INTERNATIONAL TRADE AND THE DEFENSE OF THE RIGHT TO UKRAINE'S SELF-DETERMINATION

By

Natalia Boyko

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ABSTRACT

In this research, we estimate the net international trade effects of the EU-Ukraine Association Agreement and Russia's contemporaneous war against Ukraine. To do so, we construct a dataset with annual, bilateral export and import flows for Ukraine and a set of comparator countries at the 6-digit level of the Harmonized Tariff Schedule for years 2000–2019. Using this data, we nest a difference-in-difference design within a series of econometric gravity models to estimate the net effects of the EU-Ukraine Association Agreement and Russia's concurrent aggression on the sectoral and geographic composition of Ukrainian trade. Our results indicate a substantial contraction in Ukraine's international trade. In 2019, the total value of lost exports was $24.4 billion. Imports fell by approximately $21.2 billion. However, the Ukrainian agro-food sector prevailed with a net export gain of $7.1 billion. In contrast, the industrial export sector faced a net loss. Net trade reduction effects were found not only in the trade with Russia, but also with the EU and major third-country trade partners, including the USA, China, and Turkey. We stress that our findings do not imply that the pursuit of Ukraine's self-determination was ill-conceived. Our estimates are necessarily "short-term" net impacts and trade outcomes are only one of the many considerations that govern Ukraine's pursuit of EU integration, while Russia's unprovoked, illegal, and unjustified concurrent war against Ukraine has had destructive impacts on the net trade outcomes. The redirection of the trade with Russia to the EU and third countries in the agro-food and "other goods" export sectors and the strategic fuels import sector may signal that Ukraine had already become more resilient in the face of Russia's punitive measures.

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AA   EU-Ukraine Association Agreement

ACAA   Agreement on Conformity Assessment and Acceptance of Industrial
            Products

CEPII   Centre d'Études Prospectives et d'Informations Internationales

CIS   Commonwealth of Independent States

DCFTA   EU-Ukraine Deep and Comprehensive Free Trade Area

DSB   Dispute Settlement Body

EU   European Union

FTA   free trade agreement

HS   Harmonized Tariff Schedule

MTR   multilateral trade resistance

OON   ores, other minerals, and non-ferrous metals

PPML   Pseudo-Poisson Maximum Likelihood

SITC   Standard International Trade Classification

SPS   sanitary and phytosanitary

UN   United Nations

WTO   World Trade Organization

1. INTRODUCTION

In late 2013 and early 2014, Ukrainians gathered to protest the then-president's decision to not sign an association agreement, which included a free trade agreement, with the European Union (EU). The demonstrations were called the Revolution of Dignity or Euromaidan, and the protestors called for the fulfillment of the government's and president's promises of EU integration. The protestors also demanded the elimination of corruption, especially through the resignation of the president and his Cabinet of Ministers. Ultimately, the protestors prevailed, and a newly elected Ukrainian government signed the EU-Ukraine Association Agreement (AA) in March and June 2014, sparking reforms and furthering hopes for future EU membership. Concurrent with Ukraine's pursuit of EU integration, Ukraine has been defending itself against Russia's aggression. Prior to the full-scale invasion of Ukraine in February 2022 by more than 150,000 Russian troops, Russia invaded and illegally annexed Crimea in 2014, occupied a part of Ukraine's Donbas region and started a war there against Ukraine which has been ongoing since 2014, and applied punitive trade measures including bans, targeting various sectors of the Ukrainian economy.

Standard economic theory suggests that the promulgation of trade agreements that lower tariff and non-tariff trade barriers should be trade creating among member countries. However, such agreements do not occur in a vacuum. A trade-liberalizing country—by choosing to enhance integration with one region—may be met with retaliation from current or former economic partners in other regions. In the extreme case, this could even culminate in military invasion and trade destruction with the nations at war. In such a setting, the net trade effects of liberalization and the associated retaliation are uncertain. In this research, we estimate the effects

of these political phenomena through the lens of Ukrainian trade in the context of the EU-Ukraine Association Agreement and Russia's contemporaneous war against Ukraine.

The EU-Ukraine Association Agreement (AA) includes a Deep and Comprehensive Free Trade Area (DCFTA) between Ukraine and the EU. The agreement provides tariff liberalization between the EU and Ukraine and the alignment of Ukraine's product safety and technical regulations with those of the EU (European Commission, 2014). Ukraine's pursuit of EU integration has been met with Russian military invasion and punitive trade measures against Ukraine, which had reduced Ukraine's trade with Russia. Furthermore, Russia's unprovoked, illegal war against Ukraine and occupation of parts of Ukraine's land have also had destructive impacts on Ukraine's overall trade. These actions by Russia disrupted Ukraine's economic activity and reduced Ukraine's access to its natural resources, land, labor, and capital, many of which were stolen and destroyed by Russia.

We construct a dataset with annual, bilateral export and import flows for Ukraine and a set of comparator countries at the 6-digit level of the Harmonized Tariff Schedule (HS) for years 2000–2019. Using this data, we nest a difference-in-difference design within a series of econometric gravity models to estimate the effects of the EU-Ukraine AA/DCFTA and Russia's war against Ukraine on the sectoral and geographic composition of Ukrainian trade.

Our research contributes to several strands of literature. First, we contribute to the literature on EU economic integration and trade with post-Soviet and other EU-adjacent countries. The majority of research on international trade effects of EU integration finds that integration is trade-enhancing (Caporale et al., 2009; Montanari, 2005; Nowak-Lehmann et al., 2007; Shepotylo, 2010). Montanari (2005), for example, finds that unilateral EU trade preferences for Bulgaria and Romania in the 1990s increased those countries' exports to the EU.

Similarly, Caporale et al. (2009) find that EU association agreements generated significant positive impacts on trade with the CEEC-4 countries (Romania, Hungary, Bulgaria, and Poland). However, the magnitude of trade gains may be marginal. Nowak-Lehmann et al. (2007), for example, find that the customs union between Turkey and the EU has only slightly increased Turkey's industrial exports to the EU. Eteria (2020) find that—after the implementation of Association Agreements and Deep and Comprehensive Free Trade Areas with the EU—Georgia and Moldova experienced a reduction in export growth rates during the years 2015 to 2019 compared to the period prior to integration (2010–2014), despite some positive impacts on their trade with the EU. Also, compared to Georgia, Moldova had integrated more deeply in its trade with the EU and had attained greater increases in its exports to the EU (Eteria, 2020).

