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26-1 You Only Live Twice: Financial Inflows and Growth in a Westward-Facing Ukraine

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ABSTRACT

The monumental task of rebuilding postwar Ukraine requires early planning and identification of growth strategies. The earlier accession of Eastern European countries to the European Union and NATO offers a template that relies on massive foreign direct investment and public structural funds. This approach helps to raise incomes directly and can create a virtuous circle where capital deepening facilitates technological upgrades and repatriation of war refugees, which in turn stimulate more investment. We show theoretically that the government can refine this strategy by internalizing positive externalities from having a higher capital stock: Investment in physical capital relaxes borrowing constraints (thus allowing more capital inflows) and raises wages (thus encouraging more Ukrainian refugees to return home).

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You only live twice:
Once when you are born,
And once when you look death in the face.

–Poem by James Bond in Ian Fleming's *You Only Live Twice* (1964)

1. Introduction

When Ukraine regained independence in 1991, its real GDP per capita was on a par with those of the more prosperous Eastern European economies of the former Soviet bloc (Figure 1). Ukraine's subsequent economic history falls into four epochs.

- In the 1990s, the economy collapsed during a bumpy and distorted transition to the market. GDP per capita declined by more than half and inflation reached as high as 91 percent month-on-month in December 1993 before falling after the 1996 currency reform that introduced the hryvnia.
- Over the next decade, inflation remained in a wide range of about 5 percent to 25 percent per year while per capita GDP nearly doubled, powered (as in many other emerging markets) by buoyant commodity exports and plentiful global liquidity.
- The third epoch, characterized by stagnant incomes, began with the global financial crisis of 2008–09 and lasted through Russia's seizure of Crimea and incursion into the Donbas in the first half of 2014. Constrained foreign credit, weak foreign demand, persistent corruption, and domestic political infighting all held back growth.
- In the fourth and current epoch, dominated by overt military conflict with Russia and its proxies, incomes continued to stagnate before dropping sharply with the full-scale Russian invasion of February 2022 and the ongoing war.

When it arrives, a durable ceasefire or peace agreement will initiate a fifth epoch in Ukraine's post-Soviet development. The experience of Eastern European countries that joined the European Union, the North Atlantic Treaty Organization (NATO), or both points to the possibilities. Foreign capital inflows, EU structural funds, and sustained investment, combined with institutional reforms, offer Ukraine a realistic path to reconstruction and income growth.

In terms of incomes, Ukraine at age 35 now ranks far below its former peers of 1991 that have since joined the European Union and NATO (Figure 1). Ukraine has fared substantially worse even than Belarus, which remains closer to the Soviet economic model but has benefited from strong Russian support, including subsidized energy, in contrast to the economic and physical destruction Russia has inflicted on Ukraine. Depending on the security situation, postwar reconstruction for Ukraine will require at least a partial transition to a peacetime economy and extensive rebuilding. This transition will also provide an opportunity to overcome obstacles that have burdened growth in the past and perhaps complete the road to EU admission and enhanced security status.

Apart from the immediate demands of damage repair and demobilization, Ukraine will need to overcome long-term structural challenges to the supply of key factors of production, as well as to ensure grants, loans, and other financial resources from abroad. Ukraine's capital stock was in secular decline for decades even before the invasion by Russia. Moreover, once the largest Eastern European economy in terms of population, Ukraine has also suffered steady emigration losses since the early 1990s. So have Bulgaria, Latvia, Lithuania, and Romania, but since those countries joined the European Union in the 2000s, their citizens' admission to western European EU countries has been automatic. The notably sharp exodus after February 2022 has left Ukraine's total population only slightly above Poland's. As of late 2025, it is estimated that 5.9 million Ukrainians have been displaced abroad by the Russian invasion, 5.3 million of them residing elsewhere in Europe. Ukraine faces the task of attracting these citizens home, while also resettling and ensuring work for 3.7 million internally displaced residents (as estimated in February 2025).

The challenges may seem insurmountable, but there are good paths forward. Ukraine is now perceived to be firmly in the West's orbit, and therefore integration of Ukraine into Europe's economic and security systems is a likely outcome. This would open many possibilities for economic development. Indeed, the experience of Eastern European countries that joined the European Union and NATO provides a road map for the next steps and beyond. These countries have benefited in multiple ways.

First, we document that new EU/NATO members were able to attract massive capital inflows via private foreign direct investment (FDI) and public structural funds. In contrast, countries outside the EU/NATO perimeter relied much more on personal remittances to finance domestic investment and consumption. While helpful, remittances clearly cannot provide the benefits of FDI: The data indicate that FDI and structural funds not only increase capital intensity (and thus raise incomes directly) but also facilitate technological upgrades and help retain the population.

Second, we show that even the prospect of joining the European Union and/or NATO can spur capital inflows before accession formally takes place. Intuitively, the European Union offers market access and financing while NATO membership has made countries investable by providing credible (at least up until now) security guarantees. If the probability of accession is high, private businesses can launch investments as a beachhead for future operations in the country well before the ink on the treaties is dry. For example, German Volkswagen acquired an equity stake in Czech Škoda in 1991. That was years before Czechia joined NATO or the European Union but after the European Union launched a program to help Czechia and a few other prospective member countries attract foreign investment. Volkswagen fully acquired Škoda in 2000, a year after Czechia joined NATO and four years before it joined the European Union.

Third, the European Union and NATO can provide institutional anchors to push through reforms and to ensure political and economic stability. These considerations are particularly important in the Ukrainian context, as the country has gone through three revolutions and experienced dramatic macroeconomic volatility. Because a stable environment makes a country more attractive to foreign capital, stronger institutions can create a virtuous circle: More investment improves the economy, thus making the country more stable and resilient to shocks, and greater stability, in turn, attracts investment.

At the same time, foreign aid and investment are not guaranteed, and neither are their positive effects. As we discuss below, the evidence on the effectiveness of foreign aid and other financial inflows is decidedly mixed for emerging markets. In a similar spirit, investment can face hurdles ranging from capital controls to weak protection of property rights to incomplete contracts to corruption. As a result, having certain good fundamentals—natural resources, an educated population—is not in itself enough to succeed. Indeed, historically, professional forecasters stubbornly predicted rapid economic growth and strong investment for Ukraine but, despite many apparent reasons for the country to prosper, these predictions consistently failed to materialize. Investment rates, the pace of economic growth, and the size of productivity gains all remained disappointingly low.

What can policymakers do to put Ukraine on a stronger postwar growth trajectory? To answer this question, we develop three models of optimal economic growth. Each of these models focuses on a key aspect of investment to build intuition and keep the analysis tractable. First, we consider the implications of foreign borrowing constraints, which are likely to be particularly binding for postwar Ukraine. Second, we investigate how investments in human and physical capital interact to understand their optimal mix. Third, we examine the interplay between capital deepening and population flows to explore how higher investment can attract Ukrainian war refugees abroad to return.

A consistent message from the models is that it is optimal to restrict private consumption so that more resources can flow into capital accumulation. Intuitively, all three features that we consider point to important externalities from a higher capital stock: More capital relaxes external borrowing constraints; unlike human capital, physical capital is pledgeable as collateral and thus can help attract foreign finance more quickly; and more capital raises workers' incomes and thus helps induce war refugees to come home. All models agree in recommending a consumption tax that declines over time and potentially a permanent investment subsidy (or equivalently a permanent consumption tax) to correct the market's failure to fully internalize the national benefits of more physical capital.

In short, our analysis suggests that ample capital investment for Ukraine is a reasonable expectation as well as a policy outcome that is truly needed. To be sure, there are caveats. Capital inflows that finance consumption rather than investment can make countries vulnerable to external shocks and ultimately impede future access to foreign capital. For example, Czechia weathered the global financial crisis of 2008–09 fairly well because it had a comparatively high level of investment relative to consumption. Meanwhile, Hungary, which had more consumption relative to investment, experienced a deep contraction that led to a bailout by the International Monetary Fund (IMF) and the European Union. However, households' desire to make up for deferred consumption will likely be strong. In a similar vein, Ukraine will have limited capacity to absorb capital while the country addresses the transitional imperatives of repatriating refugees, demining, fixing critical infrastructure, and the like. Thus, macroprudential regulation and capital controls may be needed along with saving incentives to avoid overheating the economy.[1] Reconstruction will force Ukraine to navigate the difficult balancing act of reducing overall government borrowing while containing inflation and shifting spending away from immediate military needs toward investment in physical

[1] Becker et al. (2022, 2023) provide more details on the macroeconomic framework during and after the war.

capital, social infrastructure, and people. With these nuances in mind, we believe that the long-term strategy for Ukraine must center on attracting capital from abroad as well as mobilizing domestic savings.

Our paper contributes to the rapidly growing literature on how to rebuild Ukraine (see Becker, Gorodnichenko, and Weder di Mauro 2025 for a survey and synthesis). In contrast to prior analyses, we focus on capital inflows and investment as the central engine of Ukraine's post-conflict economic development. To this end, we provide a historical perspective and a theoretical framework. We emphasize that market forces could fail to internalize many potential benefits from capital such as relaxed borrowing constraints, technological transfers, and refugee repatriation. Thus, we provide additional ammunition to the proposals that call for stronger FDI and public investment for Ukraine. We also reinforce the rationale for current programs that focus on leveraging public funds to attract private investment. War insurance and public-private partnerships, for example, can de-risk private investment in Ukraine and thus relax constraints on capital inflows. Our analysis also supports efforts to reform Ukraine's institutions now—that is, while the war continues—to lay the groundwork for reconstruction in general and to attract global capital specifically.

The rest of the paper is organized as follows. In section 2, we start by surveying empirical evidence on links between foreign resource inflows and growth in developing and emerging economies. Section 3 briefly recounts Ukraine's economic history since its modern rebirth in 1991. Section 4 reviews the growth experience of the ex-Soviet bloc after the collapse of the Union of Soviet Socialist Republics (USSR), focusing on the roles of the European Union and NATO in promoting resource inflows along with foreign and domestic investment. Our three illustrative growth models are developed in section 5, which also draws out their policy implications. Section 6 covers Ukraine's capital needs during reconstruction and the prospects for obtaining and efficiently deploying additional investment resources from foreign and domestic sources. Section 7 summarizes and concludes.

2. How International Aid and Investment Inflows Promote Growth

Ukraine will need considerable resource inflows from abroad either in a postwar scenario or a scenario where a frozen conflict with Russia continues indefinitely (see section 6A). In both cases, military assistance will be a major component and will not contribute directly to growth, although it will help avoid the counterfactual of military defeat.[2] But Ukraine's needs go far beyond defense. The European Union's recently issued 2028–34 financial framework (European Commission 2025) puts aside €100 billion in dedicated potential support for Ukraine with an eye toward supporting the country's security, reconstruction, and EU accession.[3] Other sources of

[2] Military assistance of some kinds may contribute indirectly to technological progress (notably in the defense industry) and thereby have growth-enhancing effects. Programs such as Test-in-Ukraine, through which the Ukrainian army battle-tests novel weapons systems developed abroad, may confer externalities through learning by doing or other channels.
[3] The European Union pledges that "the EU will support Ukraine for as long as it takes. From support in the accession process to longer-term reconstruction, the EU will be there for Ukraine. This support will include loans financed via common EU borrowing backed by the headroom of the EU budget. Support for Ukraine will be implemented under the geographic pillar of Global Europe and sourced from above the budget ceilings from a special dedicated reserve given the scale and uncertainty of the needs." See European Commission (2025).

multilateral and bilateral support, as well as private investment inflows, are also likely to play roles.

Through what mechanisms will such resource inflows promote economic growth? A vast research literature has studied this question. The most notable early work, by Hollis Chenery and associates at the World Bank, started in the early 1960s (for an overview and early stocktaking, see Chenery and Syrquin 1975).

One strand of this research looks at foreign aid inflows. (Similar issues could arise for bilateral or multilateral official loans, even if not on concessional terms.) Empirical analysis is bedeviled with identification problems, because aid levels are not randomly assigned to recipients but usually reflect factors such as need in general and natural disasters in particular. Moreover, aid may be conditioned on existing economic ties or prospective economic arrangements. Thus, a country receiving disaster aid may subsequently experience rapid growth over a limited horizon, but part of this is attributable to reconstruction needs rather than a growth-enhancing effect of aid per se, the independent influence of which may be harder to ascertain. Alternatively, persistently poor countries may attract foreign aid disproportionately. Finally, the ways in which aid may be used are country-specific while goals and conditionality are heterogeneous, so generalizing is perilous.[4]

Largely for these reasons, the nature of the causal effect of aid inflows on growth remains contested. One of us surveyed the field in the late 1990s (Obstfeld 1999). In early papers, Boone (1994, 1996) made an early attempt to address endogeneity and omitted-variable issues in a cross-sectional framework by using instrumental variables that reflect donor interests, rather than recipient conditions, and controlling for per capita income and other relevant aid determinants. He found no investment effects except where aid was large relative to GNP and no growth effect, attributing these findings to aid mostly serving to boost consumption.

Studies since the 1990s have found more positive results. Burnside and Dollar (2000, 2004a, 2004b) infer from several empirical strategies that there is no support for an unconditional positive effect of aid on growth. But they also find that aid has a discernible positive effect conditional on strong institutional quality as well as on sound monetary, fiscal, and trade policies.

Several researchers have contested these results, notably Easterly, Levine, and Roodman (2004). Rajan and Subramanian (2008) similarly conclude that while better institutional quality is positive for growth, there is no clear evidence that aid helps even when institutions are strong. Rajan and Subramanian (2007, 2011) ventured that these results could be explained by a negative effect of aid on the quality of governance: Aid primarily flows to elites, facilitating their consumption and enhancing their ability to extract rents from the economy, at the cost of productive investment and growth. In addition, the increased aggregate spending that aid allows can cause real currency appreciation that harms exports, manufacturing, and investment in the tradable sector.

[4] An important caveat is that even if an effect of aid on investment or growth is hard to detect, aid may shift health and other metrics of human welfare favorably, with longer-run economic impacts (Dreher, Lang, and Reinsberg 2024).

In a comprehensive reassessment of these and other prior studies, Clemens et al. (2012) find that aid increases are followed on average by greater investment and growth, but with quantitative effects that are highly variable across different aid recipients. They attribute the differences between their findings and those of prior studies to allowing a longer time horizon for aid to have an impact, as well as to shortcomings of the instrumental variables used in the prior studies. Disagreement has continued. Temple and Van de Sijpe (2017) find that aid reliably raises domestic consumption but that positive investment effects are less robust. Dreher and Langlotz (2020) conclude that aid raises consumption and investment, with more tenuous growth effects, since it appears to harm exports. Seeking identification through a regression discontinuity approach, Galiani et al. (2017) do detect "a positive, statistically significant, and economically sizable effect of aid on growth."

In view of the inherent difficulty of generalizations about foreign aid (Bourguignon and Sundberg 2007, Qian 2015), caution is warranted in drawing conclusions. Safer conclusions seem to be that aid has a favorable impact on consumption and maybe also on investment and growth but that positive growth effects are most likely when the recipient has strong institutions and good economic policies.

If endogeneity problems hamper empirical assessments of foreign aid, they are even more severe in estimating causal effects of market capital inflows, which inherently reflect the interplay of global supply of external funds and domestic demand. In a global boom, capital inflows will be more plentiful, but the main driver of growth may be global activity rather than capital inflows per se; here, foreign capital supply is confounded with other external drivers of growth. Meanwhile, a fast-growing economy will likely attract more capital inflows, yet these inflows may not be the main reason for higher domestic growth; this demand for foreign capital is confounded with other internal drivers of growth. In both scenarios, growth may be faster in the short run than in the counterfactual with no capital mobility. Over longer horizons, past capital inflows could contribute to slower growth, for example, if interaction with domestic financial distortions leads to financial crises. Thus, it is challenging to understand how capital inflows interact with growth.

Earlier surveys, such as Kose et al. (2009) and Obstfeld (2009), found limited evidence that capital inflows in general directly spur faster growth in developing economies. At best, a favorable impact of foreign capital seemed to be conditional (as in the case of aid) on strong domestic institutions and policies, including more robust and better regulated domestic financial markets—themselves a potent source of growth.[5] Those surveys were written during a period of elevated international capital flows that culminated in the global financial crisis. Arguably stronger evidence of a positive nexus between external finance and growth has arisen since then, but the downside risks of resulting real appreciations and financial crises also are better documented (Committee on the Global Financial System 2021).

[5] Committee on the Global Financial System (2009) also stressed that capital inflows might go awry without proper economic preconditions. Cline (2010), in contrast, saw the evidence of emerging market gains from international financial integration as being less ambiguous. Kose et al. (2009) hypothesized that financial inflows themselves might promote financial market development and related growth-friendly evolutions.

In the context of Ukrainian recovery and reconstruction, special interest attaches to foreign direct investment, which in the past seemed less susceptible to the "uphill flow of capital" phenomenon, although FDI flow to emerging markets has declined recently (Evenett and Fritz 2021).

Several early studies suggested that of all types of capital inflow, FDI may have the strongest effect on investment and growth (Borensztein, De Gregorio, and Lee 1998; Bosworth and Collins 1999), though the results are context-dependent; for example, a sufficient level of domestic human capital appears to be necessary. In general, however, the direct causal effect of "exogenous" FDI inflows has proven difficult to isolate or detect. One set of issues relates to the sometimes noisy data on FDI flows and the different transactions that can be classified as FDI in balance of payments accounts. But the reasons go beyond data quality and, as in the case of foreign aid, also go beyond endogeneity. As Moran, Graham, and Blomström (2005, 5) observe in their valuable collection of FDI studies, divergent empirical results may reflect "differences in … countries' ability to benefit from FDI." Prior human capital is plausibly one element; another one identified by subsequent literature is financial market development, as stressed by Alfaro et al. (2004, 2010).

Despite these ambiguities, there seems to be broad agreement that strong policies and institutions, better developed and sounder financial markets, and domestic resource endowments (including human capital) are likely to raise the beneficial impact of capital inflows, and of course these attributes are growth enhancing on their own. Mismanaged capital inflows, however, may lead to unsustainable consumption booms and real appreciation, which have been Achilles' heels of many economic liberalization programs. Especially relevant for Ukraine, Li, Tanna, and Nissah (2023) confirm that institutional factors matter for supporting FDI but that the most important of these elements is the absence of civil strife and armed conflict.

3. Brief Economic History of Ukraine

Macroeconomic volatility has been a defining feature of Ukraine's economic experience since 1991 (Figure 2). After a massive collapse of output and hyperinflation in the early 1990s, the economy gradually recovered, fueled by a boom in commodity prices, an abundance of global capital, and privatization and other reforms. This trajectory was subsequently dashed by global shocks such as the Russian default in 1998 and the global financial crisis of 2008–09. The financial crisis hit Ukraine particularly hard not only because of greater exposure to fluctuations in commodity prices, but also because Ukraine had weak institutions and made policy mistakes. Both crises led to inflation of about 25 percent and a large contraction of output. They also set the stage for low business dynamism (Akcigit et al. 2025) and future vulnerabilities in Ukraine's financial sector.

Indeed, the consequences of the run on the currency and banks during these crises were not resolved. Instead, issues with nonperforming loans, undercapitalized banks, deflated asset prices, and the like accumulated. As a result, when Russia illegally annexed Crimea and partially occupied the Donbas region in 2014, another run on Ukraine's currency and the banking sector caused an even worse round of inflation, currency depreciation, and recession. To underscore the scope of that crisis, we note that more than half of Ukraine's banks were liquidated, the largest

bank was nationalized (at a total cost of close to $6 billion), the share of nonperforming loans soared to more than 54 percent, and the stock market collapsed. While such economic catastrophes typically translate into massive unemployment, this shock for Ukraine was absorbed by emigration, an expansion of the shadow economy, and a dramatic fall in real wages. The post–Crimea/Donbas recovery was modest due to the scars in the domestic financial system, limited access to global capital markets (Ukraine almost defaulted on its debt in 2014), security concerns, and other headwinds. Between 2014 and 2022 Ukraine brought utility rates to cost recovery levels, improved governance of state-owned enterprises, granted more independence to the central bank, and carried out many other structural and institutional reforms that made the country more resilient. So, although Russia's full-scale invasion in 2022 was an immense blow—GDP contracted by about 30 percent—the economy largely withstood the stress.

Exposure to the global economy brought not only shocks but also tangible gains. As summarized by Movchan and Rogoff (2022), Ukraine has been a failure in terms of attracting international capital due to poor protection of property rights, corruption concerns, macroeconomic uncertainty, and pervasive restrictions on international capital flows.[6] But, they found, it has been a success story in terms of international trade. After liberalizing trade in the early 1990s, Ukraine dramatically increased its exports from the steel, iron ore, chemicals, and other Soviet-legacy sectors. Over time, the country diversified its export variety and destinations. For example, agribusiness became the dominant export sector and the export of IT services grew from effectively nil in 2002 to $6.7 billion in 2023 (IT services are the leading export from Ukraine to the United States). After 2014, Ukraine redirected trade away from Russia, then its largest trading partner; the European Union now fills that role. This path of integration into the global economy has had ups and downs, but the full-scale war presented truly unprecedented challenges. Russia's blockade of Ukrainian ports and its broader assault on Ukraine's infrastructure greatly limited the country's physical ability to export. At the same time, Ukraine had to import fuel, machinery, and equipment to support its war effort. As a result, its trade balance deteriorated from −1.3 percent of GDP in 2021 to a staggering −21 percent in 2023.

In terms of public finances, Ukraine generally has had budget deficits of at least several percent of GDP, a typical pattern for a developing economy. Strong growth in the early 2000s helped reduce the government debt-to-GDP ratio to a mere 10 percent. Although a deep recession and bailouts after the global financial crisis raised public debt, the real hammer fell in 2014 when Russian aggression sent the economy into a tailspin. The consequent bank bailouts were very costly.

Gradual normalization in subsequent years reduced the debt burden to about 50 percent of GDP—still high, but arguably sustainable in the absence of major shocks. Alas, more shocks were in store. Like other countries, Ukraine used various government programs to combat the COVID-19 pandemic, but the fiscal implications of these efforts were quite modest. Even before the public health emergency ended, however, the full-scale Russian invasion presented the ultimate challenge to Ukraine's public finances: Owing to defense needs, government spending

[6] Appendix Figure 5 documents that unlike other transition economies, Ukraine has not lifted tight restrictions on international capital flows. Some of this can be rationalized by concerns such as fear of floating and the need to impose capital controls after major crises.

soared and tax revenue fell as the economy shrank sharply and the fiscal deficit reached 20 percent of GDP. While Ukraine's allies covered part of the deficit, most of the current support comes in the form of bilateral and multilateral loans. In the second quarter of 2025, Ukraine exceeded the psychological threshold of a 100 percent debt-to-GDP ratio. To be sure, this level of debt can potentially be handled later via reprofiling, write-offs, and fiscal consolidation. Historically, such high debt ratios have a powerful contractionary overhang effect on the private economy given investors' concerns about debt sustainability (Reinhart and Rogoff 2010, Corsetti and Maeng 2024). We discuss Ukraine's debt and debt overhang effects further in section 6.

In summary, by 2022, Ukraine was one of Eastern Europe's poorest countries, with a history of economic instability, minimal growth, and chronically high, volatile inflation. Furthermore, Ukraine has consistently underperformed relative to professional macroeconomic forecasts (Gorodnichenko and Vasudevan 2025). Some of Ukraine's economic struggles were caused by Russian aggression, global shocks, and other external factors, but others stemmed from poor policy decisions. For instance, Ukraine experienced multiple banking and currency crises until it reformed the banking sector and adopted a credible inflation-targeting regime in 2015. Since the 2022 full-scale invasion, the economic situation has been a mix of despair and hope: The losses are immense, but the economy has shown stunning resilience and signs of recovery.

At this point, fiscal and trade deficits are intertwined and will ultimately be determined by the war. The government's immediate priority, both during the war and in its aftermath, is to ensure macroeconomic stability and prevent a boom-bust cycle during reconstruction. This goal makes a rapid liberalization that fully lifts capital controls improbable. A more liberal environment will eventually be necessary, however, to attract the capital needed for postwar reconstruction and to improve risk sharing (e.g., Hoxha et al. 2013, Corsetti et al. 2025).

4. The European Union and Eastern Europe

The collapse of the Soviet Union in 1991 created a historic opportunity to integrate the freed nations of Eastern Europe into the European Union. Such integration could address economic and security issues alike. While the initial plan was to focus on Poland and Hungary, the list of potential candidates grew quickly to cover other countries in the former Soviet bloc, including the Baltic countries that had been part of the USSR. As we discussed earlier, countries that joined the European Union and NATO generally outperformed countries that did not join these organizations. Indeed, Figure 3 visualizes the emergence of two growth clubs: Holding initial conditions constant, countries firmly within the Western orbit had faster growth than countries outside. In this section, we examine the dynamics of capital, labor, and productivity to better understand the sources of these differences. In this analysis we focus on supply-side factors, but obviously demand-related factors such as the degree of (hyper)inflation in the early 1990s and fiscal deficits also contributed to differences in performance.

A. Population and Human Capital

The economic downturn in the early 1990s exacerbated demographic challenges for Eastern European countries, where fertility declined, mortality rose, and life expectancies fell. Strapped for cash, governments struggled to fund health care, education, and science. As a result, populations

shrank and human development deteriorated (Figure 4). However, the intensity of these adverse trends varied considerably. Countries subjected to Russian aggression or interference (Armenia, Georgia, Moldova, Ukraine) had particularly strong depopulation, while declines among countries that joined the European Union were relatively mild. The population of Georgia, for example, went down by about 26 percent from 1990 to 2019, and the country lost about 3 percent of its population per year due to migration from 1993 to 2000. Although Ukraine lost 12 percent of its population from 1991 to 2014 (before experiencing direct Russian aggression) and this may seem like an exceptional case, population in some other countries (Bulgaria, Croatia, Latvia, Lithuania) also declined significantly. Only in a handful of countries (Poland, Slovakia, Slovenia) was the population relatively stable. In short, depopulation trends in the region were broad-based, not specific to Ukraine.

More generally, negative net migration was typical of war-affected countries (Azerbaijan, Croatia, Georgia) or poor countries, whether inside the European Union (Bulgaria, Romania) or outside (Georgia, Moldova). Consistent with income differentials and job opportunities being a key force behind migration, the global financial crisis of 2008–09 spurred outward migration in hard-hit countries (the Baltic states and Cyprus, among others). According to Figure 5, a 10 log percentage point increase in the per capita income shortfall relative to Germany is associated with an approximate 0.1 percentage point increase in the net outward migration rate. As Figure 5 further shows, Ukraine's migration response, while likewise sensitive to income differentials, indicates a population that appears to be more attached than populations in countries with comparable income differentials: The intercept of the fitted relationship is distinctly higher.

Despite these dramatic demographic challenges, the quality of the labor force has been steadily increasing for all countries (Appendix Figure 4). On average, the quality of human capital indexes and years of schooling increased by 15 percent to 20 percent between 1990 and the latest pre-COVID-19 measurement for both non-EU and EU countries. Therefore, in terms of labor input, negative demographic trends were somewhat offset by improvements in the quality of labor inputs.

