

# Financial Market Reactions to the Russian Invasion of Ukraine

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This article analyzes financial market reactions to the Russia-Ukraine war with a focus on the opening weeks. Markets did not completely anticipate the war, and asset price reactions strengthened from the first week—when there were hopes for a quick resolution—to the second week, when prices generally peaked and began to partially revert to prewar values. Exposure to commodity trade and trade with Russia and Ukraine determined market perceptions of the riskiness of equity and foreign exchange assets. Credit default swap prices on sovereign debt and breakeven inflation rates indicate that markets saw the war as a measurable fiscal risk even for nonbelligents. (JEL Q02, F51, G15, G32, H56)

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## 1 INTRODUCTION

The February 2022 Russian invasion of Ukraine whipsawed the global economy in the midst of its recovery from the unprecedented COVID-19 pandemic. In response, international organizations, countries, and many private firms restricted trade and financial transactions with the Russian economy. Both Russia and Ukraine are important commodity exporters, so the disruptions from the conflict and the sanctions and countersanctions have roiled commodity markets, particularly oil, but also palladium and wheat, as well as other financial markets. This article examines the impact of the war on financial markets.

This article focuses on the first few weeks of the war because asset price changes indicate that financial market expectations about the length and economic repercussions of the war changed substantially during this time. Such changes in expectations were consistent across several asset classes: equity, foreign exchange, and commodities.

The financial market reactions to the war are important because financial markets provide a useful lens through which to understand how the war, the sanctions, and countersanctions have affected the cost of living and real activity around the world. For example, the global price of oil rose by about 35 percent from February 21, 2022, to March 8, 2022, which translated into a 20 percent

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increase in U.S. gasoline prices from February to March. Sharp increases in the price of oil have preceded 10 of the past 11 recessions, where the COVID-19 recession was the exception (Hamilton, 1996, 2011).

More generally, an informal analysis of the asset price patterns illustrates how geography and trade patterns determined relative risk and returns within asset classes. For example, currencies of commodity-exporting countries strengthened relative to other currencies. Unsurprisingly, stocks from commodity-producing industries, such as oil companies, tended to outperform the market, while stocks of firms that buy commodities as intermediate inputs tended to underperform the market. More surprisingly, this article illustrates that the war probably substantially increased market perceptions of fiscal risks for G7 countries, as measured by credit default swaps (CDSs) on sovereign bonds and breakeven inflation expectations.

As the war began only months before this article was finalized, there is little previous literature to discuss, although this article will tie in with contemporaneous research when appropriate. Three early and wide-ranging studies of the impact of the war have been those of the International Monetary Fund (2022a,b) and the World Bank (2022). Neely (2022) looks at oil price hikes from the war and their relation to U.S. gasoline prices. Neely and Jordan-Wood (2022) describe the sensitivity and returns of individual U.S. stocks to the price of a basket of commodities.

This article focuses on drawing informal inference from financial market reactions to the war, with only limited discussion of the macroeconomic effects. The article does not specifically examine the tremendous human toll that the war has taken on the people of the region or the suffering that high food prices will impose on people in poor, grain-importing countries. While this article briefly reviews military developments, it does not consider such events in depth or for their own sake.

Section 2 briefly outlines military developments through mid-August 2022. Section 3 reviews the ways that this war and sanctions can affect financial markets and economic activity, while Section 4 describes and interprets the reactions of financial markets to events and changes in expectations. The final section suggests lessons to be drawn.

## 2 A TIMELINE OF THE WAR

Russia's February 2022 invasion continued 2014 military operations in Ukraine during which Russia deployed troops to Crimea to annex it and Russian-backed separatists in Donetsk and Luhansk seized government buildings and declared themselves independent. These Russian-backed separatists have continued to clash with the Ukrainian military since 2014.

In response to this 2014 annexation, the West sanctioned Crimean land and production, black-listing 11 Putin allies and a number of state-owned enterprises and embargoing military exports to Russia (Christie, 2015). This Western response was generally seen as weak. Current Ukrainian President Volodymyr Zelenskyy campaigned in 2019 on a promise to end the hostilities in the Donbas region.

The first hints of the February 2022 invasion became public in late October 2021, as news services published reports from Western intelligence agencies of unusual Russian troop movements near Ukraine (Dixon, Sonne, and Stern, 2021). Table 1 shows a timeline of major events in the war through mid-August 2022, with a focus on economically important news. In response to the Russian

preparations for war, the United States evacuated the families of U.S. embassy staff in Kyiv on January 23, 2022. On February 12, 2022, the United States evacuated most of the embassy staff and sent 3,000 combat troops to Poland (Lee, 2022).

On February 21, 2022, Russian President Putin ordered troops into separatist regions of Ukraine and recognized the so-called Donetsk and Luhansk People's Republics (Troianovski, 2022). The following day, President Biden announced that the Russian invasion had begun (Liptak, 2022), and the United States, the European Union (EU), Japan, the United Kingdom, Canada, Australia, and other countries sanctioned Russia (Riley, 2022). On February 23, 2022, President Putin formally announced "special military operations" in eastern Ukraine, which he said were in response to appeals for assistance from the separatist regions (Simmons, 2022).

Although President Putin initially described the purpose of the "special military operation" as demilitarization of Ukraine and denied wanting to occupy the country, on February 24, Russian armed forces launched a full-scale invasion of Ukraine along four axes of attack, including a major thrust toward the capitol of Kyiv, which included an ultimately unsuccessful air assault on Antonov Airport, just outside Kyiv (Marson, 2022). In response, Ukrainian President Volodymyr Zelenskyy mobilized his country's armed forces and banned all males 18 to 60 years of age from leaving the country (Snodgrass, 2022).

The full-scale invasion provoked strong sanctions that began to cut the Russian financial system off from the rest of the world. On February 26, the United States and EU began procedures to prohibit some Russian banks from using the Society for Worldwide Interbank Financial Telecommunication (SWIFT) system. This move would come to fruition on March 2, 2022 (Blenkinsop, 2022).<sup>1</sup> SWIFT had previously refused U.K. demands to deny Russia use of SWIFT, to sanction Russia for its 2014 invasion of Crimea (Hutton and Wishart, 2014). On February 28, the United States, Canada, and EU froze access to Russian foreign exchange reserves held in their financial institutions. Those reserves totaled nearly \$640 billion in early February 2022 (Lederman and Da Silva, 2022; Reuters, 2022b). Also on February 28, the United States and United Kingdom prohibited their firms and citizens from transacting with the Russian Central Bank (RCB), Russia's National Wealth Fund, or the Russian finance ministry (Rappeport, 2022; Psaledakis, Shalal, and Holland, 2022).

After approximately three weeks of stalemate in northern Ukraine, on March 20, 2022, the Russians began to shift units from the north to attacks in the east and south (Gordon and Leary, 2022). The April 14 Ukrainian sinking of the flagship of Russia's Black Sea fleet, the cruiser Moskva, probably prevented a potential Russian amphibious assault on the southern coast, near Odessa (Lamothe et al., 2022).

This shift of Russian units to the east took almost four weeks but was largely completed by April 18, 2022, when Russia began a new major offensive in the east. Since that time, the Russians have made slow progress. Russian forces captured Mariupol's Azovstal steel plant after a months-long battle on May 20 (Epstein, 2022), then entered the center of Sievierodonetsk, one of the last Ukrainian strongholds in the eastern Donbas region on May 31, capturing the rest of Sievierodonetsk by June 25 and the nearby high ground of Lysychansk on July 3 (Kottasová et al., 2022). The liberal use of the great Russia superiority in artillery aided these Russian offensives in the east.

After months of offensive operations in the east, on July 4, 2022, the Russian Ministry of Defense ordered a pause in major military operations. Offensive operations resumed July 16, 2022.

**Table 1****Timeline of Events**

<b>Date</b>	<b>Description</b>
Saturday, October 30, 2021	Reports of unusual Russian troop movements near Ukraine become public.
Sunday, January 23, 2022	The U.S. government evacuates families of U.S. embassy staff in Kyiv.
Saturday, February 12, 2022	The U.S. government evacuates most U.S. embassy staff in Ukraine and sends troops to Poland.
Monday, February 21, 2022	Russian President Putin orders troops to enter separatist regions of Ukraine and recognizes the so-called Donetsk and Luhansk People's Republics.
Tuesday, February 22, 2022	President Biden announces that Russia has begun to invade Ukraine and outlines initial economic sanctions.
Wednesday, February 23, 2022	Russian President Putin announces "special military operations" in eastern Ukraine.
Thursday, February 24, 2022	Russian armed forces launch a full-scale invasion of Ukraine along four axes of attack.
Thursday, February 24, 2022	Ukrainian President Zelenskyy mobilizes his country's armed forces and bans all military-age males from leaving the country.
Thursday, February 24, 2022	The National Bank of Ukraine (NBU) fixes the exchange rate at 29.25 UAH/USD, closes the local stock market, and imposes capital controls to reduce capital flight.
Friday, February 25, 2022	The NBU provides unlimited refinancing loans to the domestic banking system and nationalizes Russian-owned banks in Ukraine.
Saturday, February 26, 2022	The United States and EU move to prohibit some Russian banks from using the SWIFT network.
Monday, February 28, 2022	Russian authorities close stocks and derivatives trading on the Moscow exchange. The Russian Central Bank (RCB) raises its key policy rate from 9.5 percent to 20 percent in response to a 30 percent plunge in the ruble's value and orders exporters to start selling 80 percent of their foreign exchange revenue to support the ruble.
Monday, February 28, 2022	The United States and United Kingdom prohibit their firms and citizens from transacting with the RCB, Russia's National Wealth Fund, or the Russian Finance Ministry.
Monday, February 28, 2022	The United States and International Energy Agency announce they would jointly release 60 million barrels of oil from strategic reserves.
Tuesday, March 1, 2022	The EU excludes seven Russian banks from SWIFT under sanctions.
Wednesday, March 2, 2022	The RCB lowers reserve requirements for credit institutions.
Tuesday, March 8, 2022	President Biden bans U.S. imports of Russian oil and gas.
Tuesday, March 8, 2022	The U.S. House of Representatives passes a \$13.6 billion aid package for Ukraine.
Wednesday, March 9, 2022	Russian troops advance on Kyiv, threatening encirclement.
Wednesday, March 9, 2022	The RCB imposes additional capital and foreign exchange controls to support the ruble.
Friday, March 11, 2022	The United States, the EU, Britain, Canada, and Japan jointly revoke Russia's most favored nation status.
Wednesday, March 16, 2022	The Federal Open Market Committee raises the federal funds target range by 25 basis points, citing strong employment and "elevated" inflation.
Sunday, March 20, 2022	Russia withdraws in the north and shifts to attacking in the east and south.
Monday, March 21, 2022	The RCB reopens the stock markets in a limited fashion.
Tuesday, March 22, 2022	Russia reduces oil exports through a major Caspian pipeline, reducing the global supply.
Wednesday, March 23, 2022	President Vladimir Putin announces that "unfriendly countries" must pay for natural gas in rubles.
Thursday, March 24, 2022	Ukraine reports that its forces sank a large Russian landing ship, the Orsk.
Thursday, March 24, 2022	Canada announces that it will raise oil and gas exports.

