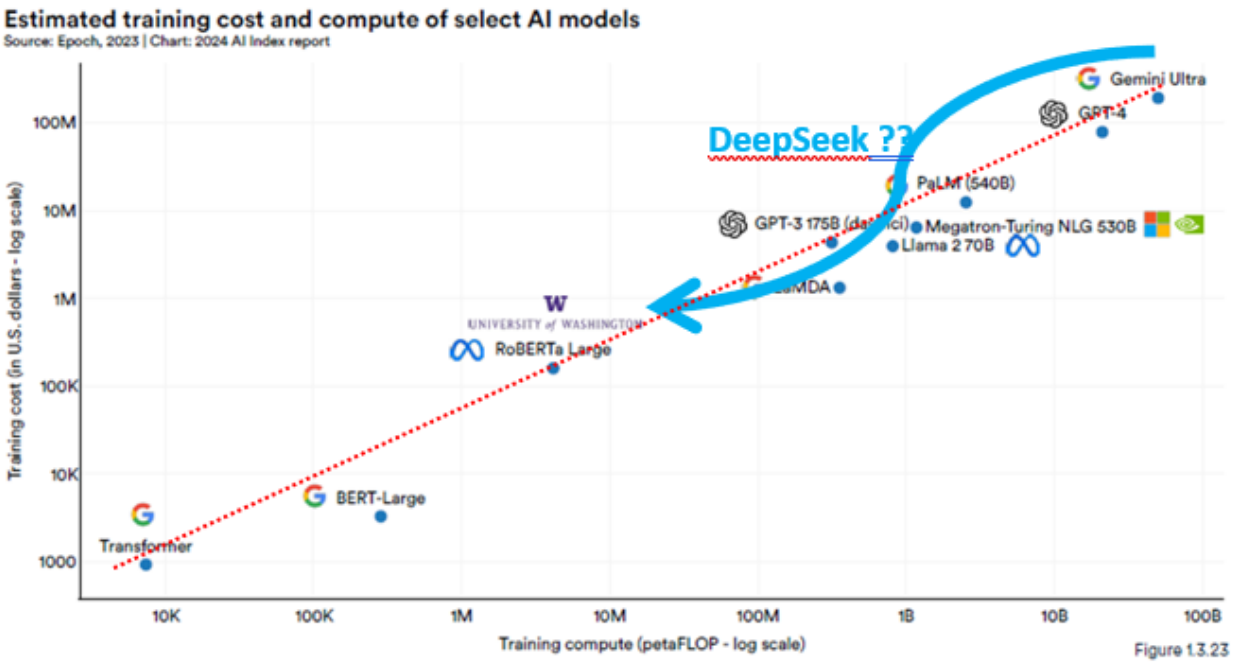
Mann and Kirkegaard (2006) argued along similar lines that what drove the relative US productivity outperformance in the 1990s was the higher diffusion of IT to more sectors of the economy than in other OECD countries. What matters for GPTs is not producing them, but using them.

Here it is particularly relevant to understand the impact of the recent DeepSeek breakthrough in large language models (LLMs) and AI in general.

What DeepSeek – and since then a number of other academic research teams and private technology firms - achieved was to significantly reduce the cost of training an LLM through smarter coding and improved reinforcement learning to produce a cheap and good reasoning LLM. And do so relying on a relatively high degree of open-source software. Figure 1 from Martens (2025)[7] illustrates the process.

[7] Bertin Martens (2025). *"Beyond the DeepSeek and Stargate AI hype: Back to economic reality",* research presentation at Bruegel, February 10, 2025.

Figure 1:



DeepSeek (and similar new models) needs a lot less data to train on, and hence fewer high-end microchips and less investment costs. It therefore represents an important cost reduction development, pushing LLM applications of AI towards what was in the semiconductor industry known as “Moore’s Law commoditization”.

Sam Altman, the founder of OpenAI, recently highlighted the forcefulness of AI LLM related price declines, noting “*The cost to use a given level of AI falls about 10x every 12 months, and lower prices lead to much more use. You can see this in the token cost from GPT-4 in early 2023 to GPT-4o in mid-2024, where the price per token dropped about 150x in that time period. Moore’s law changed the world at 2x every 18 months; this is unbelievably stronger.*”

It is important to distinguish between on the one hand currently commoditizing LLM AI applications, which will be useful to firms for carry out specific text, picture, sound and other binary data based tasks. And on the other hand ”artificial generalized intelligence” (AGI), which typically refers to artificial systems that can manage complex challenges in space and time, and in the process directly replicate multifaceted human capabilities.

The development of AGI remains aspirational and will undoubtedly be extremely costly. Meanwhile, LLMs are fundamentally just models trained on large amounts of data to predict the next letter or word in a text, or pixel in a picture, and as such represents only a particular application of AI.

LLMs can perhaps best be thought of as more advanced and flexible chess computers – these dropped in price from around $10mn needed to construct DeepBlue to beat Garry Kasparov in 1997 to today being an essentially free service available on apps in return for just watching a commercial or two.

LLMs may well already, however, prove disruptive for new and politically influential groups, including journalists, movie makers/stars, lawyers, or (even!) economists. With powerful groups potentially

economically threatened by this technology, political and popular controversy will follow.

Yet, as with earlier technological innovations, as AI LLM costs drop, usage of the technology will naturally spread more rapidly throughout the economy, and the key for future productivity gains will be for individual sectors (or firms) to tailor these technological capabilities to their specific needs.

With the core service, however, drastically dropping in price for users, it is not a real economic priority for Europe to develop indigenously designed and trained LLMs to boost productivity growth.