B. Capital

At the start of their transitions to the market, Eastern European countries exhibited considerable variation in capital abundance (Figure 6). According to IMF (2021) estimates, Czechia had over $56,000 of capital per capita (in constant 2017 international dollars) in 1990 while Bulgaria had less than $10,000. In subsequent decades, most transition economies experienced dramatic capital deepening as well as some convergence. For example, Czechia and Bulgaria increased their respective capital stocks per capita to about $117,000 and about $54,000 in 2019, thus reducing the proportional gap between the countries by more than a factor of three.

However, experiences were not uniform. Ukraine had less capital per capita in 2019 than it had in 1990, Russia and Moldova had approximately the same level, and Belarus (through 2014) and Georgia doubled their capital stocks. Ukraine's share of investment in GDP was roughly half that of other countries in the region. This lackluster performance can be attributed to many factors, including Russian interference and aggression, weak protection of property rights, underdeveloped financial sectors, volatile macroeconomic environments, and differential access

to global capital markets. For example, while the global financial crisis of 2008–09 discernably slowed capital accumulation in the region, the chilling effects of the crisis were particularly strong among countries where accumulation reversed or stalled.

What was the role in international financial flows in funding this investment? As we discuss next, there were different mixes of foreign direct investment, official capital flows, and remittances.

Foreign Direct Investment

Eastern European countries have experienced a strong inflow of foreign capital to support their economic development (Figure 7).[7] The former Commonwealth of Independent States (CIS) had not only lower FDI, but also a big share of FDI was effectively investments made by local oligarchs via Cyprus and other offshore havens.[8,9] Importantly, inflows of foreign capital started well before Eastern European countries joined the European Union.

Figure 8 depicts the 2019 correlation between FDI and domestic private investment and indicates that, unconditionally, a dollar increase in FDI is associated with a $5 increase in private investment. To be clear, this does not necessarily mean that FDI has a multiplier of 5, but it does suggest that FDI and domestic investment are moving together strongly.

Consistent with large inflows of capital, new EU members ran large, persistent trade deficits (often on the order of 10 percent of GDP or higher), as seen in Figure 9. As a result, these countries could maintain a stable share of public and private consumption in GDP as well as high investment shares. For comparison, if we exclude oil-exporting Russia, some countries outside the European Union (including Ukraine) had more balanced trade, while others (Georgia, Moldova) financed large trade deficits via remittances and other means.

Official Assistance and Capital Flows

From early on, it was clear that Eastern European countries would have to travel a long road before joining NATO or the European Union. Pre-accession funding was necessary to upgrade these countries' economies and to align their institutional frameworks with that of the European Union. To this end, the European Union established the Poland and Hungary: Assistance for Restructuring their Economies (PHARE) program in 1989; eventually PHARE grew to cover 10 countries. Shortly after, the European Union set up the Technical Assistance to the Commonwealth of Independent States (TACIS) to support transition in countries (including

[7] We exclude Hungary from this specific analysis because the FDI time series for this country exhibits extreme volatility due to mergers and acquisitions in the financial sector.
[8] Ukraine never formally became a CIS member, despite participating in the grouping from its inception in 1991. But for most purposes (for example, EU support programs), Ukraine was considered to belong to the CIS until its de facto withdrawal in 2014.
[9] Given underdeveloped capital markets (see Carletti et al. 2024), Eastern European countries did not have many opportunities for foreign investors to purchase portfolio stakes. As a result, portfolio investments played a smaller systematic role in attracting capital to former Soviet bloc countries.

Ukraine) not shortlisted for EU accession. TACIS covered a wide range of issues including institutional reforms and nuclear safety.

Panel A of Figure 10 shows that PHARE and related funding was roughly 10 times as large per capita as TACIS and subsequent programs. Thus, the split between EU/NATO candidate countries compared with Ukraine and other CIS countries was apparent from the early 1990s. The gap widened after the first round of Eastern European EU enlargement in 2004 (panel B of Figure 10): EU structural/cohesion annual funds amounted to about $300−$500 per capita for the new EU members, while EU funding to Ukraine and other EU neighbors remained only about $5–$6 per capita. By their nature, structural funds were used to upgrade infrastructure (roads, ports, and the like) in countries newly admitted to the European Union.[10]

Remittances

After the Iron Curtain fell, people could travel internationally more freely for economic reasons. These possibilities were amplified as Eastern European countries signed visa-free travel agreements and joined the European Union. As we discussed above, however, some international relocations were due to wars, persecution, or other social tensions. The migrants mostly remained attached to their nations of origin, though, and remittances soared for many countries (Figure 11). For example, personal remittances to Ukraine increased from effectively zero in the early 1990s to $337 per capita in 2019. For comparison, other war-affected countries (Croatia, Georgia, Moldova) had roughly double that amount in 2019, which likely reflected the fact that conflicts started much earlier in those countries. At the same time, remittances as a percent of GDP in 2019 were in double digits only for Georgia, Moldova, and Ukraine (Appendix Figure 1). While large, these inflows did not necessarily translate into plant and equipment investment. Remittances can be used for personal consumption (Kakhkharov and Ahunov 2022) and for starting new businesses, residential investment, education, and other investment-like endeavors (Woodruff and Zenteno 2007, Askarov and Doucouliagos 2020), a pattern observed for Ukraine as well (Kuntsevych 2017, IOM 2016).

Role of NATO and EU Membership/Negotiations in Capital Flows

Inspection of macroeconomic time series for investment suggests that being a member of the European Union and/or NATO is positively associated with capital inflows into countries formerly in the Soviet bloc. In this section, we try to formalize and quantify the role of NATO and the European Union for attracting investment.

While correlated, tracks to join NATO and the European Union are not perfectly synchronized. For example, Czechia, Hungary, and Poland—each of which either experienced a Soviet invasion or came very close to it—joined NATO in 1999 and the European Union in 2004. Albania has been a NATO member since 2009, but it has not yet joined the European Union.

[10] The European Union occasionally provided macrofinance loans to stabilize countries in the region (see Appendix Figure 2). These loans were made largely in the early 1990s when many transition countries went through fiscal and monetary crises. After Russia illegally annexed Crimea and partially occupied the Donbas, the European Union issued loans (about €3 billion) to Ukraine in 2014–19.

Cyprus joined the European Union in 2004, but it is not a NATO member. Differential timing in accession to these organizations potentially allows identification of the relative importance of security (NATO) versus economic integration (the European Union) for capital flows. Because the process of joining NATO and the European Union can be long, anticipation effects are potentially important.[11] To assess the role of these effects, we consider the change in not only membership status but also in application/negotiation status.

To be clear, both NATO and the European Union emphasize the rule of law, democracy, and other institutional aspects as preconditions for membership and therefore we cannot perfectly separate NATO versus EU effects. Nonetheless, given the differences in the purposes of these organizations and the obligations they entail, we can offer some preliminary evidence.

As a first pass at the data, we run a simple regression:

$$Y_{it} = \alpha_i + \lambda_t + \beta \times \mathbb{I}(i \in Status\ at\ t) + error \qquad (4.1)$$

where i, t index countries and year, $\mathbb{I}(i \in Group)$ is an indicator variable equal to one if country i belongs to $Group$ at time t. We consider the following options for $Status$: (1) NATO membership; (2) EU membership; (3) starting negotiations for joining NATO; and (4) starting negotiations for joining the European Union. Each option of $Status$ is an absorbing state in our sample. Membership implies that negotiations started at some point. Because NATO and EU enlargements are often done in waves and macroeconomic conditions are correlated across countries, we use Driscoll-Kraay standard errors for inference here and in what follows. Since we control for country and year fixed effects, β measures within-country variation after accounting for common shocks. In other words, we compare investment in, say, Poland before and after (say) EU membership after controlling for global factors.

We find that both NATO and EU membership—or realistic prospects of joining either of these unions—have a positive association with investment (Table 2). For example, NATO membership is associated with an additional $189 (constant 2017 international dollars) per capita in FDI per year (panel A). Furthermore, the estimate is similar when we consider merely starting negotiations with NATO. The estimated magnitude is even greater for private investment (about $600 per capita per year; panel B), which suggests a large multiplier. When we include both the European Union and NATO tracks (columns 1 and 4), we observe that, in these horse race regressions, NATO tends to be more important than the European Union. Interestingly, the European Union estimate is statistically significant only when the EU indicator variable appears alone, perhaps because then it picks up the omitted NATO effect. Nonetheless, both the European Union and NATO appear

[11] The average delay between starting negotiations and accession for our sample is 1.8 years for NATO and 6.3 years for the European Union. Appendix Table 1 shows the dates when countries started negotiations and joined NATO and/or the European Union. We also note that, technically, NATO membership is "by invitation" while EU membership is "by application." Thus, starting negotiations for NATO effectively means that a country was invited by NATO and therefore the country was expected to join. In contrast, EU applications may be aspirational exercises (as in the cases of Iceland, Norway, Switzerland, and Turkey) rather than a realistic prospect. It can also take a long time between application and the opening of official negotiations. For example, Albania applied for EU membership in 2009 but negotiations did not start until 2024. As a result, we focus on "opening negotiations" for EU membership as an early indication that both the European Union and the applicant country are seriously interested.

independently to promote domestic investment strongly. Thus, if we include only one of these in the regression, it gets a much larger coefficient, because the coefficient also reflects the strong independent effect of the omitted variable. One can interpret these results as suggesting that FDI investors (but less so domestic investors) are focused primarily on security risks, which has clear implications for the case of Ukraine. At the same time, the case of Turkey (a NATO member since 1952 and in formal negotiations with the European Union since 2005) suggests that EU membership is important, too: Turkey's net FDI per capita increased by a factor of 10 between 2003, when the country launched far-reaching political and economic reforms following a financial crisis, and 2006.

Although these basic regressions summarize empirical patterns, they of course do not imply causality and have several potential econometric limitations. To address these concerns at least partially, we use the local projection difference-in-difference estimator proposed by Dube et al. (2025):

$$Y_{i,t+h} = \alpha_i^{(h)} + \lambda_t^{(h)} + \gamma^{(h)} \times Y_{i,t-1} + \beta^{(h)} \times \mathbb{D}(i \in Status\ at\ t) + error \qquad (4.2)$$

In equation (4.2), $\mathbb{D}$ is an indicator variable equal to 1 once country i has a change in status and 0 before. Importantly, while estimating these regressions, we restrict the sample to: (1) countries that do not change their status up to $t + h$; and (2) observations up to and including a change in status for countries that do change status at t. That is, we do not use previously treated units as controls for newly treated units.[12] By varying h, we estimate the impulse response function (or IRF, which is given by $\beta^{(h)}$) of Y to a change in status.

We find (Figure 12) that the estimated impulse responses to joining NATO or the European Union (or to starting negotiations with them) are in line with our earlier results (that is, investment increases), although the confidence bands are fairly large due to the small sample size. Comparison of IRFs for accession and starting negotiations suggests a gradual buildup in investment momentum.

In summary, the evidence appears to point to substantial NATO and European Union effects in spurring investment. While data limitations preclude establishing exact mechanisms behind our estimates, we conjecture that NATO makes countries investable by reducing threats of Russian aggression or other conflicts and that the European Union provides market access, financing, and other public goods to help each member country reach its potential. Because security and economic considerations interact, the presence of both forces likely maximizes the investment response.

Taking Stock

To recap the role of these three broad sources of international funds for transition economies—FDI, EU support, and remittances—Figure 13 plots the cross-country distribution of cumulative

[12] Using previously treated units as controls for newly treated units in a difference-in-differences estimation is the "forbidden comparison" that introduces a bias. Intuitively, the outcomes of the previously treated units already include the treatment effect. When these observations are used as a control group, one essentially subtracts their changes from the changes of the newly treated group, thus contaminating the estimate of the true treatment effect.

financial inflows per capita over 1990–2019. By far, the most important source for new EU members was FDI. At the same time, personal remittances contributed more than EU transfers even for relatively advanced economies. Furthermore, remittances were the most important source for countries that did not join the European Union. Poland, Hungary, and other EU members attracted massive amounts of foreign capital that supported convergence toward advanced European countries. In contrast, Ukraine and countries with similar challenges and security threats had rather modest success in attracting foreign capital.[13] Capital inflows from abroad created both new opportunities and challenges for the recipient countries. The global financial crisis of 2008–09 dented growth trajectories of emerging economies, and Eastern Europe was no exception. FDI inflows contracted sharply during the crisis and have remained at low(er) levels, a phenomenon that is generally true globally as well (Evenett and Fritz 2021).

C. Productivity

Economists have long emphasized the low productivity of planned economies due to inappropriate incentives, poor protection of property rights, and related distortions (see, for example, Berliner 1978, Kornai 1980, and Roland 2004). The transition to the market was therefore expected to improve productivity significantly, albeit with bumps along the way (Blanchard and Kremer 1997). Consistent with this prediction, Eastern European countries demonstrated strong productivity gains as measured in Penn World Table (PWT) data (see Feenstra, Inklaar, and Timmer 2015 for a description), gradually and to varying degrees catching up to the technological frontier with perhaps a slowdown after the global financial crisis (Figure 14). In addition to establishing clearer property rights, strengthening incentives, enforcing budget discipline, and implementing other reforms, improvements in productivity stemmed from having access to Western technology and machinery. Indeed, 75 percent of firms in the region reported that productivity improved after they acquired new machinery (Gorodnichenko, Svejnar, and Terrell 2010). In other words, imitation was likely the most important source of productivity gains. But this approach required financing—a scarce and expensive resource in many transition economies—and financing frictions delayed the technological catch-up process (Gorodnichenko and Schnitzer 2013). In line with this observation, Figure 15 documents a strong positive correlation between the net international investment position (a proxy for net capital inflows) and the level of productivity. As we discussed earlier, this relationship can reflect mutual causation. On the one hand, more productive countries can be more attractive destinations for global capital; on the other, larger capital inflows can help upgrade productivity.

D. Growth Accounting

To quantify the role of labor, capital, and technological progress for economic development in Eastern Europe, we do a standard growth accounting exercise for the period from 1994 (generally the trough of structural economic contractions in transition economies; see Blanchard 1999) to 2019 and report results in Table 1. Both EU/NATO and non–EU/NATO countries had similar rates of growth, but the mix of their sources of growth differed.

We find that productivity gains were experienced by all countries irrespective of their EU/NATO membership status. The gains were greater in non–EU/NATO countries largely because these

[13] The pattern is the same when we use the net international investment position in 2019 (see Appendix Figure 3).

countries started from a base that was 0.24 log point lower in comparison. By 2019, the level of TFP was similar for both groups on average.

Given the negative demographic trends in the region and consistent with Caselli and Tenreyro (2006), labor was not a major source of growth. In fact, if not for improvements in the quality of the workforce, labor input would have been a clear drag for aggregate growth. Strikingly, Ukraine is one of only three countries in the region to have a large negative contribution from labor. That fact underscores the importance of attracting refugees back to Ukraine, addressing education gaps, and launching strategic human resources initiatives, among other measures (Dombrovskis et al. 2024).

In terms of effects on capital accumulation, there is a clear 0.2 log point difference between EU/NATO and non–EU/NATO countries. Capital intensity is higher in the EU/NATO countries. This result suggests that facilitating capital flows into Ukraine will likely play a pivotal role in not only the postwar reconstruction of the country but also in its long-term growth trajectory. To the extent that capital flows help facilitate productivity gains and maintain population, this role is even more important than suggested by standard growth accounting. In short, for Ukraine to have (conditional) income convergence to Poland or other peer countries, ensuring long-term capital inflows is critical.

5. Models of Factor Inflows and Growth

We have argued that the scarcity of capital in Ukraine and its low level of domestic saving imply that inflows of foreign aid and finance will be a necessary condition for restoring growth. Necessary, that is, but not sufficient; labor repatriation and TFP growth are additional prerequisites. These productive inputs are complementary, and they can set off sustained growth in an environment of reformed institutions and markets even if some security challenges remain. Moreover, it is imperative that foreign-sourced resources flow, at least initially, into investment. Excessive consumption up front may undermine later growth, as has often been the case with aid and financial inflows in development and reform episodes.

This section develops three growth models that underscore that point, presenting examples of how markets may fail to fully internalize the national benefits from capital accumulation. The first model shows how excessive consumption can slow growth in the presence of financial frictions in foreign financing of a sovereign borrower. The second makes the same point in a model of endogenous TFP growth but also shows how financial friction might motivate the government to favor physical investment over educational investment (and other investments in TFP enhancement) in the initial recovery phase. A final model stresses the complementarity between domestic investment and labor repatriation, which provides a further rationale for initially lower consumption. All three models justify fiscal tools that the government can use to raise welfare by accelerating the economy’s convergence. Those tools include a tax on consumption (a VAT) that declines through time to a long-run level consistent with a sustainable public budget.

To be sure, these models do not cover the full range of mechanisms through which market participants may undervalue the social benefits from capital accumulation. For example, domestic investment and FDI may be complementary, with the latter bringing technology or know-how

spillovers that raise economywide productivity. Alternatively, high domestic consumption may cause real currency appreciation, reducing beneficial production externalities originating in the economy's manufacturing sector. We discuss some of these additional mechanisms less formally below.

A. Ramsey-Cass-Koopmans Model with Constrained Foreign Borrowing

We first analyze foreign borrowing in a Ramsey-Cass-Koopmans single-good, representative-agent economy that lacks full access to international capital markets. Instead, a collateral constraint limits its external borrowing to a fraction of its capital stock, γk. We will assume $\gamma < 1$, in contrast to Barro, Mankiw, and Sala-i-Martin (1995), who imposed $\gamma = 1$ in a similar model with exogenous growth, augmented by human capital.[14] Closed economy results follow in the present model from setting $\gamma = 0$. We are interested in the possibility that residents of the borrowing economy underestimate the contribution of new investment to future economic growth and therefore consume excessively.

Two questions of interpretation arise. The first is the meaning of "collateral." It could be that creditors are able to seize a fraction of a borrower's capital in case of default. However, such a literal reading is unnecessary. As a borrower's capital grows, so will its engagement in foreign trade, furnishing disappointed creditors more opportunities to seize shipments or foreign bank balances (Rogoff and Bulow 2015 survey how these principles apply to sovereign borrowers). If borrowers are willing to lend no more than the amount they can extract through threats of punishment, the borrowing constraint can plausibly be represented as a fraction of capital. The copious literature on borrowing under asymmetric information likewise suggests that agency constraints are mitigated by a borrower's higher net wealth.

A second question of interpretation is whether to think of Ukraine's future foreign borrowing as the result of sovereign borrowing by the state or of decisions by individual firms and households. We think it is likely that even after Ukraine as a nation regains access to private foreign capital, much of the resulting borrowing will initially be sovereign or carried out under state guarantees. In effect, the government may effectively stand for some time as an intermediary between world capital markets and the domestic market. As private Ukrainian borrowers increasingly gain direct market access over time, the state's capacity to enforce contracts will remain important. This is also correlated with the economy's economic development and thus its success in accumulating capital. That is why a large literature finds that institutional quality and good governance are key to attracting private capital inflows (Alfaro, Kalemli-Özcan, and Volosovych 2007; Fratzscher 2012).

As the model will show, overconsumption and underinvestment can occur when foreign borrowing is substantially intermediated by the state. We call this the "market equilibrium" model below. The rationale for state intermediation is that in the early stages of postwar

[14] For an alternative model in which foreign borrowing is limited by current income, see Obstfeld and Rogoff (1996, section 7.2.2.3). Itskhoki and Moll (2019) develop a closed economy growth model with financial frictions where the government optimally boosts investment early in the development process by suppressing wages (and therefore workers' consumption) so that entrepreneurs have more investable earnings. As our third model below shows, however, wage suppression for Ukraine could be undesirable if it deters return migration. The Itskhoki-Moll model's optimal policy leads to higher productivity and wages in the long run.

reconstruction, γ might equal 0 without close government involvement—and correspondingly, the more that involvement reassures creditors, the higher γ is likely to be. When the private sector itself borrows and fully internalizes the collateral constraint, however, there is no overconsumption and the "planning solution" described next applies. This should be the longer-term goal for Ukraine: financial infrastructure and investor protections such that businesses can directly access foreign finance without direct government guarantees of foreign loans.

Here is how either version of the model works: On date $t = 0$, the country gets partial access to global capital markets when its initial stock of physical capital is $k^a(0)$, where superscript "a" stands for "autarky." The country immediately borrows $\gamma k^a(0)$ abroad, at a real foreign capital cost rate r^* that we assume will prevail over the entire planning horizon. Consistent with capital being scarce in Ukraine, we assume that the domestic marginal product of capital initially exceeds and will continue to exceed the external cost of funds over the entire planning horizon. With this new initial condition on the capital stock set, $k(0) = (1+\gamma)k^a(0)$, the economy evolves according to the full set of dynamic equations that we derive next.[15]

Planning Solution

The planner maximizes

$$\int_0^\infty e^{-\delta t} u[c(t)]dt = \int_0^\infty e^{-\delta t}\left[\frac{c(t)^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}}\right]dt \tag{5.1}$$

subject to

$$\dot{k} = y + \gamma\dot{k} - c - r^*\gamma k - \theta k, k(0) = (1+\gamma)k^a(0), k(0) \text{ given} \tag{5.2}$$

where γ is the fraction of the capital stock that can be collateralized for foreign lenders, θ is the depreciation rate of capital, and $y = Ak^\alpha L^{1-\alpha} = Ak^\alpha = f(k)$ (adopting the normalization $L = 1$ for the moment).

Equation (5.2) gets at the heart of the model. The resources available for capital accumulation include the new borrowing from abroad that domestic capital accumulation allows ($\gamma\dot{k}$), which of course entails a higher future flow of interest payments to foreign creditors later (thus, the subtraction of $r^*\gamma k$ from national income). In a market setting, if the collateral constraint is operative at the national level, investing firms would likely fail to internalize that a decision to invest loosens the country's aggregate borrowing constraint. This failure would imply a suboptimally low private investment rate and socially excessive consumption.

An economic planner, however, will internalize the national benefits of higher investment and will take into account that investment has a multiplier effect on domestic resource availability. The planner will therefore read the economy's effective capital accumulation constraint as the following transform of (5.2):

[15] By implication, we are assuming that the economy's initial borrowing $\gamma k^a(0)$ still leaves the initial capital stock $k(0)$ strictly below the steady-state capital stock $\bar{k}$ that we describe below.

$$\dot{k} = \frac{y - c - r^*\gamma k - \theta k}{1 - \gamma}. \tag{5.3}$$

The implied dynamic system in *c* and *k* under optimal growth is (see the appendix at the end of the paper for details):

$$\frac{\dot{c}}{c} = \sigma\left[\frac{\alpha A k^{\alpha-1} - (\gamma r^* + \theta)}{1 - \gamma} - \delta\right], \tag{5.4}$$

$$\dot{k} = \frac{A k^{\alpha} - c - \gamma r^* k - \theta k}{1 - \gamma}. \tag{5.5}$$

The steady state is given by

$$\bar{c} = A\bar{k}^{\alpha} - (\gamma r^* + \theta)\bar{k},$$

$$\bar{k} = \left[\frac{\alpha A}{(1-\gamma)\delta + \gamma r^* + \theta}\right]^{\frac{1}{1-\alpha}}.$$

Market Equilibrium

The representative household still maximizes (5.1) but now takes the amount it can borrow from abroad as exogenous, giving the flow budget constraint

$$\dot{k} = Ak^{\alpha} + \dot{b} - c - r^* b - \theta k, k(0) \text{ given} \tag{5.6}$$

(By implication, $b(0) = \frac{\gamma}{1+\gamma}k(0)$ is also given.) We assume it is optimal for the household to always borrow up to the limit of its foreign credit, given the cost, r^*. That assumption implies that $r^* \leq \delta$. The first-order optimality conditions are those from the standard Ramsey-Cass-Koopmans model, implying that

$$\frac{\dot{c}}{c} = \sigma(\alpha A k^{\alpha-1} - \theta - \delta). \tag{5.7}$$

The steady-state capital level of $\bar{k} = \left[\frac{\alpha A}{\delta+\theta}\right]^{\frac{1}{1-\alpha}}$ would be the same as in the planning case if $r^* = \delta$. Steady-state consumption is $\bar{c} = A\bar{k}^{\alpha} - (\gamma r^* + \theta)\bar{k}$, after noting that in equilibrium, the country's steady-state borrowing will be $\gamma\bar{k}$. However, in the market case, the household perceives its return to saving as being below the social return, so convergence to the steady state is slower, which lowers intertemporal welfare compared with the planner optimum.

Figure 16 shows the consumption paths that the planner (green) and market (red) choose, under the simplifying assumption that $r^* = \delta$, which implies that steady-state capital $\bar{k}$ and steady-state consumption $\bar{c} = A\bar{k}^{\alpha} - (\theta + \gamma\delta)\bar{k}$ are the same in the planner and market allocations (even without fiscal intervention). Despite having initially lower consumption, the planner path is welfare-superior because it implies faster convergence to $\bar{c}$.

Case for a Consumption Tax

In the planner model the social return to capital is $\frac{\alpha A k^{\alpha-1}-(\gamma r^*+\theta)}{1-\gamma}$. In the competitive market model, the household's perceived return to capital is $\alpha A k^{\alpha-1}-\theta$. The social return exceeds the privately perceived return provided

$$\frac{\alpha A k^{\alpha-1}-(\gamma r^*+\theta)}{1-\gamma} > \alpha A k^{\alpha-1}-\theta \Leftrightarrow \alpha A k^{\alpha-1}-\theta > r^*.$$

That is, if and only if the domestic net marginal product of capital exceeds the global cost of borrowing. For simplicity, assume $r^* = \delta$. Then as long as the economy has not attained its (closed economy) steady state, households will perceive a return to saving that is too low, because they fail to internalize how more investment eases the national borrowing constraint. The wedge between the social return to investment and the private return is equal to

$$\Delta(t) = \frac{\gamma}{1-\gamma}\left[\alpha A k(t)^{\alpha-1} - \alpha A \bar{k}^{\alpha-1}\right]. \tag{5.8}$$

To decentralize the planning equilibrium, the government can impose a time-varying consumption tax (a VAT) that declines toward 0 according to equation (5.8), rebating the proceeds in a lump-sum transfer. Let $P(t)$ be the price of consumption at time t, inclusive of the VAT, $P(t) = 1 + \tau(t)$. Any initial *level* of the VAT works, so long as the VAT declines in accord with (5.8), so that $\dot{P}(t)/P(t) = -\Delta(t)$. With this VAT path, the return to saving appears higher and the household Euler equation becomes

$$\begin{aligned}\frac{\dot{c}}{c} = \sigma(\Delta + \alpha A k^{\alpha-1} - \theta - \delta) &= \sigma\left\{\frac{\gamma}{1-\gamma}[\,\alpha A k^{\alpha-1} - \theta - \delta] + \alpha A k^{\alpha-1} - \theta - \delta\right\} \\ &= \sigma\left\{\frac{\alpha A k^{\alpha-1}-(\gamma r^*+\theta)}{1-\gamma} - \delta\right\},\end{aligned}$$

which is the same as the planner optimality condition (recall that we assumed $r^* = \delta$).