**Table 1, cont'd****Timeline of Events**

Date	Description
Friday, March 25, 2022	The chief of the Main Operational Directorate of the General Staff of Russia's armed forces states that the "main goal" of the war is merely to control the Donbas, not the entire Ukraine.
Friday, March 25, 2022	The EU and United States agree that the United States will supply the EU with more liquified natural gas to reduce dependence on Russia.
Tuesday, March 29, 2022	Ukrainian forces recapture northern territory, including suburbs of Kyiv, while Russian forces continue to advance in the southern port city of Mariupol.
Thursday, March 31, 2022	President Biden announces the release of a million barrels of oil a day from the Strategic Petroleum Reserve, for about 180 days.
Thursday, March 31, 2022	Russian negotiators state that its military will "radically" reduce its activity in northern Ukraine, after "meaningful" talks in Istanbul.
Saturday, April 2, 2022	The discovery of mass graves and "executed" civilians in Bucha prompts Ukraine and Western nations to accuse Russian troops of war crimes.
Wednesday, April 6, 2022	The United States and its allies in the International Energy Agency (IEA) will release an additional 60 million barrels of oil from strategic reserves, bringing the total released to 240 million barrels.
Thursday, April 7, 2022	The EU bans Russian coal imports from August as part of new sanctions, but the group remains divided over oil and gas sanctions.
Friday, April 8, 2022	Japan bans coal imports from Russia as part of stricter sanctions that included expelling eight diplomats.
Friday, April 8, 2022	The RCB reduces its policy rate from 20 percent to 17 percent at an unscheduled meeting, consistent with the effectiveness of capital and exchange controls in maintaining the notional value of the ruble.
Sunday, April 10, 2022	The World Bank estimates that the economies of Russia and Ukraine will shrink by 11.2 percent and 45 percent, respectively, in 2022.
Thursday, April 14, 2022	Ukrainian missiles sink Russia's Black Sea fleet flagship vessel, the cruiser Moskva.
Friday, April 15, 2022	The Biden administration resumes plans for oil and gas development on federal lands, contrary to a Biden campaign pledge.
Monday, April 18, 2022	Russia begins an offensive in eastern Ukraine.
Monday, April 18, 2022	The RCB relaxes exchange controls on domestic banks' sales to individuals.
Saturday, April 23, 2022	The Russian government ceases publication of many economic statistics, masking the effects of sanctions.
Wednesday, April 27, 2022	Russia stops natural gas flows to Poland and Bulgaria after the two countries refused to pay in rubles, boosting European gas prices.
Friday, April 29, 2022	The RCB cuts its policy rate from 17 percent to 14 percent.
Friday, April 29, 2022	The RCB raises reserve requirements.
Wednesday, May 4, 2022	The Federal Open Market Committee raises the federal funds target range 50 basis points, from 25-75 basis points to 50-100 basis points, and the interest on reserves to 90 basis points.
Thursday, May 5, 2022	The EU seeks to remove Sberbank, Russia's largest lender and a main channel for oil and gas payments, from the SWIFT international payment system.
Sunday, May 8, 2022	G7 leaders and Ukrainian President Volodymyr Zelensky meet virtually to discuss Western support for Ukraine.
Sunday, May 8, 2022	The G7 commits to end imports of Russian oil and the United States imposes sanctions against Gazprombank executives and other businesses.

**Table 1, cont'd****Timeline of Events**

Date	Description
Friday, May 13, 2022	The G7 foreign ministers vow to isolate Russia economically and politically while supplying weapons to Ukraine.
Wednesday, May 18, 2022	Treasury Secretary Janet Yellen warns that the United States would likely prevent Russia from paying U.S. bondholders in dollars, which could force Russia into default. The current exemption on such dollar payments expires on May 25, 2022.
Friday, May 20, 2022	Russian forces capture the Azovstal steel plant in Mariupol after a months-long battle for the city.
Friday, May 20, 2022	The NBU eases exchange controls, eliminating the 30+/- 10 percent UAH/USD rate for commercial bank foreign exchange sales.
Monday, May 23, 2022	The Russian Finance Ministry loosens capital controls and cuts required foreign currency conversion by exporters from 80 percent to 50 percent.
Wednesday, May 25, 2022	Russian forces advance into the center of Sievierodonetsk, one of the last Ukrainian strongholds in the eastern Donbas region.
Thursday, May 26, 2022	The RCB cuts its policy rate from 14 percent to 11 percent.
Tuesday, May 30, 2022	EU leaders agree to ban Russian oil imported by sea.
Tuesday, May 31, 2022	The United Kingdom and EU coordinate a ban on insuring ships carrying Russian oil.
Wednesday, June 1, 2022	An industry body rules that Russia defaulted on its obligations by missing an interest payment in April, triggering \$2.2 billion in credit default swaps (CDS).
Thursday, June 2, 2022	Oil prices fall after reports that Saudi Arabia was prepared to increase oil output.
Friday, June 3, 2022	The EU approves a sixth sanctions package against Russia.
Friday, June 3, 2022	Ukraine's ambassador to Turkey accuses Russia of "stealing" and exporting Ukrainian grain to international markets.
Wednesday, June 8, 2022	The OECD slashes its global growth forecast and predicts a spike in inflation caused by the war in Ukraine.
Wednesday, June 8, 2022	The Institute of International Finance (IIF) predicts that Russia's economy will shrink 15 percent in 2022 and 3 percent in 2023.
Thursday, June 9, 2022	Analysts warn of a disappointing EU wheat harvest this year, complicating efforts to make up for lost Ukrainian and Russia production.
Friday, June 10, 2022	The RCB reduces its policy rate to 9.5 percent from 11 percent as officials say inflation is slowing.
Saturday, June 11, 2022	The average U.S. price of premium gasoline exceeds \$5 a gallon for the first time.
Monday, June 13, 2022	The Energy Minister of Colombia said that his country will increase coal and petroleum production in response to the shortfalls created by sanctions against Russia.
Tuesday, June 14, 2022	The U.S. Treasury announces it will continue to allow payments to Russia for energy products through December 5, 2022, to give European countries time to prepare for a near-total oil embargo.
Wednesday, June 15, 2022	Russia's Gazprom PJSC warns of further reductions in gas flows through the Nord Stream pipeline to Germany, a day after a 40 percent cut in the quantity carried.
Tuesday, June 21, 2022	Russian forces press an offensive in eastern Ukraine and fight to control Sievierodonetsk.
Tuesday, June 21, 2022	Russia warns Lithuania of "serious" consequences over its decision to ban the rail transit of EU-sanctioned goods between mainland Russia and Kaliningrad.
Tuesday, June 21, 2022	Russia simulates missile attacks on Estonia, a member of NATO.
Thursday, June 23, 2022	Germany considers rationing natural gas after Russian makes cuts to the supply.

**Table 1, cont'd****Timeline of Events**

<b>Date</b>	<b>Description</b>
Thursday, June 23, 2022	EU leaders grant “candidate status” to Ukraine and Moldova.
Saturday, June 25, 2022	Russian forces capture the last parts of Sievierodonetsk.
Saturday, June 25, 2022	Ukraine reports a “massive bombardment” from Belarus, which is allied to Russia but not officially involved in the war.
Sunday, June 26, 2022	The G7 announces an import ban on gold from Russia.
Monday, June 27, 2022	Russia defaults on foreign debt.
Monday, June 27, 2022	G7 leaders agree on new sanctions, including restricting defense technology transfers.
Tuesday, June 28, 2022	Turkey drops its objections to Sweden and Finland joining NATO, making acceptance likely.
Sunday, July 3, 2022	Russian forces capture the high ground of Lysychansk, opposite Sievierodonetsk.
Monday, July 4, 2022	Russia pauses major military operations temporarily to allow units to recover.
Thursday, July 14, 2022	The U.S. reassures banks, shipping, and insurance companies that assisting Russian food and fertilizer exports would not breach sanctions on Moscow.
Saturday, July 16, 2022	The Russian Ministry of Defense announces the end of its “operational pause.”
Wednesday, July 20, 2022	Ukraine requests a two-year payment freeze on payments on \$20 billion of international bonds.
Wednesday, July 20, 2022	The European Commission urges EU members to cut their natural gas use by 15 percent and permit it to ration gas to prepare for a much-reduced supply of Russian gas.
Wednesday, July 20, 2022	Russian Foreign Minister Sergei Lavrov says Russia has designs on more than just the Donbas region in eastern Ukraine.
Thursday, July 21, 2022	The NBU devalues UAH to 36.5686 UAH/USD.
Friday, July 22, 2022	The RCB cuts the policy rate from 9.5 percent to 8 percent.
Friday, July 22, 2022	Russia and Ukraine agree that Russia would allow grain exports through Ukrainian ports.
Tuesday, July 26, 2022	The IMF World Economic Outlook increases its forecast of 2022 Russian GDP to a 6 percent fall while seeing world growth slowing to 3.2 percent.
Wednesday, August 3, 2022	OPEC nations agree to a small increase in oil production.
Thursday, August 4, 2022	Russian oil stops flowing through a pipeline to Central and Eastern Europe. Transneft PJSC, the government-owned oil-pipeline operator, blames Western sanctions for payment difficulties.
Monday, August 8, 2022	IKAR, an agricultural research firm, forecasts Russia’s wheat harvest at 95 million metric tons, up from the USDA’s 81.5 million metric ton estimate.
Tuesday, August 9, 2022	Ukrainian forces use unknown means to successfully attack the Russian Saky airbase on the Crimean Peninsula, destroying at least nine Russian combat aircraft.
Wednesday, August 10, 2022	Ukraine’s creditors agree to a two-year freeze in payments on \$20 billion in bonds.