Second, and most relevant for our purposes, is the subset of trade literature that focuses on Ukraine-EU-Russia trade relationships. Shepotylo (2010) finds that accession into the EU during the 2004 EU enlargement could have doubled Ukrainian exports of manufactured goods by 2007, and future EU accession would outweigh the benefits from integration with the Commonwealth of Independent States of which Russia is a member. Von Cramon-Taubadel, Hess and Brummer (2010) and Nekhay, Gay and Fellmann (2011) conduct *ex ante* analyses to simulate the effects of an EU-Ukraine free trade agreement (FTA) on the Ukrainian agriculture sector. Both von Cramon-Taubadel, Hess and Brummer (2010) and Nekhay, Gay and Fellmann (2011) predict that such an FTA would be trade-enhancing for the Ukrainian agricultural export sector, but the gains would vary significantly for different agricultural commodities. Baryshpolets and Devadoss (2021) find that the EU-Ukraine AA/DCFTA decreases the EU's sunflower oil price and, as a result, benefits EU consumers.

We contribute to these two strands of literature by (i) conducting an *ex-post* analysis of the trade agreement and by (ii) extending the analysis to other sectors than agriculture. This allows us to take into account potential retaliatory behavior by Russia and the effect on other sectors than agriculture. In contrast to this previous literature, our results indicate that the net trade effect of the EU-Ukraine Association Agreement and Russia's concurrent aggression is a substantial contraction in Ukraine's international trade. In 2019, the total value of lost exports was $24.4 billion. Imports fell by approximately $21.2 billion. However, the Ukrainian agro-food sector prevailed with a net export gain of $7.1 billion. In contrast, the industrial export sector faced a net loss. Net trade reduction effects were found not only in the trade with Russia, but also with the EU and major third-country trade partners, including the USA, China, and Turkey.

<div align="center">**2. BACKGROUND**</div>

This section provides a historical overview of the EU-Ukraine AA/DCFTA (Section 2.1) and Russia's punitive trade measures and war against Ukraine (Section 2.2). Section 2.3 discusses the implications of these events for the redirection of the trade with Russia to the EU and other markets.

2.1 EU-Ukraine AA/DCFTA

Ukraine's pursuit of EU integration began in the early years of its independence, including with the signing of the EU-Ukraine Partnership and Cooperation Agreement in 1994 and the Orange Revolution in 2004. In 2007, the EU and Ukraine began negotiating the EU-Ukraine Association Agreement (AA), designed to strengthen political, economic, and legal ties between the EU and Ukraine. The Deep and Comprehensive Free Trade Area (DCFTA) section of the AA entails a process of tariff liberalization between Ukraine and the EU. The AA also commits Ukraine to achieve conformity with EU product safety and technical standards and regulations and EU quality infrastructure (European Commission, 2014).

The Ukrainian government signed the EU-Ukraine AA in March and June 2014, and many sections of the AA were provisionally applied on September 1, 2014. However, Russia's threat to revoke its 2011 Commonwealth of Independent States (CIS) free trade agreement (FTA) with Ukraine in response to the AA led to the postponement of the "provisional implementation" of major elements of the EU-Ukraine Association Agreement, including the DCFTA, until January 1, 2016 (Cenusa et al., 2014). Nevertheless, in consideration of the unprecedented political, economic, and security challenges faced by Ukraine, the EU granted Ukraine autonomous trade preferences by unilaterally decreasing or eliminating EU customs duties on imports from Ukraine beginning from 2014 (European Union, 2014). Ukraine began its

process of tariff liberalization for imports from the EU in 2016, and the AA entered into full effect on September 1, 2017.

2.2 Russia's punitive trade measures and war against Ukraine

Negotiation of the EU-Ukraine AA/DCFTA received backlash from the Russian government. Ahead of the November 2013 Vilnius summit for the signing of the EU-Ukraine AA/DCFTA, Russia implemented punitive trade measures against Ukraine starting in July and August 2013 and further increased them later that year and in 2014 (Cenusa et al., 2014). Most of Russia's trade bans on Ukrainian imports were imposed on the agro-food sector (Cenusa et al., 2014). Some manufactured goods from Ukraine, such as railcars and steel, were also included in Russia's trade bans (Åslund, 2018; Cenusa et al., 2014). In addition, Russia increased its border controls for all Ukrainian goods in 2013 and further in 2014 (Cenusa et al., 2014; Nazdravetska, 2014).[1] On November 21, 2013, the Ukrainian government announced its decision to cease the preparations for the signing of the EU-Ukraine AA/DCFTA, which, ultimately, the former president of Ukraine, Viktor Yanukovych, refused to sign on November 29, 2013. This sparked the Euromaidan pro-EU protests which began in Ukraine on November 21, 2013. When the EU-Ukraine DCFTA took effect in January 2016, Russia revoked its CIS FTA with Ukraine, banned agro-food imports from Ukraine,[2] and restricted the transit of Ukrainian exports via Russia to third countries (Varfolomeyev, 2016; Wolczuk, 2016).[3] Ukraine responded by banning various

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[1] Ukraine strengthened its border controls for Russian goods in 2014 (Nazdravetska, 2014).

[2] The Russian embargo on agro-food imports from Ukraine was also a form of backlash for the sanctions that were imposed by Ukraine on Russia for its war against Ukraine (Varfolomeyev, 2016).

[3] Ukraine had filed petitions with the World Trade Organization (WTO) Dispute Settlement Body (DSB) concerning Russia's implementation of multiple restrictions on traffic from Ukraine passing through Russia to third countries (WTO, 2019).

food and manufactured imports from Russia and imposing import duties on Russian goods (Varfolomeyev, 2016).

Near the end of the Revolution of Dignity in February 2014, Russia invaded the Crimean Peninsula of Ukraine and illegally annexed it in March 2014. Russia then invaded and occupied a part of the Donbas region in the east of Ukraine and began a war against Ukraine in the Donbas which has been ongoing since 2014.[4] This disrupted the various economic activities that characterize the Donbas, including the minerals, metals and mining industries, coal-fired thermoelectric power plants, and chemical and other manufacturing plants.[5] Note that in 2013, prior to the war, the Donbas produced 14.5% of Ukraine's GDP, 29.4% of Ukraine's mining and quarrying output, 21% of total manufacturing output, 20.3% of total electricity, steam, gas, and air conditioning supply, and 16.2% of total transporting and storage (Mykhnenko, 2020).