If there is a desired terminal (or asymptotic) VAT $\bar{\tau}$ and $\bar{P} = 1 + \bar{\tau}$, then the desired initial VAT $\tau(0)$ that (5.8) implies is given by:

$$P(0) = 1 + \tau(0) = \bar{P}\exp\left\{\int_0^\infty \frac{\gamma}{1-\gamma}\left[\alpha A k(s)^{\alpha-1} - \alpha A \bar{k}^{\alpha-1}\right]\mathrm{d}s\right\}.$$

In the case we have analyzed, a declining VAT is the only fiscal tool the government needs to decentralize the planner allocation. Because the steady states of the two allocations coincide, there is no need for a long-run constant saving or investment subsidy to drive the economy to a steady state with more capital than in the market allocation, as would be implied by $r^* < \delta$. However, the next two models will feature such permanent subsidies.

It can be objected that in the context of postwar Ukraine, a consumption tax might impose an excessive burden on consumers already living hand to mouth. As usual, our VAT suggestion is

intended to align incentives and is only part of the fiscal program that will determine household real incomes and their distribution. Government subsidies and service provision will mitigate the negative income effects of a VAT for the most vulnerable, and these government outlays can be financed by foreign funds or other taxes. For example, a tax or tariff on luxuries not only yields revenue but also acts as a further brake on consumption and may promote social cohesion.

Phase Diagram

The complete phase diagram for the model will depend on assumptions about the possibilities for lending abroad when the net marginal product of capital (MPK) is less than the world real interest rate. This possibility is not practically relevant for Ukraine now, but we include it for completeness.

We continue to assume that $r^* = \delta$ to simplify comparison of the planner and market trajectories. When capital is so abundant domestically that the domestic MPK is below the steady-state level $f'(\bar{k}) = A\bar{k}^{\alpha-1} = \theta + \delta$, no one in the economy will want to borrow abroad to invest in more capital at home, nor will this be socially desirable. Among possible assumptions, the one that best combines realism with simplicity is that capital outflows are fully restricted. In that case, equations similar to the standard closed economy growth model apply when $f'(k) < \theta + \delta$, whereas the dynamics set out previously apply when $f'(k) \geq \theta + \delta$.

The phase diagram is shown in Figure 17.[16] As in the previous figure, the green arrow indicates the planner solution and the red arrow indicates the market solution, which has a more steeply tilted convergence path and a lower level of consumption for every value of the capital stock, but implies a faster approach to the steady state.

Effect of a Looser Collateral Constraint

An eased collateral constraint is modeled as a rise in the pledgeable fraction of the capital stock, γ. Our earlier empirical findings suggest that this change could be a consequence of enhanced security guarantees. For concreteness, consider how this change operates in the market allocation. In terms of Figure 17, an economy with a higher γ would see a downward shift in its steady-state consumption level from $\bar{c} = A\bar{k}^{\alpha} - (\theta + \gamma\delta)\bar{k}$ to $\bar{c}' = A\bar{k}^{\alpha} - (\theta + \gamma'\delta)\bar{k}$, and its approach path to the steady state would in general be flattened. Long-run consumption falls because the economy reaches the steady state with a bigger foreign debt to service.

For a given initial autarky capital stock, $k^a(0)$, the flatter approach path (due to the higher speed of convergence) and the larger initial foreign-financed jump in the capital stock to $k(0) = (1 + \gamma' k^a(0))$ imply a higher consumption level for every initial capital stock. However, consumption smoothing implies that the lower long-run consumption level, other things equal, induces a lower short-run consumption level (which can nonetheless be consistent with higher intertemporal welfare because convergence accelerates). The net effect on consumption is

[16] The diagram assumes that in the low-MPK region, the economy is still carrying the foreign debt $\gamma\bar{k}$ that it incurred in its transition from its initial capital stock up to the steady state but that somehow a shock has displaced the economy from the steady state to some $k(0) > \bar{k}$. This assumption makes the $\dot{k} = 0$ schedule continuous, albeit not differentiable, at $k = \bar{k}$.

indeterminate, but it is most likely to be positive when the economy's capital stock is far below the steady state. In this case, the prospect of faster convergence to higher consumption levels dominates the associated fall in the long-run consumption level due to higher steady-state foreign debt. The appendix provides support for these findings in a neighborhood of the steady state.

Anticipation of Direct Aid

Another scenario to consider is one where the economy comes to anticipate a permanent aid inflow from abroad; perhaps negotiations for EU entry reach a decisive phase with a positive outlook. If the anticipated permanent aid inflow is a in per capita terms, then once aid materializes, the capital accumulation equation will become

$$\dot{k} = \frac{a + y - c - r^*\gamma k - \theta k}{1 - \gamma}.$$

But until then, equation (5.3) still governs the economy. Figure 18 shows the implied dynamics, which are qualitatively the same whether the Euler equation (5.4) (optimal plan) or (5.7) (market allocation) applies.

If the economy is initially at capital stock $k(0)$ and consumption level $c(0)$ when the future aid flow is announced, consumption immediately jumps to the higher level $c(0)'$ and continues to rise from there. A consumption boom follows. The reason is households' desire to smooth consumption in the face of the higher expected permanent consumption level, $\bar{c} + a$.

Initially people merely reduce their saving. But if the consumption smoothing motive is strong enough, the economy must eventually begin to eat into its capital and so the capital stock soon begins to fall. At the moment that the aid materializes as expected, the economy will have just reached the stable adjustment path for the new system with permanent aid inflow a, thereby avoiding a discontinuity in the path of consumption. A new steady state with higher consumption is eventually attained, and the ground lost in capital investment is recovered in the long run.

A problematic aspect of this scenario is the possibility that expectations of EU aid were too optimistic. In this case, the consumption boom may turn out to have been unjustified. Once the disappointment sinks in, the result is a consumption collapse to the point implied by the diminished capital stock, and a net welfare loss. The possibility of unjustified great expectations is another reason that the government should be cautious in the face of high consumption demand.

Other Possible Borrowing Externalities and the Real Exchange Rate

The example of sovereign borrowing provides one setting in which consumption could be socially excessive, but other plausible mechanisms point in the same direction. For example, a positive external effect of the aggregate capital stock on production, as postulated by Romer (1986), would pull in the same direction because it would lead private agents to underestimate the true national marginal product of capital.

Another potential mechanism operates through the effect of capital inflows on the real exchange rate, a factor that has limited the gains from aid inflows in past experiences, as discussed in section 2. Financial inflows that allow higher consumption also promote real currency appreciation and movement of productive factors into nontradable sectors. If tradable goods are a source of unappropriated positive spillovers to the economy—perhaps because the sector invests more heavily in R&D with local external benefits—a shrinking tradable sector results in an inefficiently big reduction in productivity growth (not to mention a crowding out of foreign resources available for investment). To address the possibility, Benigno and Fornaro (2014) and Benigno, Fornaro, and Wolf (2025) model this "financial resource curse." Benigno and Fornaro suggest capital inflow controls as a possible welfare-enhancing intervention. In the Ukraine context where capital accumulation is imperative, however, capital inflows are necessary; a preferable intervention would be to limit consumption.

B. Model of Endogenous TFP Growth with Constrained Foreign Borrowing

The next model extends the closed economy Uzawa-Lucas model in Barro and Sala-i-Martin (2003) by allowing limited foreign borrowing subject to a collateral constraint, as above. This model features endogenous economic growth via ongoing increases in labor-augmenting technical change, and thus TFP growth. The maximand for the planning problem is once again given by equation (5.1).

There is a fixed labor supply L. Production uses this labor but exhibits constant returns to physical and human capital

$$y = Ak^{\alpha}(uhL)^{1-\alpha}, \tag{5.9}$$

where h is interpreted broadly as "innovative capacity," u is the fraction of the labor force engaged in producing output (as opposed to innovative work), and human capital is predetermined at any moment but can be accumulated over time according to

$$\dot{h} = B(1-u)h - \theta h. \tag{5.10}$$

The variable h will drive TFP because (5.9) can be written as $y = Ah^{1-\alpha}k^{\alpha}(uL)^{1-\alpha} = \tilde{A}k^{\alpha}(uL)^{1-\alpha}$, where TFP is $\tilde{A} = Ah^{1-\alpha}$. To economize on notation, we again normalize $L = 1$.

Planning Solution

The planner wishes to maximize (5.1) subject to (5.9), (5.10), the capital accumulation equation (5.2), and the predetermined state variable values $h(0)$ and $k(0)$.

As before, the planner (but not the market) will internalize the economy's effective capital accumulation constraint as the transform of (5.3) of constraint (5.2). The appendix derives necessary conditions for the planner's optimum allocation.

To proceed further, we define the physical/human capital ratio as $\omega \equiv k/h$ and the average product of capital as $z \equiv y/k = Au^{1-\alpha}\omega^{-(1-\alpha)}$. The resulting consumption Euler equation,

$$\frac{\dot{c}}{c} = \sigma\left(\frac{\alpha z - \gamma r^* - \theta}{1-\gamma} - \delta\right), \tag{5.11}$$

has the same rationale as (5.4) and can be derived in the same way from the planner's first-order maximization condition for consumption, reported in the appendix. We would like to track the evolution of the consumption/capital ratio $\chi \equiv c/k$, which will be constant in the steady state. Combining the last equation with (5.5), we find that

$$\frac{\dot{\chi}}{\chi} = \frac{\dot{c}}{c} - \frac{\dot{k}}{k} = \frac{(\sigma\alpha - 1)z + \chi + (1-\sigma)(\gamma r^* + \theta)}{1-\gamma} - \sigma\delta. \tag{5.12}$$

The ratio $\omega = k/h$ also is constant in steady state and, using equation (5.10), its growth rate is given by

$$\frac{\dot{\omega}}{\omega} = \frac{\dot{k}}{k} - \frac{\dot{h}}{h} = \frac{z - \chi - \gamma r^* - \theta}{1-\gamma} - B(1-u) + \theta. \tag{5.13}$$

As the appendix explains, the dynamics of u are described by:

$$\frac{\dot{u}}{u} = Bu - \frac{\chi}{1-\gamma} + \left(\frac{1-\alpha}{\alpha}\right)B + \frac{\gamma(1-\alpha)}{\alpha(1-\gamma)}(r^* + \theta). \tag{5.14}$$

Equations (5.12), (5.13), and (5.14) completely describe the dynamics of optimal growth. However, it is convenient to represent our dynamic system in terms of z (rather than ω). Because $z = Au^{1-\alpha}\omega^{-(1-\alpha)}$, we have

$$\frac{\dot{z}}{z} = (1-\alpha)\left(\frac{\dot{u}}{u} - \frac{\dot{\omega}}{\omega}\right) = (1-\alpha)\left(\frac{B}{\alpha} - \frac{z}{1-\gamma}\right) + \frac{\gamma(1-\alpha)}{\alpha(1-\gamma)}(r^* + \theta). \tag{5.15}$$

The steady state of the model is defined by

$$\frac{\dot{z}}{z} = \frac{\dot{\chi}}{\chi} = \frac{\dot{u}}{u} = 0,$$

and by solving these three equations, we can find the steady-state values $\bar{z}$, $\bar{\chi}$, and $\bar{u}$ as well as the economy's steady-state growth rate. The linearized dynamics are relatively straightforward to analyze, given that equation (5.15) shows the evolution of z as dependent on z alone (as in the closed economy case; see Obstfeld 1999).

The simple form of equation (5.15) allows us to write the gross steady-state marginal product of capital αz (i.e., the marginal product gross of depreciation) as

$$\alpha \bar{z} = (1 - \gamma)B + \gamma(r^* + \theta) \equiv \bar{\rho}^*. \tag{5.16}$$

This result can be compared with the closed economy or autarky steady-state gross marginal product of capital, which is simply B (see Barro and Sala-i-Martin 2003, 252). Intuitively, the gross marginal product of capital is a weighted average of the closed economy and world values, approaching the autarky value B as $\gamma \to 0$ and foreign borrowing dries up entirely. For partial market access, using the preceding planner-optimal marginal product of capital, the consumption Euler equation (5.11) predicts a long-run consumption growth rate of $\sigma(B - \theta - \delta)$, identical to the autarky long-run growth rate and (as we shall see in a moment) the market-implied long-run growth rate for the present model. However, the transitional dynamics for the planner solution imply higher intertemporal welfare than either the autarky or the market solution. The ability to borrow abroad at a rate below the marginal product of capital is a gain from trade, and the planning solution promotes more borrowing, leading to a quicker approach to the steady-state consumption path.

Market Equilibrium

As in the Ramsey-Cass-Koopmans model, individuals view their foreign credit limits as exogenous and always borrow up to the limit that foreign credit markets offer whenever the domestic net marginal product of capital exceeds the cost of foreign funding. They maximize (5.1) subject to (5.6) above and the human capital accumulation constraint (5.10), also taking $h(0)$ and the path of external credit availability as given.

The consumption Euler equation for the market setting is

$$\frac{\dot{c}}{c} = \sigma(\alpha z - \theta - \delta). \tag{5.17}$$

The appendix derives equation (5.17). It also shows that the dynamics of the average product of capital, z, follow

$$\frac{\dot{z}}{z} = (1 - \alpha)\left(\frac{B}{\alpha} - z\right),$$

rather than equation (5.15).

Fiscal Instruments to Decentralize the Planner Optimum

In this model, there are two wedges calling for government intervention, one static and the other dynamic. The static wedge arises because the market economy allocates too much labor to accumulating non-pledgeable capital h, ignoring the benefits of an extra unit of pledgeable k via a looser external credit constraint. If ν is the shadow price of k and μ is the shadow price of h

(derived in the appendix for the planner and market allocations, respectively), then the planner's indifference between allocating the last unit of labor between sectors is expressed as

$$\nu(1-\alpha)A\omega^{\alpha}u^{-\alpha} = \mu(1-\gamma)B,$$

whereas the market allocation will satisfy

$$\nu(1-\alpha)A\omega^{\alpha}u^{-\alpha} = \mu B$$

for the relevant private shadow prices, which will generally differ from public prices. A fiscal corrective would be a subsidy at rate $\gamma/(1-\gamma)$ for output production relative to production of h.

Positive spillovers from the human capital sector to production would be a reason to favor the former through fiscal policy. While very possibly relevant in practice, however, the model does not incorporate such an effect, instead focusing on the borrowing friction. Even when human capital spillovers operate, however, the addition of a pledgeability advantage of physical capital still raises the relative social return to physical capital accumulation. (Physical capital, too, is likely to generate positive external spillovers; see Romer 1986.) Over the longer term, a shift of the economy into higher-value tradable services might alter the production function, enhancing the social incentive to accumulate human capital, as suggested by Rodrik (2016).

The second, dynamic wedge is as in the previous Ramsey-Cass-Koopmans model: Investors in physical capital ignore its utility in loosening the country's external credit constraint. As before,

$$\frac{\alpha z-(\gamma r^{*}+\theta)}{1-\gamma} > \alpha z-\theta \Leftrightarrow \alpha z-\theta > r^{*}.$$

So, provided the net marginal product of capital exceeds its external opportunity cost r^{*}, the social return to investment will exceed the private return. A consumption tax can be part of the solution, but in this model, a predictably declining VAT may not be enough to entirely mitigate the dynamic wedge.

We can see this by considering the steady state of the planner allocation. As we have seen, the long-run efficient gross rate of return to capital is $\bar{\rho}^{*} = \alpha\bar{z} = (1-\gamma)B + \gamma(r^{*}+\theta)$ according to (5.16). Given this private or market gross return to capital, the long-run gross social rate of return is

$$\frac{(1-\gamma)B+\gamma(r^{*}+\theta)-(\gamma r^{*}+\theta)}{1-\gamma}+\theta = B.$$

This equality implies that in the long run, the government must offer a constant saving or investment subsidy $\bar{\xi}$ equal to the divergence between the long-run optimal social return and the long-run private return,

$$\bar{\xi} = B-[(1-\gamma)B+\gamma(r^{*}+\theta)] = \gamma[B-(r^{*}+\theta)],$$

which we assume to be nonnegative.

It is along the transition to the steady state from a low initial $k(0)$—as the marginal product of capital is steadily falling; see equation (5.15)—that there is a role for a VAT that falls through time to some desired asymptotic level. In analogy with equation (5.8), define

$$\Delta(t) = \frac{\gamma}{1-\gamma}[\,\alpha z - (r^* + \theta)] - \bar{\xi}, \tag{5.18}$$

which is the out-of-steady-state component of the saving subsidy that the VAT must correct through a price level path that satisfies $\dot{P}(t)/P(t) = -\Delta(t)$. Observe that the total saving subsidy, $\Delta(t) + \bar{\xi}$, aligns the privately perceived capital rate of return with the social rate because

$$\alpha z(t) - \theta + \Delta(t) + \bar{\xi} = \frac{\alpha z(t) - \gamma r^* - \theta}{1-\gamma}$$

Once again, with a terminal desired VAT rate of $\bar{\tau}$ and an associated terminal price level of $\bar{P} = 1 + \bar{\tau}$, the initial VAT level should be

$$P(0) = 1 + \tau(0) = \bar{P}\exp\left(\int_0^\infty \left\{\frac{\gamma}{1-\gamma}[\alpha z(s) - (r^* + \theta)] - \bar{\xi}\right\} \mathrm{d}s\right)$$

$$= \bar{P}\exp\left(\int_0^\infty \left\{\frac{\gamma}{1-\gamma}[\alpha z(s) - \bar{\rho}^*]\right\} \mathrm{d}s\right),$$

so that $P(t) \downarrow \bar{P}$ as $\alpha z(t) \downarrow \bar{\rho}$, where

$$P(t) = \bar{P}\exp\left(\int_t^\infty \left\{\frac{\gamma}{1-\gamma}[\alpha z(s) - \bar{\rho}^*]\right\} \mathrm{d}s\right).$$

The intuition for this VAT path is similar to that in the last model. The VAT rate must decline over time to create an incentive for extra saving, and the last expression shows how it falls to its terminal level at a rate just sufficient to align the market's perceived deviation from the steady-state return to investment with the return deviation that the optimal plan requires. However, because we now allow the planner steady state to differ from the market steady state, a permanent subsidy to saving/investment, $\bar{\xi}$, must also be in place.[17] The other component of an optimal tax scheme raises the market's perceived return to investing in physical capital as opposed to investing in human capital. This is justified because as long as the external credit constraint is binding, the market undervalues the role of a larger physical capital stock in easing the constraint.

[17] The last model would have allowed for such a steady-state deviation had we assumed that $r^* < \delta$.

C. A Model with Endogenous Labor Repatriation and Government Preference for a Bigger Economy

Ukraine will wish to draw its diaspora back into the domestic labor force. It is not obvious how to represent this policy preference in standard optimal growth frameworks. If the government aims to maximize the utility of the representative household, effectively basing its criterion on the per capita consumption path, then drawing labor from abroad could be seen as reducing the output-labor ratio and hence reducing per capita consumption—a negative in terms of the assumed social welfare function. The challenge is to represent that the government cares not only about resident Ukrainians, but also about the welfare of Ukrainians abroad and their potential to contribute to the domestic economy after returning.

One way of capturing this social preference is to assume that the government maximizes the objective function

$$\int_0^\infty e^{-\delta t} u[C(t)]dt \; = \int_0^\infty e^{-\delta t} \left[\frac{C(t)^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}} \right] dt, \tag{5.19}$$

which in equation (5.1) depends on *aggregate consumption* C, rather than per capita consumption $c = C/L$, where L is the domestic labor force. The rationale for this assumption is that a larger economy is preferred owing to enhanced network externalities in innovation or otherwise, unspecified increasing returns of other kinds, or geopolitical influence.[18]

The supply of returning workers is an increasing function of the real wage, making labor supply relative to its initial value equal to:

$$L = L_0 \left(\frac{w}{w_0} \right)^{\psi}.$$

This means that

$$\frac{\dot{L}}{L} = \psi \frac{\dot{w}}{w}. \tag{5.20}$$

If production is Cobb-Douglas, $Y = AK^{\alpha}L^{1-\alpha}$, the wage equals the marginal product of labor, $w = (1-\alpha)A(K/L)^{\alpha}$, and capital accumulation draws in labor from abroad:

$$\frac{\dot{L}}{L} = \left(\frac{\alpha\psi}{1+\alpha\psi} \right) \frac{\dot{K}}{K}. \tag{5.21}$$

[18] An alternative approach would be to weight utility per capita by the number of workers present on each date, as suggested by Koopmans (1967). This would effectively introduce the K/L ratio into the government utility function, increasing complexity without necessarily increasing insight. One could also consider a model with a Romer (1986)–type positive externality related to the aggregate population L.

The capital accumulation constraint for the economy is

$$\dot{K} = AK^{\alpha}L^{1-\alpha} - C - \theta K, \tag{5.22}$$

where θ is the capital depreciation rate. To simplify, this formulation ignores the possibility of (constrained) foreign borrowing, which could be added at the cost of complicating the notation.

The appendix shows that the optimal planner path for the economy implies a social Euler equation for aggregate consumption,

$$\frac{\dot{C}}{C} = \sigma \left\{ \underbrace{[\alpha A k^{\alpha-1} - \theta - \delta]}_{decentralized\ economy} + \underbrace{(1-\alpha)\left(\frac{\alpha\psi}{1+\alpha\psi}\right) A k^{\alpha-1}}_{labor\ flow\ externality} \right\}, \tag{5.23}$$

where $k = K/L$. The interpretation is straightforward. An additional unit of investment dK yields the direct marginal return $\alpha A k^{\alpha-1} - \theta$. But by equation (5.21), the investment also draws in additional labor equal to $dL = \left(\frac{\alpha\psi}{1+\alpha\psi}\right)(L/K)dK$, with marginal product equal to $\left(\frac{\alpha\psi}{1+\alpha\psi}\right) \times (L/K) \times (1-\alpha)Ak^{\alpha} = (1-\alpha)\left(\frac{\alpha\psi}{1+\alpha\psi}\right) Ak^{\alpha-1}$.

Private-sector agents do not internalize this additional component of the social return, since the representative resident's per capita consumption c follows the individual Euler equation $\dot{c}/c = \sigma(\alpha A k^{\alpha-1} - \theta - \delta)$. This Euler equation implies a steady-state capital–labor ratio equal to

$$\bar{k} = \left(\frac{\alpha A}{\theta + \delta}\right)^{\frac{1}{1-\alpha}} \tag{5.24}$$

(which is independent of σ). The social Euler equation (5.23), however, implies a steady-state capital–labor ratio (also independent of σ) of

$$\bar{k}^{*} = \left\{ \frac{\alpha A}{\theta + \delta} + \frac{\alpha\psi}{1+\alpha\psi} \frac{(1-\alpha)A}{\theta + \delta} \right\}^{\frac{1}{1-\alpha}},$$

which is strictly above the market equilibrium level $\bar{k}$ of (5.24).

The steady-state gross MPK for the planner solution is $\alpha A \bar{k}^{*\,\alpha-1} \equiv \bar{\rho}^{*}$, which is strictly below that in the market equilibrium, $\alpha A \bar{k}^{\alpha-1}$.

Phase Diagram

In the (C, k) plane, equation (5.23) furnishes one equation of motion. The second is

$$\dot{k} = \frac{1}{1+\alpha\psi}\left(Ak^{\alpha} - \frac{C}{L} - \theta k\right)$$

which follows from equations (5.21) and (5.22). Using the labor-supply equation, this can be written as

$$\dot{k} = \frac{1}{1+\alpha\psi}\left(Ak^{\alpha} - \frac{C}{L_0 w_0^{-\psi}[(1-\alpha)Ak^{\alpha}]^{\psi}} - \theta k\right). \tag{5.25}$$

According to this equation, *aggregate* consumption C is maximized where

$$f'(k) = \alpha A k^{\alpha-1} = \theta\frac{(1+\alpha\psi)}{1+\psi},$$

a capital level that exceeds the standard "golden rule" level in the standard Ramsey-Cass-Koopmans growth model (given by $f'(k) = \theta$). This capital level also exceeds $\bar{k}^*$, given above, so in this sense the optimal plan is "dynamically efficient." Figure 19 shows the economy's dynamics in the planned allocation.

Fiscal Policies for the Decentralized Optimum

As in the previous models, the social optimum could be decentralized with the help of a VAT that alters the perceived return to saving. Because

$$\frac{\dot{C}}{C} = \frac{\dot{c}}{c} + \frac{\dot{L}}{L},$$

the optimal VAT path acts by raising both components on the right-hand side above. That increase requires a lower consumption level on any date (compared with the market allocation), a correspondingly higher rate of capital accumulation and wage growth, and therefore a higher rate of labor force growth. (Other things equal, a higher initial VAT lowers the initial real wage and therefore the initial labor supply. But over time, the falling VAT induces a more rapid return of labor.)

However, a declining VAT is not the only instrument needed to decentralize the planner solution, because the planning steady state differs from the one that the market converges toward. This means there must be a long-run divergence between perceived market and social returns, in the form of a subsidy to saving or investment.

As noted above, the steady-state marginal product of capital in the planner allocation is denoted by $\bar{\rho}^* = \alpha A \bar{k}^{*\alpha-1}$. According to equation (5.26), however, the long-run constant investment subsidy that decentralizes the planner steady state, $\bar{\xi}$, is given by

$$\bar{\xi} = \left[\alpha + (1-\alpha)\left(\frac{\alpha\psi}{1+\alpha\psi}\right)\right] A \bar{k}^{*\alpha-1} - \bar{\rho}^* = (1-\alpha)\left(\frac{\alpha\psi}{1+\alpha\psi}\right) A \bar{k}^{*\alpha-1}. \qquad (5.27)$$

The optimal saving/investment subsidy will be the sum of $\bar{\xi}$ and a VAT, $\dot{P}(t)/P(t) = -\Delta(t)$, such that along the social optimum path (signified by asterisks),

$$\sigma\left\{\left[\alpha + (1-\alpha)\left(\frac{\alpha\psi}{1+\alpha\psi}\right)\right] A k^{*\alpha-1} - \theta - \delta\right\} - \left(\frac{\alpha\psi}{1+\alpha\psi}\right)\left(A k^{*\alpha-1} - \frac{c^*}{k^*} - \theta\right)$$

$$= \sigma\left(\alpha A k^{*\alpha-1} + \Delta + \bar{\xi} - \theta - \delta\right),$$

Or, using (5.27) to eliminate $\bar{\xi}$,

$$\Delta = \underbrace{(1-\alpha)\left(\frac{\alpha\psi}{1+\alpha\psi}\right)\left(A k^{*\alpha-1} - A \bar{k}^{*\alpha-1}\right)}_{deviation\ from\ planner\ steady\ state} - \underbrace{\frac{1}{\sigma}\left(\frac{\alpha\psi}{1+\alpha\psi}\right)\left(A k^{*\alpha-1} - \frac{c^*}{k^*} - \theta\right)}_{spread\ of\ aggregate\ consumption\ over\ more\ people}.$$

Assuming this subsidy is always positive (a weak assumption, since investment is likely to be constrained), the optimal VAT will fall over time toward zero as capital rises toward $\bar{k}^*$ according to equation (5.25); see the phase diagram (Figure 19).

The interpretation of tax policy is much like in earlier models, but now the distortion that policy corrects is the market's undervaluation, relative to the government's preference, of how more capital investment induces more immigration from abroad through higher wages. Once again, the planner-preferred steady state differs from the market steady state, requiring a long-run saving/investment subsidy along with a transitorily falling rate of VAT.