In July, Ukrainian forces began using U.S.-supplied high mobility artillery rocket system (HIMARS) missiles to destroy Russian ammunition depots and river crossings. These attacks on logistics greatly reduced the Russian artillery advantage. On August 9, Ukrainian forces used unknown means to successfully attack the Russian Saky airbase on the Crimean Peninsula, destroying at least nine Russian combat aircraft. The latter operation was part of a Ukrainian offensive to retake Kherson.

## 3 THE INVASION AND THE GLOBAL ECONOMY

### 3.1 How Can a War Affect Financial Markets?

A war can affect financial markets through expectations of or actual physical disruptions to trade and economic sanctions applied by either side or neutral parties. In the present case, the war physically disrupted the creation and extraction of some commodities in both Russia and Ukraine. For example, many Ukrainian farmers have not been able to plant or harvest crops, and exports of harvested crops via the Black Sea will be limited. This is a serious impediment, as grain exports via the Black Sea constituted 95 percent of Ukrainian grain exports in 2021 (Salin, 2022). Only at the end of July did Russia and Ukraine, via U.N. negotiations, agree to resume both Russian and Ukrainian wheat and fertilizer exports through the Black Sea (Reuters, 2022d). An EU initiative to ship Ukrainian grain by river, rail, and road routes, the “Solidarity Lanes,” has successfully exported considerable quantities of grain (Agence France-Presse, 2022). Sanctions imposed by both sides will also restrict the supplies of commodities to the global economy. For example, the United States has banned imports of Russian oil and the EU has banned such imports by sea. Western countries have not sanctioned many commodities, such as food and fertilizer, although removing Russian banks from SWIFT and other sanctions have impeded purchases of food and fertilizer (Rappeport, 2022).

The efficient market hypothesis (Fama, 1970) implies that all information about future supply of or demand for an asset typically affects the price of that asset when the information affects the market’s expectations, not necessarily when the change in supply or demand occurs. To take an example, suppose it were announced that a major oil field would have to be shut down in two weeks for repairs or to prevent environmental damage. In that case, market participants could expect a rise in oil prices in two weeks when supply decreases. To profit from that expected rise in prices, suppliers could reduce their current sales—storing some oil to sell at higher prices in two weeks—while oil purchasers would increase their immediate demand to increase inventories and reduce their purchases at the expected higher prices in two weeks. These actions would reduce quantities supplied and increase those demanded today, raising current prices until the expected future price rise became too small to justify further actions. So, prices should always reflect current expectations about future market conditions. The process of bidding prices toward a value that is consistent with expectations of future fundamentals is colloquially known as “risk arbitrage.”<sup>2</sup>

A similar process usually keeps the prices of closely substitutable assets very close to each other in different markets. The substitutability of two commodities limits the divergence in their prices. For example, the price of oil around the world depends on the oil’s grade and/or the location of delivery. Marginal buyers’ willingness to accept a different grade of oil or the cost to transport oil from cheaper sources will limit the variation in prices between two substitute commodities. If marginal buyers consider different grades of oil to be poor substitutes or it costs a lot to transport oil between markets, then the prices can diverge substantially.

By legally impeding arbitrage, however, sanctions can induce persistent, large deviations in the prices of similar assets on different markets. For example, the prices of palladium delivered in Russia and in Western Europe might diverge persistently if sanctions prevent the import of palladium from Russia.



**Table 2****Major Russian and Ukrainian Exports in 2020**

	Percent of world exports	Percent of domestic GDP
<b>Russian exports in 2020</b>		
Petroleum oils and oils obtained from bituminous minerals; crude	7.6	4.9
Petroleum oils and oils from bituminous minerals, not crude	5.0	3.1
Commodities not specified according to kind	3.0	2.7
Gold (including gold plated with platinum)	2.5	1.2
Coal; briquettes, ovoids, and similar solid fuels from coal	7.8	0.8
Wheat and meslin	8.8	0.5
Platinum	6.2	0.5
Petroleum gases and other gaseous hydrocarbons	2.3	0.5
Iron or non-alloy steel; semi-finished products thereof	11.4	0.3
Copper; refined and copper alloys, unwrought	3.6	0.3
<b>Ukrainian exports in 2020</b>		
Sunflower-seed, safflower, or cotton-seed oil	20.0	3.4
Maize (corn)	6.7	3.1
Iron ores and concentrates	1.5	2.7
Wheat and meslin	4.0	2.3
Iron or non-alloy steel; semi-finished	6.4	1.8
Iron or non-alloy steel; flat-rolled	2.0	1.0
Insulated wire, cable and other electric conductors	0.6	0.9
Oil-cake and other solid residues	8.0	0.8
Rape or colza seeds	4.6	0.6
Pig iron and spiegeleisen in pigs, blocks, or other primary forms	10.4	0.6

NOTE: The table shows the top categories of exports for Russia and Ukraine for 2020, both as percentages of world exports of that product and as percentages of the respective GDPs of Russia and Ukraine.

SOURCE: Export data from U.N. Comtrade; GDP data from World Bank.

**3.2 What Commodity Markets Are Affected?**

Both Russia and Ukraine are important commodity exporters. Table 2 shows the major exports of Russia and Ukraine, sorted by the percentage of world exports for each category. For example, the first row of Table 2 shows that Russian exports of crude oil amounted to 7.6 percent of world crude oil exports in 2020, while making up 4.9 percent of Russia's gross domestic product (GDP). Energy products, that is, oil, coal, and natural gas, and precious metals, such as gold and platinum, make up much of Russian exports. Ukraine's major exports consist of food products—sunflower seeds, corn, and wheat—and iron/steel products. These exports often make up large percentages of world exports. For example, Table 2 shows that Ukrainian exports of sunflower-seed, safflower, or cotton-seed oil account for 20 percent of world exports of those products.

Physical disruption of a market and sanctions can have different effects on a market. A physical disruption might make the commodity completely unavailable, while in the presence of sanctions the product presumably still exists and can be consumed if the sanctions can be evaded. Also, the disruption to a global market depends crucially on the nature of the product, that is, how easy it is to transport and how easy it is to disguise the source of the commodity. For example, crude oil can be easily shipped around the world, so Western sanctions on purchases of Russian oil mean that it will still be sold to non-sanctioning states such as India or China, albeit at a substantial discount. On the other hand, natural gas is most easily transported through existing pipelines and cannot easily be redirected without substantial infrastructure to liquify it, transport the liquified natural gas (LNG) in special ships, and then use the offloaded LNG at the destination. Therefore, it is much easier to evade sanctions on oil than on natural gas. European sanctions on natural gas would likely prove quite effective, as it would be difficult to deliver the gas to new markets.

A large percentage of Russian natural gas exports go to EU nations. The lack of existing infrastructure for handling LNG makes it very difficult to replace these Russian exports with LNG from the United States or other gas exporters.<sup>3</sup> This lack of infrastructure has significantly impeded the expansion of Western sanctions to Russian gas.

Exports of food have been mostly subject to physical disruption rather than sanctions. The combination of fears of reduced wheat exports from Ukraine and a poor wheat harvest in Europe greatly raised wheat prices (Khan, 2022). Throughout the spring, rising food prices produced fears of a famine in relatively low-income, wheat-importing countries, such as Fiji, Morocco, Mauritania, Azerbaijan, Georgia, and Egypt.<sup>4</sup>

## 4 FINANCIAL MARKET REACTIONS

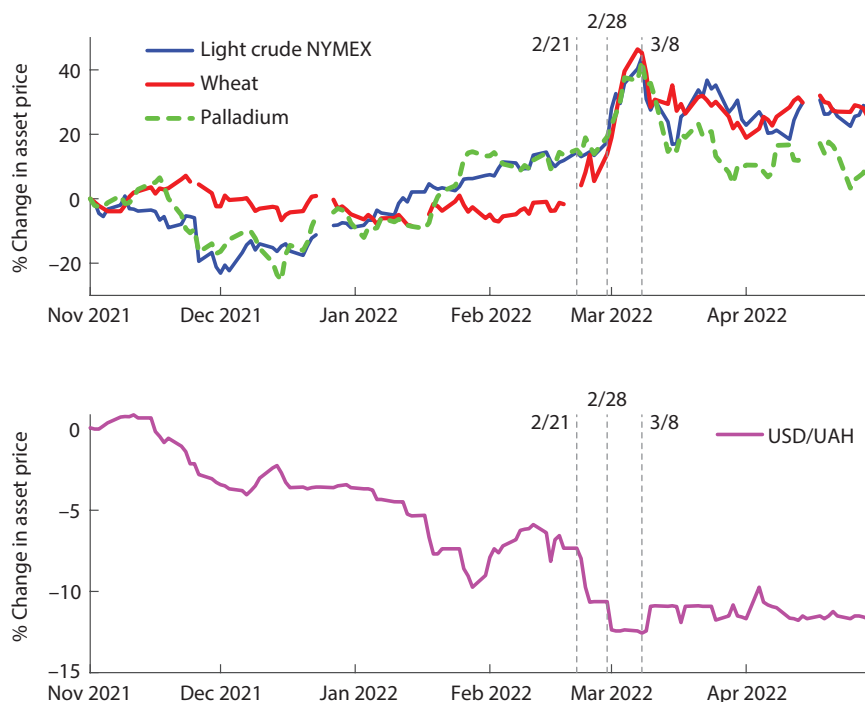
### 4.1 *Prewar Anticipation in Commodities Prices*

The efficient market hypothesis implies that financial markets should price in expected effects of future events, such as war. The Russian invasion of Ukraine was preceded by almost four months of war warnings in the press (Dixon, Sonne, and Stern, 2021). Such a war would be expected to disrupt supplies of many important commodities, as it actually did, as well as depreciate the currencies of the belligerents. Therefore, one might think that rising commodity prices and/or depreciating currencies could be interpreted as warning signs of the impending invasion. Many factors, aside from war, can influence asset prices, which complicates the exercise of looking for evidence of war anticipation in such prices.