Much better to purchase commoditized AI LLMs and instead spend the resources to promote the use and diffusion of ever cheaper available AI services.

As Martens (2025) succinctly notes *"Even with a €200bn investment* [from the EU's InvestAI initiative[8]] *spread out among 60 companies, the EU is unlikely to develop its own foundation LLMs. But it may develop a layer of smaller and more specialized fine-tuned AI models and applications on top of these baseline models. That would be sufficient to spur innovation and productivity growth in the EU."*

Yes, the EU's likely inability to generate an indigenous and globally competitive technology-producing AI sector will further, given the sector's weight in aggregate productivity measurements, pose a challenge for any productivity catchup with the US. But The EU's productivity enhancement efforts must instead focus on accelerating the absorption and diffusion capability of AI, arguably the contemporary novel technology with the most obvious GPT characteristics, across as many AI technology using sectors and across all the EU economies.

This first means promoting broad based educational attainment in the EU workforce across all age groups to be able to better understand and design AI applications, and use commoditized AI services across the European economy.

This must happen through adequate funding of full-time educational institutions, adult (lifelong learning) education opportunities, and flexible curricula adjusted in accordance with identified skills gaps in an ongoing manner based on input from employers and other stakeholders.

To promote cross-border EU labour flows, common EU certifications should be introduced across especially the professional services sectors, complementing national certifications frequently administrated domestic self-interested professional bodies.

Such EU level certifications must be legally valid across the EU and as such function akin to a "28th regime" enabling private sector employers to hire workers from across the EU with a degree of transparency regarding their skill levels[9].

Secondly, it means promoting especially private corporate investments in new AI applications and use across all sectors. Public investments play a role here, but the focus must be to facilitate higher private technology investment levels.

A long stagnant, but "prestige policy project" mentioned again in the Draghi Report, the EU Capital

[8] The InvestAI initiative was launched on February 10th 2025 an includes €20bn in new EU public funding. See details at https://ec.europa.eu/commission/presscorner/detail/en/ip_25_467

[9] A private employment contract based on an EU level certificate should generally not be associated with lengthy employment security or severance payments.

Markets Union (CMU) is unlikely in a still fundamentally banking intermediated European financial system to yield relevantly sized declines in businesses' cost of capital to materially boost investment levels in the near or medium term.

Attempts at "mobilising European savings" should instead be focused on making more risk capital available to European start-up businesses pioneering the use of new AI applications in their sectors. This can be done by for instance having national or European level financial institutions offer non-diluting, non-senior, medium-term (say 5y) 'matching funding' at the government interest rate to business angel or VC investors putting their own money at risk in European upstart companies.

The big lift in terms of promoting more private European investments is, however, not found on the supply side through the lower cost of capital, but as highlighted repeatedly by the Draghi Report, on the demand side. European businesses must face improved incentives to invest more resources in the EU economies.

Apart from improved skills availability highlighted above, this involves general political measures to reduce businesses' and especially SME's regulatory and reporting burdens, permitting delays, and other obstacles related to not facing a fully digitised e-government based public sector.

III Promoting EU Economic Resiliency

The EU in 2022 faced the obvious consequences of its fossil fuel dependency on Russia, and geopolitical tension remains major risk factor today. Improving the resiliency of the EU economy to adverse supply shocks related to for instance critical minerals remains important.

Here in particular the EU must sensibly address the true nature of the alleged ordeal from new professed EU dependencies arising in critical minerals used in the green transition.

The Draghi Report warns against that a decarbonising Europe develop a new critical raw materials dependency on especially China arguably worse than what that the continent experienced with Russian natural gas after the invasion of Ukraine[10]. Fortunately for EU competitiveness such comparisons are fundamentally flawed, as even an unexpected and sudden loss of supply of 'critical raw materials' will not in fact be economically critical for the EU. Rather therefore than implementing costly policies to rapidly exit from critical minerals supply from China, the EU must instead protect its competitiveness by pursuing gradual market-led diversification of supply, innovative substitution, incentivised and mandatory recycling and stockpiling.

The EU should not seek to replicate the accelerated exit from Chinese critical minerals stipulated in the US IRA law.

The traditional definition of dependency is a situation in which one needs something and are unable

[10] See also for instance Ursula von der Leyen State of the European Union Speeches 2022 and 2023, or Thierry Breton (2022).

to continue to function normally without it. As has been repeatedly illustrated in economic history since at least 1973, modern economies have suffered for decades from dependency on fossil fuels, as broad increases in inflation and recessions have frequently followed dramatic fossil fuel price hikes. This was most recently experienced in Europe during the summer of 2022.

In other words, it made perfect economic and political sense for EU governments to take even very expensive precautions to mitigate the 2022 fossil energy price spike. Fossil fuels accounts for about 20% of all EU imports, and energy remains about one tenth of the consumer price basket in the EU (impact on producer prices tend to be even bigger) and voters who tend to dislike governments failing to stop material declines in disposable incomes after fuel purchases.

Fortunately, no 'critical raw materials' amounts to any discernible share of total EU imports, or consumers' purchases, and hypothetical Chinese supply disruptions will not cause consumers (non-energy) disposable income to decline or therefore be the channel for a consumption decline riven downturn in the economy.

Japan's economy did not for instance sink into a recession, when China cut off rare earth exports in late 2010[11]. Nor have we yet seen any material economic impact on the U.S. economy of China's ban on shipments of Antinomy, Gallium, and Germanium in December 2024 to the United States. These were instituted under China's recent implemented export control regime regulating critical minerals and utilized here in response to Biden Administration restrictions on the Chinese semoconductor industry.