2.3 Redirection of the trade with Russia to the EU and third countries

The timeline in Figure 1 summarizes the events discussed in Sections 2.1 and 2.2, where the top of the timeline highlights activity related to the AA/DCFTA and the lower part of the timeline details the Russian backlash. The timeline suggests three institutional regimes for Ukrainian trade. First, the period prior to the Russia-Ukraine war and signing of the EU-Ukraine AA/DCFTA from 2000–2014, which—for the purposes of our study—constitutes the "base period". We designate the period from 2014–2016, in which the EU-Ukraine AA/DCFTA was signed and autonomous trade preferences were unilaterally applied by the EU, as "Regime 1". In this period, Ukraine began to increase its integration with the EU in the context of the AA while

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[4] The term "the Donbas" is used to refer to the coal, steel, and machine-producing industrial region in the east of Ukraine. The Donbas does not have official boundaries, but it is often implied to represent the aggregate of the Ukrainian administrative regions ("oblasts") of Donetsk and Luhansk.
[5] Russia also stole and destroyed Ukrainian production equipment and infrastructure, including railways and power lines.

trade with Russia decreased significantly as Russia implemented additional punitive trade

measures, occupied Crimea and a part of the Donbas, and began a war against Ukraine in the

Donbas. We designate the period from 2016–2019 as "Regime 2". In this period, Ukraine further

integrated itself with the EU as the trade agreement (DCFTA) was implemented and the AA

entered into full effect. On the other hand, Russia revoked its free trade agreement with Ukraine.

Figure 1: Institutional Changes Affecting Ukrainian Trade Relations with Russia & the EU
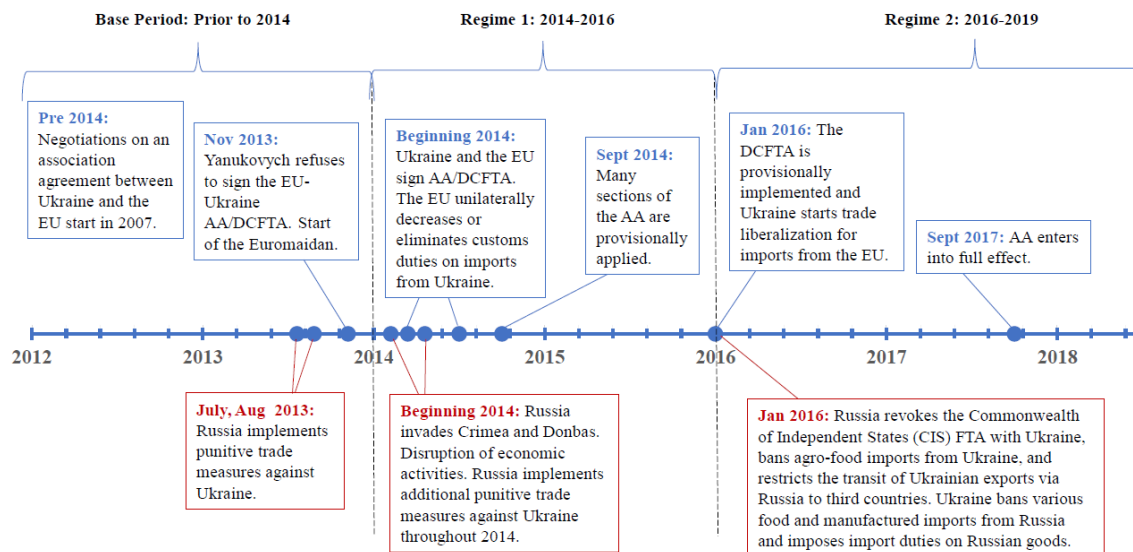
Overall, the implication of Russia's punitive trade measures is that there was a reduction

in access to the Russian market. In addition, Ukraine reduced its trade with Russia due to

Russia's war against Ukraine. On the other hand, Ukraine gained more favorable access to the

EU market due to the AA/DCFTA. Thus, the ability to mitigate trade losses may have been

contingent on Ukrainian exporters' and importers' ability to redirect the trade with Russia

towards the EU or, potentially, other markets. Dabrowski, Zachmann and Domínguez-Jiménez

(2020) discuss stylistic characteristics within the Ukrainian market that affect this transition.

First, the EU and Russia were Ukraine's largest trade partners and together they

accounted for around half of Ukraine's exports and imports (see Figure 2). The decrease in trade

between Russia and Ukraine (for instance, due to the war and trade bans and restrictions) may have led to a reduction in overall trade unless Ukraine redirected a significant share of its previous trade with Russia to the EU or other markets.

Second, although both Russia and the EU were Ukraine's major trade partners, accounting for similar amounts of Ukraine's exports and imports in 2013, another point made by Dabrowski, Zachmann and Domínguez-Jiménez (2020) is that the success of the redirection of trade also depends on the composition of trade. Historically, a higher share of Ukrainian exports to Russia consisted of manufactured goods, which accounted for more than 76% of total exports to Russia in 2013, compared to over 48% of exports to the EU.[6] Since Russia and Belarus in the past were the largest markets for Ukrainian high-value, technological exports (Nikonenko, 2020), a portion of Ukrainian machinery and equipment was built to comply with the standards of those CIS markets. Therefore, the trade losses associated with Ukrainian exports of manufactures that were previously destined for Russia could be offset by redirecting such exports to other CIS countries. However, the share of manufactured exports to Russia was high and if there is a lack of sufficient additional demand in other CIS countries, considerable time and investments may be required for producers of these manufactures to adjust their production to meet the technical standards of non-CIS markets, such as the EU, for export redirection to such markets. Again, redirecting this subset of trade to the EU requires both a demand for these products within the EU in addition to compliance with EU technical standards, which may differ from those in Russia and other CIS countries (Movchan, Shepotylo and Vakhitov, 2020). The trade losses could also be offset if Ukrainian exporters of high-value goods to the EU market increase their

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[6] Historically, Ukrainian exports to Russia focused more heavily on transport equipment and machinery, while those to the EU have specialized in vegetable and mineral products and base metals (Havlik, 2013).

exports to the EU due to tariff liberalization under the AA/DCFTA. Furthermore, Ukraine's value-added exports have shown to be competitive on the EU market (Nikonenko, 2020).