The top panel of Figure 1 depicts futures prices of oil, wheat, and palladium from November 1, 2021, to April 30, 2022, while the bottom panel depicts the U.S. dollar/hryvnia (USD/UAH) exchange rate over the same period. The figure provides some casual evidence that markets priced in some significant probability of war. Crude oil and palladium prices rose from December 2021 to the start of the war in late February 2022. Similarly, the hryvnia depreciated by about 10 percent from November 1, 2021, to the start of the war on February 24, 2022. Wheat prices, however, did not rise much until the last week of February, when hostilities were imminent. The figure shows that anticipation was only partial in that commodity prices and exchange rates changed substantially in late February when hostilities commenced. If markets had fully priced in the war, prices would have changed very little or not at all when the invasion occurred.

**Figure 1**

**Prewar Trends in Commodity Prices and the UAH**



NOTE: The top panel of the figure shows normalized daily futures prices for commodities from November 1, 2021, to April 30, 2022. The bottom panel shows the normalized USD/UAH exchange rate from November 1, 2021, to April 30, 2022. Normalization depicts the percentage change in the asset price relative to its initial value in the figure. NYMEX, New York Mercantile Exchange; USD, U.S. dollar; UAH, Ukrainian hryvnia.

SOURCE: Tickdata.

**4.2 The First Weeks of the War: February 14 to March 28**

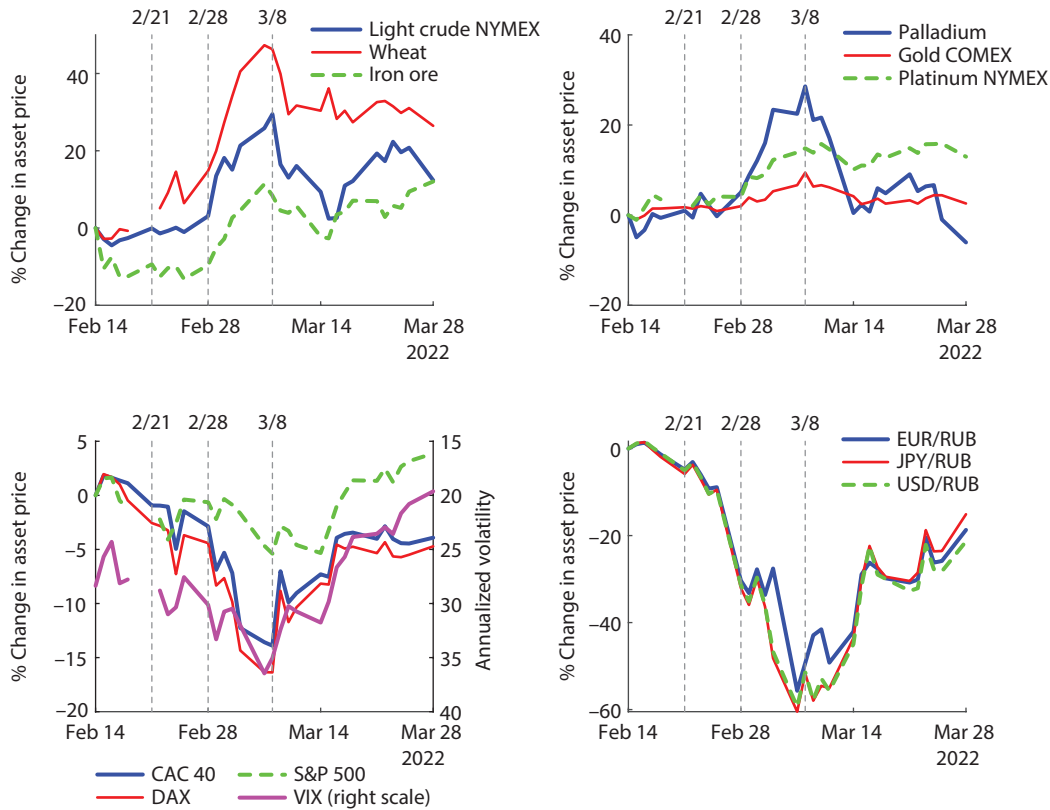
Figure 2 shows patterns in normalized asset prices from February 14 to March 28, a period of six weeks. Clockwise from top left, the four panels of Figure 2 show the percentage change in normalized futures prices for oil, wheat, and iron; precious metals; the Russian ruble; and equities/VIX.

Some patterns are common to many assets: Prior to the commencement of hostilities in the last week of February, the asset prices showed no major and consistent changes. As hostilities began to break out in the last week of February, most of the futures prices moved in consistent directions, however. From February 21 to February 28, crude oil and palladium prices rose by about 10 percent while equities fell by about 5 percent. The VIX rose from about 30 to 34, and the ruble’s value plunged by about 30 percent.<sup>5</sup>

The directions of the price changes are not difficult to plausibly explain. Russia is a major exporter of crude oil and palladium, and markets doubtless fear that some combination of physical disruption and Western sanctions—national or private—would disrupt their supply and raise prices. Similarly, one would generally expect war and commodity price rises to lower stock prices while raising estimates of implied stock volatility because war interferes with international trade and investments.

**Figure 2**

**Asset Price Changes from February 14 to March 28**



NOTE: The panels of the figure shows normalized daily futures or spot prices for assets from February 14, 2022, to March 28, 2022. Moving clockwise from top left, the figures depict commodities futures prices, precious metals, spot exchange rates, and equity indices. Normalization depicts the percentage change in the asset price relative to its initial value in the figure. Note that the inverted right axis is the VIX scale. EUR, euro; JPY, Japanese yen; RUB, Russian ruble; USD, U.S. dollar.

SOURCE: Tickdata.

The initial price movements in the last week of February were more modest than larger moves in the same direction from March 1 to March 8. Wheat prices rose about 14 percent from February 21 to February 28 (the first week of the war) but cumulatively rose about 45 percent from February 21 to March 8 (the end of the second week of the war). Oil and palladium followed similar patterns, rising about 3 percent in the first week but cumulatively rising about 25 percent by the end of the second week. Equities declined by over 10 percent over the initial two weeks. Prices generally peaked on March 8 and declined thereafter, retracing much of the territory back to their prewar values. By April, asset prices had ceased to move in pronounced and coordinated swings and became more stable.

Why did commodity prices move in these patterns over time? The efficient market hypothesis implies that prices should change as expectations of current and future fundamentals change. The first few weeks of the war contained a lot of news that would influence expectations. The modest initial price changes indicate that markets did not fully price in the war—or prices would not have

changed—but that markets initially judged that the war would have a smaller effect on prices than they would just a week later. Initial market reactions may have priced in only a short conflict and only weak Western sanctions and support for Ukraine. In fact, Ukraine has received over \$45 billion in military support alone (Statista, 2022) and Western sanctions were much wider and stronger than those in the wake of the annexation of Crimea in 2014.

By March 1, 2022, the initial Russian advances had bogged down, and early peace talks had been fruitless. It is reasonable to infer that markets may have reevaluated the impact of the war when it became more likely that initial Russian objectives were overly ambitious, the war would last indefinitely, and Western nations would impose serious sanctions on Russia. The following summarizes that sentiment:

The last full trading week of February ended with optimism that Russia’s invasion of Ukraine would end quickly and not become a global issue. How wrong we were. The scenes out of Ukraine have been devastating, and while resistance has been stiff, Russia’s tactics have gotten more extreme. Europe has rallied together in response, but sanctions don’t look like they will bring a speedy end to the war. (Levisohn, 2022)

The reversal in asset price movements after March 8 may be consistent with several interpretations:

- Simple overreaction from February 21 to March 8
- Anticipation of events that did not occur
- Failure to expect events that occurred

**Simple Overreaction.** The fact that the March 1 to March 8 price rise was a one-off event and was followed by a more sustained retrenchment might also be consistent with a simple overreaction; that is, subsequent trading showed that prices on March 8 were excessive compared with underlying fundamentals.<sup>6</sup> Markets must estimate the effects of events on prices. While these estimates might be very good, educated guesses, markets will typically overestimate or underestimate, particularly for complex, one-time events such as the outbreak of a war involving important commodity producers.

**Anticipation of Events That Did Not Occur.** Markets may have priced in some price-boosting events that did not come to pass, such as near-term European sanctions on Russian oil and gas.

**Failure to Expect Events That Occurred.** Markets might also have failed to fully anticipate some events or policies that moderated prices. Two types of possibly unanticipated policy reactions are the releases of oil reserves by Western countries and capital controls applied by the National Bank of Ukraine (NBU) and the RCB.<sup>7</sup>

On March 1, 2022, the United States and the International Energy Agency (IEA) announced that they would jointly release 60 million barrels of oil from strategic reserves (Faucon and Said, 2022). This release was just the first of several. On March 31, 2022, President Biden announced the release of 180 million barrels of oil over about 180 days; then on April 6, 2022, the United States and IEA announced the release of an additional 60 million barrels (Frank, 2022; Morales, Mohsin, and Jacobs, 2022).

### 4.3 Exchange Controls, Capital Controls, and Exchange Rates

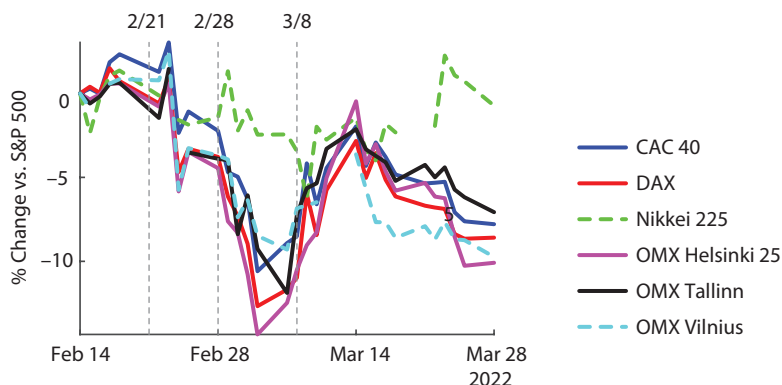
Both the NBU and the RCB found themselves in similar situations after Russia invaded. Both the hryvnia and ruble had been depreciating against G7 currencies since November, and such depreciation threatened the ability of both countries to maintain stable domestic prices and the ability to import. Both central banks then engaged in similar, but not identical, policies to confront their similar problems.