D. Taking Stock

Augmenting the capital stock is imperative to achieve per capita income growth through standard neoclassical channels. Additionally, it is likely to confer external social benefits through mechanisms that market actors will not internalize. These mechanisms include eased external credit constraints and enhanced incentives for refugee workers to return. Fiscal policies that compress consumption therefore are likely to improve welfare, at least during an initial transitional period. They also can help avoid disruptive consumption booms and the associated real currency appreciation. The challenge is to embed these policies within social support frameworks that protect those who are most vulnerable.

6. Additional Considerations and Next Steps

The monumental task of rebuilding Ukraine has myriad important nuances and crosscutting issues. For example, we don't cover the labor market, refugees, urban redevelopment (including brown vs. green investment), modernization of energy and transport infrastructure, and the like. A thorough treatment of these areas is not possible in this paper, and we refer the interested reader to Anastasia et al. (2022), Anastasia, Boeri, and Zholud (2025), Glaeser, Kirchberger, and Parkhomenko (2025), Becker, Gorodnichenko, and Weder di Mauro (2025), and Gorodnichenko, Sologoub, and Weder di Mauro (2022).

At the same time, we would like to provide a few additional estimates and flag a few issues for further consideration.

A. Capital Needs

How much capital does Ukraine need over the next five to 10 years to recover rapidly from the war and start convergence to the European Union?[19] In the thick fog of war, any estimate is necessarily tentative as it must rely on preliminary assessments and various assumptions (e.g., we assume that the immediate postwar population of Ukraine will be 90 percent of the prewar level, which was approximately 41 million in 2021) as well as on many other factors to consider. For the latter, we focus on three key considerations. First, Ukraine needs to rebuild capital destroyed in the war. Second, Ukraine's capital intensity needs to catch up to that of its Eastern European peers in the European Union. Third, we should bear in mind the capacity of Ukraine to absorb new investment. We find that the ballpark for Ukraine's need is at least $40 billion per year, which will have to come from foreign resource inflows and domestic saving.

Destroyed Capital

To understand the scale of destruction, we rely on two data sources: Rapid Damage and Needs Assessment reports from World Bank (2025) and a database of capital damage compiled by the Kyiv School of Economics (KSE). Because the Bank and the KSE use more or less the same underlying reports compiled by the Ukrainian government, there is generally high consistency across these two sources. Their estimates give the replacement value in current dollars of totally or partially destroyed physical assets in the affected area.[20] The numbers are clearly a lower

[19] The standard closed economy Solow growth model predicts a rather slow convergence that is independent of the saving rate: $(1-\alpha_K)(n+g+\delta)$ where α_K is the elasticity of output with respect to capital, n is the growth rate of population, g is the growth rate of productivity, and δ is the depreciation rate for capital. Assuming zero population growth for postwar Ukraine, taking productivity growth for Poland in 1995–2019 (1.1 percent per year according to the PWT), and setting values for other parameters from the PWT ($\alpha_K = 0.45, \delta = 0.03$), the implied speed of convergence is 0.0225 and so the expected time to close half of the gap between Ukraine and Poland is about 30 years. Obviously, this time frame can be radically reduced with external capital inflows.

[20] As described in the Materials of the "Audit of war damage" working group of the National Council for the Recovery of Ukraine, "Damage assessment is calculated in replacement cost. … Damage to large facilities (airports, large industrial enterprises, ships, aircraft, etc.) is assessed individually using financial statements. Individual coefficients of destruction can be used to estimate large infrastructure objects. The value of fixed assets as of the beginning of 2021 is taken for the identified enterprises. Medium-sized objects that can be counted (schools, hospitals, shops, cultural facilities, etc.) are valued at the average unit cost (estimated from financial statements, Prozorro tenders, etc.). Mass facilities (real estate, vehicles, small business assets) and networks (road and rail, electricity and gas distribution, telecommunications) are

bound for various reasons. For one, they do not necessarily equal the cost of reconstruction, which includes clearing rubble, demining, and many other costs.[21] Furthermore, these estimates do not cover Ukrainian territories that Russia occupied after the full-scale invasion; various reports indicate the nearly total destruction of cities in those territories. In addition, the assessment does not include the cost of equipment that was present in destroyed or ruined buildings. In any case, if we concentrate on physical units rather than valuations (e.g., as of December 2024, 14 percent of the housing stock was destroyed or severely damaged), we immediately conclude that the degree of Ukraine's destruction is of the same order of magnitude as the devastation in Europe due to World War II (Britannica 2025).

Figure 20 plots the evolution of damage estimates and the distribution of damage across sectors and regions. Damage is concentrated in housing, energy/utilities, and transport infrastructure and in regions close to the contact line. The most recent estimate indicates that $176 billion (in current dollars) of the capital stock had been destroyed as of December 2024. Given the growing intensity of Russian attacks and the fact that Russia captured approximately 1 percent more of Ukraine's territory in 2025, one can project that the damage is at least $200 billion as of December 2025. Assuming that the reconstruction stage will last 10 years, we estimate the need for rebuilding this lost capital as at least $20 billion per year.[22]

Capital Deepening

As we discussed earlier, Ukraine moved from being relatively capital abundant in 1990 to relatively capital poor in 2019 (see Figure 6). Using IMF (2021) capital stock estimates (in constant 2017 international dollars), we observe that capital stock per capita for Poland and Bulgaria—EU members with the lowest capital intensity—was approximately 60 percent higher than the corresponding figure for Ukraine in 2019. Furthermore, the IMF data suggest that both Poland and Bulgaria were adding approximately $2,000 in capital per capita per year between 2007 and 2019. In contrast, Ukraine was losing roughly $600 per year in per capita capital over the same period even though Ukraine's population was shrinking.

What is needed to stop the divergence in capital intensity between Ukraine and its peers? The Penn World Table reports that the average depreciation rate of capital for Eastern European countries is about 4.4 percent per year but estimates the rate for Ukraine to be 2.6 percent per year. Differences in depreciation rates can reflect changes in the composition of investment across countries (Fraumeni 1997). To anticipate the future pattern for Ukraine, we assume a 3 percent depreciation rate. Given that the capital stock per capita in Ukraine was approximately $35,500 (constant 2017 international dollars) in 2019, fresh investment should be initially $\$2{,}000 + 0.03 \times \$35{,}000 = \$3{,}050$ per capita per year (if we ignore capital destruction during

estimated via indirect methods, a combination of relevant regional statistics and the level of damages for individual regions or cities." See https://www.kmu.gov.ua/storage/app/sites/1/recoveryrada/eng/audit-of-war-damage-eng.pdf for more details.

[21] Both the World Bank and KSE also provide estimates for total capital recovery needs. These depend on various assumptions and additional estimates. Generally, capital recovery needs are two to three times as large as capital damage alone.

[22] Although one should adjust the needed rebuilding of capital to a smaller postwar population, we expect the war to continue for a while and therefore reducing the estimate by 10 percent does not change the order of magnitude of the capital replacement need by the war's end.

the war) and then should grow as capital is accumulated. For comparison, Ukraine's GDP per capita in 2019 was $13,700 (constant 2017 international dollars), according to the IMF 2021 Investment and Capital Stock Dataset. This level of income and the historical investment rate of approximately 10 percent of GDP make clear that, if past trends continue, Ukraine will fall further behind its peers.

Given the enormous uncertainty in the macroeconomic outlook for postwar Ukraine, it is hard to project which portion of the required gross capital formation can be financed via domestic saving. For the purpose of discussion, suppose that Ukraine can increase its saving (and investment) rate from 10 percent of GDP to 15 percent in the immediate aftermath of the war, which is consistent with post-accession investment rates for Eastern European EU members and (as we discuss below) postwar experience for other countries.[23] This still leaves an investment gap of about $1,000 per year per capita in constant 2017 international dollars, which is approximately $300 per capita per year in current dollars at the market exchange rate. Suppose this gap is the amount funded via EU structural funds, private FDI, and other external sources. With our assumption about Ukraine's postwar population, investment from external sources should be about $10 billion per year in current dollars.

However, this amount is needed just to ensure that Ukraine does not fall further behind. To generate convergence with EU peers, Ukraine requires even more fresh capital. Suppose that the objective is to close 5 percent of the capital intensity gap between Poland and Ukraine every year. According to IMF (2021), Poland has $58,000 in capital per capita in constant 2017 international dollars. That means that Ukraine would need to raise another roughly $1,000 per capita per year in constant 2017 international dollars, which suggests the need for an additional $10 billion per year in current dollars from foreign sources.

Absorptive Capacity

How much capital can Ukraine absorb? We see two important elements. First, we want to know how much and how quickly the investment rate can increase once the war ends. Second, we want to know what rate of investment would keep costs under control. Both elements are difficult to quantify, but we can rely on historical precedents and studies done in other countries and contexts.

Figure 21 plots time series for investment rates after World War II. Although the data are somewhat sparse, we observe that investment rates increase from about 10 percent to 15 percent during the war, then to 20 percent or more after the war. Importantly, this increase was gradual; it took about five years after the end of hostilities to reach a new, higher level of the investment share. This pattern holds for other countries and wars (e.g., Croatia after its war for independence in 1991–95 and Georgia after the Russian invasion in 2008; see Figure 6). Thus, a 20 percent investment rate appears within Ukraine's reach, albeit not immediately, and it probably can be implemented with reasonable efficiency.

[23] If we continue to work within the Solow growth model and assume that Ukraine will share demographic, productivity, and other trends with neighboring Eastern European countries, the level of capital per capita in Ukraine can be brought to the level in peer countries only if Ukraine has the same saving (and investment) rate (assuming a steady-state balanced current account). This means that in the long run, Ukraine should at least double its saving rate from 10 percent to 20 percent or more.

For the second element, the main concern is that above-capacity investment ends up largely going into higher prices and waste. As a result, it can be optimal to spread investment over time rather than front-load it. At the same time, a small investment can fail to reach the optimal scale. So what is the best point on this tradeoff? To the best of our knowledge, there are estimates only for public investment. This of course gives an incomplete picture, but investment in the early postwar years is likely to be dominated by public investment, and so the omission of private investment may be acceptable.[24] Using data from the World Bank's cost database, Gurara et al. (2021) find a U-shaped relationship between the cost and volume of public investment: The cost is minimized when public investment is about 10 percent of GDP on average, but this point is reduced to 7 percent of GDP for countries with a high incidence of corruption. Collier, Kirchberger, and Söderbom (2016) also find that corruption and conflict raise the cost of investment in infrastructure. If we take the (projected) level of GDP at $210 billion (current dollars) in 2025 and assume that Ukraine is successful in its anti-corruption efforts and pursues efficient procurement mechanisms such as Prozorro (Bosio et al. 2022), we conclude that public investment at $25 billion per year should be within Ukraine's absorptive capacity.

Taking Stock

Our analysis suggests that Ukraine needs at least $40 billion per year in new investment from external sources and domestic saving: $20 billion for rebuilding the capital stock, $10 billion for keeping Ukraine from falling further behind in capital intensity, and $10 billion to launch modest convergence toward EU peers. This estimate obviously is provisional, and the magnitude can vary depending on the course of the war (for instance, if more capital is destroyed, the gap between gross and net investment will be smaller than in a steady state because with little preexisting capital, there is little to depreciate).

Bearing these caveats in mind, we believe that this resource inflow is feasible in terms of Ukraine's ability to absorb new investment. Indeed, Ukraine received about $40 billion per year in budgetary support during the full-scale war. Private capital inflows can eventually cover a significance share of investment: Poland's net FDI was approximately $20 billion in 2024. Finally, we note that, for the 2021–27 period, the EU budget for cohesion policy is €392 billion, which translates to roughly €56 billion per year and suggests some room for EU funds earmarked for Ukraine.

B. Debt Overhang

Since 1980, several post-conflict countries have received considerable relief on both bilateral and commercial external debts (Appendix Table 2). These treatments have varied in nature and depth. The canonical historical example may be the London Debt Agreement (LDA) of 1953, which finally resolved Germany's interwar debts and helped set the stage for Germany's postwar *Wirtschaftswunder* (Guinnane 2015). Galofré-Vilà et al. (2019) describe multiple channels through which the LDA catalyzed German economic growth. Looking at official debts relief over the years 1920–39 and private debts over 1978–2010 (not necessarily associated with prior

[24] During the war, Ukraine's public investment has been focused on restoring infrastructure; other public investments have been largely postponed.

conflicts), Reinhart and Trebesch (2016) find that debt write-offs tend to lead to higher growth and improved credit ratings; reprofiling, interest rate reductions, and other softer relief modes are less effective.

These precedents are highly relevant for Ukraine, as its postwar public debt burden could pose a threat to economic progress. Fears about fiscal sustainability are a drag on investment, as they raise the prospect of higher taxes or other business costs in the event of government funding difficulties. Key requirements for ensuring fiscal sustainability include improved tax collection, strategic prioritization of government expenditures, and an enhanced business climate, including digital transformation and efficient public procurement.

Figure 22 shows the size and composition of Ukrainian central government debt, by creditor, as a share of GDP. (Appendix Figure 6 shows the numbers in domestic currency units.) The overall public debt has doubled from about 50 percent of GDP on the eve of the war in 2021 to about 100 percent now.

While high domestic public debts can impair domestic investment and growth through several well-known channels, as noted in section 3, domestic debt repudiation, including through inflation, should be off the table as it would harm financial stability and growth going forward (commercial banks account for most domestically held government debt). In any case, domestic private creditors held only a bit over 16 percent of Ukraine's total debt in 2025, so the potential gains to the government are limited while the potential losses in credibility are big. The bulk of Ukraine's public debt (more than three-quarters) is held by foreign creditors, some private but mostly official. Thus, external debt restructuring will inevitably be an important component of external funding.

One cost associated with external loans is debt overhang. At the governmental level, reform efforts may be deterred if part of their fruits goes to pay external creditors. Moreover, if the penalties that private creditors can impose in case of default are proportional to output, investment may also suffer an overhang effect (Cohen 1995; Obstfeld and Rogoff 1996, chapter 6). We did not include this effect in the models of section 5 on the assumption that debt default was perfectly deterred in all states of the world by potential creditor sanctions. However, this assumption is not realistic and, in fact, Ukraine still has some ongoing disputes with private foreign creditors as well as with the Russian state. Comprehensive resolution of private claims is essential to release resources for home use and to avoid ongoing and costly creditor-debtor conflicts.

Debt treatments have already helped to reduce external private claims, which in total have fallen by 7 percentage points of Ukraine's GDP since 2022. The restructuring of about $20.5 billion in Eurobonds in August–September 2024 (claims equal to about 11 percent of 2024 GDP) produced a face value haircut of 37 percent and some interest deferral. In December 2025, Ukraine agreed with private creditors to swap $2.6 billion in GDP warrants into fixed-income bonds. Because the warrants explicitly linked payments to creditors to growth performance, they carried the risk of especially strong overhang effects.

Private external claims amounted to about 11 percent of the public debt in 2025, so again, any gains from further restructuring in this claim category are limited, albeit material and probably

necessary for longer-term debt sustainability. Bigger gains could come from restructuring or reprofiling official external debts, which amounted to 65 percent of the public debt in 2025. Even official foreign debts to allies can have disincentivize reform efforts at the margin, while reducing liquidity. Moreover, sustainability in a present value sense does not ensure availability of the foreign exchange needed to pay foreign debts when due, so foreign official lenders will no doubt need to roll over Ukrainian obligations. Far from deterring future private financial inflows, realistic debt write-down and extensions are a prerequisite for durably regaining access to international capital markets. Debt reductions would further enhance the resource envelope Ukraine will have for reconstruction efforts. Such reductions also arguably will even be in the interest of many creditors, due to positive spillovers from a stronger Ukrainian economy and Ukraine's considerable current and potential future security contributions to Europe.

A useful source of official credit for Ukraine has been the Extraordinary Revenue Acceleration (ERA) program, under which interest on EU and G7 loans is paid using the interest on Russian reserve assets immobilized in Europe.

Merz (2025) went further with a proposal that would collateralize the immobilized Russian assets to back a €140 billion loan. Ukraine was to repay that loan only after Russia compensated the country for war damage it has inflicted. While the Merz proposal was not approved in December 2025, EU leaders did authorize a large issuance of common debt to support Ukraine, leaving the frozen Russian reserves as a potential resource for the future.

Under the 48-month Extended Fund Facility (EFF) program for Ukraine that the IMF approved in March 2023, bilateral creditors extended their standstill on principal and interest payments through the program's end in March 2027 (IMF 2025, 28). IMF staff envisions that Ukraine's debt trajectory will be sustainable, albeit with substantial downside risks, provided private and bilateral debts receive sufficiently deep treatments by the end of the EFF program, sufficient fiscal adjustment occurs, and financing on concessional terms continues at a sufficiently high level through the end of the program period and beyond. The public debt targets the IMF assumes are 82 percent of GDP by 2028 and 65 percent of GDP by 2033 (both figures not including ERA loans, which are assumed not to impose a fiscal burden). These objectives are ambitious. The 2028 target is roughly the same level that prevailed before the Russian incursion of 2014, and again, before the start of the war in 2022.

This discussion underscores the importance of supporting Ukraine via grants rather than loans. Loans may be easier to accomplish politically, but saddling the country with debt creates a time bomb (Rogoff 2022). Creative financial instruments such as a reparation loan backed by Russian immobilized assets are a move in the right direction, but work on postwar debt relief must start now.

C. Mobilizing Domestic Resources

Our discussion has focused on attracting foreign capital to rebuild Ukraine's economy quickly and to initiate convergence to the European Union. Of course, one can also—or even instead—concentrate on mobilizing domestic resources. This strategy, while possible, seems unlikely to yield fast results. Indeed, it relies on the ability of the financial sector or the government to

collect savings and direct them to high-return projects. As documented by Carletti et al. (2024) and others, Ukraine's financial sector was underdeveloped before 2022 and was negatively affected by the war (see Appendix Figure 7 for basic statistics and comparisons). Even compared with peer economies in Eastern Europe, Ukraine's ratio of bank deposits to GDP is low. Furthermore, pension funds, insurance companies, and other traditional financial intermediaries have negligible assets in Ukraine. The stock market and corporate bond market are effectively nonexistent. In a similar spirit, there is no state capacity to aggregate and allocate savings.

This situation does not mean that progress is unachievable, but a more realistic expectation could be many years of organic growth in the financial sector until Ukraine develops satisfactory capacity. To this end, it is imperative to start laying the groundwork now for future development of the sector. For example, state-owned banks currently dominate, which raises concerns about market concentration, corruption risks, and other distortions. For longer-run payoffs such as an improved allocation of capital, stronger corporate governance of these banks, their privatization, and entry of foreign banks are required, among other policy steps.

Another possibility is to borrow against existing assets. According to the World Bank (2024), the value of Ukraine's agricultural land in 2020 was $112 billion (real 2019 dollars); for nonrenewable resources, it was $158 billion. While these amounts are significant by Eastern European standards (Appendix Figure 8), leveraging their potential may be challenging. First, the mortgage market in Ukraine is grossly underdeveloped: The ratio of mortgages to GDP is only about 1 percent, and therefore there is effectively no established infrastructure to borrow against these assets. Second, these assets are illiquid and carry significant expropriation and military risks, which limits interest in them. Third, selling off Ukraine's resources (especially to oligarchs and foreigners) is a political minefield. The so-called minerals deal forced onto Ukraine by the Trump administration in 2025 created a backlash, and there may be stronger pushback after the war is over and Ukraine is less dependent on the United States. Given these constraints, foreign direct investment into agribusiness and mining appears to be a more viable option.

In short, mobilizing domestic resources should be an integral part of Ukraine's modernization, but it can bear fruit only in the longer run, whereas the need for investment is immediate. This brings us back to the importance of foreign capital inflows.

D. Allocation Efficiency

Our discussion has focused on the volume of capital flows rather than the efficiency of capital allocation, which is obviously important (e.g., Gopinath et al. 2017, Gorodnichenko et al. 2020). While detailed policy recommendations on this matter are beyond the scope of this paper, the playbook is familiar (e.g., Becker et al. 2023): a stable macroeconomic environment, deregulation of economic activity, transparent and competitive bidding for government contracts, and the like. In this context, Akcigit et al. (2025) note that Ukraine's business dynamism significantly declined after the global financial crisis due to industry capture and high barriers to entry Their analysis calls for opening Ukraine to more trade, streamlining regulatory requirements, simplifying tax administration, thoroughly upgrading the labor code (which largely builds on Soviet laws adopted in the 1970s!), accelerating legal resolution of business disputes,

and easing access to the energy grid, among other reforms.[25] Further improvement in allocation efficiency will come from resolving nonperforming loans. De Haas and Pivovarsky (2022), for example, suggest a semi-centralized approach. Given the anticipated massive postwar reallocation of resources across regions and industries (Becker, Gorodnichenko, and Weder di Mauro 2025; Gorodnichenko and Stepanchuk 2024), one can improve matching efficiency by gathering and sharing more data as many government surveys and reporting programs have been canceled or suspended since the full-scale invasion. Perhaps Airbnb-like platforms can help improve matches in residential housing, commercial real estate, and production facilities. Only recently has Ukraine legalized trading land, but cadasters, ownership rights, and other elements of market need further work to complete the process to facilitate using land as collateral and making ownership transparent.

Another track for improving capital allocation centers on how reconstruction efforts should be organized. Although many proposals on institutional architecture are being floated, Becker, Gorodnichenko, and Weder di Mauro (2025) recommend establishing a Kyiv-based agency akin to the Economic Cooperation Administration that was set up to manage the Marshall Plan after World War II. Intuitively, some centralization is essential to aggregating needs, sharing information, minimizing waste and delays, and ensuring accountability.

7. Concluding Remarks

Growth miracles can happen. Indeed, the success of new EU and NATO members in Eastern Europe is a vivid demonstration of how a relatively poor country such as Czechia can recover from the Soviet yoke and catch up to an advanced economy such as France, Italy, or the United Kingdom in a matter of 30 years—the blink of an eye in long-run economic growth. Obviously, many factors contributed to this phenomenon, but the basic facts suggest a simple recipe: Productivity gains and physical capital accumulation played the key role in the stunning rise of incomes. Improvements in human capital helped, too, but these were largely offset by depopulation trends.

Can this triumph be repeated by Ukraine? Productivity is a big mystery in economics, but the country's creativity in defending itself militarily from Russian assault gives us hope that Ukraine can catch up to the technological frontier as other EU/NATO countries in the region did. If this hope is not enough for a plan, the tried-and-true recipe of capital accumulation is a safe bet for Ukraine's economic development. In fact, capital deepening in 1990–2019 was the main feature that separated EU/NATO members from countries that did not join these organizations. While Ukraine and Moldova relied on personal remittances to finance their consumption and investment, Poland and Czechia received massive private capital inflows and public structural funds. Furthermore, those investments facilitated technology transfer and helped address demographic issues. In other words, capital, technology, and labor reinforced each other, creating a virtuous circle: More investment makes countries more productive and livable, which in turn makes those countries more attractive for investment.

[25] According to World Bank (2020), before the war it took more than 250 days to obtain a permanent electricity connection for a newly constructed warehouse.

We argue that this strategy can be further refined to attain even better results. We show theoretically that investment in physical capital can generate benefits that are not internalized by market forces. For example, investment in physical capital relaxes borrowing constraints (thus allowing more capital inflows) and raises wages (thus encouraging more Ukrainian refugees to return home). The government can achieve superior outcomes by directing more resources to investment. We model such policies as a consumption tax that declines over time as the country accumulates more capital. Furthermore, there is a potential need for a permanent investment subsidy (equivalently, a permanent saving subsidy) to correct market myopia. Of course, such policies can be implemented through a variety of tools. In addition to taxes, financial repression, regulation, capital controls, and other standard instruments, Ukraine can rely on complementary strategies to de-risk investments such as providing war insurance, loan guarantees from donor countries, and public-private partnerships.

Over the longer term, Ukraine may well need to overcome a middle-income trap, which will likely mean a shift into producing more high-value, exportable, human capital–intensive services (Rodrik 2016). But Ukraine's main problem right now is not to find jobs for an abundant domestic labor force but to attract workers back from abroad as soon as is practical and rebuild its basic production infrastructure, which has been devastated by a long period of armed conflict. Its endowment of human capital, relative to other factors of production, is an asset. The more immediate reconstruction task is to rebuild plant, equipment, and infrastructure with the essential help of financial inflows from abroad.

To be clear, we do not advocate an uncontrolled tsunami of capital flowing into Ukraine. Such a flood would likely plant seeds for a boom-bust cycle that would not only inflict severe economic pain and create deep scars but also erode public support for democracy, markets, and EU integration. Prudence and caution are necessary. At the same time, we show that delaying aid or capital for Ukraine can exacerbate problems. On balance, the nature of postwar reconstruction and the logic of long-term growth suggest that only capital accumulation—via foreign capital inflows and domestic saving—can yield a dependable, rapid development of Ukraine.

However, as every (good) financial advisor will tell you, past performance does not guarantee high returns in the future. Will the strategy that worked in Poland and Czechia work for Ukraine? Ukraine's past failure to attract FDI illustrates the costs of unreformed judicial power, weak property rights, corruption, oligarchic rule, and an unstable macroeconomic environment. None of these factors is impossible to address, but it is the homework that only Ukraine can do. And unfortunately, Ukraine was not always a good student: It took three currency crises to move from a fixed exchange regime to a (managed) float, three banking crises to reform the sector and the central bank, and even after ambitious reforms of the public sector the country continues to score poorly on the rule of law, corruption, and other key metrics.

Yet despite Ukraine's record of missed opportunities, we believe this time will be different. The existential threat to Ukraine emanating from Russian aggression and the prospect of Ukraine joining the European Union—or, as Ukrainians joke, perhaps one day NATO will join Ukraine—are a powerful combination of sticks and carrots. There is an overwhelming consensus in Ukrainian society that the European Union is the only civilizational choice for Ukraine. This sentiment creates a mighty force that can overcome vested interests and political differences to

thoroughly modernize the country. No less importantly, Europe now views Ukraine as part of Europe rather than a Russian sphere of influence or a buffer state. Thus, both sides demonstrate serious interest in making things happen. Ukraine's chances will be better, of course, if the European Union raises its own ambition and unity in the face of a triad of threats from a hostile Russia, a revisionist China, and a commercially aggressive but militarily disengaging United States.

This historic opportunity may be the last chance for Ukraine to survive and prosper as a sovereign nation. You only live twice.