Even if this the EU were to face similar restrictions from China in the future, it is misguided policy to spend a large amount of public resources to counter a threat with only very limite economic impact.

Critical raw materials are invariably inputs into only specific—though often important—supply chains, and a sudden stop for their delivery will not result in an economy-wide activity drop, but merely affect individual industries. The overall negative impact of critical raw materials trade restrictions is hence far smaller than for fossil fuels. They are in fact just not macroeconomically critical.

This is particularly true in green energy, where the EU's continued near total reliance on imported Chinese solar panels is often highlighted as a key and dangerous EU dependency. The Net Zero Industry Act (NZIA) deemed this dependency sufficiently damaging to strive for a 40% domestic production share of solar panels by 2030[12]. Yet, what would happen if China suddenly stopped exporting solar panels to the EU tomorrow?

Unlike when Russia stopped shipping natural gas through NordStream 1, which caused European natural gas prices to skyrocket over the summer of 2022 and led to concerns that Europeans would freeze in their homes the following winter, if solar panel shipments to the EU stopped, not much would happen.

Existing installed solar panels would still produce electricity, though obviously the speed of Europe's future rollout of solar energy would slow significantly. This would, if sustained, possibly jeopardise

[11] The Chinese export restrictions did though only last an alleged few months in late 2010, and subsequent analysis suggests that it was never a total ban on exports to Japan, but rather related to an earlier aggregate reduction in Chinese rare earth exports.
[12] Fortunately, the NZIA is unfunded and as such, there is no money available to pursue this merely aspirational though reckless solar panel production target.

the EU's 2030 climate goals, but does not have any short or medium term economic or political impact remotely comparable to that of fossil fuel supply disruptions.

The scope of possible EU policies to counter the effects of hypothetical future supply disruptions of solar panels or other critical raw materials and protect its competitiveness should reflect this much lower economic impact.

There are in fact better and more cost conscious solutions than the domestic production capability benchmark policies currently pursued by the EU in the NZIA or the Critical Raw Minerals Act[13], or indeed in the Draghi Report. The first is 'diversification subsidies'. China's current dominant position in many of these markets is not due to the raw materials themselves only being present in China, but rather that Chinese extraction and processing of these minerals is often far cheaper than elsewhere.

This is partly due to sometimes laxer environmental rules in China, economies of scale from a very very large domestic market for them in China, and likely also an amount of government subsidies. China in other words wins on production costs, not by controlling the actual extraction locations of most critical raw materials. EU governments can therefore explicitly pursue diversification of supply and subsidise the purchase of critical minerals from non-Chinese sources. This would not entail implementing any trade restrictions, merely spending taxpayer funds on securing critical raw materials from other places than China.

EU governments could do this by directly funding relevant transactions, or by offering firms corporate tax credits to get them to pursue an even more diverse supplier-base than rising market-driven corporate concerns over 'China risk' would dictate.

The broader supply diversification strategy will also be enhanced by continued pursuit of FTAs with countries other than China an the United States. Dedicating resources on the other hand to negotiate entire tailored "critical minerals deals" with third countries rich in such minerals is a waste of political time and effort.

Robust critical minerals supply chains and sector relevant "Strategic Partnerships" are best built as part of as wide a network as possible of broad and deep FTAs with countries in all parts of the world.

Such "Strategic Partnerships" should not, however, be pursued independently with third countries outside the broader anchoring of increased economic interaction inside an FTA.

What true purpose would seeking to negotiate a stand alone "Critical Minerals Agreement" or implement critical minerals related "Strategic Projects" (as called for in the Critical Minerals Act) with and in say the Democratic Republic of Congo serve the EU?

Secondly, the EU should actively pursue 'substitution through innovation'. Unlike burning fossil fuels, critical raw materials are used because of the particular capabilities they give to the decarbonised products they are part of—whether say lithium, nickel, or cobalt in batteries, or rare earth minerals in the permanent magnets in wind turbines or EV engines.

[13] The CRMA among other things envisions that 10 percent of EU strategic raw materials are extracted in the EU and that 40 percent of strategi raw materials are processed in the EU.

This means demand for a given critical raw material is subject to innovative substitution, as scientists discover new and cheaper materials with the same capabilities with which to replace them.

The incentive for private actors to pursue innovation substitution is directly related to the price of a given critical raw material, and de facto puts a cap on likely future price increases and also makes it commercially risky to invest large sums in new extractive capacity for 'critical green raw materials' that innovation may replace in the future.

The price of cobalt for instance, much sought after for use in car batteries, has dropped more than 70% since early 2022, as new cobalt-free iron-phosphate based battery technologies have emerged. Similarly, sodium-based batteries are increasingly competing directly with traditional lithium batteries, effectively putting a price ceiling on the main ingredient in the latter, as lithium prices have dropped more than 75% since late 2022.

Future innovative breakthroughs will see new, cheaper and more available materials replace expensive critical raw materials. Due to the risk of substitution innovation if prices remain high, there will be no OPEC-like monopolies in critical raw materials.

The EU Framework Programs for research and member state governments should continue to actively promote innovative substitution by funding additional and long-term funding for basic materials research aimed at replacing an/or complementing existing known "critical minerals".

Thirdly, the EU should incentivise and mandate comprehensive and very high 'critical raw materials recycling' targets in the medium-term[14]. Fossil fuels are consumed in the process of producing energy, while critical raw materials can be recycled for safe domestic supply of critical raw materials. The use of some rare earths minerals in individual goods is only in such small quantities that recycling may not be cost efficient with regards to all such materials.