The NBU moved first. On the morning of the general invasion, February 24, 2022, the NBU fixed the value of the hryvnia at 29.25 UAH/USD and imposed capital and exchange controls. These regulatory controls included prohibitions on repatriation of profits abroad and withdrawal of foreign currency from Ukrainian banks (see Table 1).<sup>8</sup> On February 25, the NBU announced that it would provide unlimited refinancing loans in the national currency to the banking system, with a maturity up to one year (Druhov and Druhova, 2022).<sup>9</sup> The lower panel of Figure 1 shows that these policies arrested the depreciation of the hryvnia and stabilized it.

By July 2022, however, imbalances in Ukraine's imports and exports had built up. Ukrainian exports were severely hampered by the shutdown of its maritime trade from the Black Sea while its government needed to import a great deal to support its population and fight the war. Ukrainians taking refuge in neighboring countries also put pressure on the hryvnia by purchasing foreign currency for their living expenses (Yahoo News, 2022). To improve the international competitiveness of its products, the NBU devalued its domestic currency by 20 percent, from 29.25 UAH/USD to 36.5686 UAH/USD on July 21, 2022 (Reuters, 2022c). The NBU's alternatives to such a devaluation would have been to raise interest rates, which would slow economic activity and reduce seignorage, or to impose stronger capital controls. With the national economy expected to contract by 35 to 45 percent in 2022, a further contraction of the domestic economy was especially unappealing.<sup>10</sup>

The RCB did not immediately impose capital controls at the outbreak of hostilities as did the NBU, but it saw the ruble's value plunge 30 percent in the war's first week as markets assessed the likely impact on demand for Russian assets and goods. On February 28, 2022, the Russian authorities reacted by suspending stock and derivatives trading on the Moscow exchange, while the RCB raised its key policy rate from 9.5 percent to 20 percent. To support the ruble, the RCB imposed additional capital controls on March 9, 2022 (Grove and Osipovich, 2022). That is, the Russian authorities also ordered exporters to start selling 80 percent of their foreign exchange revenue for rubles (Reuters, 2022a) and limited Russian citizens to withdrawing \$10,000 in foreign currency (Reuters, 2022b). On March 22, 2022, President Vladimir Putin announced that "unfriendly countries" must pay for natural gas in rubles, although this demand would only be enforced a month later. These exchange and capital controls increased the supply of and limited demand for foreign currency, thereby buoying the highly visible but managed value of the ruble. This boost allowed the RCB to cut its policy rate from 20 percent back to 17 percent on April 8, 2022, to 14 percent on April 29, to 11 percent on May 25, to 9.5 percent on June 10, and to 8 percent on July 25 (Hannon and Chernova, 2022; Bloomberg News, 2022). On May 24, the Russian finance ministry cut the share of required foreign currency conversion by exporters from 80 percent to 50 percent.

These capital and exchange controls successfully stabilized the value of the ruble on internal markets, allowing the Russian government to claim a public relations victory. Because the ruble is not freely tradable on international markets, however, its value on highly regulated internal markets is meaningless. In addition, capital and exchange controls can be costly in subtle ways, as they

**Figure 3****Equity Index Price Changes Relative to the S&P 500**

NOTE: The figure shows normalized international equity indices from February 14, 2022, to March 28, 2022. Normalization depicts the percentage change in the asset price relative to the initial value of the S&P 500 in the figure. Positive (negative) values indicate positive (negative) cumulative returns of the foreign index compared to the S&P 500.

SOURCE: Tickdata.

prevent firms and citizens from trading assets and protecting themselves from risk. Such regulations function as a subtle tax.

#### 4.4 Cross-Sectional Commodity Price Patterns from February 14 to March 28

Commodity price movements contain instructional cross-sectional patterns. For example, the upper-right panel of Figure 2 shows that platinum prices rose further and faster than did gold prices, with platinum prices experiencing a nearly 15.8 percent rise by March 10 versus gold's 9.4 percent peak on March 8. The larger effect on platinum prices is consistent with the fact that Russian platinum exports were 6.2 percent of world platinum exports, while its gold exports were only 2.5 percent of world gold exports, although the value of the latter is more than double that of the former (Table 2).

#### 4.5 Equities from February 14 to March 28

Figure 2 also suggests that markets perceive European assets to be more exposed to war risk than are North American or Asian assets. That is, the S&P 500 did not fall as far as did two European indices, the French CAC 40 and the German DAX (lower-left panel of Figure 2).<sup>11</sup> Similarly, the lower-right panel of Figure 2 shows that the ruble did not fall quite as far and fast against the euro as it did against the U.S. dollar and yen, which implies that the euro depreciated against the dollar and yen. European equity indices presumably had lower returns than those of the United States and Japan during this initial phase of the war because Europe depends on Russian energy exports and European firms have greater trading and financial ties with Russia and Ukraine.

Figure 3 provides a more detailed view of cross-sectional patterns in international equity markets using a U.S. market, the S&P 500, as the benchmark. That is, Figure 3 shows the cumulative returns to six equity markets less the cumulative returns to the S&P 500: the French CAC 40, the

German DAX, the Japanese Nikkei 225, the Finnish OMX Helsinki 25, the Estonian OMX Tallinn, and the Lithuanian OMX Vilnius.<sup>12</sup> Positive (negative) values on the figure indicate that the respective markets outperformed (underperformed) the S&P 500 since February 14. The relative performance of an equity market likely reflects the relative exposure of the country's economy to the effects of the Russia-Ukraine war, such as commodity price hikes, sanctions, and economic performance in the region.

Relative equity prices did not move consistently and strongly prior to the outbreak of hostilities in the last week of February, but Figure 3 illustrates that European markets generally underperformed the S&P 500 from February 23 to February 28. As previously discussed, these equity markets plunged further after February 28, reaching their respective nadirs with respect to the S&P 500 from March 4 to March 7. The European markets generally continued to underperform the S&P 500 throughout March, ending the month about 6 to 10 percent lower relative to the S&P 500 than they had been on February 14. In contrast, the Japanese Nikkei 225 ended the period almost exactly where it had started with respect to the S&P 500.

The fact that only the Nikkei kept pace with the S&P 500 is consistent with a market view that Japan and the United States are more insulated from the fallout from the war. Somewhat surprisingly, the markets in states bordering Russia, that is, Finland, Estonia, and Lithuania, did not perform appreciably worse than markets in parts of Europe seemingly more geographically insulated from the Russia-Ukraine war, such as France and Germany.

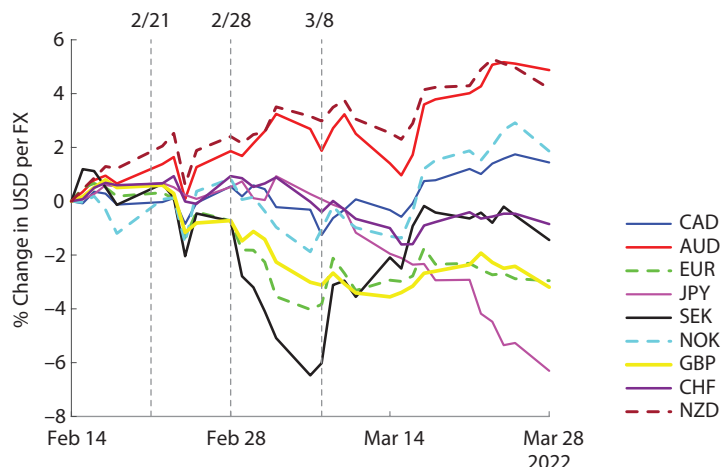
#### **4.6 Nonbelligerent Exchange Rates from February 14 to March 28**

Figure 4 illustrates the paths of nine major flexible exchange rates against the U.S. dollar from February 14 through March 28 and allows us to infer factors that might have driven differential reactions. A rise in the respective lines indicates an appreciation of the foreign currency against the U.S. dollar. The countries differ in their trading patterns and proximity to the war.

Four of the currencies appreciated against the U.S. dollar over the sample, while five depreciated. Not surprisingly, the four currencies that appreciated against the U.S. dollar are all "commodity currencies," that is, currencies of major commodity-exporting countries: Australia, Canada, New Zealand, and Norway. Table 3 shows the five largest categories of exports for countries of the 10 monetary areas used to construct the nine exchange rates. Exports for the euro area are not available, so I used French, German, and Italian exports to proxy for those of the euro area.<sup>13</sup> The final column of Table 3 shows that mined or agricultural commodity exports make up substantial portions of the GDP of Australia, Canada, New Zealand, and Norway, while being much less important for Japan, the United Kingdom, and the United States. Switzerland is a major exporter of refined gold, but it imports gold in unrefined form, so the Swiss franc is not a commodity currency on net. When commodity prices rise, the currencies of commodity-exporting countries tend to appreciate because of the increased demand for those currencies.

Four of the five depreciating currencies are European: the British pound, the euro, the Swedish kroner, and the Swiss franc. Of these four currencies, the Swiss franc, which is traditionally considered to be among the safest of currencies, had only a small total depreciation. European currencies tended to depreciate because countries in this region have relatively close business ties to Russia and Ukraine and will tend to be most impacted by sanctions and the macroeconomic retrenchment in those countries (Table 4). Weaker business activity is associated with currency depreciation.



**Figure 4****Exchange Rates Relative to the U.S. Dollar, February 14 to March 28**

NOTE: The figure shows nine normalized exchange rates against the USD from February 14, 2022, to March 28, 2022. Normalization depicts the percentage change in the asset price relative to its initial value in the figure. Positive (negative) values indicate appreciation (depreciation) of the foreign currency against the U.S. dollar. FX, unit of foreign exchange. AUD, Australian dollar; CAD, Canadian dollar; CHF, Swiss Franc; EUR, euro; GBP, British pound; JPY, Japanese yen; NOK, Norwegian kroner; NZD, New Zealand dollar; SEK, Swedish krona.

SOURCE: Tickdata.

The Japanese yen is the fifth depreciating currency, but the depreciation is out of sync with the movements of other exchange rates and did not start in earnest until about March 10, which indicates that the depreciation may not be related to the Russia-Ukraine war. Some currency analysts attribute the yen's decline to market perceptions that the Bank of Japan is much less willing to raise policy rates than is the Federal Reserve (Hongxu, 2022; McCarthy, 2022).