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TABLES AND FIGURES

Table 1. Growth accounting for transition economies

	Growth, log points, 1994–2019				Contribution	
Economy	Output	Productivity	Capital	Labor	Capital	Labor
ARM	1.511	1.533	0.798	–0.554	0.342	–0.356
BGR	0.606	–0.206	1.429	0.153	0.736	0.076
CZE	0.677	0.252	0.732	0.145	0.348	0.077
EST	1.027	0.555	0.991	0.111	0.423	0.046
HRV	0.591	0.133	0.760	0.298	0.269	0.19
HUN	0.632	0.213	0.729	0.215	0.298	0.121
KAZ	1.197	0.541	0.764	0.439	0.453	0.206
LTU	1.019	0.540	0.793	0.196	0.383	0.095
LVA	0.908	0.580	0.635	0.033	0.317	0.011
MDA	0.709	0.623	0.093	0.119	0.033	0.060
POL	1.028	0.328	1.278	0.317	0.518	0.184
ROU	0.817	0.392	0.932	–0.097	0.479	–0.054
RUS	0.651	0.470	0.102	0.263	0.044	0.136
SRB	0.820	0.774	0.397	–0.157	0.156	–0.099
SVK	0.951	0.457	0.752	0.282	0.348	0.146
SVN	0.682	0.314	0.825	0.144	0.282	0.089
UKR	**0.154**	**0.418**	**–0.318**	**–0.213**	**–0.140**	**–0.119**
Memo: Group averages						
Non-EU	0.865	0.700	0.375	0.013	0.181	–0.011
EU	0.792	0.301	0.906	0.160	0.402	0.089

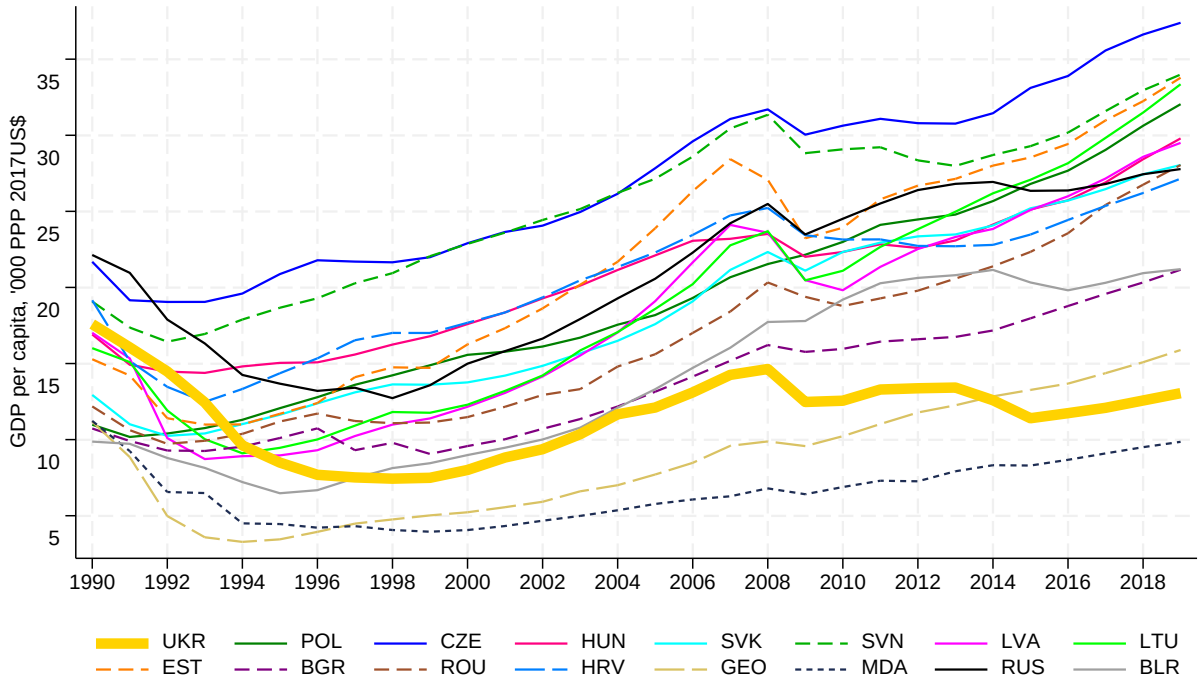
Source: Penn World Table.

Table 2. Investment and NATO/EU membership status

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Dependent variable: FDI per capita, constant 2017 international dollars						
$\mathbb{I}(NATO\ accession^{+})$	188.5**	177.2**				
	(71.68)	(71.98)				
$\mathbb{I}(EU\ accession^{+})$	–17.39		116.3*			
	(47.01)		(63.28)			
$\mathbb{I}(open\ NATO\ negotiations^{+})$				184.2***	177.3**	
				(55.25)	(68.83)	
$\mathbb{I}(open\ EU\ negotiations^{+})$				–11.41		111.1
				(69.93)		(81.73)
Observations	551	551	551	551	551	551
Panel B. Dependent variable: Private investment, constant 2017 international dollars						
$\mathbb{I}(NATO\ accession^{+})$	623.4***	1,002***				
	(179.7)	(226.9)				
$\mathbb{I}(EU\ accession^{+})$	576.1***		1,030***			
	(148.9)		(229.7)			
$\mathbb{I}(open\ NATO\ negotiations^{+})$				640.8***	1,021***	
				(112.4)	(216.4)	
$\mathbb{I}(open\ EU\ negotiations^{+})$				625.2***		1,045***
				(173.2)		(243.7)
Observations	588	588	588	588	588	588
Panel C. Dependent variable: Private investment to GDP ratio, percent						
$\mathbb{I}(NATO\ accession^{+})$	0.540	0.391				
	(0.667)	(0.524)				
$\mathbb{I}(EU\ accession^{+})$	–0.228		0.166			
	(0.802)		(0.624)			
$\mathbb{I}(open\ NATO\ negotiations^{+})$				0.0228	1.005**	
				(0.500)	(0.424)	
$\mathbb{I}(open\ EU\ negotiations^{+})$				1.613***		1.628***
				(0.539)		(0.380)
Observations	588	588	588	588	588	588

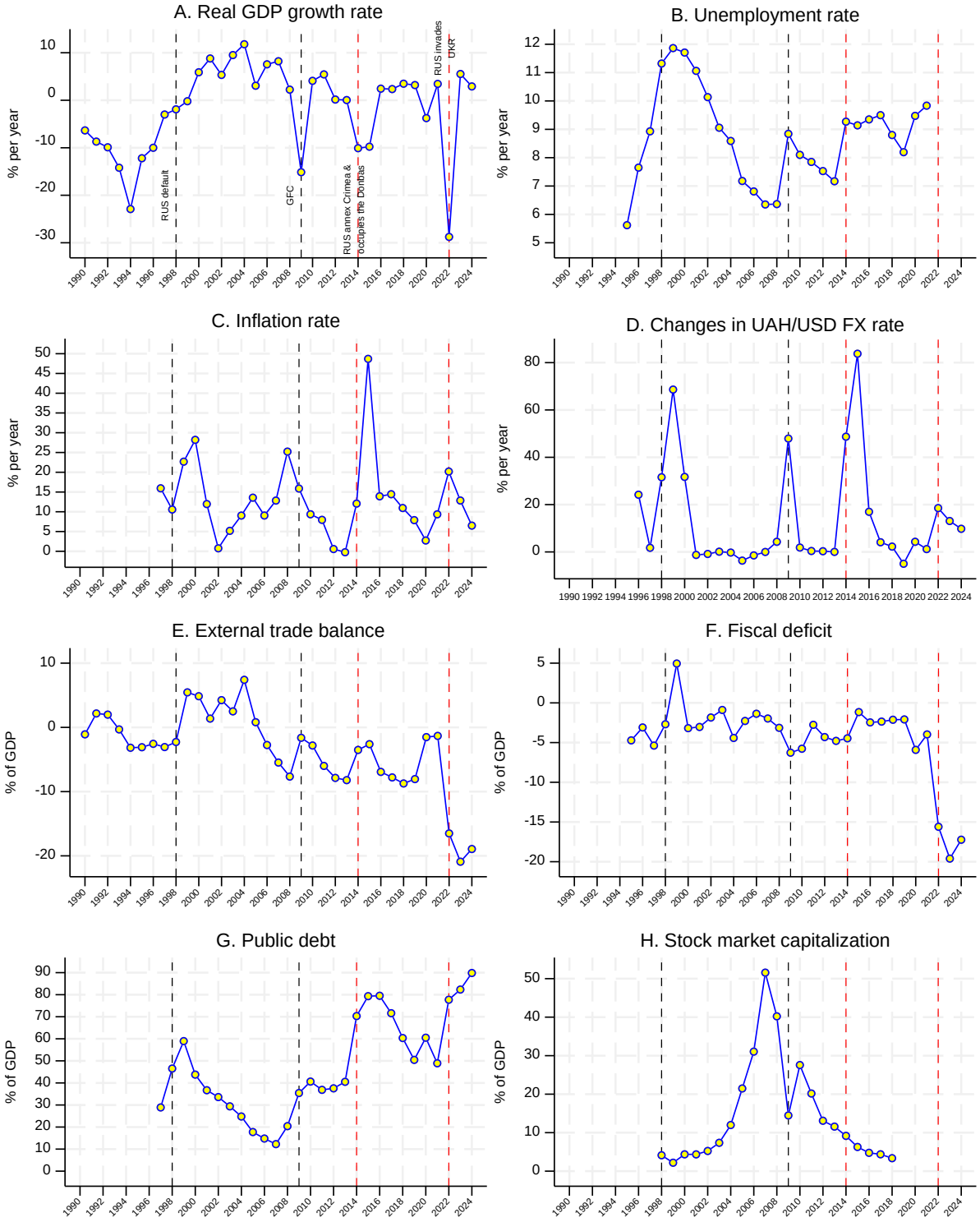
Notes: Country and year fixed effects are included but not reported. Driscoll and Kraay (1998) standard errors are in parentheses. ***,**, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively. + indicates post-event regime = 1.
Source: Authors' calculations.

Figure 1. GDP per capita since the collapse of the Soviet bloc, 1990-2019



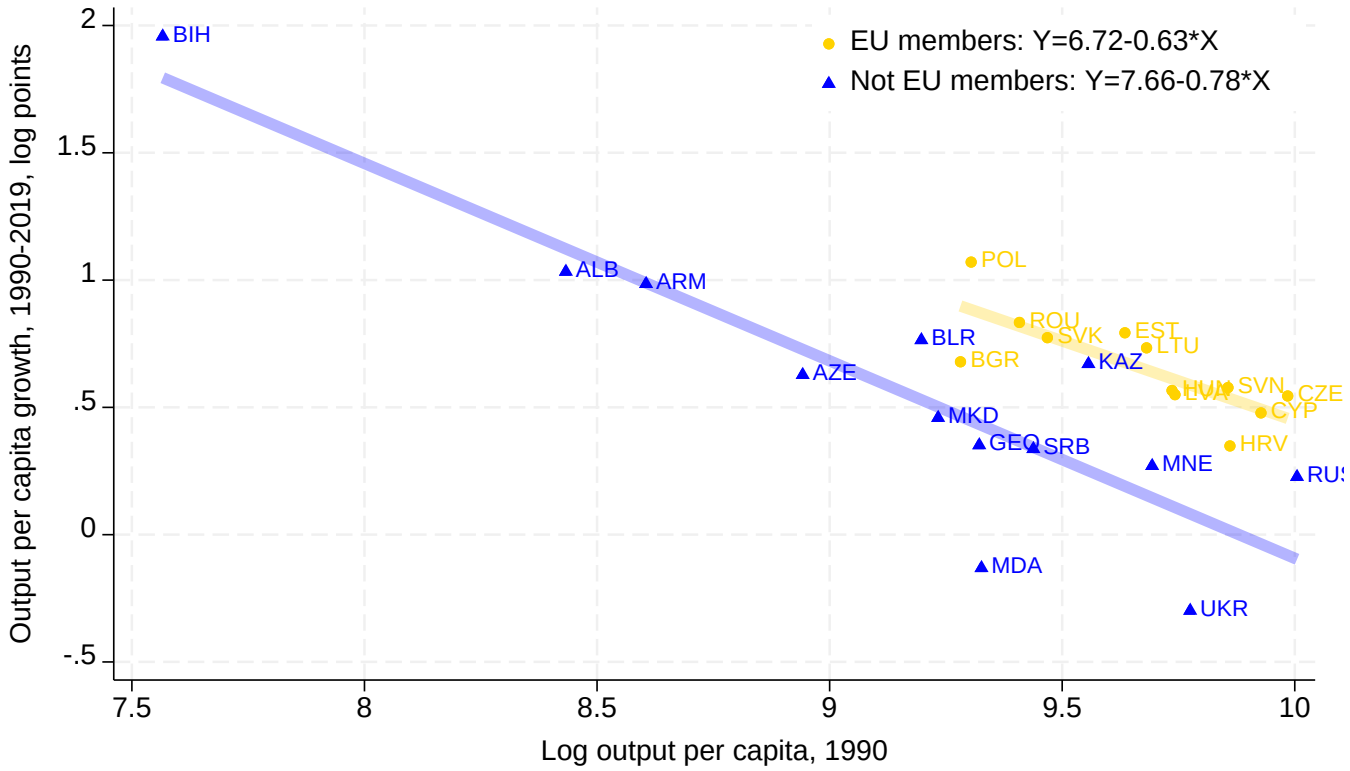
PPP = purchasing power parity
Source: Penn World Table.

Figure 2. Ukraine's macroeconomic indicators, 1990-2024



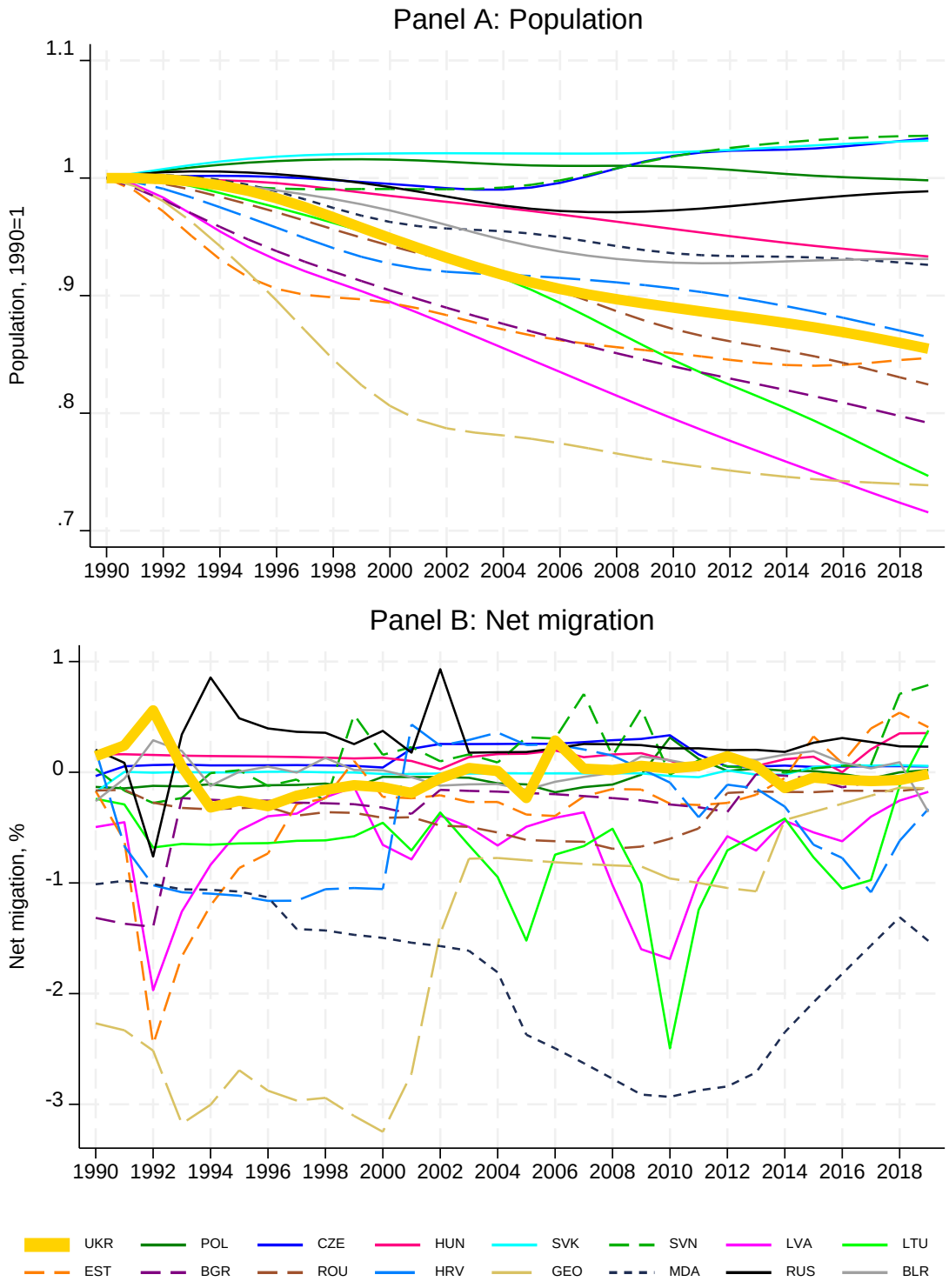
Sources: World Bank, International Monetary Fund, Penn World Table, Beck et al. (2000), Kose et al. (2022), National Bank of Ukraine, Ukraine State Statistics Service, and International Labor Organization.

Figure 3. Convergence in output per capita



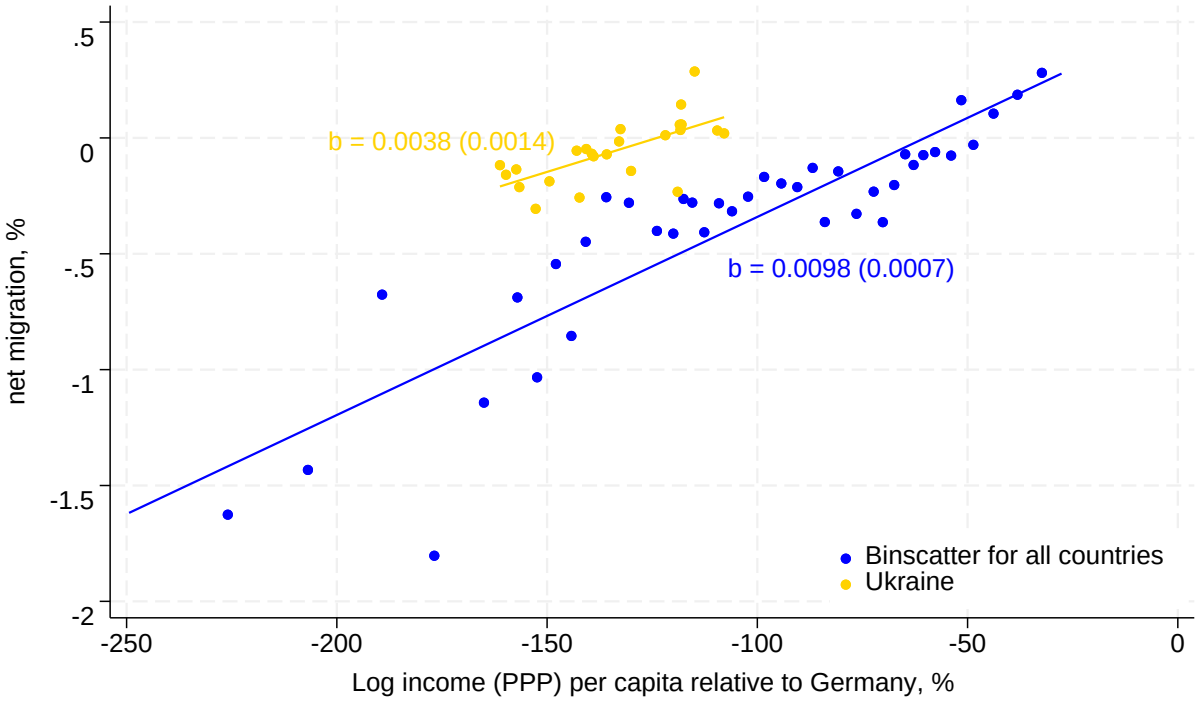
Note: Output per capita is measured in 2017 chained purchasing power parity (PPP) US dollars.
Source: Penn World Table.

Figure 4. Population and net migration, 1990-2019



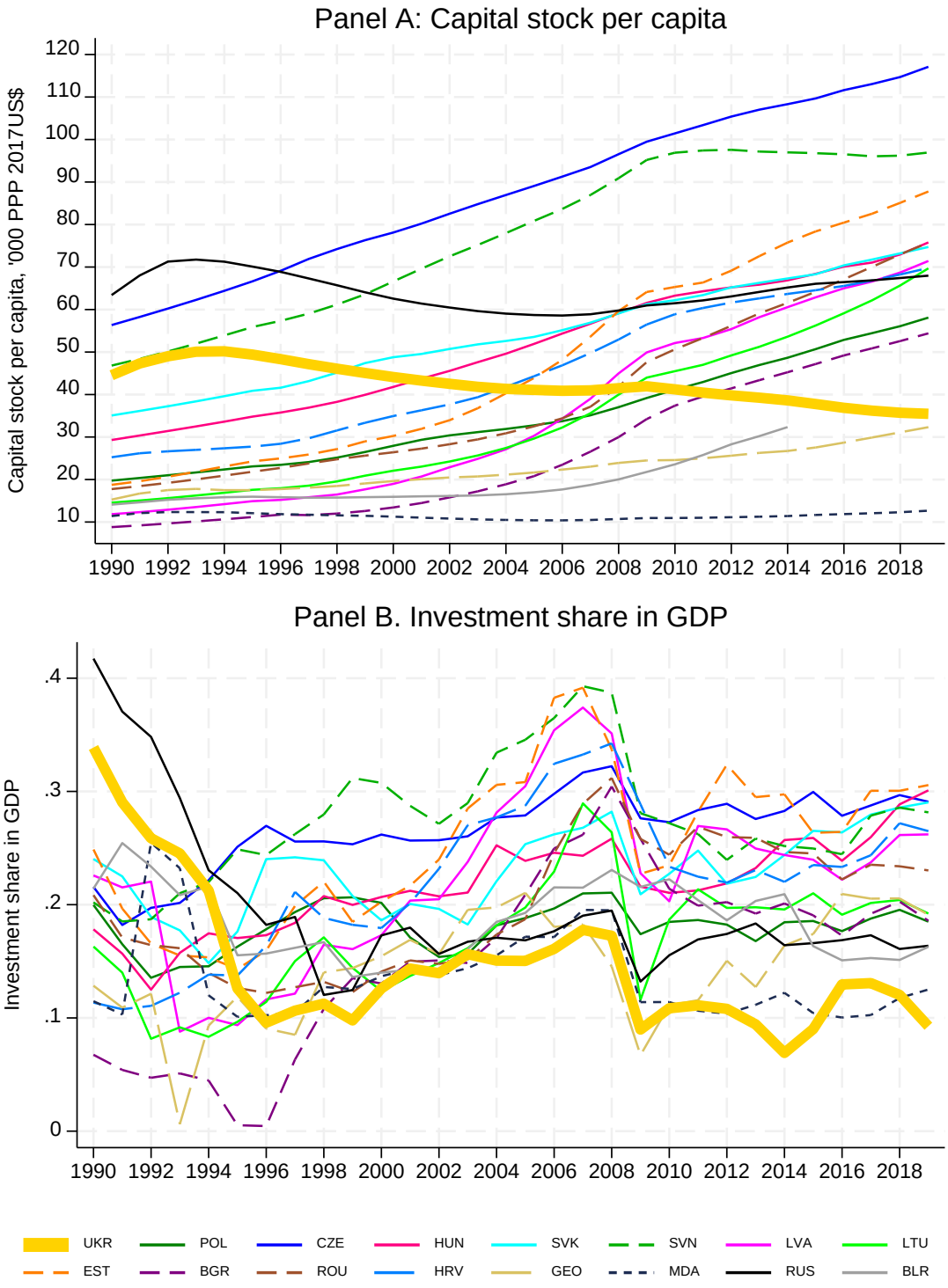
Sources: World Bank, Penn World Table, and authors' calculations.

Figure 5. Net migration vs. income per capita



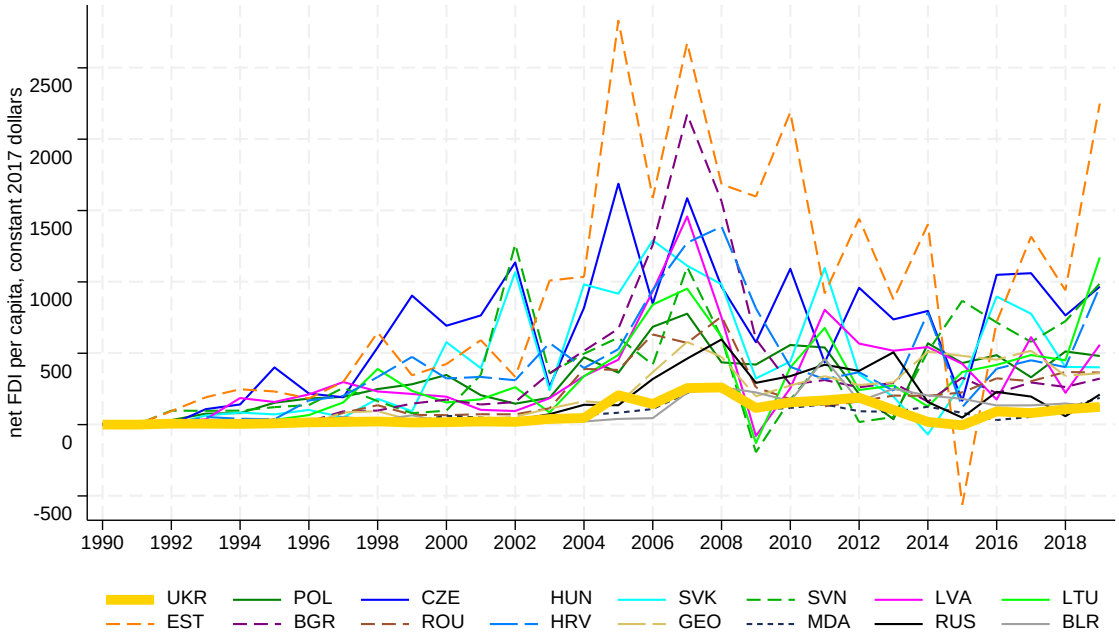
PPP = purchasing power parity
Notes: Binscatter plot after controlling for year fixed effects. Former Soviet bloc and Yugoslavia. Sample period: 1995–2019. Standard errors for estimated slope coefficients are reported in parentheses.
Source: Penn World Table.