On the other hand, it may be easier and quicker to redirect many primary agro-food exports that were previously destined for Russia to other markets such as the EU. Also, the AA/DCFTA facilitates the increase in Ukrainian agro-food exports to the EU and third countries. Ukraine, which is known as the "breadbasket of Europe," has very fertile soil and landscape characteristics that allow for large fields and high yield, with almost 90% of crop areas devoted to cereals and oilseeds in the period 2015–2019 (Nykolyuk et al., 2021).[7] Agro-food goods are one of the key Ukrainian exports to the EU and as part of the AA/DCFTA, Ukraine agreed to approximate its sanitary and phytosanitary (SPS) legislation to the EU SPS legislation (European Commission, 2014). Alignment with EU SPS regulations is expected to improve Ukrainian producers' access to the EU market and other markets beyond the EU with similar regulations (Dabrowski, Zachmann and Domínguez-Jiménez, 2020). In addition, Ukrainian agro-food exports to the EU are expected to increase also due to the positive effects of tariff liberalization under the AA/DCFTA. Nonetheless, increases in agro-food exports to the EU and third countries need to be sufficiently large to offset the losses in trade associated with high-value manufactured exports to the Russian market since they accounted for a large share of exports to Russia which used to import a similar amount of Ukrainian goods as the EU. Alternatively, increasing industrial exports to fill the gap may have been difficult since, historically, many of these goods were produced in or linked to the supply chains of the Donbas which has been facing Russian occupation and war since 2014 (discussed in the following paragraph).

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[7] In addition to agro-food, Ukraine also has a comparative advantage in metallurgy (OON).
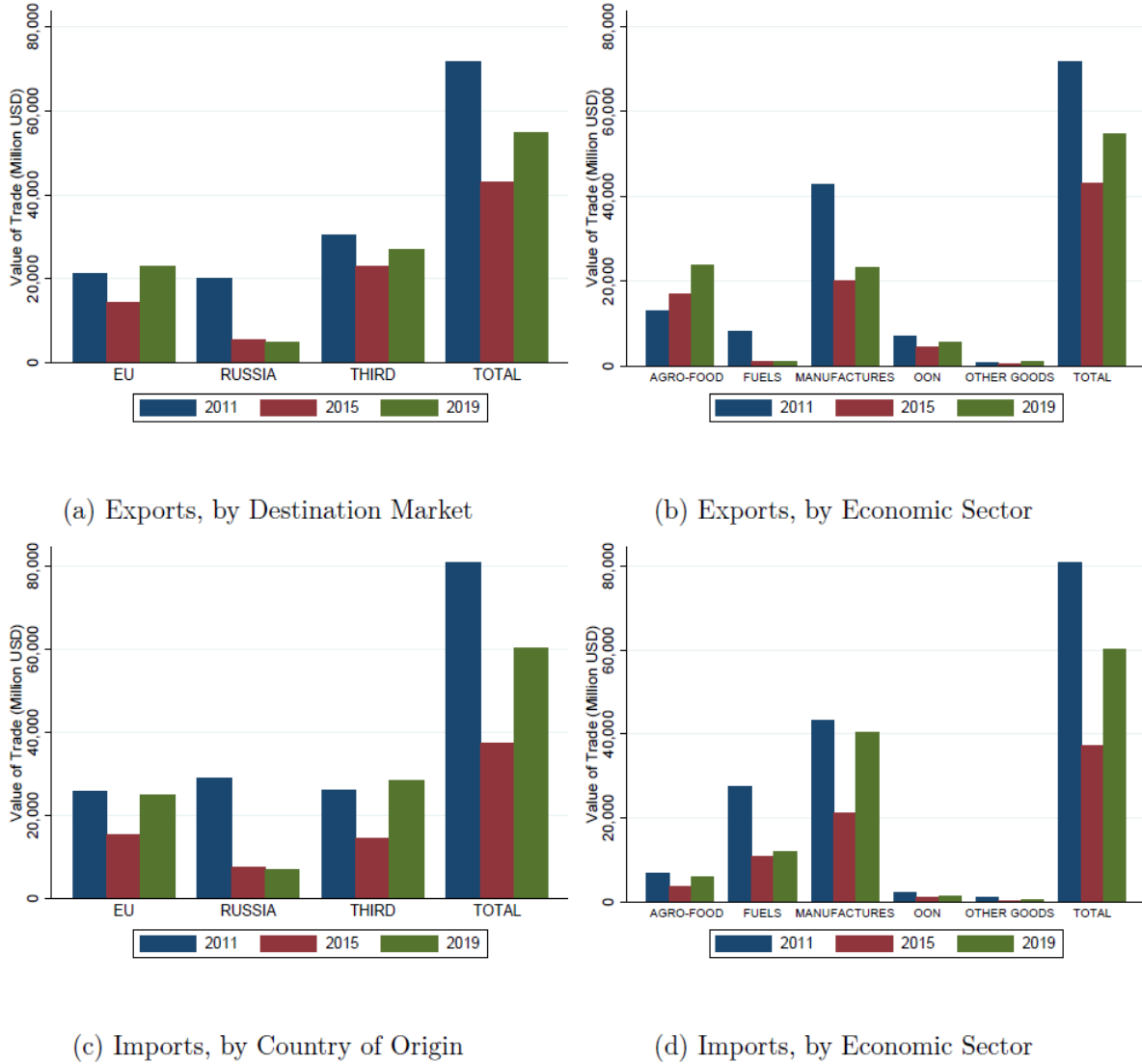
Third, the war and Russian occupation of Crimea and a part of the Donbas since 2014 disrupted Ukraine's economic activities along the supply chains and have had contractionary effects on foreign direct investments into Ukraine and the overall Ukrainian economy. This likely had a negative impact on trade with all of Ukraine's trade partners. For instance, Russia has stolen and destroyed Ukrainian production equipment and infrastructure, including railways and power lines. Ukrainian production has been disrupted also due to the loss in access to Ukrainian natural resources and many production assets in the temporarily occupied territories. Note that in 2013, prior to the war, the Donbas accounted for 21.4% of Ukrainian total exports and 7.9% of its total imports (Mykhnenko, 2020). Overall, the Donbas was Ukraine's greatest exporting region, and three-fourths of its commodity exports consisted of railway locomotives and ferrous metals and fuels, especially steel and coal, respectively (Mykhnenko, 2020). Since the Donbas is a key industrial region of Ukraine, it is unsurprising that there have been significant losses in the production and export of Ukraine's industrial goods due to Russia's war and occupation. For fuels in particular, there are significant reserves of natural gas and oil in the east of Ukraine and Crimea and in its offshore deposits in the Black Sea. However, Ukraine had lost access to such reserves, as well as many production assets, in the temporarily occupied territories in the Donbas and in annexed Crimea (and its associated Black Sea resources) due to Russian occupation since 2014. Furthermore, the destruction caused by the Russian military also disrupted Ukraine's production of fuels in the Donbas, including coal and electricity.