To casually explore the possibility that trade patterns with Russia or Ukraine affect the reactions of exchange rates to war-induced commodity price shocks, Table 4 presents 2020 exports, imports, and total trade of 12 countries with Russia and Ukraine. These 12 countries represent the monetary areas for the exchange rates represented in Figure 4, with France, Germany, and Italy jointly representing the euro area.

First, Table 4 shows that all 12 countries trade much more with Russia than with Ukraine, whose economy is only about 10 percent as big as that of Russia. Second, the quantity of trade with Russia varies considerably among the countries. Germany, Italy, and the United Kingdom each trade with Russia equal to about 1 percent of their respective GDPs. Other European countries, France, Norway, Sweden, and Switzerland, have trade shares of 0.5 to 0.6 percent of their respective GDPs, while countries that are geographically distant with more commodity-intensive economies—Australia, Canada, New Zealand, and the United States—have very low trade exposure, at only 0.1 percent of their respective GDPs. Japan is an intermediate case. It is geographically near Russia's Asian coast, and its trade with Russia is 0.3 percent of its GDP. The importance of trade with Russia seems to match tolerably well with the exchange rate behavior in Figure 4: The euro and the British

**Table 3****Exports of Selected Countries**

Country	Export	Percent of world exports	Percent of domestic GDP
Australia	Iron ores and concentrates	28.5	6.0
Australia	Commodities not specified	2.9	2.9
Australia	Coal; briquettes, ovoids, and similar solid fuels	18.9	2.3
Australia	Gold unwrought	2.3	1.3
Australia	Meat of bovine animals; frozen	7.5	0.3
Canada	Petroleum oils; crude	5.0	2.9
Canada	Motor cars and other motor vehicles	2.5	1.9
Canada	Commodities not specified	1.5	1.2
Canada	Gold unwrought	2.1	1.0
Canada	Motor vehicles; parts and accessories	1.3	0.5
France	Medicaments	3.6	1.1
France	Commodities not specified	1.9	1.0
France	Aircraft	15.1	0.9
France	Motor cars and other motor vehicles	1.5	0.7
France	Motor vehicles; parts and accessories	1.8	0.5
Germany	Motor cars and other motor vehicles	9.7	3.2
Germany	Medicaments	7.7	1.6
Germany	Motor vehicles; parts and accessories	8.0	1.4
Germany	Commodities not specified	3.6	1.2
Germany	Human blood; animal blood	7.4	0.9
Italy	Medicaments	3.4	1.4
Italy	Commodities not specified	1.1	0.8
Italy	Motor cars and other motor vehicles	1.2	0.8
Italy	Motor vehicles; parts and accessories	1.8	0.7
Italy	Petroleum oils and oils from bituminous minerals, not crude	0.9	0.4
Japan	Motor cars and other motor vehicles	6.4	1.6
Japan	Commodities not specified	3.1	0.8
Japan	Electronic integrated circuits	1.8	0.6
Japan	Motor vehicles; parts and accessories	4.0	0.5
Japan	Machines for manufacture of semiconductors	12.7	0.5

**Table 3, cont'd****Exports of Selected Countries**

Country	Export	Percent of world exports	Percent of domestic GDP
New Zealand	Milk and cream	14.1	2.8
New Zealand	Meat of sheep or goats; fresh, chilled, or frozen	17.4	1.2
New Zealand	Meat of bovine animals; frozen	4.0	1.0
New Zealand	Wood in the rough	8.8	0.9
New Zealand	Butter and other fats from milk	11.0	0.9
Norway	Petroleum oils; crude	2.4	6.3
Norway	Petroleum gases	4.0	3.8
Norway	Fish; fresh or chilled	17.1	1.7
Norway	Commodities not specified	0.3	1.0
Norway	Petroleum oils, not crude	0.4	1.0
Sweden	Motor cars and other motor vehicles	0.9	2.1
Sweden	Medicaments	1.2	1.7
Sweden	Petroleum oils, not crude	0.6	1.0
Sweden	Commodities not specified	0.4	1.0
Sweden	Telephone sets	0.4	0.9
Switzerland	Gold unwrought	9.5	9.5
Switzerland	Medicaments	6.0	6.3
Switzerland	Human blood; animal blood	8.7	5.3
Switzerland	Heterocyclic compounds	8.0	1.7
Switzerland	Watches	25.6	1.5
United Kingdom	Motor cars and other motor vehicles	2.1	1.0
United Kingdom	Gold unwrought	2.8	0.8
United Kingdom	Turbo-jets, turbo-propellers, and gas turbines	8.9	0.7
United Kingdom	Medicaments	2.3	0.7
United Kingdom	Commodities not specified	1.3	0.6
United States	Commodities not specified	8.7	0.5
United States	Petroleum oils, not crude	6.8	0.3
United States	Petroleum oils; crude	5.3	0.2
United States	Motor cars and other motor vehicles	3.6	0.2
United States	Electronic integrated circuits	2.8	0.2

NOTE: The table shows the top five categories of exports of 12 countries for 2020, both as percentages of world exports of that product and as percentages of the respective GDPs of each of the 12 countries.

SOURCE: Export data from U.N. Comtrade; GDP data from World Bank.

**Table 4****Exports, Imports, and Total Trade with Russia and Ukraine as a Percentage of GDP for Selected Countries**

Selected countries	Exports to Russia as a percentage of GDP	Imports from Russia as a percentage of GDP	Trade with Russia as a percentage of GDP	Exports to Ukraine as a percentage of GDP	Imports from Ukraine as a percentage of GDP	Trade with Ukraine as a percentage of GDP
Australia	0.0	0.0	0.1	0.0	0.0	0.0
Canada	0.0	0.1	0.1	0.0	0.0	0.0
France	0.2	0.2	0.5	0.0	0.0	0.1
Germany	0.7	0.5	1.2	0.1	0.1	0.2
Italy	0.4	0.6	1.0	0.1	0.1	0.2
Japan	0.1	0.2	0.3	0.0	0.0	0.0
New Zealand	0.1	0.1	0.2	0.0	0.0	0.0
Norway	0.1	0.4	0.5	0.1	0.0	0.1
Sweden	0.4	0.3	0.6	0.1	0.0	0.1
Switzerland	0.4	0.2	0.6	0.1	0.0	0.1
United Kingdom	0.1	0.9	1.0	0.0	0.0	0.0
United States	0.0	0.1	0.1	0.0	0.0	0.0

NOTE: The table shows the exports, imports, and total trade (X + M) of 12 countries with Russia and Ukraine for 2020, as percentages of the respective GDPs of each of the 12 countries.

SOURCE: Trade data from U.N. Comtrade; GDP data from World Bank.

pound depreciate with respect to the U.S. dollar, while the Australian dollar and New Zealand dollar appreciate.

**Commodity Betas for Exchange Rates.** To formally determine the effect of supply-induced commodity price changes on a group of exchange rates would require a formal econometric model with identification assumptions. This is not an easy task. Under the heroic assumptions that only war shocks are important during this sample, that such shocks directly affected expected commodity returns, and that exchange rates reacted to those, one can regress exchange rate returns on returns in nine commodities whose prices might be strongly affected by the Russia-Ukraine war—coal, oil, gold, platinum, copper, iron ore, palladium, corn, and wheat—and interpret the resulting coefficients as the effect of the commodity returns on the exchange rates:

$$(1) \quad r_t^{FX,i} = b_0 + \sum_{j=1}^{j=9} b_j r_t^{c,j} + e_t^{FX,i},$$

where  $r_t^{FX,i}$  is the daily return on day  $t$  to the  $i$ th exchange rate,  $r_t^{c,j}$  is the daily return to the  $j$ th commodity ( $c$ ), and  $e_t^{FX,i}$  is the error at time  $t$  for the  $i$ th exchange rate.<sup>14</sup>

To see the reaction of each country's currency to a variety of numeraire currencies, I estimate equation (1) using daily returns from February 14 to March 28 on three base exchange rates: the U.S. dollar, the Japanese yen, and the euro. As shown in Table 4, Europe's extensive trade and financial ties with Russia and Ukraine expose the euro to the Russia-Ukraine conflict, while the U.S. dollar and yen are much less exposed. Most of the commodity returns were not significant

**Table 5**  
**Commodity Betas for Selected Exchange Rates**

Panel A			Panel B							Panel C										
USD/CAD	Beta		Gold	Iron ore	Palladium	Wheat	Coal	Oil	Gold	Platinum	Copper	Iron ore	Corn	Wheat	JPY/CAD	Beta	Gold	Iron ore	Corn	Wheat
	SE	(0.02)				-0.03 (0.02)				0.10 (0.03)					SE	-0.24 (0.10)				
USD/AUD	Beta			0.08 (0.03)		-0.07 (0.03)			0.26 (0.07)		0.05 (0.02)				JPY/AUD	Beta				-0.06 (0.03)
USD/EUR	Beta					-0.06 (0.02)									SE					
USD/JPY	Beta			0.05 (0.02)					0.24 (0.12)		0.15 (0.07)				JPY/EUR	Beta	-0.24 (0.12)		-0.15 (0.07)	
USD/SEK	Beta		-0.26 (0.13)			-0.13 (0.03)									SE		-0.40 (0.14)			-0.14 (0.04)
USD/NOK	Beta					-0.07 (0.03)		0.07 (0.02)							JPY/NOK	Beta			-0.21 (0.07)	
USD/GBP	Beta		-0.27 (0.10)		0.10 (0.05)					0.11 (0.05)					SE					
USD/CHF	Beta			0.03 (0.02)						0.15 (0.07)		0.15 (0.05)			JPY/GBP	Beta	-0.27 (0.10)			
USD/NZD	Beta			0.06 (0.02)		-0.06 (0.03)			0.19 (0.08)						SE				-0.12 (0.06)	

NOTE: The table shows the results of the regression of daily exchange rate returns on daily commodity returns (equation (1)) from February 14 to March 28, 2022. Panels A, B, and C respectively show results for exchange rates vs. the USD, EUR, and JPY. Green (red) coefficients denote a depreciation (appreciation) of the USD, EUR, or JPY against the other currency. The Bayesian information criterion selected sets of commodity regressors for each exchange rate. See equation (1). SE, standard error. AUD, Australian dollar; CAD, Canadian dollar; CHF, Swiss Franc; EUR, euro; GBP, British pound; JPY, Japanese yen; NOK, Norwegian kroner; NZD, New Zealand dollar; SEK, Swedish krona; USD, U.S. dollar.