Figure 6. Capital stock and investment share, 1990-2019



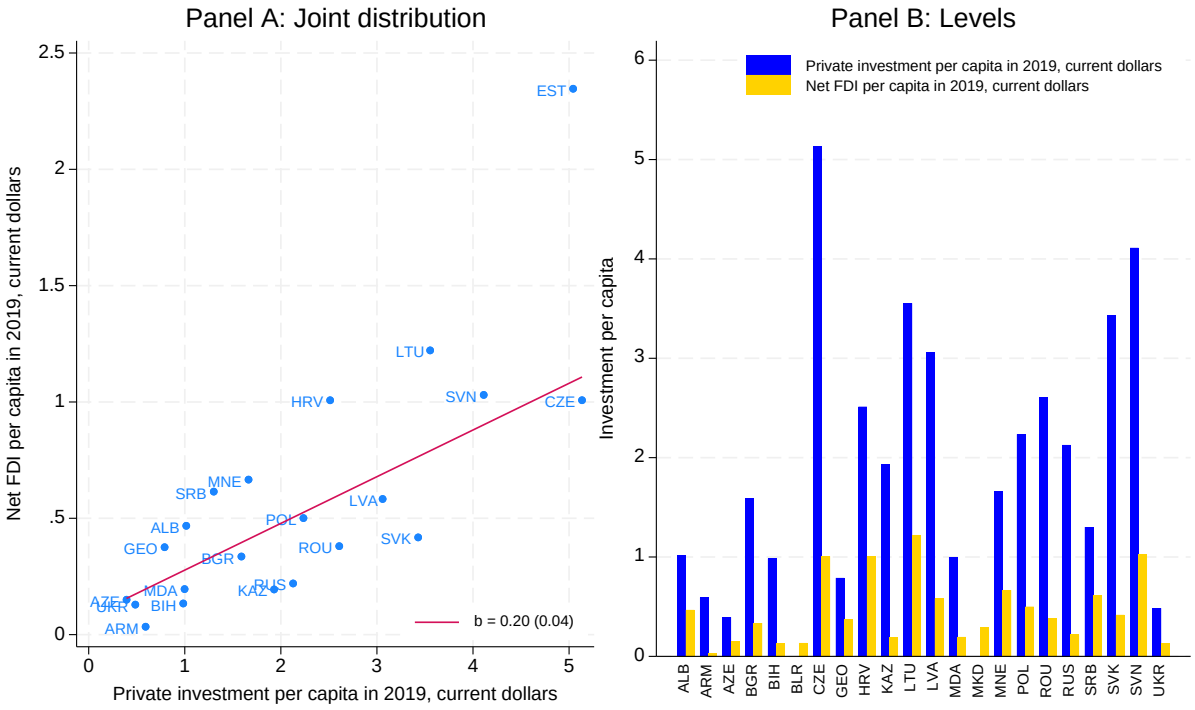
PPP = purchasing power parity
Sources: International Monetary Fund, Penn World Table.

Figure 7. Net FDI flows, 1990-2019



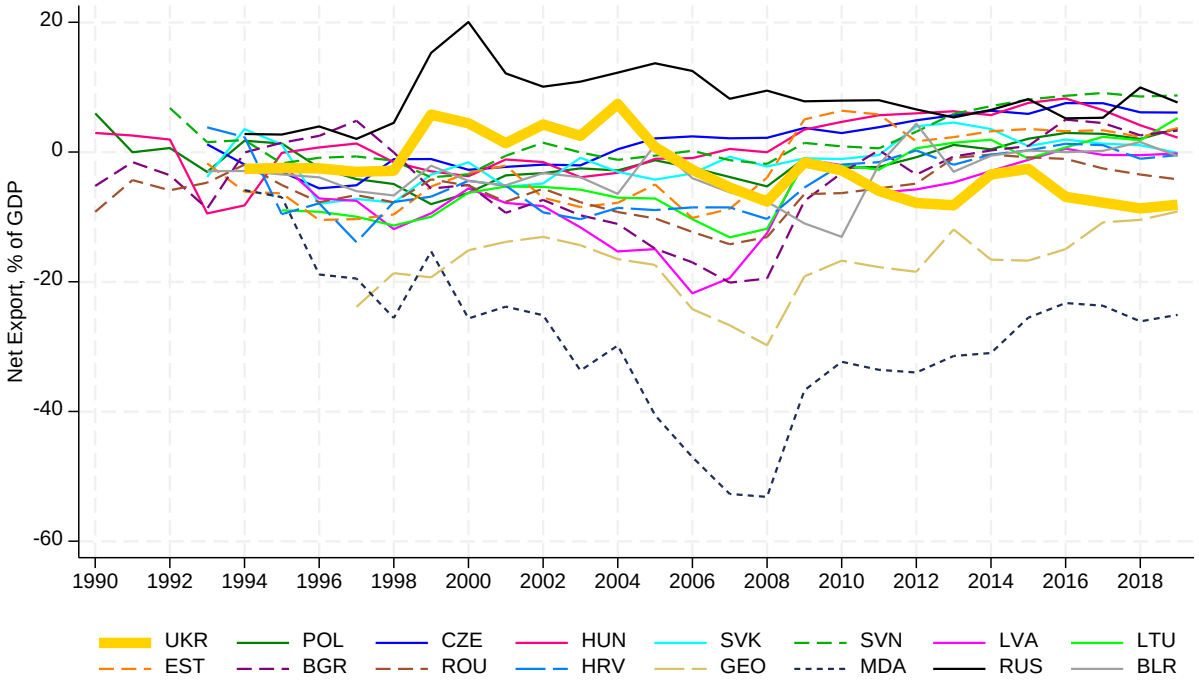
Source: World Bank.

Figure 8. Net FDI and private investment per capita, 2019



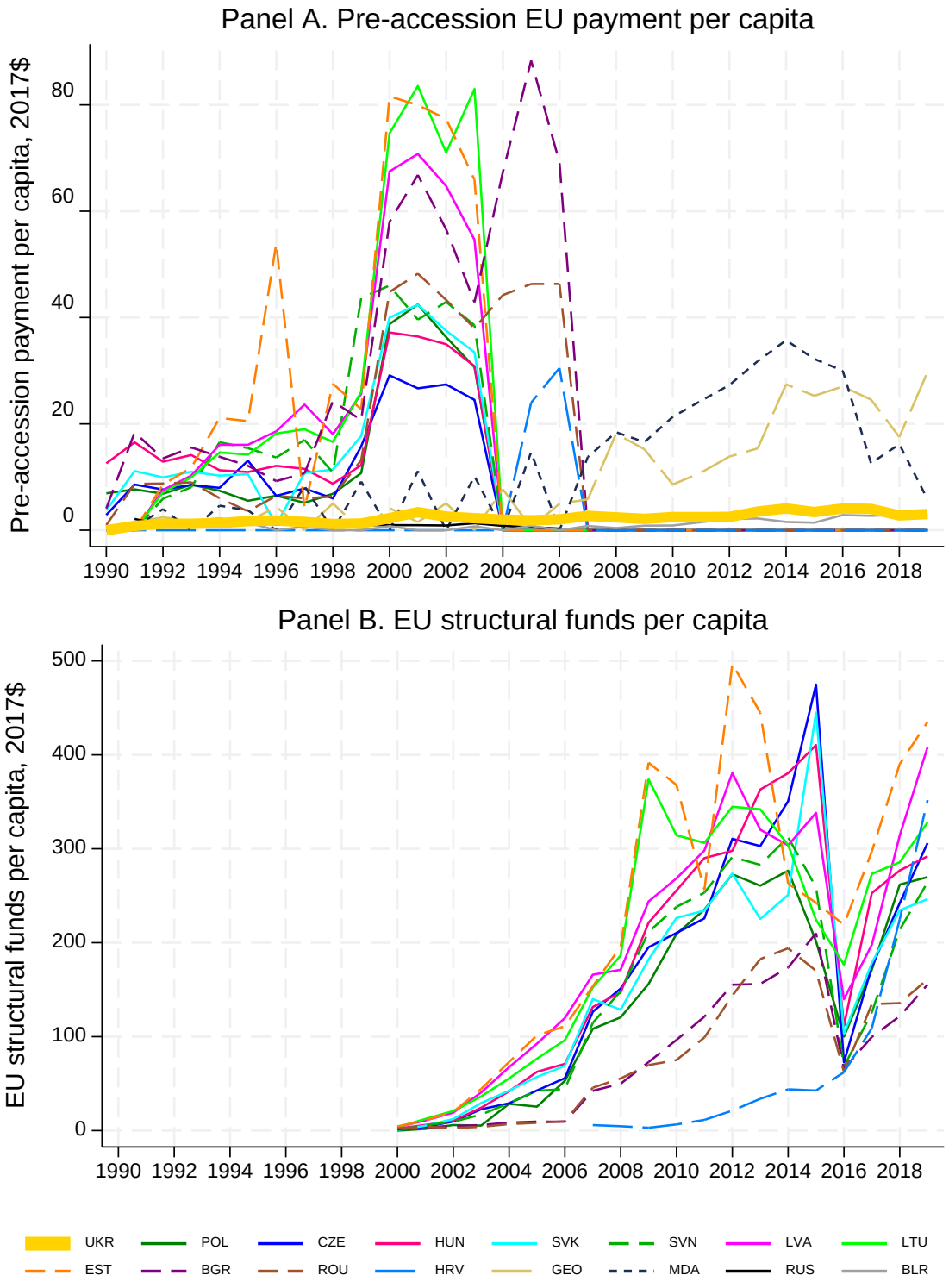
FDI = foreign direct investment
Sources: World Bank, International Monetary Fund.

Figure 9. Net exports of goods and services, 1990-2019



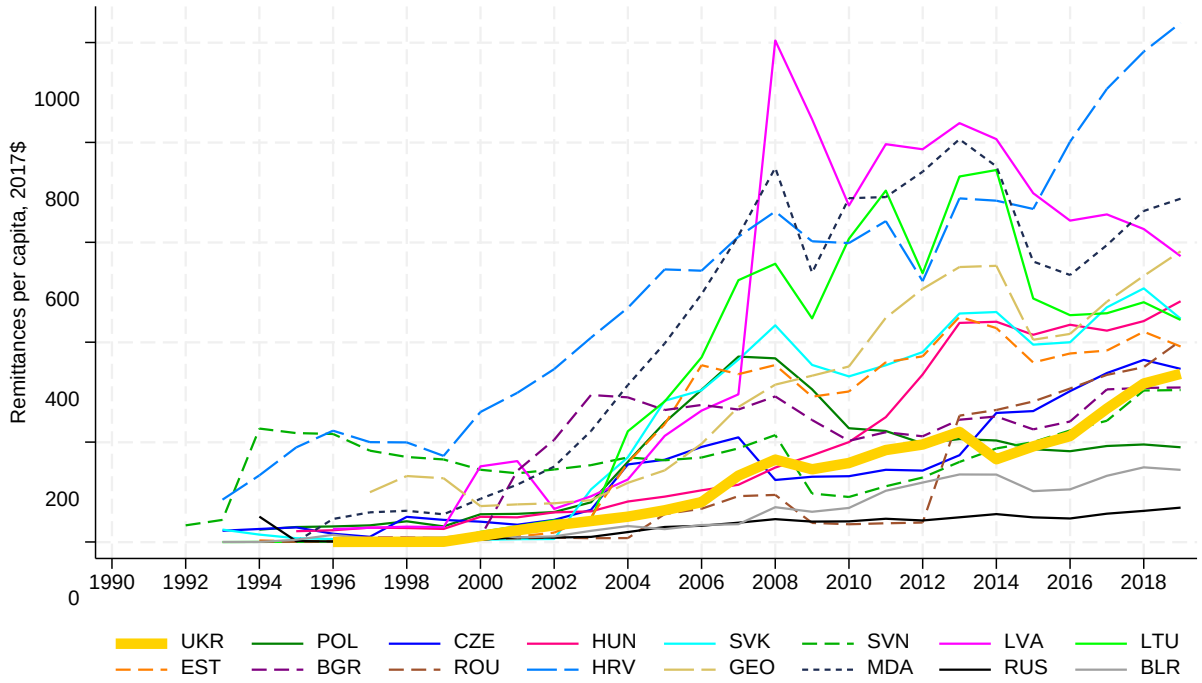
Source: World Bank.

Figure 10. Official EU flows to Eastern European countries, 1990-2019



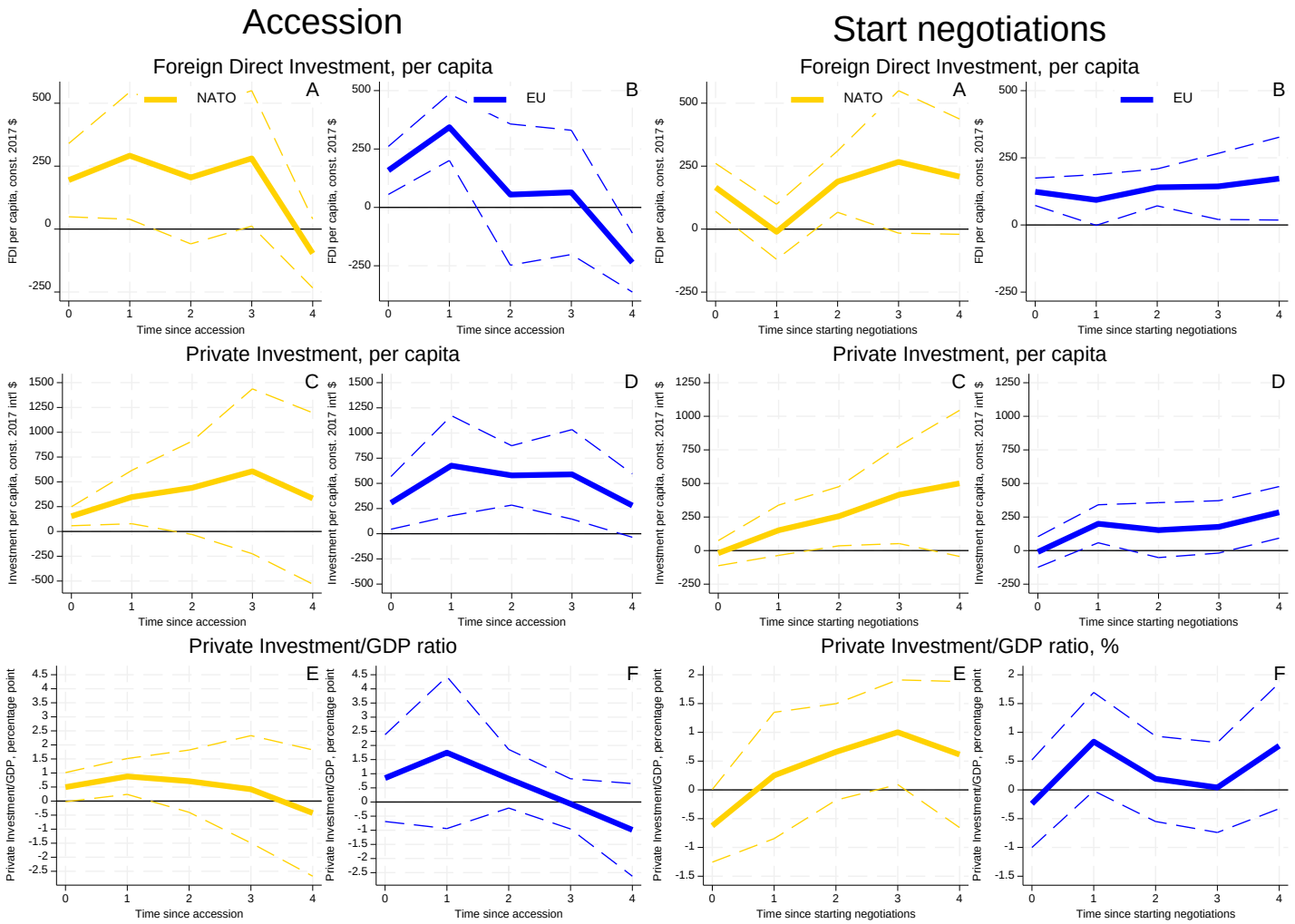
Sources: European Commission, Eurostat, World Bank.

Figure 11. Personal remittances received per capita, 1992-2019



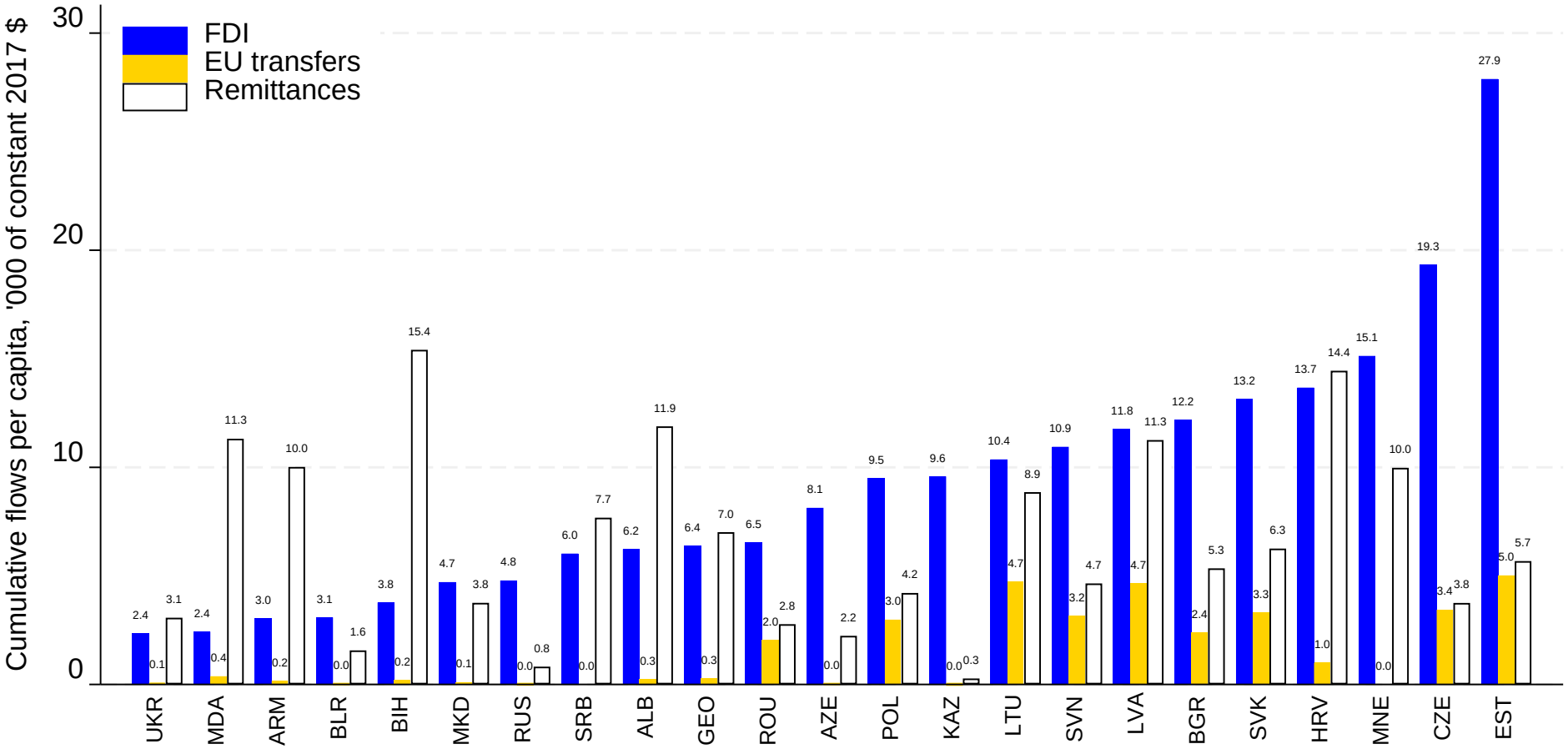
Source: World Bank.

Figure 12. Response of investment to EU/NATO membership



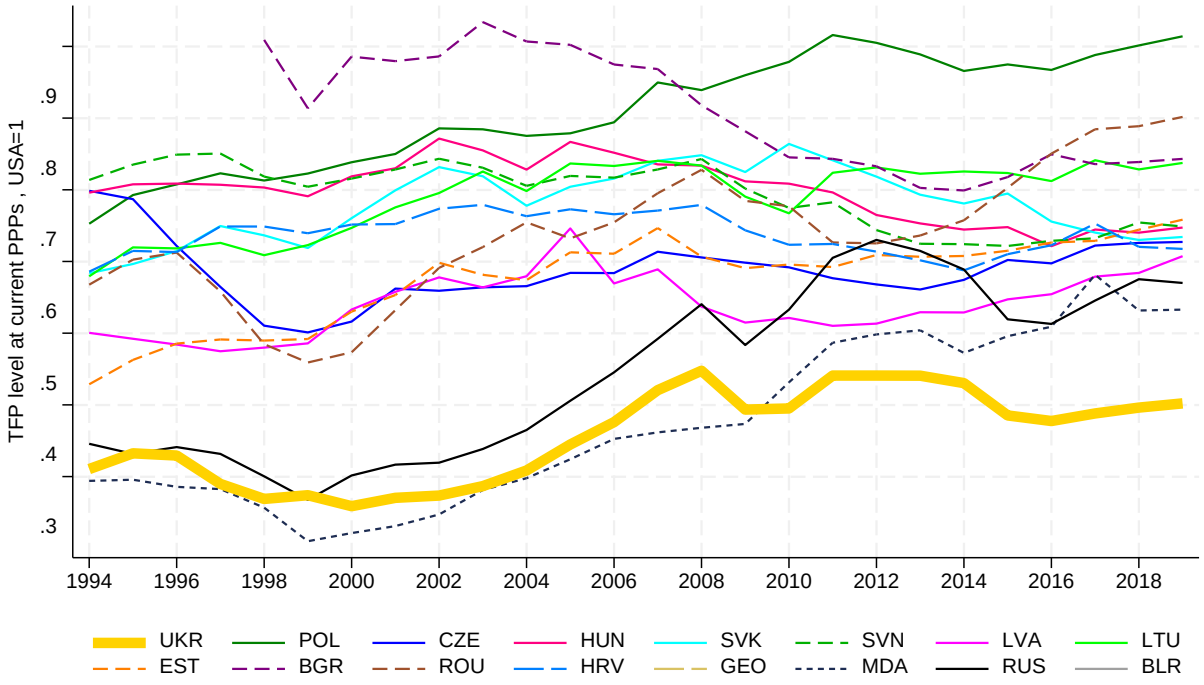
Note: The figure plots impulse responses (dashed line are 90 percent confidence intervals) estimated using equation (4.2).
Source: Authors' calculations.

Figure 13. Cumulative international capital flows, 1990–2019



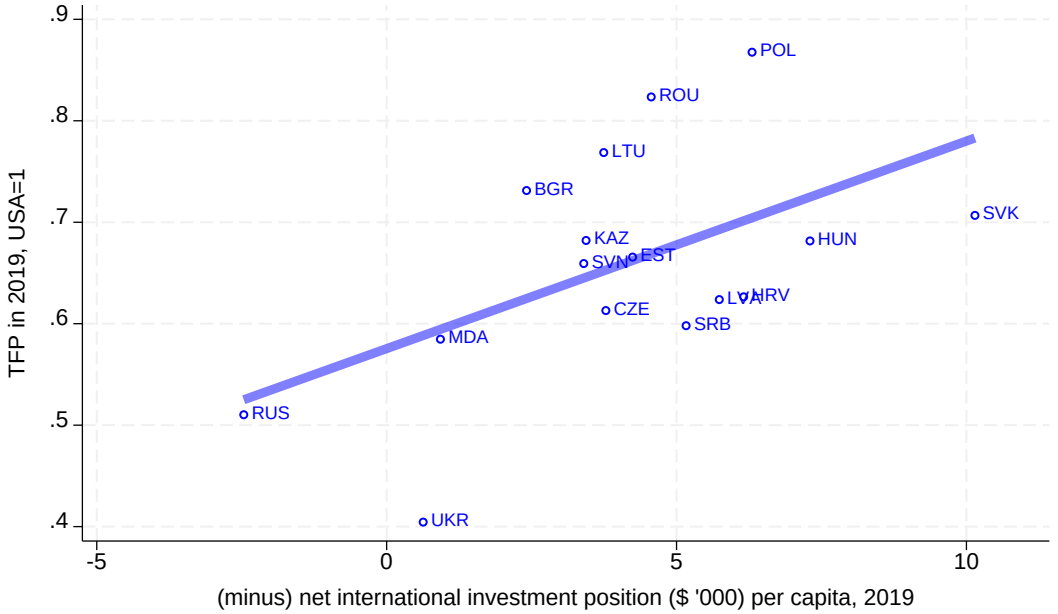
Sources: World Bank, European Commission, Eurostat, International Monetary Fund.

Figure 14. Productivity, 1994-2019



Source: Penn World Table.

Figure 15. Net international investment position and productivity, 2019



Sources: World Bank, International Monetary Fund, Penn World Table.

Figure 16. Planner and market consumption paths

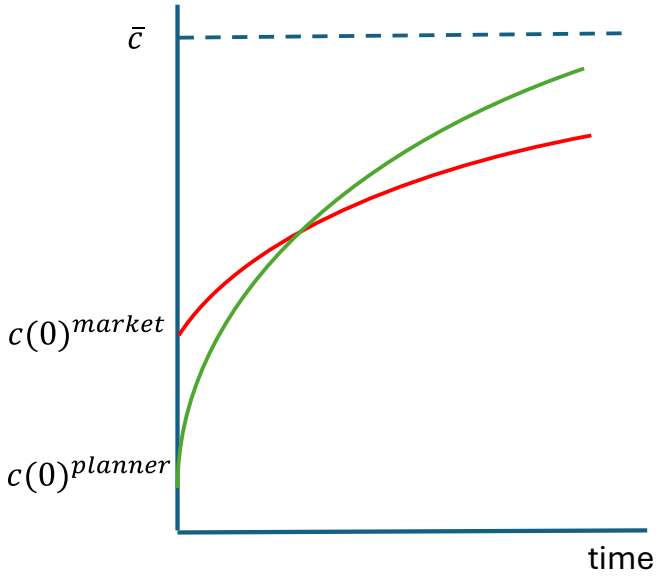
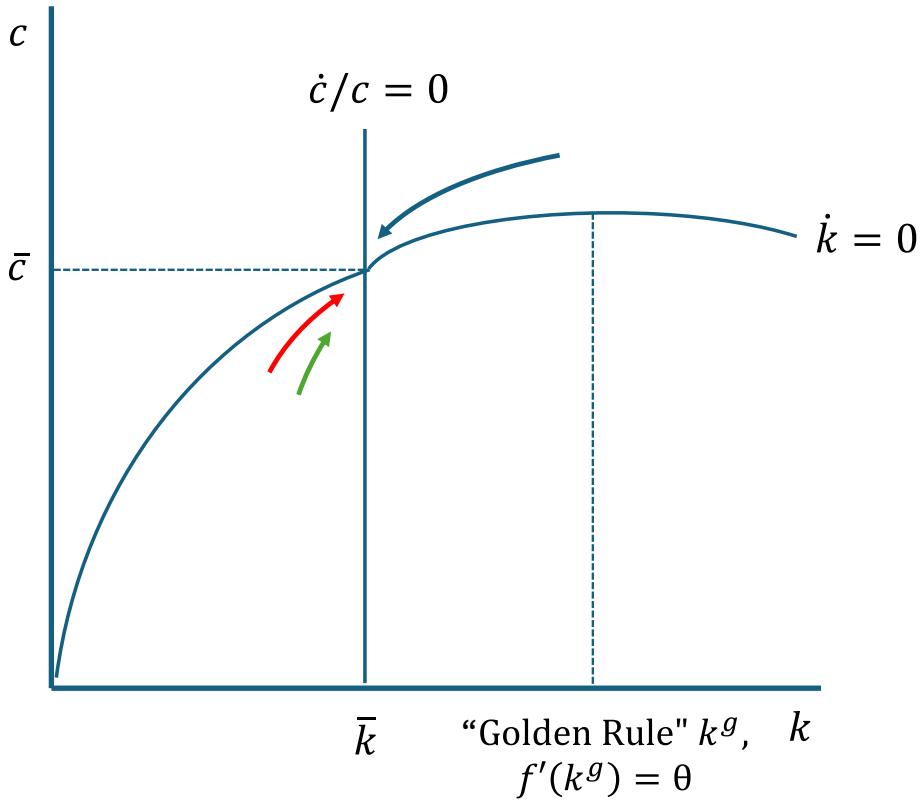


Figure 17. Optimum and market convergence with constrained capital inflows: Phase diagram



Note: The red arrow denotes the market solution. The green arrow denotes the planner solution.