Figure 2 summarizes the geographical and sectoral composition of Ukrainian exports and imports for years 2011 (prior to the Russia-Ukraine war and signing of the EU-Ukraine AA/DCFTA), 2015 (after the onset of the Russia-Ukraine war, but before the full implementation of the EU-Ukraine AA/DCFTA), and 2019 (in light of the ongoing war and the

full implementation of the EU-Ukraine AA/DCFTA). Panels (a) and (b) summarize Ukrainian exports by destination market (panel a) and by economic sector (panel b) during these periods. Panels (c) and (d) summarize Ukrainian imports by country of origin (panel c) and economic sector (panel d). Trade partners in panels (a) and (c) of Figure 2 are grouped into Russia, EU, and "third countries". Economic sectors in panels (b) and (d) are grouped into five categories: (1) agro-food, (2) fuels, (3) manufactures, (4) ores, other minerals, and non-ferrous metals (OON), and (5) all other goods.

Figure 2 is consistent with the arguments made by Dabrowski, Zachmann and Domínguez-Jiménez (2020). Referring to panels (a) and (c) Figure 2, prior to the war and signing of the EU-Ukraine AA/DCFTA, Ukraine exported and imported approximately the same amount in its trade with Russia and the EU. However, both exports and imports (with all trade partners) dropped in 2015, after the onset of the Russia-Ukraine war and before the full implementation of the EU-Ukraine AA/DCFTA. In 2019, exports to third countries partially recovered and imports from the EU almost fully rebounded, while exports to the EU and imports from third countries that year slightly outweighed those in 2011. In contrast, Ukrainian trade (both exports and imports) with Russia faced a very significant decrease in 2015 and a further reduction in 2019. With regard to the sectoral composition of Ukrainian trade shown in panels (b) and (d) of Figure 2, all export and import sectors faced reductions in 2015 relative to 2011, except agro-food exports, which increased in 2015 and further in 2019. Also, in 2019, industrial exports (fuels, manufactures, and OON) and imports of each of the five economic sectors remained lower than in 2011, while exports of other goods (and agro-food) in 2019 outweighed those in the first period. In all three periods, Ukraine's largest shares of total exports consisted of agro-food and

Figure 2: Geographic and Sectoral Composition of Ukrainian Trade

(a) Exports, by Destination Market

(b) Exports, by Economic Sector

(c) Imports, by Country of Origin

(d) Imports, by Economic Sector

Note: Figure summarizes the geographical and sectoral composition of Ukrainian exports and imports for years 2011 (prior to the Russia-Ukraine War and signing of the EU-Ukraine AA/DCFTA), 2015 (after the onset of the Russia-Ukraine War but before the full implementation of the EU-Ukraine AA/DCFTA), and 2019 (in light of the ongoing war and the full implementation of the EU-Ukraine AA/DCFTA). Panels (a) and (b) summarize Ukrainian exports by destination market (panel a) and by economic sector (panel b) during these periods. Panels (c) and (d) summarize Ukrainian imports by country of origin (panel c) and economic sector (panel d). Trade partners in panels (a) and (c) are grouped into Russia, EU, and "third countries". Economic sectors in panels (b) and (d) are grouped into five categories: (1) agro-food, (2) fuels, (3) manufactures, (4) ores, other minerals, and non-ferrous metals (OON), and (5) all other goods.

manufactures.[8] However, the share of agro-food exports increased from 18% in 2011 to 43% in 2019, while the share of manufactures decreased from 60% in the first period to 42% in 2019. On the other hand, fuels and manufactures were the dominant imports during all three periods. Lastly, the total trade effects are negative relative to the first period.

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[8] Åslund (2018) notes that, traditionally, Ukraine's main exports have been steel, agricultural products, machinery, and chemicals (i.e., manufactures and agro-food).

3. METHODOLOGY

In this section, we exploit the timing of the regime changes described in Figure 1 to formally estimate the net trade impacts of the EU-Ukraine AA/DCFTA and contemporaneous Russia-Ukraine war on Ukrainian trade. To do so, we construct a dataset with annual, bilateral export and import flows for Ukraine and a set of comparator countries at the 6-digit level of the Harmonized Tariff Schedule (HS) for years 2000–2019. Using this data, we nest a difference-in-difference design within a series of econometric gravity models to estimate the effects of regime change.

3.1 Econometric model

Consistent with economic gravity theory (Baier and Bergstrand, 2009; Baldwin and Taglioni, 2006; Silva and Tenreyro, 2006), we postulate that the value of bilateral trade (V) in a given product p between an exporting country e and an importing country i in a given year t is a function of the economic "mass" of the exporting and importing countries (evaluated in terms of GDP), exchange rates, the level of (time variant) "multilateral resistance" experienced by the trade flow, and a set of time invariant factors (e.g., common colonial history and official language and geographic proximity and contiguity). Accordingly, we specify two models of the form:

$$V_{iept} = \alpha Y_{it}^{\beta_1} Y_{et}^{\beta_2} exp[\beta_3 FX_{et} + \beta_4 FX_{it} + \sum_r \sum_j \sum_s \gamma_{r,j,s} \left(\iota_r \times \iota_j \times \iota_s \right) + \mathbf{Z}'\theta]\varepsilon_{iept} \qquad (1)$$

The first model described by equation (1) is specified to measure the net effects of the EU-Ukraine AA/DCFTA and Russia's aggression (military invasion, occupation, and punitive trade measures) on Ukrainian exports. In this construction, dependent variable V measures trade outflows from Ukraine and a set of control countries. The second model—specified to measure the effects on Ukrainian imports—specifies the dependent variable as trade inflows into Ukraine

and the same set of control countries. In both models, variables *Y* and *FX* denote exporter and importer GDP and exchange rates (relative to U.S. dollars), respectively.