SOURCE: Tickdata.

**Table 6****Correlation Among Commodity Returns**

	Oil	Gold	Platinum	Copper	Iron ore	Palladium	Corn	Wheat
Coal	53	38	13	56	30	21	32	40
Oil		73	38	47	57	61	44	43
Gold			26	38	69	74	43	26
Platinum				35	47	39	31	12
Copper					39	35	28	28
Iron ore						64	51	39
Palladium							8	12
Corn								61

NOTE: The table shows the correlations in percentage terms for daily commodity returns from February 14 to March 28, 2022.

SOURCE: Tickdata.

predictors of most of the exchange rates, which is not surprising for such a short sample, so I used the Bayesian information criterion to select a more parsimonious model for each exchange rate. This procedure may select a different set of regressors for each regression.

Panels A, B, and C of Table 5 show the results of these regressions using the U.S. dollar, the euro, and the Japanese yen, respectively. The positive coefficients in Panel A show that the U.S. dollar tends to depreciate against most currencies when the price of iron ore or palladium increases, while the negative coefficients show that the U.S. dollar tends to appreciate when the price of gold or wheat rises. The positive coefficients in Panel B show that the euro tends to depreciate against almost all currencies when commodity prices rise. The exceptions to this were that increases in the price of wheat caused the euro to appreciate against the Swedish krona and Norwegian kroner. In contrast, the Japanese yen tended to appreciate against all the other currencies when commodity prices increased (Panel C). In summary, the euro, which is relatively exposed to the ramifications of the Russia-Ukraine war, tended to depreciate when commodity prices rose, while the yen, considered to be much less exposed, tended to appreciate with commodity prices.

The commodity returns on the right-hand side of equation (1) are positively correlated over the sample, creating collinearity in the regressors and making it difficult to interpret individual coefficient estimates in Table 5. Table 6 shows that all the correlations among the one-day commodity returns are positive and 6 of the 36 correlations are greater than 60 percent. Gold and palladium returns exhibit the largest correlation at 74 percent. Gold returns are also highly correlated with oil returns at 73 percent.

#### **4.7 The Cross-Section of U.S. Equities: February 14 to March 28**

This subsection will illustrate how supply-induced commodity price changes can affect the cross-sectional returns of individual U.S. equities. I assume that supply shifts primarily drive the commodity price changes in the February 14 to March 28 period; demand shifts for commodities would likely have very different effects on equity prices. I consider the returns of individual stocks

**Table 7****Commodity Betas for Selected Equities**

Commodity	Firm	Industry description	Beta	t-Statistic
Oil	A P A Corp.	Crude petroleum extraction	0.37	3.07
Oil	Suncor Energy Inc. New	Petroleum refineries	0.35	2.56
Oil	Shell Plc	Crude petroleum extraction	0.42	2.49
Oil	Continental Resources Inc.	Crude petroleum extraction	0.39	2.32
Oil	Ovintiv Inc.	Crude petroleum extraction	0.44	2.02
Oil	Canadian Natural Resources Ltd.	Crude petroleum extraction	0.25	1.87
Oil	Imperial Oil Ltd.	Petroleum refineries	0.27	1.83
Gold	SPDR Gold Trust	Other financial vehicles	1.56	3.86
Gold	Barrick Gold Corp.	Gold ore mining	1.50	2.09
Coal	General Electric Co.	Turbine and turbine generator manufacturing	-0.27	-2.24
Gold	Seagate Technology Holdings Plc	Computer storage device manufacturing	-1.68	-2.34
Gold	Canadian Imperial Bank of Commerce	Commercial banking	-1.13	-2.30
Gold	Bank of Montreal Quebec	Commercial banking	-0.76	-2.29
Gold	Toronto Dominion Bank Ontario	Commercial banking	-0.99	-2.14
Platinum	Astrazeneca Plc	Pharmaceutical preparation manufacturing	-1.03	-3.91
Platinum	Sanofi	Pharmaceutical preparation manufacturing	-0.92	-3.41
Platinum	Glaxosmithkline Plc	Pharmaceutical preparation manufacturing	-0.81	-3.05
Copper	Ferguson Plc	Plumbing and heating equipment and supplies	-0.58	-2.97
Copper	P G & E Corp.	Other electric power generation	-0.21	-2.04
Iron ore	Paccar Inc.	Automobile manufacturing	-0.21	-2.48
Palladium	10x Genomics Inc.	Biological product manufacturing	-1.62	-2.31

NOTE: The table shows the results of selected regressions of daily individual stock returns in excess of the market return on daily commodity returns (equation (2)) from February 14 to March 28, 2022. See equation (2).

SOURCE: CRSP and Tickdata.

relative to the market, that is, cross-sectional returns, rather than the overall reaction of stocks to supply-induced changes in commodity prices, which will almost surely be negative.

Determining how supply-induced commodity price changes affect the cross-section of daily excess equity returns is subject to the same problems as determining their effect on exchange rates. Without a formal econometric model with identification assumptions, one can casually analyze the relation by assuming that only war shocks are important determinants of stock prices during the sample and that they affect stock returns through their effect on commodity prices. Under these heroic assumptions, I regress the excess returns on individual stocks on the returns of nine previously considered commodities that might be strongly affected by the Russia-Ukraine war: coal, oil, gold, platinum, copper, iron ore, palladium, corn, and wheat. I use returns to the 1,000 stocks with the largest market capitalizations on February 14, 2022, from the Center for Research on Security Prices (CRSP). I construct the market return as the equally weighted average of these 1,000 stock returns:

$$(2) \quad r_t^{e,i} - r_t^m = b_0 + \sum_{j=1}^{j=9} b_j r_t^{c,j} + e_t^{e,i},$$

where  $r_t^{e,i}$  is the daily return on day  $t$  to the  $i$ th stock,  $r_t^m$  is the daily market return on day  $t$ ,  $r_t^{c,j}$  is the daily return to the  $j$ th commodity at time  $t$ , and  $e_t^{e,i}$  is the error at time  $t$  for the  $i$ th stock return.<sup>15</sup>

Estimating equation (2) with daily data from February 14 to March 28 with 1,000 stocks and nine commodity prices produces far too many coefficient estimates to easily analyze. Therefore, we focus on a few of the more instructive and/or interesting findings. The top panel of Table 7 shows stocks whose excess returns reacted positively to commodity price increases, while the lower panel of Table 7 shows stocks that reacted negatively to commodity price increases.

Reassuringly, the top panel of Table 7 shows that the excess returns of oil- and gold-producing firms reacted positively to hikes in the prices of oil and gold, respectively. The most common reason for the negative reactions in the bottom panel of Table 7 is that a firm heavily uses some commodity as an input to its manufacturing processes or manufactures a product that uses the commodity itself. For example, the stock of General Electric, which manufactures equipment for power plants, declines in price when coal prices rise. Seagate Technology, which manufactures computer storage devices, is negatively exposed to gold, which is used to produce much electronic equipment. Several pharmaceutical firms, that is, Astrazeneca Plc, Sanofi, and Glaxosmithkline Plc, are negatively exposed to the price of platinum, which is used in the manufacture of some drugs. Finally, firms that manufacture plumbing or power generation equipment are negatively exposed to the price of copper.

One regularity in the lower panel of Table 7 is difficult to explain. Several Canadian banks, that is, Canadian Imperial, Bank of Montreal, and Toronto Dominion, are negatively exposed to gold. This seems peculiar: Canada is a major gold-exporting country, and one might expect a rising price of gold to benefit banks that loan money to Canadian individuals and firms. One possibility is that Canadian banks are much more exposed to—that is, have lent more to—net purchasers of gold, such as electronics firms, than they are to producers of gold.

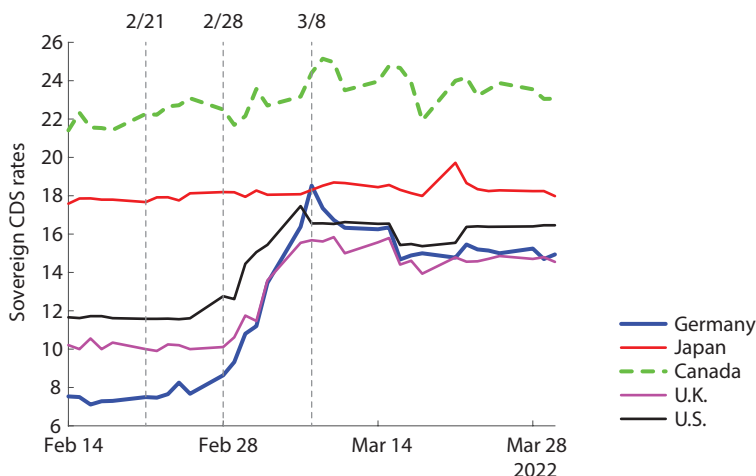
#### **4.8 Fiscal Risk and Expected Inflation: February 14 to March 28**

Major wars are very expensive for participants. Buying armaments and paying troops greatly increases government outlays while non-military economic activity often declines, which tends to reduce tax revenue. These factors produce fiscal risk and inflationary pressures for the combatants. One can obtain information from financial markets about fiscal default risk and inflation risk from credit default swaps (CDSs) and “breakeven” inflation rates. This subsection illustrates the movement of CDS prices and breakeven inflation rates during the first weeks of the war to informally assess the effect of the war on the fiscal risks for noncombatants.

CDSs function much like insurance for bonds in that CDS buyers agree to pay the seller an annual premium in exchange for the seller’s agreement to buy the bond at face value (par) if the bond issuer defaults on a principal or coupon payment.<sup>16</sup> Just as the likelihood of a car accident affects the price of auto insurance, CDS prices reflect market expectations about the likelihood of default by a bond issuer, such as a corporation or government.

Figure 5 shows the CDS rates for Germany, Japan, Canada, the United Kingdom, and United States from February 14 through March 28. The CDS rates are fairly stable over time, except for February 28 through March 8, when all the CDS rates rose strongly, except that of Japan. For example,



**Figure 5****Credit Default Swap Rates for the Sovereign Debt of Selected Countries**

NOTE: The figure shows CDS rates for the sovereign debt of five selected countries from February 14, 2022, to March 28, 2022.