Overall, however, it is important to understand the power of recycling materials already mined. If for instance a 95% EV battery recycling rate is achieved (not unreasonable if mandated and with economic incentives) and the lifetime of an EV battery is 10y, more than half of all the materials in today's EV batteries will still be in use in the year 2150. And that is assuming that no battery performance improvements happen over each cycle.

Add such improvement each cycle, and EV performance has recently improved a lot, and minerals mined today will serve us literally for centuries. This is the true promise of a 'circular green economy'.

Crucially in key critical mineral use products, such as EV batteries, commercially available key battery elements recycling rates are already today up to 95 percent[15]. There is no reason such ambitious targets should not be mandated by law for many critical minerals used in the EU for instance 10y from now in 2035, providing private investors and innovators with the long-term incentives to develop and diffuse recycling technologies.

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[14] The EU Battery Passport mandating lithium recovery rates from waste batteries of 80% by 2031, or mandatory recycled content requirements in EV and other batteries is one such example. See https://www.consilium.europa.eu/en/press/press-releases/2023/07/10/council-adopts-new-regulation-on-batteries-and-waste-batteries/. The CRMA similarly aims for 25 percent recycling of strategic raw materials in the EU.

[15] See for instance Redwood Materials at https://www.redwoodmaterials.com/

Lastly, as was pioneered by the founding of IEA in 1974 and the introduction of required oil stock levels equivalent to no less than 90 days of net oil imports in industrial nations, concerns about supply security for critical raw materials unsuited commercially for high recycling rates can be addressed through incentivised or mandatory minimum stockpiles.

Either governments can choose to do this together themselves by simply buying and stockpiling the raw materials deemed sufficiently important, or they can incentivise businesses to do it themselves via tax benefits or prescribed firm-level inventory levels. Given the risks in a genuine scarcity of national preferences prevailing in accessing individual member state stockpiles, elevating these measures to the European level is of the utmost importance.

The Critical Minerals Act's measures to increase transparency regarding member states' national stockpiling frameworks is welcome, but its failure to harmonize relevant national laws and regulations, and replace existing such mechanisms (reflecting current political conditions in the EU) is an evident source of potential friction in the future.

Gros 2024 argues that the stockpiling would best be done at the EU, instead of the national, level because in case a scarcity arises every country would have an incentive to protect its own reserves and users of the critical mineral in short supply.

As mentioned above, the value of imports of critical minerals is rather low. The calculations in Gros 2024 suggest that with an investment of 2 billion euro the EU could create a stockpile worth more than one year of consumption of the 5 most important critical minerals. This sum does not need to be financed out of the budget of the EU.

An alternative would be to create a small 'European Sovereignty' Fund that would buy and hold the stockpiles and release them in EU-wide auctions to ensure that they go to the most important users.[16] As in other areas, the EU should offer its European neighbours to participate in this insurance policy.

Countries like the UK, Norway and even Switzerland should have an interest because this would allow them to participate in large pool that would be much more expensive to put together themselves.

IV Increasing European Defence Industrial Capacity[17]

In light of the Trump Administration's decision to betray Ukraine (combine with the Congressional GOP's unwillingness to confront the president on behalf of a democratic ally) in early March 2025, it is self-evident that the EU with the rest of Europe and likely other democracies around the world faces an urgent task in rearming to confront and hopefully militarily deter and irredentist and fascist

[16] There would be no need for the EU to create warehouses for the stockpile (that anyway does not need a lot of space). The quantities in question could be warehoused by traders or even users, while remaining the property of the EU.

[17] This last section builds on Kirkegaard, *Ukraine: European democracy's affordable arsenal,* forthcoming Bruegel Policy Brief.

Russia increasingly likely without U.S. support. With increasing doubts about the fundamental trustworthiness of the United States as an ally of Ukraine and as the anchor NATO security provision in any conflict with Russia, the importance of ever closer EU and Ukrainian collaboration rises. As U.S. military supplies and intelligence for the war dry up, Ukraine's dependency on rising European financial and military support increases correspondingly, as does the EU's immediate dependency on Ukraine today for current military deterrence of Russia. The EU and Ukraine need each other, as Ukraine must survive Russia's current onslaught, and the EU find an affordable path to lasting rearmament.

As reflected in the recent proposals for ReArm Europe by the Commission, and the endorsement hereof by the European Council on March 6th, this reality is today quite clear to European leaders. There is hence good reason to assume that activating the national escape clause of the Stability an Growth Pact (SGP) will see a significant response in most member states. Certainly, the incoming German government has made its intentions clear to dramatically increase German defence spending[18].

The EU's current security predicament can meaningfully be split into two parts. First, the EU must secure the ongoing ability of Ukraine to resist Russia's invasion, also without U.S. military and intelligence support.

Without Ukraine's battle-hardened army in the field today, a still militarily weak EU will be acutely vulnerable to Russian aggression.

Putin is highly unlikely to simply dismiss his mobilized army currently marauding Ukraine back into Russian society, if Russia manages to succumb Ukraine. This will be expensive – at a minimum, the EU (or the broader ex-US group of countries in NATO) must ensure that Ukraine has adequate general budget support in 2025 and beyond.

More importantly, however, the EU (mostly though member states bilaterally) most step up military and intelligence support for Ukraine to supplement – an possibly entirely replace – U.S. assistance. Perhaps most importantly, however, the EU must ensure that Ukraine's own military industrial sector can produce arms and equipment at full capacity.

Through the "Danish Model", direct support is already flowing to the Ukrainian defence sector, but it is not yet working at full capacity. According to Ukrainian estimates, this would require an additional €15-18bn in funding in 2025 – a rough sum that the EU simply must supply immediately. Europe cannot afford to let its most efficient and low-cost arsenal stand idle at this critical point time.