Vector **Z** in both models includes panel fixed effects (i.e., fixed effects for each importer-exporter-product combination), which control for time invariant geopolitical factors, such as distance between trade partners, common colonial history and official language, and geographical contiguity. We also include in Vector **Z** an indicator variable to denote whether the trade partners are mutual members of an FTA. We include a series of year fixed effects, which control for market-level shocks in a given year that affect all trade partners and products equivalently. Finally, to control for time-varying, importer-exporter-product-specific elements of multilateral trade resistance (*MTR*), we use Baier and Bergstrand (2009) first-order expansions of distance between trading country pairs (MTR_{dist}), mutual free trade agreements (MTR_{FTA}), the existence of a common colonial relationship (MTR_{colony}), geographical contiguity (MTR_{contig}), and a common official language ($MTR_{comlang}$) (Nes, Schaefer and P Scheitrum, 2022).

3.1.1 Treatment variables

We allow—but do not impose—that the promulgation and implementation of the EU-Ukraine AA/DCFTA and onset of the Russia-Ukraine war affected gravity relationships heterogeneously for different sectors and trade partners. We estimate a separate impact for each trade partner-sector combination for Regime 1 (beginning in 2014) and Regime 2 (beginning in 2016). To do so, in the models described in equation (1), we include interactions between series of indicator variables indexed as ι_s, ι_j, and ι_r. Indicators ι_s are three binary variables to denote whether the observed trade partner is Russia (ι_{RUSSIA}), the EU (ι_{EU}), or a third country (ι_{THIRD}). In each case, the variable takes value one for the relevant trade partner and is otherwise equal to zero. Equivalently, indicators ι_j are five binary variables to denote whether the product is within the

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agro-food sector (ι_{AGRO}), the fuels sector (ι_{FUEL}), the manufactures sector (ι_{MAN}), the OON sector (ι_{OON}), or all other goods (ι_{OTHER}). Finally, indicators ι_r are binary variables that indicate whether the observation occurs in Regime 1, i.e., any period from 2014 onward, (ι_{R1}) or Regime 2, i.e., any period from 2016 onward, (ι_{R2}). Note that the "net" effect of the EU-Ukraine AA/DCFTA and Russia's aggression on trade partner-sector s, j in Regime 2—relative to the pre-2014 base period—is the sum of coefficients $\gamma_{R1,s,j} + \gamma_{R2,s,j}$.[9]

3.1.2 Sampled countries

For each regression, we include as "treated" observations all trade flows originating from Ukraine (in the export model) or destined for Ukraine (in the import model). Countries chosen as controls are post-Soviet countries and other countries that had similar proximity to the EU and Russia, whose trade policy relationships with the EU and Russia had not "substantially" changed over the sample period. Thus, we exclude CEEC-4 countries (Romania, Hungary, Bulgaria, and Poland), which were annexed into the European Union in the early 2000s. We also exclude Georgia and Moldova because they also signed Association Agreements, which include Deep and Comprehensive Free Trade Areas, with the EU during the sample period. Our final set of control countries includes Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Belarus, Kazakhstan, Kyrgyzstan, North Macedonia, Serbia, and Turkey. "Control" observations are all trade flows originating from these countries (in the export model) or destined for these countries (in the import model).

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[9] In Section 4, treatment effects are reported as percent changes using the following transformation: $e^{\hat{\gamma}} - 1$.

3.1.3 Estimation method

We estimate the models using the (Silva and Tenreyro, 2006) Pseudo-Poisson Maximum Likelihood (PPML) method. Consistent with previous applied trade policy literature (Nes and Schaefer, 2022), standard errors for all coefficients are clustered at the importer-exporter level. To aggregate impacts across all trade partners for a given economic sector or across all economic sectors for a given trade partner, we calculate—for each trade flow—the value of trade predicted by our model in light of the policy treatments—$\hat{V}$ (i.e., the fitted values of the gravity models described in equation (1)). We then calculate the corresponding value of trade predicted by our model had no regime change occurred—$E(V \,|\iota_r = 0 \forall r)$. Thus, for a given trade flow, the total change in trade induced by regime change is calculated as $\hat{V} - E(V \,|\iota_r = 0 \forall r)$, and the total value of lost trade for a given trade partner or given sector is the sum of affected trade flows.

3.1.4 Model robustness

We assess the sensitivity of our results with respect to alternative assumptions regarding the number of policy regime changes and allowing for trade diversion and destruction in the fuels sector driven by historical natural gas supply cuts. For the first set of robustness checks, we re-estimate the model, allowing for only a single regime change at year 2014 (and running through 2019). Additionally, we estimate models that control for the major natural gas supply cuts by Russia to Ukraine in 2006, 2009, 2014, and 2015 by including an additional indicator variable (cut_t), which is interacted with sectoral dummies for Ukrainian manufactures, fuels and OON based on the assumption that industrial production and exports may have been negatively impacted by these shutoffs. The results of these robustness checks are consistent with those in the preferred model. Estimated treatment effects are shown in Appendix Figure 6.

3.2 Data and summary statistics

The bilateral trade data used in our analysis are obtained from UN Comtrade. Information on GDP and exchange rates are from the World Bank Group. Data on FTAs are from the World Trade Organization (WTO) Regional Trade Agreement database. Information on the existence of common colonial relationships, geographic distance, contiguity, and common official language between the trade partners, used to construct the Baier and Bergstrand (2009) MTR terms is obtained from CEPII (Mayer and Zignago, 2011; Melitz and Toubal, 2014). Trade flows are allocated to the five sectoral categories (agro-food, fuels, manufactures, OON, and other goods) based on the concordance between 6-digit HS product description and the Standard International Trade Classification (SITC) Revision 4 of the European Commission (European Commission, 2020).