SOURCE: Bloomberg.

the black line in Figure 5 shows that the rate on CDS on U.S. Treasury bonds rose from about 12 basis points on February 28 to about 16 basis points on March 8. CDS prices rose most strongly for Germany and the United Kingdom, which are geographically closest to the conflict and most economically exposed to disruptions in trade with Russia and Ukraine. The rising prices of CDSs is consistent with the view that the Russia-Ukraine war boosts the perceived likelihood of default for these countries. Alternatively, the higher CDS prices might indicate that participants demand higher compensation to bear the same amount of risk.

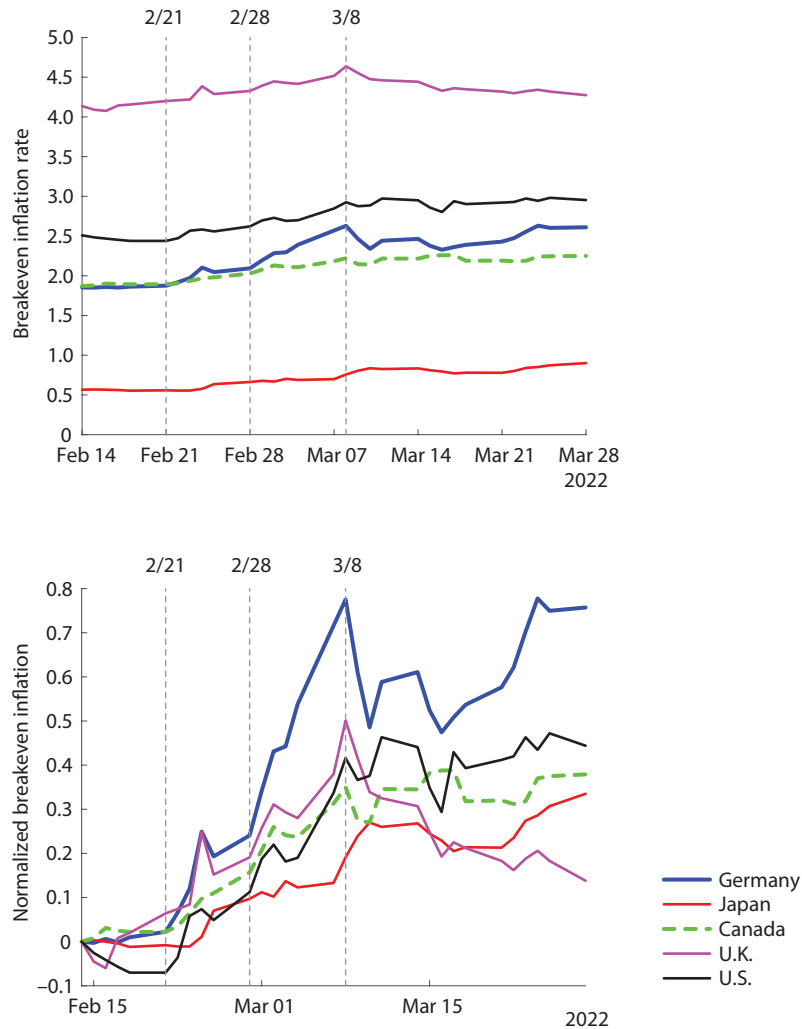
One can measure market expectations of consumer price index (CPI) inflation with “breakeven” inflation, that is, the spread between yields of bonds with inflation-adjusted payouts (Treasury inflation-protected securities [TIPS]) and those of nominal bonds. The top panel of Figure 6 shows 10-year breakeven inflation rates for Germany, Japan, Canada, the United Kingdom, and the United States, while the bottom panel centers the five series by subtracting the February 1 breakeven value for each. This centering allows one to better compare the cross-country changes in the expected inflation measures.

The usually fairly stable 10-year breakevens rose approximately 10 to 25 basis points in the last week of February before rising even more sharply—from 15 to 55 basis points—in the first week of March. Germany, the United Kingdom, and United States showed the largest increases, but even Japan’s breakeven inflation rate rose by more than 20 basis points. After March 8, the changes in the breakeven inflation rates diverged somewhat, with the U.K. breakevens falling but German and Japanese breakevens eventually rising further.

The combination of rising CDS rates and rising breakeven inflation rates are consistent with the idea that financial markets believe that the Russia-Ukraine war created relatively small but measurable fiscal risks for these nonbelligerent countries.

**Figure 6**

**Breakeven Inflation for Selected Countries**



NOTE: : The figure shows breakeven inflation rates, derived from nominal and real bonds, for five selected countries from February 14, 2022, to March 28, 2022. The top panel shows the raw breakeven inflation rates while the bottom panel normalizes the breakeven rates for easier comparison by subtracting the respective initial value of each series.

SOURCE: Bloomberg.

## 5 CONCLUSION

This article has reviewed financial market reactions to the Russian invasion of Ukraine with a focus on the events of February and March 2022, during which financial market expectations changed substantially. Markets appear to have priced some probability of war into exchange rates and some commodity prices during the 12 weeks prior to the war. That is, crude and palladium prices increased during this period, while the hryvnia and ruble depreciated. The outbreak of hostilities in the last week of February continued and strengthened these trends. During the first week of March, the trends were consistent with a revision of expectations toward a prolonged struggle that would curtail supplies of many commodities for at least months and perhaps years. By the second week of March, asset prices ceased rising and began to retrench as markets reevaluated the likely impact of events. International equity, foreign exchange, and commodities markets all dependably showed effects consistent with these changes in expectations.

Forward-looking financial markets provide an excellent lens through which to view the economic effects of the war because many of those effects will be felt through commodities markets, given that Russia and Ukraine are both important commodity exporters.

The effects of the war on equity and currency assets appear to have depended on the economic exposure and geographic separation from the Russia-Ukraine region. In particular, currencies of commodity-exporting and geographically distant countries strengthened relative to those of commodity-importing and geographically near countries as the former (latter) had positive (negative) correlations with commodity price changes. Among individual equities, the stocks of commodity-producing firms, such as oil companies, tended to outperform the market, while stocks of firms that use commodities as intermediate inputs or produce commodity-consuming products, such as electrical generators, tended to underperform the market.

Governments used economic policies to influence or even control the path of asset prices. Western nations released oil from strategic reserves to limit oil price hikes. Both the NBU and the RCB imposed capital and exchange controls to prevent capital flight, aid in revenue collection, and support their respective currencies. The NBU also fixed the value of the hryvnia from February to July. Such policies have costs as well as benefits, and their efficacy should be carefully considered.

In addition to affecting commodity, equity, and foreign exchange markets, casual analysis suggests that the war substantially increased market perceptions of fiscal risks for G7 nations, that is, the risks of sovereign default and inflation. Although markets still judge these risks to be quite low, the perceived level of such risks increased substantially during the first two weeks of the war. ■

## NOTES

- <sup>1</sup> SWIFT is a secure electronic messaging system designed to facilitate payments between international financial institutions. It was founded in 1973 and is chartered as a cooperative society under Belgian law (Kolhatkar, 2022). In 2012, the EU prohibited Iranian banks from using SWIFT as part of sanctions against Iran (Hutton and Wishart, 2014).
- <sup>2</sup> The process is known as “risk arbitrage” because it involves accepting some risk while buying and selling for expected gain. This practice is related to pure arbitrage, which involves buying and selling the same asset in different markets for low and high prices, respectively, until the prices are equalized.
- <sup>3</sup> Prior U.S. administrations discouraged EU nations from relying on Russian energy for this reason.
- <sup>4</sup> This list of relatively low-income countries uses a \$6,000 threshold for per capita income.
- <sup>5</sup> The series labeled “VIX” is the Chicago Board of Options Exchange (CBOE) VIX Index. Its price is a risk-neutral estimate of the volatility of the constant, 30-day expected volatility of the S&P 500 derived options.
- <sup>6</sup> The potential errors in market responses to the one-off outbreak of the Russia-Ukraine war contrasts with the presumably much smaller errors in reactions to monetary policy events, such as forward guidance and/or the announcement of bond purchases. Markets have much more experience with the latter, which have occurred many times in many countries.
- <sup>7</sup> Neely (1999) provides an introduction and in-depth discussion of capital controls. Davis et al. (2022) discuss the recent application of capital controls by the RCB.
- <sup>8</sup> Exchange controls are regulations on the exchange of foreign and domestic monies, such as limiting withdrawals of foreign currency from bank accounts. Capital controls include exchange controls but also include any taxes or restrictions on international asset transactions, such as prohibitions on buying foreign stocks or bonds.
- <sup>9</sup> De Groot and Skok (2022) discuss the recent monetary history of Ukraine, usefully putting the wartime policy measures in the context of the structure of the Ukrainian financial system.
- <sup>10</sup> Seigniorage is revenue for a government produced by money creation.
- <sup>11</sup> Note that the VIX series in Figure 2 is displayed with an inverted scale. Boubaker et al. (2022) examine equity market reactions in the first five days of the war, concluding that stocks from firms in countries with greater trade were more negatively exposed to war news, while Federle et al. (2022) identify a “proximity penalty” for firms geographically closer to Ukraine.
- <sup>12</sup> The cumulative stock returns in Figure 3 can be considered normalized prices relative to S&P 500 prices.
- <sup>13</sup> France, Germany, and Italy jointly account for slightly more than half of the euro area’s output.
- <sup>14</sup> An econometrician might object to equation (1) because it implicitly suggests that commodity prices drive exchange rates, when exogenous shocks, such as those to preferences or technology, drive both sorts of asset price changes. One might defend the regression in equation (1) as justified by the assumption that during this sample, war shocks directly affected expected commodity returns and that exchange rates reacted to those.
- <sup>15</sup> Equation (2) is subject to the same criticism as equation (1) in that both assume that commodity prices drive other asset prices, when market action jointly determines both types of variables after mediating the influence of exogenous shocks. That is, fundamental shocks hit financial markets that then simultaneously determine all returns.
- <sup>16</sup> CDSs are not regulated like insurance, however. They are transacted in over-the-counter markets to allow financial institutions and individuals to hedge the risk of bond defaults.

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