The importance of Ukraine for Europe's security today becomes more apparent once the second part of our current security predicament is considered, namely how to pay for a longer-term rearmament of Europe at a time of ageing populations and rising social expenditures? The guns vs. butter debate is back with a vengeance, but here, too, Ukraine offers part of the solution.

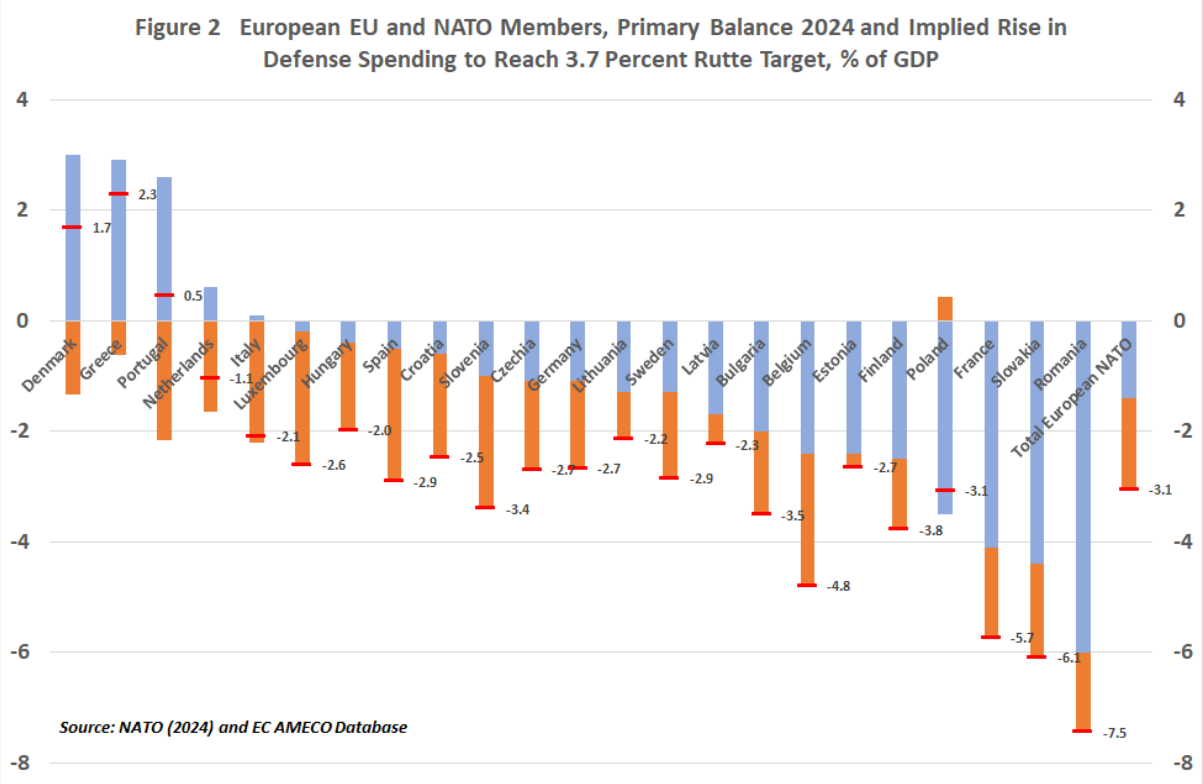
We do not yet know the full necessary extent of European rearmament, through given that Russia is

[18] Italy, another major European manufacturing economy is on its part reportedly mulling an increase in the size of its army by 40,000 troops. See https://www.repubblica.it/politica/2025/03/09/news/giorgia_meloni_vertice_parigi_difesa_europa-424051601/?ref=RHLF-BG-P1-S1-T1

a dramatically economically and militarily weaker opponent than the Soviet Union was, it seems reasonable to assume that defence budgets do not need to return to Cold War levels.

Much less will, however, also prove a dramatic fiscal challenge for many member states. Taking NATO Secretary General Mark Rutte's target of 3.7 percent of GDP in defence spending would effectively double the current average primary deficit among the EU's NATO members (figure 2).

Figure 2:



Large differences exist among member states with only three able to go to 3.7 percent without falling into a primary deficit, and Poland illustrating how political choices (and borders with Russia?) matter and that it is possible (at least for a fast growing member with low debt) to already exceed this target today.

Whatever the Commission might still propose with regards to "additional funding sources at the EU level" in the coming months, many capitals will face the dilemma of either letting domestic debt levels rise, increase taxes or cut spending elsewhere.

Fortuitously for the EU, a new major European defence industrial player is emerging: Ukraine, once home to large parts of the Soviet Union's advanced weapons production.

Driven by the urgency of compensating for depleted Soviet-era weapons stockpiles, inadequate Western military aid and the need to sidestep often shackling Western restrictions on striking targets deep inside Russia, Ukraine has had to rapidly expand its domestic weapons industry. It has done so at astonishing speed, relying extensively on new entrepreneurial military producers, noticeably in drone production.

Ukraine has since late 2023 through its Brave1 initiative provided extensive funding and logistical

support for Ukrainian defence-production related startup companies. In 2024, Ukraine produced domestically 96 percent of the drones used by its forces in the war – over 1.5 million – domestically and will in 2025 aim to purchase 4.5 million small first-person view (FPV) and kamikaze drones. In addition, the domestic production of 30,000 long-range strike drones is planned, alongside up to 3,000 long-range drone-missiles and cruise missiles.