Summary statistics for the final dataset are reported in Table 1. Our export model contains 6,373 commodities at the 6-digit HS level spanning 168 importing countries for a total of 810,070 unique panel groups and 14,953,119 observations. Our import model includes observations on 6,481 commodities spanning 174 countries of origin for a total of 982,789 unique panel groups and 17,997,260 observations.

Table 1: Summary Statistics for Gravity Estimation

Variable	Export Model (obs = 14,953,119)				Import Model (obs = 17,997,260)			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
V_{iept} (in $ Millions)	0.3	27.3	0	27,600	0.3	18.2	0	17,500
Ln GDP$_{et}$	25	2	21	28	27	2	18	31
Ln GDP$_{it}$	25	2	18	31	24	2	21	28
Ln FX$_{et}$	1.8	1.9	-2.4	6.4	2.5	2.6	-3.1	22.6
Ln FX$_{it}$	2.7	2.6	-3.1	22.6	2.6	2.3	-2.4	6.4
FTA$_{iet}$	0.2	0.4	0	1	0.2	0.4	0	1

4. RESULTS

As discussed above, we estimate equation 1 separately for Ukrainian imports and Ukrainian exports. Results are provided in Section 4.1. Recall from Section 2.3 that the net effects of the AA/DCFTA and Russia's aggression are likely to be heterogeneous in the trade with different partners and the composition of trade. Thus, we discuss the aggregated impacts by trade partners in Section 4.2 and the aggregated impacts by economic sectors in Section 4.3. We discuss the aggregated total impacts in Section 4.4.
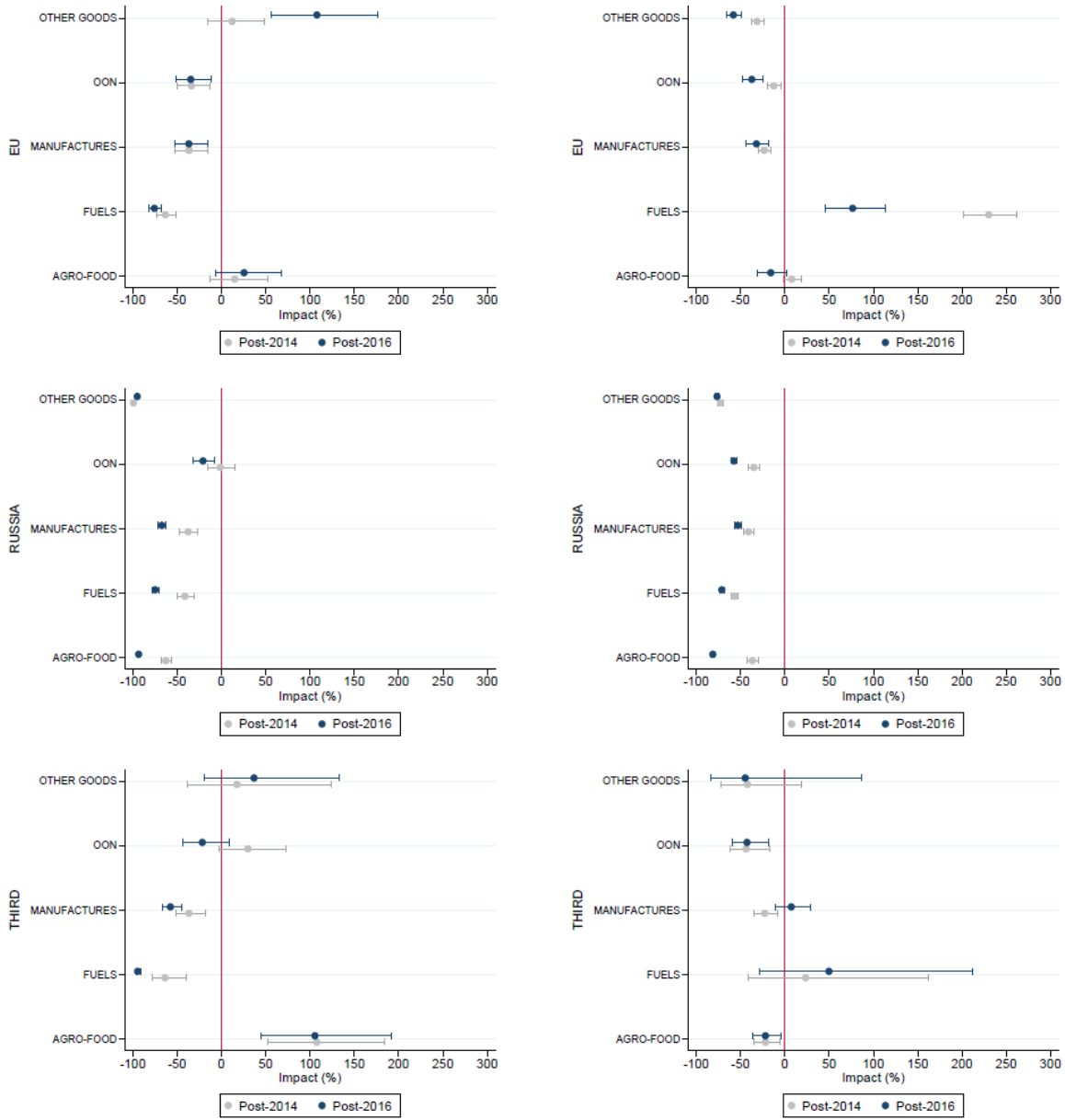
4.1 Regression results

Figure 3 reports the estimated treatment effects of regime change from the base period (2000–2014) to Regime 1 (2014–2016) and to Regime 2 (2016–2019) for Ukrainian exports (panel a) and imports (panel b).[10] In each quadrant of the Figure, the dots characterize point estimates for the corresponding treatment effect and the whiskers represent the 95% confidence intervals. Note that the Regime 2 treatment effects reported in Figure 3 are "net" effects, which—as explained in Section 3—are interpreted relative to the pre-2014 base period.