Figure 18. Great expectations: Adjustment to a permanent expected increase in foreign aid

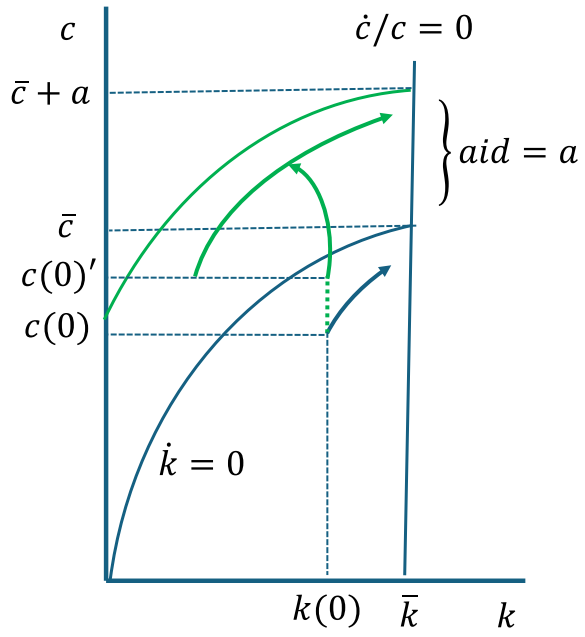


Figure 19. Dynamics of aggregate consumption and capital per worker when the government favors a larger economy

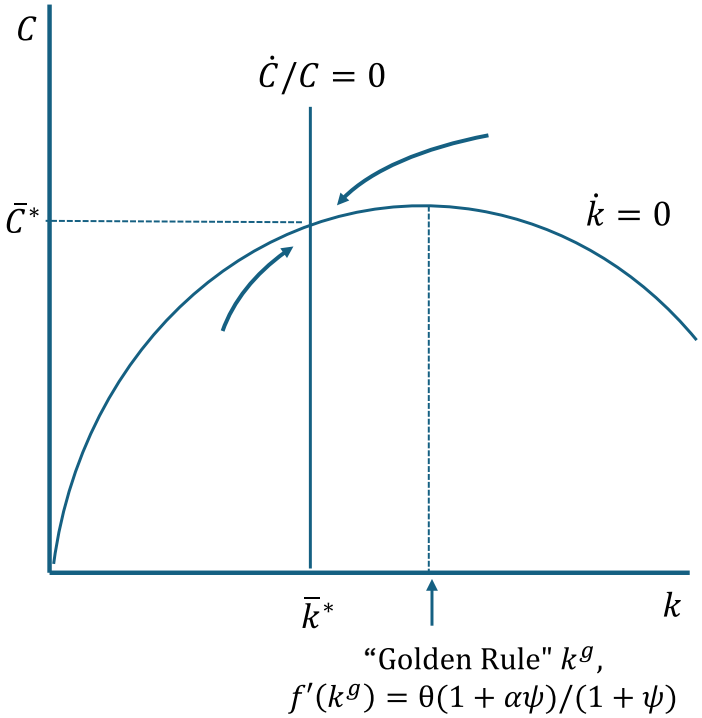
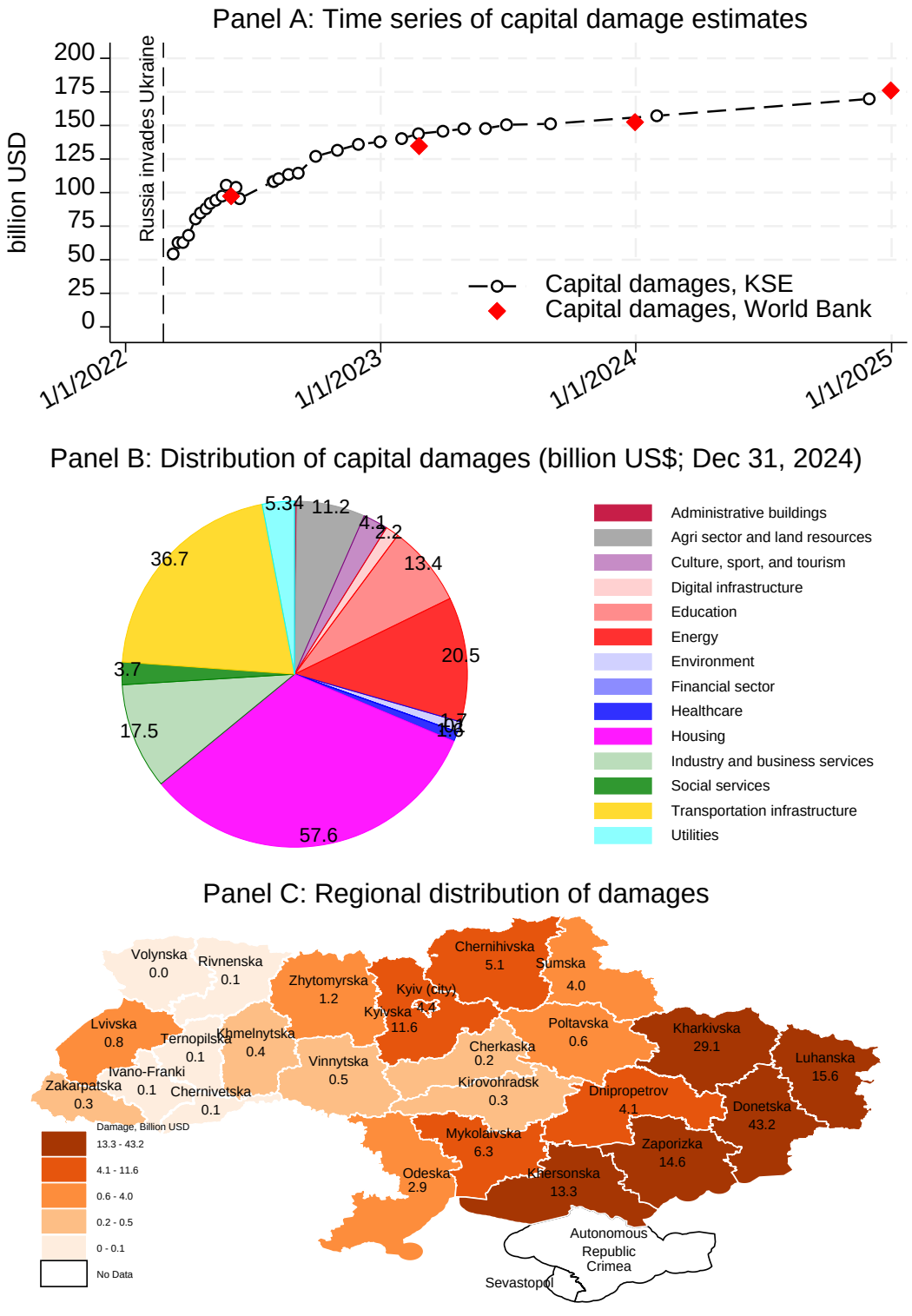
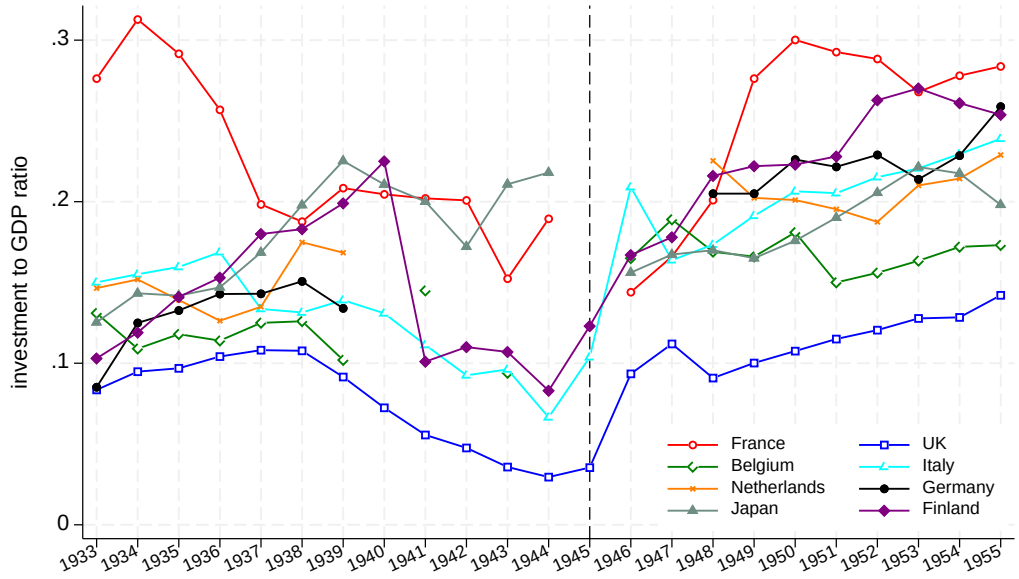


Figure 20. Capital damage



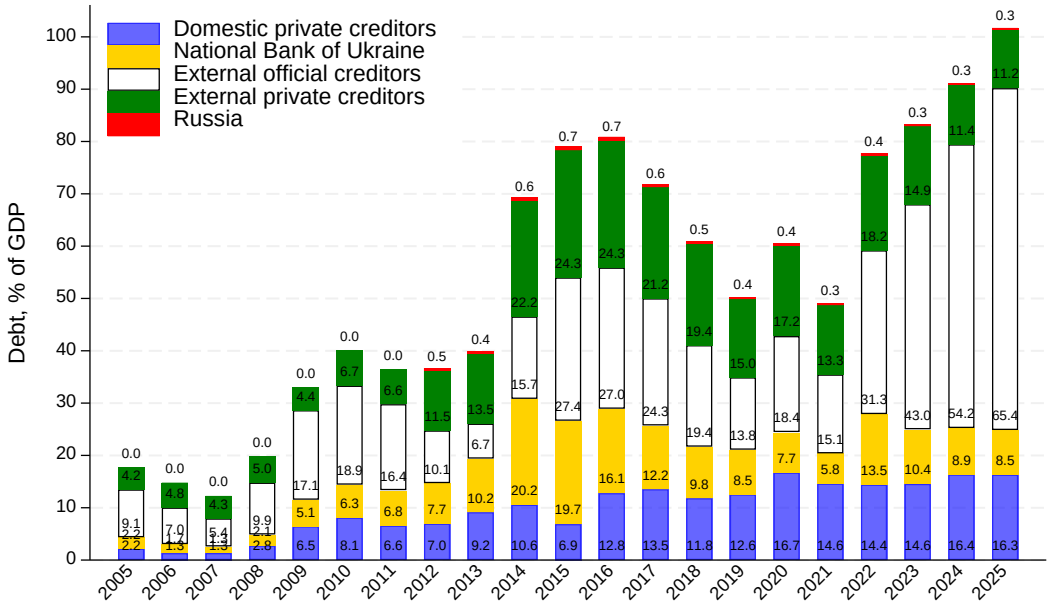
Sources: World Bank, Kyiv School of Economics.

Figure 21. Investment rates after World War II, 1933-1955



Source: Jordà-Schularick-Taylor Macrohistory Database, https://www.macrohistory.net/database/.

Figure 22. Ukraine government's debt and its holders, 2005-2025



Sources: Ministry of Finance of Ukraine, https://mof.gov.ua/en/derzhavnij-borg-ta-garantovanij-derzhavju-borg (accessed November 13, 2025) (2025 numbers are for September 30, 2025); National Bank of Ukraine, https://bank.gov.ua/en/markets/t-bills (accessed November 13, 2025) (2025 NBU holdings of Treasury securities are for September 30, 2025); and State Statistics Service of Ukraine, https://ukrstat.gov.ua (accessed November 13, 2025) (2025 GDP estimate is the average of the first two quarters, converted to an annual rate).

APPENDIX

Derivations

This appendix shows the derivation of socially optimal policies in the three growth models.

Ramsey-Cass-Koopmans Model with Constrained Foreign Borrowing

To analyze the planner solution, we form the Hamiltonian

$$H(c,k,\lambda) = u(c) + \nu\left\{\frac{Ak^{\alpha} - c - (\gamma r^{*} + \theta)k}{1-\gamma}\right\}$$

and derive the necessary optimality conditions

$$c^{-1/\sigma} - \frac{\nu}{1-\gamma} = 0, \qquad \text{(A1)}$$

$$\frac{\dot{\nu}}{\nu} = \delta - \frac{\alpha A k^{\alpha-1} - (\gamma r^{*} + \theta)}{1-\gamma}. \quad \text{(A2)}$$

Equation (5.4) in the text is derived by differentiating equation (A1) and using the result to eliminate $\dot{\nu}/\nu$ in equation (A2).

Effect of a Looser Collateral Constraint in the Ramsey-Cass-Koopmans Model

A version of the model linearized near its steady state provides some insight into the consumption effects of a higher fraction of collateralizable capital, γ. We take the market allocation as an example, but the dynamics for the planner allocation are qualitatively similar. The example assumes $r^{*} = \delta$.

Taking first-order approximations to equations (5) and (7) gives the system:

$$\begin{bmatrix}\dot{c}\\ \dot{k}\end{bmatrix} \approx \begin{bmatrix}0 & -\sigma(1-\alpha)(\theta+\delta)\left(\bar{c}/\bar{k}\right)\\ -1/(1-\gamma) & \delta\end{bmatrix}\begin{bmatrix}c-\bar{c}\\ k-\bar{k}\end{bmatrix}.$$

The characteristic roots of this system are

$$\lambda_1, \lambda_2 = \frac{\delta \pm \sqrt{\delta^2 + \frac{4\sigma(1-\alpha)(\theta+\delta)\left(\frac{\bar{c}}{\bar{k}}\right)}{1-\gamma}}}{2},$$

where $\lambda_1 > 0, \lambda_2 < 0$. The linear approximation to the stable adjustment path near the steady state therefore is:

$$c(t) - \bar{c} = (1-\gamma)(\delta - \lambda_2)\left[k(t) - \bar{k}\right].$$

To see the effect of a rise in γ on c, differentiate the preceding equation:

$$\frac{dc(t)}{d\gamma} = -\delta\bar{k} - \left[(\delta - \lambda_2) - (1-\gamma)\frac{d\lambda_2}{d\gamma}\right]\left[k(t) - \bar{k}\right] + (1-\gamma)(\delta - \lambda_2)k(t).$$

The first (negative) term above reflects the fall in steady-state consumption, whereas the next (positive) term reflects the flattening of the stable adjustment path and the last (positive) term reflects the immediate increase in borrowing that the rise in γ permits. It is evident that the lower the capital stock relative to its steady state level, the more likely is the preceding derivative to be positive.

Uzawa-Lucas Model of Endogenous TFP Growth with Constrained Foreign Borrowing

Necessary conditions to solve the planner's maximization problem come from the Hamiltonian

$$H(c,u,k,h,\nu,\mu) = u(c) + \nu\left\{\frac{y - c - (\gamma r^* + \theta)k}{1-\gamma}\right\} + \mu\{B(1-u)h - \theta h\}$$

in the form

$$\frac{\partial H}{\partial c} = 0,$$
$$\frac{\partial H}{\partial u} = 0,$$
$$\dot{\nu} = \delta\nu - \frac{\partial H}{\partial k},$$
$$\dot{\mu} = \delta\mu - \frac{\partial H}{\partial h}.$$

along with equations (5.3) and (5.10).

Define the ratio $\omega \equiv k/h$. The preceding necessary conditions can then be written:

$$u'(c) - \frac{\nu}{1-\gamma} = 0, \qquad \text{(A3)}$$
$$\frac{\nu(1-\alpha)}{1-\gamma} A\omega^{\alpha}u^{-\alpha} - \mu B = 0, \qquad \text{(A4)}$$
$$\frac{\dot{\nu}}{\nu} = \delta - \frac{\alpha A u^{1-\alpha}\omega^{-(1-\alpha)} - \gamma r^* - \theta}{1-\gamma}, \text{(A5)}$$
$$\frac{\dot{\mu}}{\mu} = \delta - \frac{\nu}{\mu}\left[\frac{(1-\alpha)Au^{1-\alpha}\omega^{\alpha}}{1-\gamma}\right] - [B(1-u) - \theta]. \text{(A6)}$$

If we solve equation (A4) for the ratio

$$\frac{\nu}{\mu} = \left(\frac{1-\gamma}{1-\alpha}\right)\frac{B}{A\omega^{\alpha}u^{-\alpha}}, \qquad \text{(A7)}$$

we can then write condition (A6) much more simply as

$$\frac{\dot{\mu}}{\mu} = \delta + \theta - B. \text{ (A8)}$$

To derive equation (5.14) in the text, notice that (A7) implies that

$$\frac{\dot{\nu}}{\nu} - \frac{\dot{\mu}}{\mu} = \alpha\frac{\dot{u}}{u} - \alpha\frac{\dot{\omega}}{\omega}.$$

Equations (A5), (A6), and (5.13) then lead to equation (5.14).

As noted in the main text, the *market equilibrium* of the model is derived by maximizing (1) subject to (6) and (10), taking $h(0)$ as given along with $k(0) = (1+\gamma)k^a(0)$, $b(0) = \gamma k^a(0)$, and the path of external credit availability. The Hamiltonian for the market problem posits multipliers ν and μ on the dynamic constraints for k and h, respectively, such that

$$\begin{aligned} u'(c) - \nu &= 0, \\ \nu(1-\alpha)A\omega^{\alpha}u^{-\alpha} - \mu B &= 0, \\ \frac{\dot{\nu}}{\nu} &= \delta + \theta - \alpha A u^{1-\alpha}\omega^{-(1-\alpha)}, \\ \frac{\dot{\mu}}{\mu} &= \delta - \frac{\nu}{\mu}(1-\alpha)Au^{1-\alpha}\omega^{\alpha} - [B(1-u) - \theta] \end{aligned}$$

at the private optimum. The analogues of equations (5.12) through (5.14) are:

$$\begin{aligned} \frac{\dot{\chi}}{\chi} &= \frac{[(1-\gamma)\sigma\alpha - 1]z + \chi + \gamma r^* + [1-(1-\gamma)\sigma]\theta}{1-\gamma} - \sigma\delta, \\ \frac{\dot{\omega}}{\omega} &= \frac{z - \chi - \gamma r^* - \theta}{1-\gamma} - B(1-u) + \theta, \\ \frac{\dot{u}}{u} &= \frac{\gamma z}{1+\gamma} + Bu - \frac{\chi}{1-\gamma} + \left(\frac{1-\alpha}{\alpha}\right)B - \frac{\gamma}{(1-\gamma)}(r^* + \theta). \end{aligned}$$

Recalling

$$\frac{\dot{z}}{z} = (1-\alpha)\left(\frac{\dot{u}}{u} - \frac{\dot{\omega}}{\omega}\right),$$

we see that the preceding equations imply

$$\frac{\dot{z}}{z} = (1-\alpha)\left(\frac{B}{\alpha} - z\right),$$

giving the steady-state marginal product of capital $\alpha\bar{z} = B$, the steady-state growth rate $\sigma(B - \theta - \delta)$, and the steady-state real interest rate $\sigma(B - \theta)$.

Model with Labor Repatriation

To understand the solution to the government's maximization problem, we form the Hamiltonian

$$H(C,K,L,\lambda,\mu) = \left[\frac{C(t)^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}}\right] + \lambda(AK^{\alpha}L^{1-\alpha} - C - \theta K) + \mu\left(\frac{\alpha\psi}{1+\alpha\psi}\right)\left(\frac{L}{K}\right)(AK^{\alpha}L^{1-\alpha} - C - \theta K)$$

with $K(0)$ and $L(0)$ predetermined state variables. This can be simplified to:

$$H(C,K,L,\lambda,\mu) = \left[\frac{C(t)^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}}\right] + \left[\lambda + \mu\left(\frac{\alpha\psi}{1+\alpha\psi}\right)\left(\frac{L}{K}\right)\right](AK^{\alpha}L^{1-\alpha} - C - \theta K).$$

The necessary conditions for an optimum are:

$$\frac{\partial H}{\partial C} = C(t)^{-\frac{1}{\sigma}} - \left[\lambda + \mu\left(\frac{\alpha\psi}{1+\alpha\psi}\right)\left(\frac{L}{K}\right)\right] = 0, \qquad \text{(A9)}$$

$$\dot{\lambda} = \delta\lambda - \frac{\partial H}{\partial K} = \delta\lambda - C(t)^{-\frac{1}{\sigma}}(\alpha K^{\alpha-1}L^{1-\alpha} - \theta) + \mu\left(\frac{\alpha\psi}{1+\alpha\psi}\right)\left(\frac{L}{K}\right)\frac{\dot{K}}{K}, \text{(A10)}$$

$$\dot{\mu} = \delta\mu - \frac{\partial H}{\partial L} = \delta\mu - C(t)^{-\frac{1}{\sigma}}(1-\alpha)AK^{\alpha}L^{-\alpha} - \mu\left(\frac{\alpha\psi}{1+\alpha\psi}\right)\frac{\dot{K}}{K}. \text{(A11)}$$

Differentiating equation (A9) with respect to time and using equations (A10) and (A11) to eliminate $\dot{\lambda}$ and $\dot{\mu}$ yields a social Euler equation for aggregate consumption (where $k = K/L$):

$$\frac{\dot{C}}{C} = \sigma\left\{\left[\alpha + (1-\alpha)\left(\frac{\alpha\psi}{1+\alpha\psi}\right)\right]Ak^{\alpha-1} - \theta - \delta\right\}. \text{(A12)}$$

Appendix Table 1. Timing of EU and NATO accession

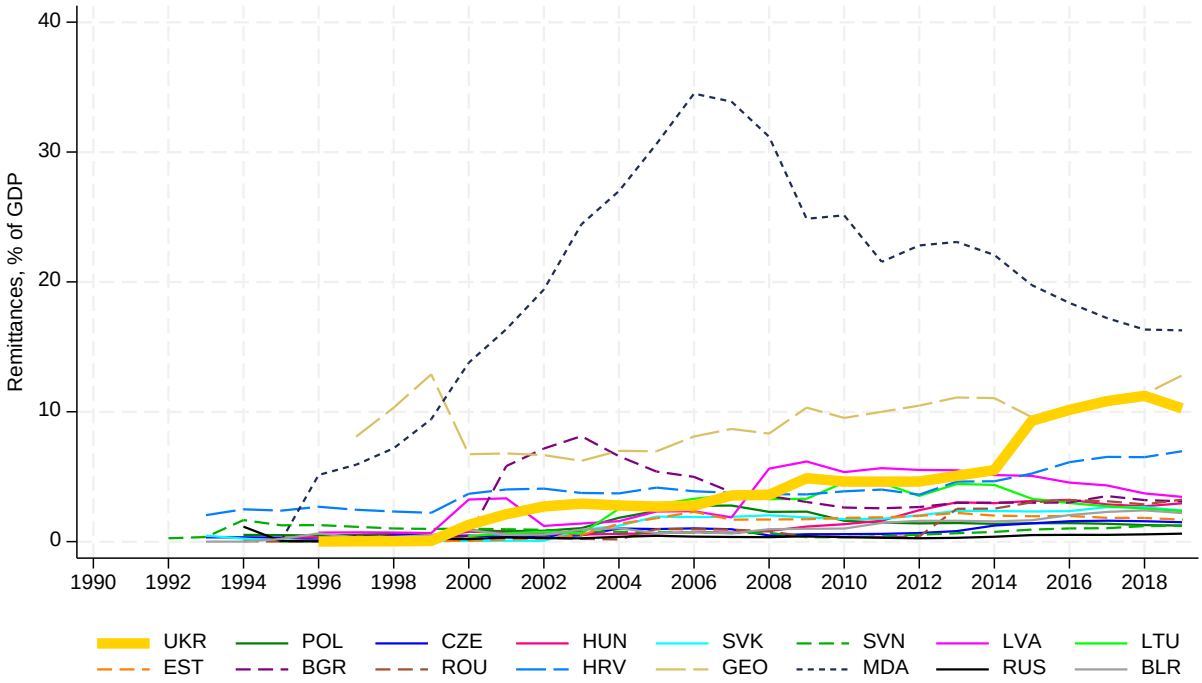
	European Union			NATO	
Country	Application	Start negotiations	Accession	Start negotiations	Accession
ALB	2009	2024		2008	2009
AZE					
BGR	1995	2000	2007	2002	2004
BIH	2016	2024			
BLR					
CYP	1990	1998	2004		
CZE	1996	1998	2004	1997	1999
EST	1995	1998	2004	2002	2004
GEO	2022				
HRV	2003	2005	2013	2008	2009
HUN	1994	1998	2004	1997	1999
KAZ					
LTU	1995	2000	2004	2002	2004
LVA	1995	2000	2004	2002	2004
MDA	2022	2024			
MKD	2004	2022		2019	2020
MNE	2008	2012		2015	2017
POL	1994	1998	2004	1997	1999
ROU	1995	2000	2007	2002	2004
RUS					
SRB	2009	2014			
SVK	1995	2000	2004	2002	2004
SVN	1996	1998	2004	2002	2004
UKR	**2022**				

Appendix Table 2. Debt treatment for post-conflict and transition countries (all amounts in millions of US dollars)