Ukrainian production costs for FPV drones are currently estimated at around $500/unit. This is an astonishingly low cost by Western standards: implied production costs related to a January 2025 initiative of the Drone Capability Coalition (comprising the UK, Denmark, Netherlands, Latvia and Sweden) to ship 30,000 FPV drones to Ukraine are €1800/unit (total budget of about €54 million), though it is unclear whether this contract will see drones actually arrive at the front at this price point.

While care should be taken in directly comparing the capabilities of Ukrainian FPV drones and Western produced drones, €1800 per Western drone would be a paradigm shift compared to alternative US-produced drones (presumably without any Chinese components in them).

US costs are estimated to range from the low to high tens of thousands of dollars, while the Pentagon Inspector General in late 2024 estimated the unit cost of US Switchblade 300 drones supplied to Ukraine was $78,369. In short, Ukraine remains the cost competitive FPV drone producer (Inspector General, 2024).

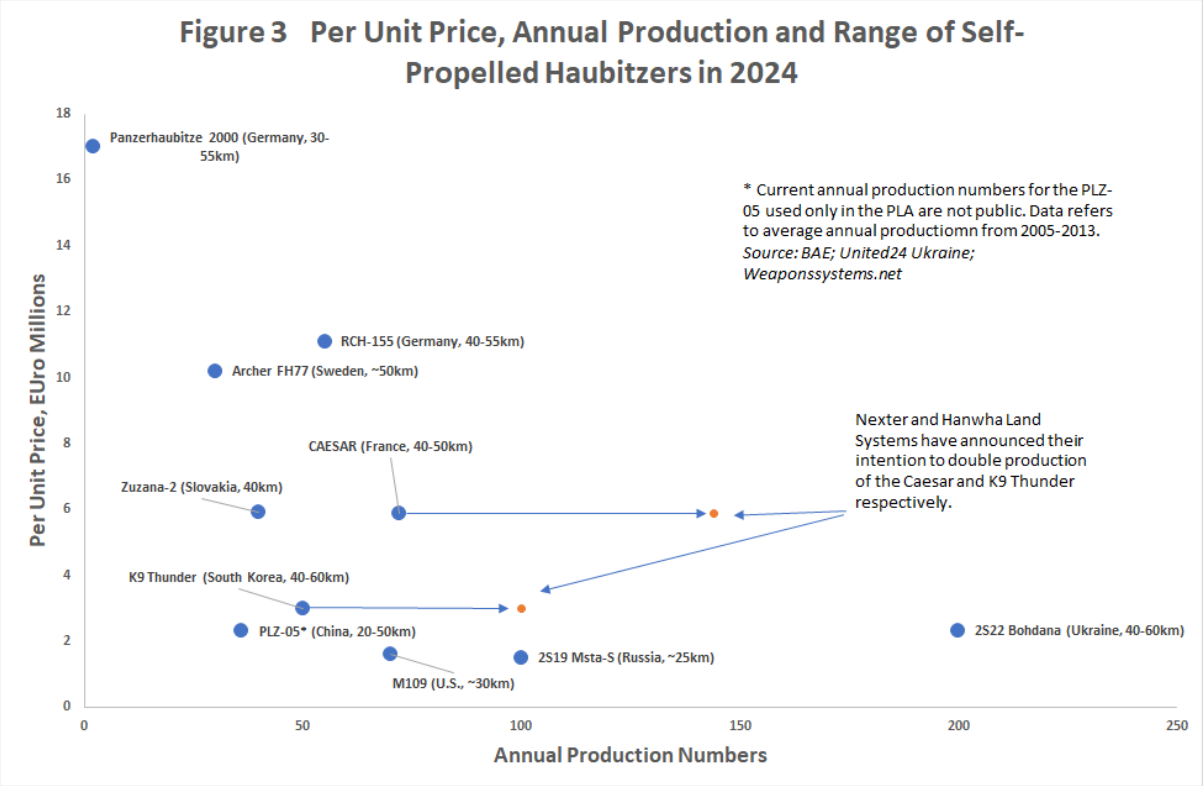
Ukraine's scale-up of drone production and other aspects of weapons production at very low cost is partly a function of technological innovation and partly a function of Ukraine's embrace of the use of commercially available parts in weapons manufacturing. Integrating far cheaper, adequate and commercially available parts and materials is a key competence with far-reaching cost-cutting potential in Ukrainian wartime arms manufacturing.

The war in Ukraine, however, shows that it is not only drones that matter on the battlefield, even if they represent the military revolution of our time, currently responsible for the vast majority of Russian (and likely Ukrainian) manpower and equipment losses.

Traditional artillery (especially if drone adjusted in real-time) is the other main component of the type of modern defensive war European countries might have to also fight or participate in against Russia in the future. As noted, several individual NATO members have begun to support Ukraine's domestic arms production directly. Denmark, Norway, Sweden, Lithuania and Iceland and the EU have on a bilateral basis in line with the 'Danish Model" earmarked Western financial assistance (including from proceeds from frozen Russian assets) for the procurement of weapons produced in Ukraine for the Ukrainian armed forces. This model, implemented initially to produce Ukrainian 155mm Bohdana 2S22 self propelled howitzers (SPHs), ensures fast equipment delivery, low-cost production and training and maintenance capacity close to the frontlines.

Bohdana 2S22 production has already been scaled up in Ukraine to approximately 16 per month, or almost 200 units annually, at a unit price of about €2.3 million. This makes the Bohdana 2S22 both the cheapest modern long-range SPH produced today among Western nations. It is price competitive with even less-sophisticated shorter-range Russian 2S19 Msta-S weapons systems (figure 3).

Figure 3:



Also it can be seen in Figure 3, SPHs are also produced in several other EU members, so while it is clear that Europe is likely to continue to produce several such large guns, Ukraine as a production location offers an attractive price point. At the corporate level, Ukraine's price competitiveness is already having an effect, with a number of Europe's leading defence producers, including KNDS and Rheinmetall, setting up maintenance and increasingly also weapons-production facilities inside Ukraine, even as the war is still going on.

France's Thales, meanwhile, has established a joint venture with Ukraine's Ukroboronprom to develop and produce air defence, radar systems, electronic warfare, tactical communications and electro-optical systems . And Germany's Diehl Defense intends to begin air defence systems in Ukraine. The expansion of Ukraine's military-industrial sector and its integration with that of the rest of Europe is in other words alreay ongoing.

While the ultimate outcome of the war in Ukraine cannot be foreseen, it is clear that in any post-war scenario in which Ukraine survives as a wholly independent state in control of most of its 1991 territory, it will remain Europe's biggest weapons producer.

This is a direct function of the likely scale of Ukraine's post-war standing army (certain to be the EU's largest, because of the proximity to Russia), which will need a sizable domestic military-industrial supply.

But it could also be directly derived from Ukraine's ongoing integration and ultimately full entry into the EU, and then its status as the EU's most cost-competitive location for the production of much, if not most, of Europe's critically needed military equipment.

Ukraine is and will remain a considerably poorer country that any EU member, even if high economic growth rates can be expected during a period of post-war reconstruction and full EU accession.

Thus, Ukraine has – and will continue to have for a prolonged period – considerably lower investment and wage costs than any EU member. In arms production, post-war Ukraine will in other words have both scale and low costs, plus unrivalled recent military experience and what seems likely to be among the most innovative domestic military industries in the world.

For other EU governments, looking to meet NATO's potential informal 3.7 percent defence spending target and equip their armed forced with modern weaponry at a fiscally affordable cost and produced to the greatest extent possible inside the EU, relying on Ukraine as a future military production platform will increase their purchasing power.

Full integration of lower-cost Ukrainian production locations into the corporate structures and pan-EU supply chains of the EU's major arms producers will also offer these companies improved profitability and global competitiveness.

Jobs and control over critical military technology are always important political issues, though Ukraine's future role as the EU's (and European NATO's) ultimate security guarantee against renewed Russian aggression should encourage other EU governments to share their most advanced relevant technology with Ukraine. Jobs on the other hand tend to be zero-sum – scaled up weapons-production facilities are either built in a jurisdiction or they are not.

EU countries will have to accept that if they wish to benefit from the lower prices provided by a fully-integrated Ukrainian defence sector in the EU, a big chunk of all the EU's future arsenal will have to be built in Ukraine.

A fully-integrated EU internal market in defence equipment facilitated by EU competition policy exemptions (as called for in the Draghi Report) will see market forces shift towards Ukraine and likely make it the principal weapons production location in an enlarged EU.

This will help rebuild the Ukrainian economy, and help restore the cost-competitive military-industrial capacity of the entire EU, and with it Europe's military deterrence against Russia. It will, however, also see fewer defence-sector jobs created in the rest of the EU than might have otherwise been created as a result of higher defence spending. This is a policy trade-off EU countries should be conscious of, but should embrace for their own security.

Successful Draghi'esque integration of the EU's military industrial sectors will enable all of an enlarged EU, including Ukraine, to take full advantage of the future lower-cost military production capabilities of Ukraine, also after the end of Russia's invasion.

Fiscally necessary relentless pursuit of cost-conscious weapons procurement, technical experience and scale will see market forces and commercial logic push a large share of the EU's future total military industrial capacity to locate in Ukraine. This will be good for Ukraine's reconstruction and long-term security, good for EU taxpayers and good for all of Europe's military deterrence.

V How To Pay For It: A European Security Fund for Ukraine

A coalition of most EU Member States plus the UK and Norway should create a European Security Fund to provide Ukraine with a reliable source of financing, large enough to substitute the US.

There exists an encouraging precedent. Back in 2010 the EU faced an existential crisis. Financial markets were in turmoil with many fearing a generalized bank run. One of the smaller EU member countries, Greece, was at the epicenter of the crisis, but it proved impossible to use EU institutions to organize a rescue.

Only when financial market tensions became unbearable, a solution was found: euro area member countries joined forces and created a special purpose vehicle, dubbed the European Financial Stability Fund (EFSF) supported by 440 billion euro in guarantees, later increased to € 780 billion that could provide countries under financial stress with emergency long-term financing on the back of its own high rating.

Today the EU faces an even more existential crisis. A revanchist Russia is being held at bay only by the heroic defense of Ukraine. Military and financial support coming in about equal measure from Europe and the US has enabled Ukraine to hold off Russia for over 3 years. But US support has suddenly been withdrawn. Even if it was partially reinstated, as many hope, it clearly can no longer be relied upon. Europe must thus dramatically increase its support for Ukraine and clearly signal that this will continue as long as necessary.

EU-level initiatives face the problem that they can be paralyzed by a veto from a single member country. So far enormous pressure has succeeded in overcoming the resistance of Hungary to various EU support packages for Ukraine. But this cumbersome process has delayed many decisions and might not work tomorrow.

Furthermore, the existing packages were considered adequate under the hypothesis that US support would continue. Clearly further packages will now be needed, and the Orban problem will become even more difficult over time as other countries might join his Moscow friendly position. The EFSF experience provides a useful example of how to escape the veto problem.