Country	War, Transition	Round	Paris club (bilateral or multilateral debt)							London club (privately held debt)								GDP at the time of treatment
			Debt relief	Treat year	Outstanding debt	Amount treated	Debt relief	Face value reduction		Debt relief	Treat year	Debt restructured	Preferred haircut HSZ	Underlying discount rate	Market haircut HM	Face value reduction		
Iraq	Invasion of Iraq	1	Yes	2005	37,158	37,158	29,727	80.0%		Yes	2006	17,710	89.40%	12.30%	89.40%	81.50%		65,147
Bosnia	Yugoslav war	1	Yes	1998		588	–	0%		Yes	1997	1,300	89.60%	13.10%	90.50%	69.20%		4,117
		2	Yes	2000		9	–	0%										5,568
Ethiopia	Badme Border	1	Yes	2001	1,900	432	130	30%										8,231
		2	Yes	2002		8	8	100%										7,851
		3	Yes	2004	1,899	1,487	1,296	87%										10,131
Sierra Leone	First Sierra Leone War of 1991–96	1	Yes	1996		39	–	0%										942
		2	Yes	2001	313	180	22	12%										1,681
		3	Yes	2002		3	3	100%										1,934
		4	Yes	2007	363	363	320	88%										3,633
DR Congo	Africa's World War of 1998–2002	1	Yes	2002	9,703	8,980	4,640	52%										8,728
Congo	Second Congo–Brazzaville War of 1998–99	1	Yes	2004	4,694	3,016	1,680	56%		Yes	2007	2,100	90.80%	11.80%	90.80%	76.20%		4,657
		2	Yes	2006		5,048	–	0%										8,072
		3	Yes	2008	3,354	961	806	84%										11,650
		4	Yes	2010	2,523	2,474	981	40%										13,148
Ukraine	Russia aggression 2014	1	No		1,437					Yes	2015	1,800				20%		133,504
Ukraine	Russia aggression 2022	1	No		9,231					Yes	2024	2,500		14%		37%		190,741
Mozambique	Mozambique War of 1981–92	1	Yes	2001	2,802	2,800	2,270	81%		Yes	1991	124	90.00%	none	90.00%	90.00%		5,650
Eritrea	Badme Border		No							No								8,242
Yugoslavia	Yugoslav war		No							No								256,395
Turkey	Turkey-PKK War of 1991–99		No							No								256,395
Iraq	Iran-Iraq war, 1980–88		No							No								62,684
Iran			No							No								123,057
Georgia	Russian invasion 2008		No							No								12,795
Croatia	Yugoslav war	1	Yes	1995		861	–	0%		Yes	1996	858	11.00%	12.30%	19.70%	0.00%		22,772
Nicaragua	Contra War of 1982–88	1	Yes	2002	1,638	580	406	70%		Yes	1995	1,100	92%	none	92%	92%		5,224
		2	Yes	2004	1,579	1,579	1,338	85%		No								5,793
Sudan	Sudan War of 1983–2002	1	No							No								53,921
Poland	Transition	1	Yes	1981	61,541	2,200	–	0%		Yes	1982	1,957	40.6%	33.4%	40.6%	0.0%		56,017
		2	Yes	1985	61,541	11,570	–	0%		Yes	1982	2,225	62.9%	39.2%	62.9%	0.0%		73,333
		3	Yes	1987	61,541	8,500	–	0%		Yes	1983	1,192	52.5%	33.4%	52.5%	0.0%		66,018
		4	Yes	1990	61,541	9,400	–	0%		Yes	1984	1,390	26.9%	27.9%	38.9%	0.0%		65,978
		5	Yes	1991	61,541	29,871	–	0%		Yes	1986	1,970	37.5%	23.4%	41.5%	0.0%		85,501
		6	No							Yes	1988	8,441	24.4%	20.4%	38.4%	0.0%		68,963
		7	No							Yes	1989	206	12.0%	20.2%	14.2%	0.0%		67,237
		8	No							Yes	1994	13,531	49.0%	11.4%	52.7%	31.9%		111,370
Romania	Transition	1	Yes	1982		410	–	0%		Yes	1982	1,598	32.9%	23.7%	32.9%	0.0%		51,291
		2	Yes	1983		126	–	0%		Yes	1983	567	31.7%	25.2%	31.7%	0.0%		47,329
		3	No							Yes	1986	800	12.3%	13.0%	14.1%	0.0%		52,290
Albania	Transition	1	Yes	1993		27	–	0%		Yes	1995	501	80.4%	15.9%	80.4%	54.8%		1,185
Bulgaria	Transition	1	Yes	1991		642	–	0%		Yes	1994	7,910	56.3%	12.9%	56.3%	31.1%		7,629
		2	Yes	1992		251	–	0%		No								8,603
		3	Yes	1994		200	–	0%		No								9,709
.Macedonia	Yugoslav war	1	Yes	1995		288	–	0%		Yes	1997	229	34.60%	14.10%	48.10%	0.00%		4,707

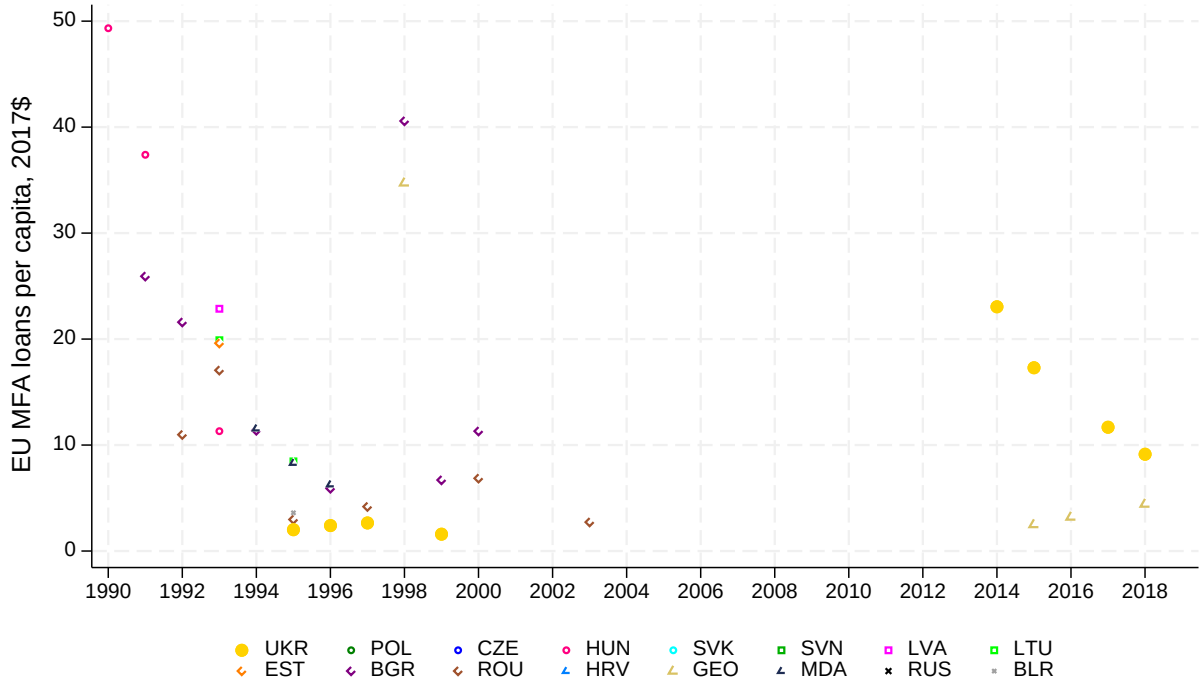
Source: Christoph Trebesch dataset, https://sites.google.com/site/christophtrebesch/data.

Appendix Figure 1. Personal remittances received, share of GDP, 1992-2019



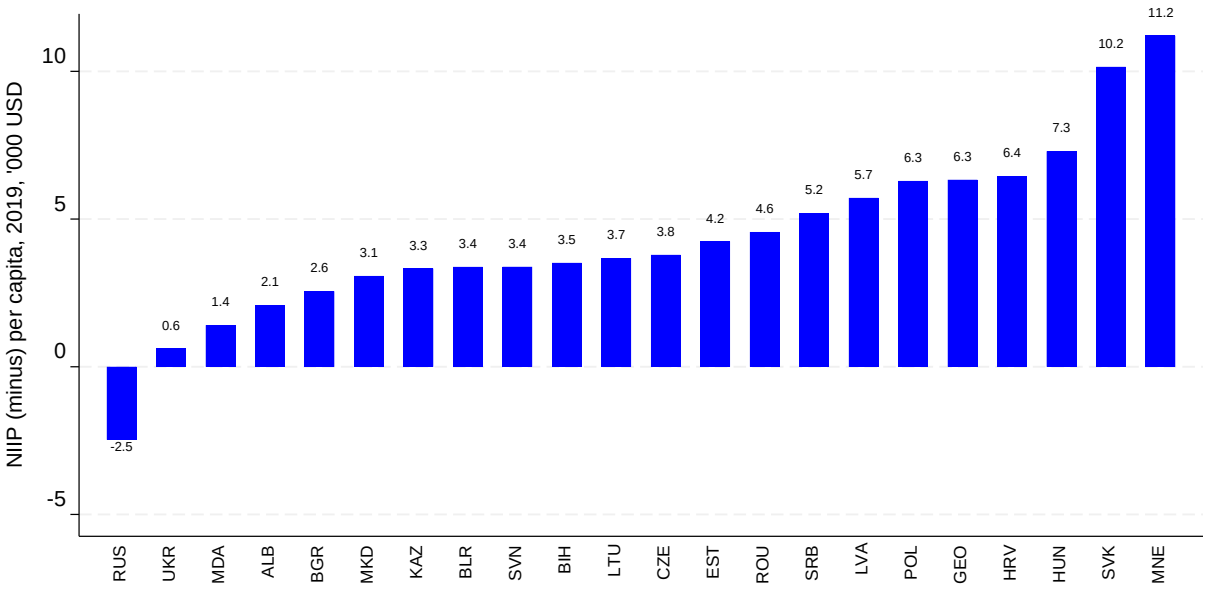
Sources: World Bank, International Monetary Fund.

Appendix Figure 2. Macrofinance loans from the European Union to Eastern European countries, 1990-2019



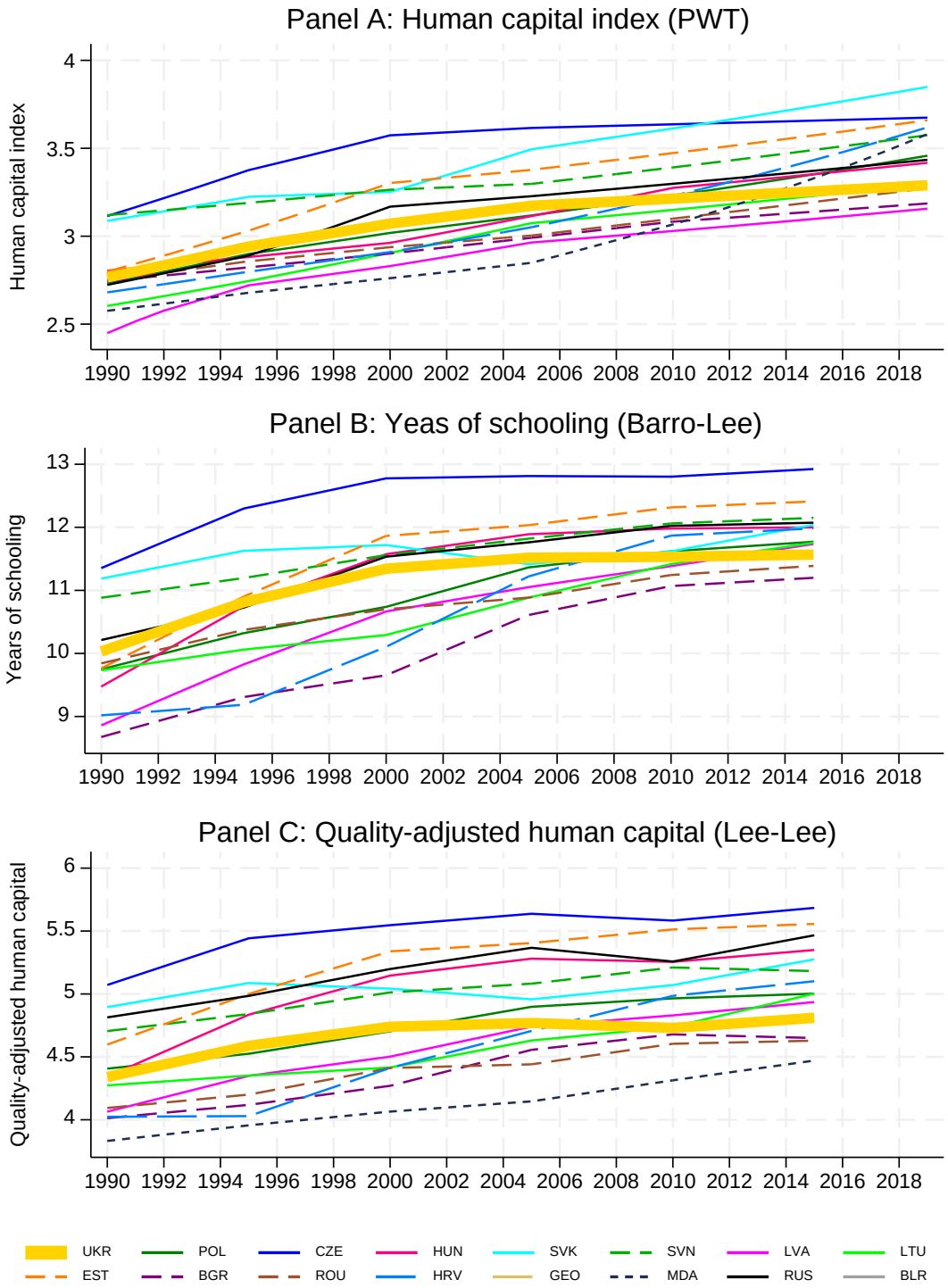
Sources: European Commission, Eurostat.

Appendix Figure 3. Net international investment position, per capita, 2019



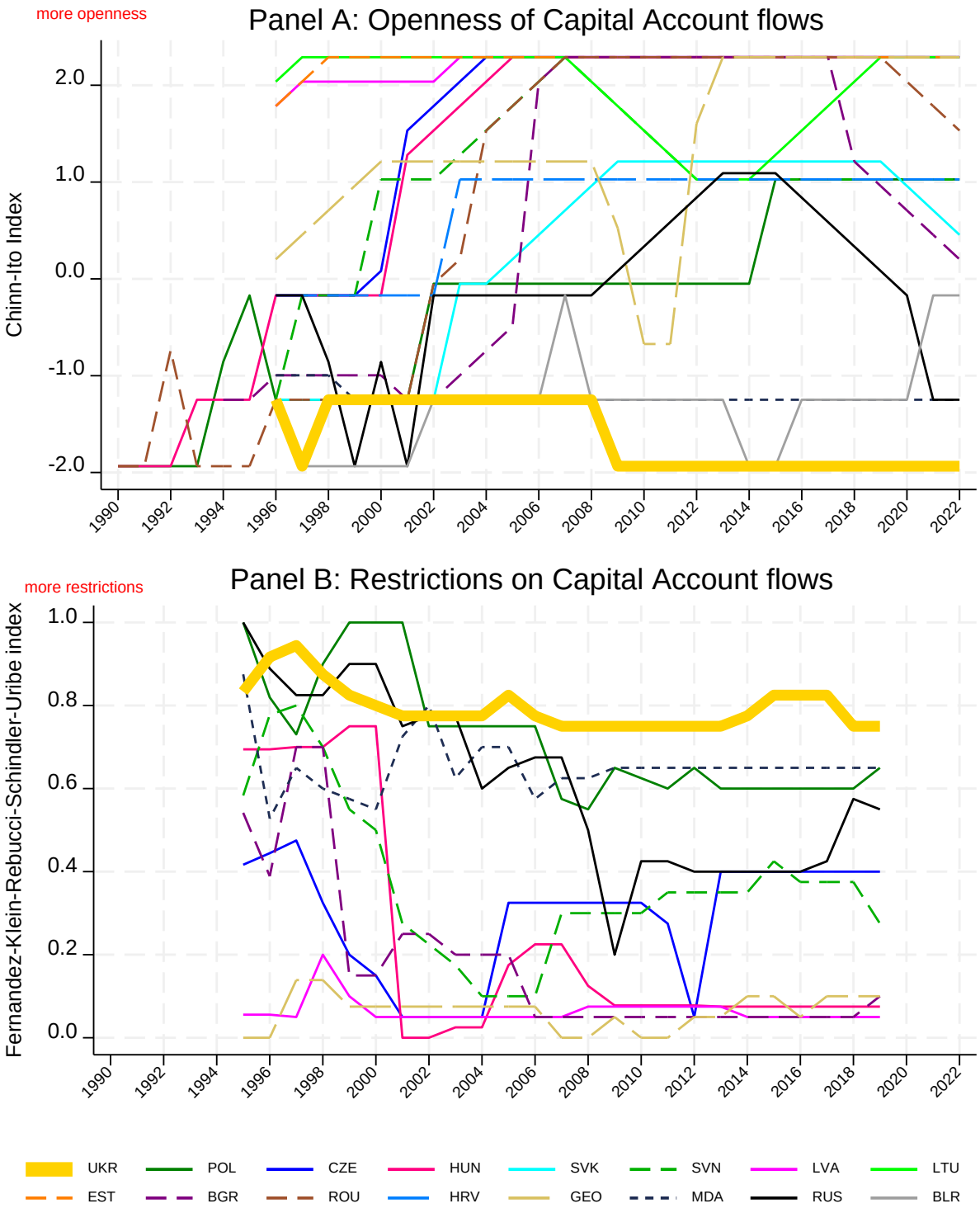
Sources: World Bank, national central banks.

Appendix Figure 4. Human capital index, 1990-2019



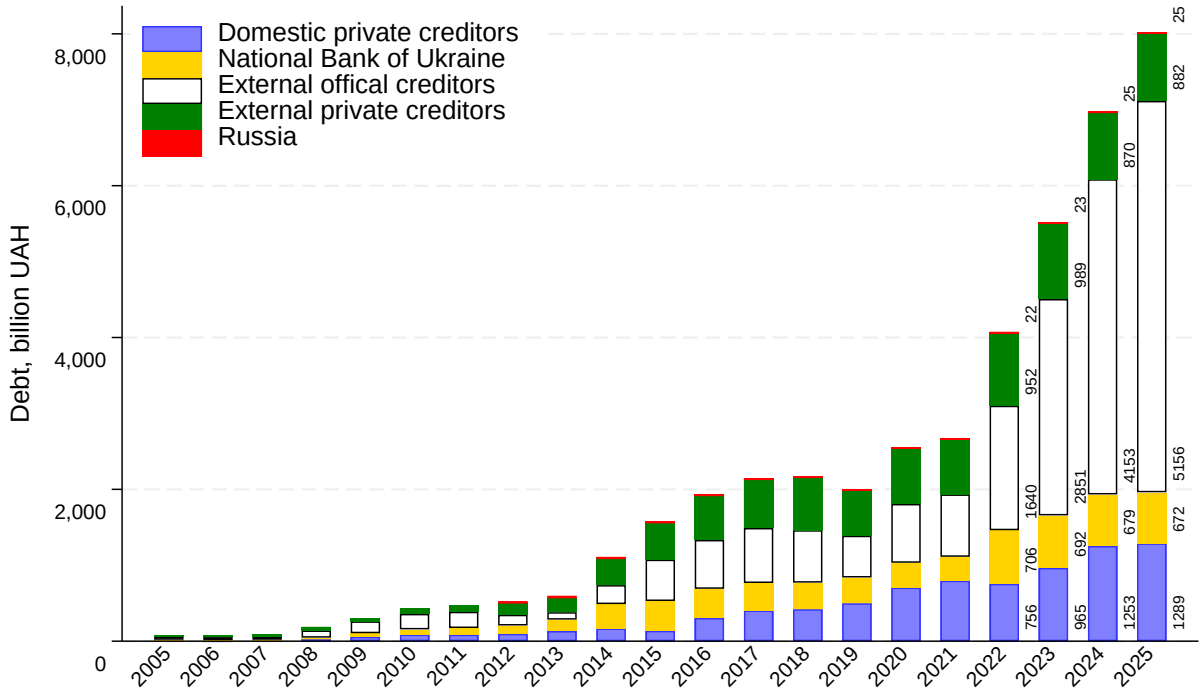
Sources: Penn World Table for panel A; Barro-Lee Educational Attainment Dataset (http://barrolee.com/) for panel B; Lee and Lee (2024) for panel C.

Appendix Figure 5. Capital controls, 1990-2022



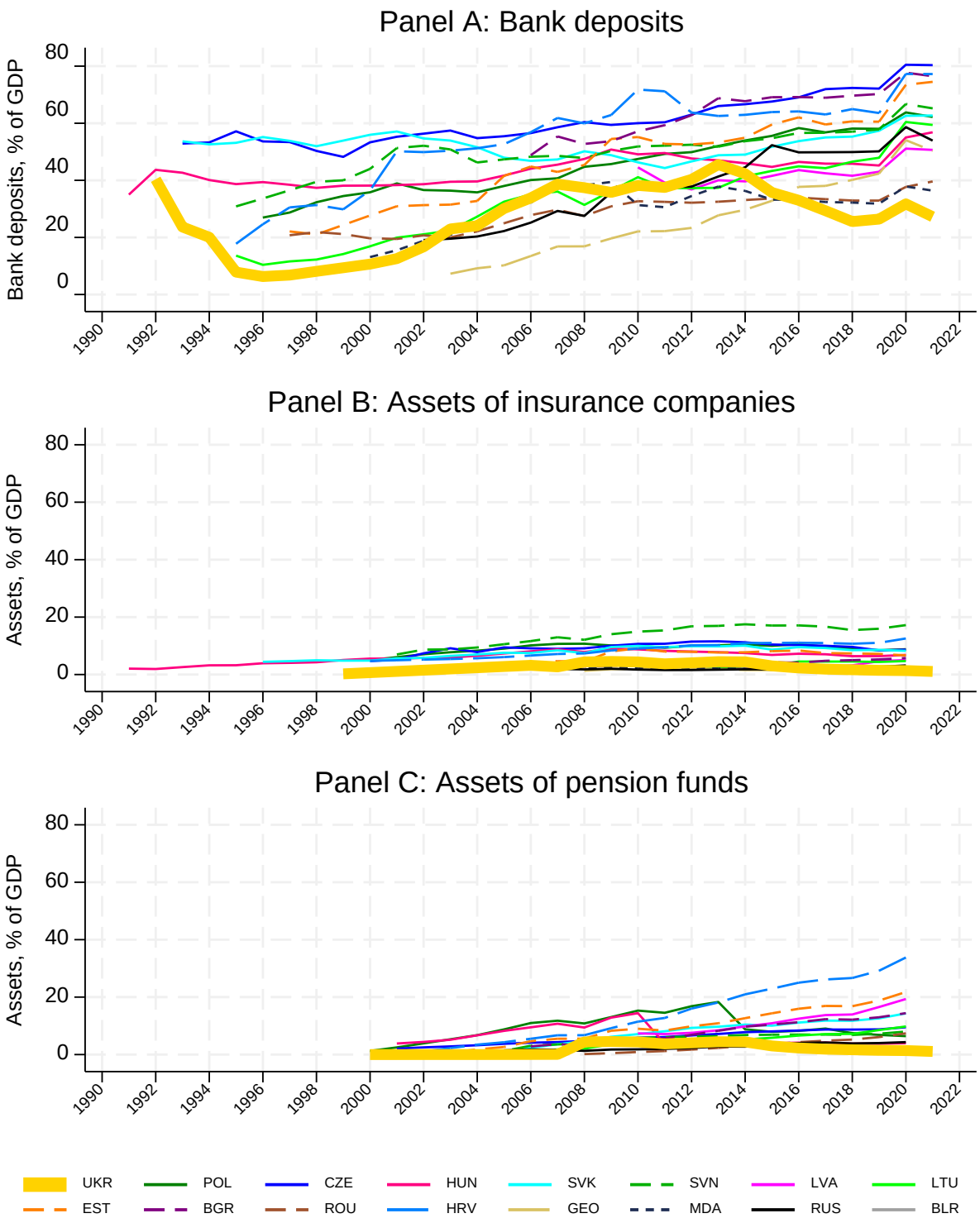
Sources: The figure reports times series for Chinn and Ito (2006) and Fernández et al. (2016) indexes measuring restrictions on international capital flows.

Appendix Figure 6. Time series and composition of Ukraine's public debt, 2005-2025



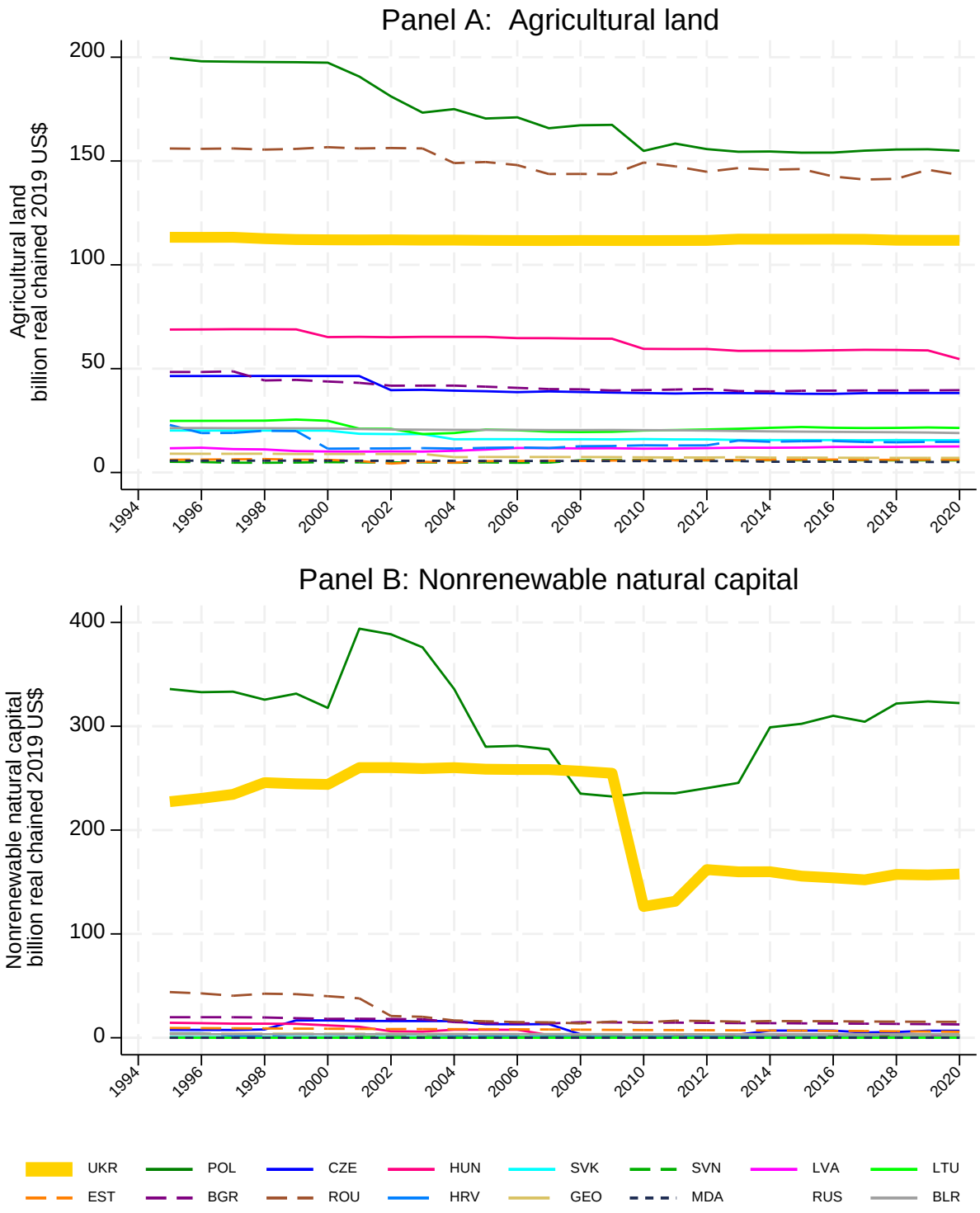
Sources: Ministry of Finance of Ukraine, https://mof.gov.ua/en/derzhavnij-borg-ta-garantovanij-derzhavju-borg (accessed November 13, 2025) (2025 numbers are for September 30, 2025); National Bank of Ukraine, https://bank.gov.ua/en/markets/t-bills (accessed November 13, 2025) (2025 NBU holdings of Treasury securities are for September 30, 2025); and State Statistics Service of Ukraine, https://ukrstat.gov.ua (accessed November 13, 2025) (2025 GDP estimate is the average of the first two quarters, converted to an annual rate).

Appendix Figure 7. Measures of loanable funds, 1991-2021



Sources: World Bank, National Bank of Ukraine.

Appendix Figure 8. Value of selected natural resources, 1995-2020



Source: World Bank (2024).

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