A coalition of the willing should create a European Security Fund (ESF) via an intergovernmental treaty. Participants would probably encompass most EU Member States plus the UK and Norway. This fund would finance itself on the capital market to provide Ukraine with loans at favorable rates. The loans would be very long term and could be collateralized by the returns on Russian assets.

Participating countries would provide guarantees for the bonds to be issued by the EFS. The guarantees would be proportional to national GDP. Even limiting the guarantee amount to 5 % of GDP would provide the ESF with guarantees of about 1000 billion euro given the combined GDP of the EU, the UK and Norway of about 20 000 billion euro.

The € 780 billion guarantees for the EFSF were equivalent to over 8 % of GDP then. What is proposed for the ESF would thus be smaller relative to today's GDP. These guarantees would give the ESF a top-notch rating, like the EFSF, and allow it to finance itself at a low cost. The guarantees would not constitute joint and several obligations. The risk for each participating country would remain limited to at most 5 % of GDP.

The initial financing requirements of the ESF would be much smaller than those of the EFSF, that had to take care right away of Greek debt amounting to 130 billion euro. By contrast, substituting US for aid for Ukraine would require only about 50-60 billion euro annually. The ESF should thus start with a pre-agreed annual flow of loans of about this magnitude.

A large part of this funding for Ukraine would flow back to Europe through orders for European, tanks, ammunition and even planes. A significant fraction would remain available for highly efficient Ukrainian manufactures of traditional armaments but also cutting-edge drones. Many of the intermediate inputs needed in Ukraine would probably also come from Europe.

Even with a 5 % of GDP limit, the ESF would have enough fire power to support Ukraine for many years to come. This would constitute a powerful message to Russia that Europe is really serious about doing 'whatever it takes' to stop its war on Ukraine and democracy in Europe. The aim of the ESF would of course not be to prolong the fighting, but to make it more likely that Putin agrees to stop his aggression. Even when, if, the fighting stops Ukraine will need financial support, including for its reconstruction. The ESF could also finance these expenditures.

Details: timing, participation, the UK and decision making

Given the precarious situation of Ukraine time is of the essence. The EFSF was set up in a few months. Euro area finance ministers decided to set up the EFSF in May and by July it was already operational. Bond issuance came somewhat later, when the national parliaments of enough participating countries had ratified the treaty. The ESF could thus be up and running this summer.

It would not be necessary to have all EU members on board. The fund could achieve a lending volume of over 500 billion euro already if only the four largest EU members and the Nordic countries participate.

The role of the UK is the opposite of the situation in 2010. The UK, a member of the EU then, did not want to participate in a euro area rescue operation. Today the UK, although outside the EU is very much willing to participate in a European initiative to rescue Ukraine. Its contribution to the ESF would be about 15 %. That of Norway could also be significant if the country were to accept a higher contribution than the one based on GDP.

The decision-making mechanisms of the EFSF could also serve as a blueprint for the ESF. The main decision-making body of the EFS should be the finance ministers of the participating countries, with defense ministers as alternative members. Major decisions like enlarging the size of the fund or engaging in new activities would be taken by unanimity.

Like for the EFSF, decisions on ramping up support in a crisis could be taken by a super majority that was 85 % for the EFSF[19] (and the ESM later).

The ESF should be considered an emergency measure that could morph into a more complete EU-based security and defense mechanism. But this will take time. The EFSF was meant to have been temporary. It was later folded into a permanent structure the European Stability Mechanism, when it became clear that the euro area needed a permanent rescue fund. Likewise, the ESF should also be considered as a steppingstone towards a more permanent financing mechanism for European security and defense.

[19] The EFSF should not be confused with the EFSM, which was an EU based fund, limited to € 60 billion to the EU budget because of the understandable reluctancy of the non-euro area members to run any risks just in order to save the common currency they did not believe in. More recently the EFSM was used to provide some financing to Ukraine.

Policy Proposals

Raising European Productivity By Using AI

- Abandon large-scale EU public investments in generating EU-based LLMs an associated “super computer centers”. Instead focus public investments in promoting AI literacy among the broader EU workforce to maximize AI diffusion and specialized AI application development
- Deprioritize implementing the EU Capital Markets/Savings and Investment Union, and focus on generating more actual “risk capital” in the EU willing to fund EU upstart and growth companies
- Proceed without delay to complete EU level simplification and deregulation to provide private European businesses with better incentives to invest

Improving EU Critical Minerals Supply Chain Resiliency

- Promote ”China + X” diversification of critical minerals sources and pursue deep general FTAs with new partner countries towards this goal, avoiding wasting resources on narrow “critical minerals deals” or domestic EU production/processing targets
- Dramatically increase public funding for basic materials research to maximize chances of “innovative substitution” of potentially expensive critical minerals
- Mandate far higher EU critical minerals long-term 10y recycling targets in accordance with the most ambitious private sector forecasts
- Mandate EU minimum stockpiles for hard-to-recycle/substitute critical minerals through public or create small European Sovereignty Fund to buy and hold the necessary quantities.

Integrate Ukraine’s Military Industrial Sector Fully To Cost-Consciously Rearm

- Immediately provide the necessary EU funds to enable the Ukrainian military industrial complex to produce at 100% capacity
- Immediately invite Ukraine to become a full member of all EU defense industrial institutions
- Immediately lift all EU and member state restrictions on sharing military techonology with Ukrainian entities

Create a European Security Fund (ESF)

- Establish on an intergovernmental basis among the European Coalition of the Willing an ESF to provide Ukraine long-term loans at concessional rates
- Let participating countries provide loan guarantees for ESF bonds to be issued for up to 5 percent of national GDP
- Have the ESF provide Ukraine with a steady €100+bn annual loan flow from 2H 2025