4.1.1 Impacts on Ukrainian exports

Referring to the sector-specific treatment effects for Ukrainian exports to the EU shown in the upper left-hand-side quadrant in Figure 3, the fuels sector experienced the largest reduction in trade as a result of policy regime change. Transition to Regime 1 generated a 63.5% reduction (statistically significant at the 1% level) in fuel exports. This trade impact was slightly intensified in transition to Regime 2 under which the estimated treatment effect was a 93.5% reduction (significant at the 1% level). Exports of manufactures to the EU experienced a 36.5% decrease

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[10] Coefficient estimates for control variables are reported in Appendix Table 2 and are consistent with previous literature (Schaefer, Scheitrum and Nes, 2018).

Figure 3: Estimated Treatment Effects of Regime Change

(a) Exports   (b) Imports

Note: Figure reports the estimated treatment effects of regime change from the base period (2000–2014) to Regime 1 (2014–2016) and to Regime 2 (2016–2019) for Ukrainian exports (panel a) and imports (panel b). Regime 2 treatment effects are "net" effects interpreted relative to a no-regime-change counterfactual. In each quadrant of the Figure, the dots characterize point estimates for the corresponding treatment effect and the whiskers represent the 95% confidence intervals.

(significant at the 1% level) under Regime 1 and a 36.9% decrease under Regime 2, relative to the counterfactual scenario in which the Russia-Ukraine war and other Russian backlash were to have not occurred and the AA/DCFTA was to have not been signed. In contrast, agro-food exports to the EU experienced an increase of 14.9% (statistically significant at the 10% level) during Regime 1 and an increase of 12.3% (statistically significant at the 10% level) during Regime 2. For each of these sectors, the similarity in treatment effects between Regime 1 and Regime 2 is consistent with the fact that EU preferential trade access to Ukrainian goods started in 2014. Thus, the provisional implementation of the DCFTA in 2016 may not have had a meaningful additional impact on Ukrainian exports to the EU.

Referring to the sector-specific treatment effects for Ukrainian exports to Russia shown in the middle left-hand quadrant in Figure 3, we see that all sectors faced substantial reductions in trade. These results are expected because Russia's aggression substantially reduced the trade between Ukraine and Russia. In addition to the Russian military invasion and occupation, Russia had implemented punitive trade measures against Ukraine, including increases in border controls for all Ukrainian goods. Ukrainian agro-food and manufactures exports to Russia fell 62.8% and 37.6%, respectively, under Regime 1 (both statistically significant at the 1% level). This is also expected because Russia imposed bans on many agro-food and manufactured goods from Ukraine. Under Regime 2 when Russia revoked its FTA with Ukraine and banned Ukrainian agro-food goods, trade losses in both sectors intensified for a net reduction of 93.5% and 67.3%. The largest reductions are observed for "other goods". We estimate a 99.4% decrease (significant at the 1% level) in Ukrainian exports of other goods to Russia during Regime 1 and a 95.1% decrease (significant at the 1% level) in such exports to Russia in Regime 2.

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Sector-specific treatment effects for Ukrainian exports to third countries—shown in the bottom left-hand-side quadrant of Figure 3—are mixed. Fuel exports to third-country partners fell by 63.8% (statistically significant at the 1% level) under Regime 1 and by 94.6% under Regime 2 (significant at the 1% level). Manufactures exports experienced the second-largest reduction among third-country partners with a 36.8% reduction (significant at the 1% level) in Regime 1 and a 57.7% reduction (significant at the 1% level) in Regime 2. In contrast, agro-food exports to third countries increased by approximately 107.6% (significant at the 1% level) following regime change.

4.1.2 Impacts on Ukrainian imports

Referring to the sector-specific treatment effects for Ukraine's imports from the EU shown in the upper right-hand-side quadrant in Figure 3, we see that fuel imports from the EU increased in both regimes (230.2% in Regime 1 and 76.5% in Regime 2), almost certainly as a result of the reduction in the imports of fuels from Russia (discussed in the following paragraph). Treatment effects for agro-food imports from the EU are statistically indistinguishable from zero under both regime changes. For all other sectors, we see that the "Regime 1" treatment effects are negative, and statistically significant at the 10% level. For each of these sectors, "Regime 2" treatment effects at least partially intensify the losses in trade associated with the initial regime change. For example, Ukrainian imports of other goods from the EU experienced a 31.4% reduction in trade in Regime 1. This trade loss was intensified in Regime 2, such that the net reduction during that period was 58.1% (relative to a counterfactual scenario of no regime change). Somewhat unique among EU sector-specific treatment effects, there is a relatively small difference between the post-2014 and post-2016 treatment effects for manufactured imports—23.3% reduction in Regime 1 compared with a 32.2% reduction in Regime 2.

Referring to the sector-specific treatment effects for Ukrainian imports from Russia shown in the middle right-hand-side quadrant of Figure 3, we see that the net result of the EU-Ukraine AA/DCFTA and the concurrent Russian backlash was a reduction in trade for all sectors for both Regime 1 and further exacerbated in Regime 2. Recall that during Regime 2, Ukraine banned various food and manufactured imports from Russia and imposed import duties on Russian goods. The treatment effects are statistically significant at the 1% level. Russian fuels experienced the second-largest Regime 1 trade loss with an estimated treatment effect of a 56.7% reduction. Under Regime 2, these trade losses increased to 71.2% of the counterfactual. Agro-food imports from Russia experienced the largest trade reduction in Regime 2 at 81.3%. Sector-specific treatment effects for Ukrainian imports from third countries—shown in the bottom right-hand-side quadrant of Figure 3—are generally statistically indistinguishable from zero, with the exception of OON and agro-food imports (and manufactures in Regime 1), which experienced losses of 43.8% and 21.8%, respectively.

After estimating the marginal impacts on trade due to regime change, we turn to the aggregated impacts. The regression results show that the net effects of the AA/DCFTA and Russia's aggression were heterogeneous both in terms of various trade partners and on the sectoral composition of trade. These effects are discussed in turn below.

4.2 Aggregate impacts by trade partner

The aggregation of impacts by trade partner is performed as described in Section 3.1. Specifically, we use the coefficient estimates reported in Figure 3 to assess the aggregate value of change in Ukrainian exports and imports experienced for a given trade partner across all sectors. Figure 4 shows these aggregate country-level impacts for year 2019.

Figure 4: Country-Level Impacts of Regime Change (2019)

(a) Impact on Exports

(b) Impact on Imports
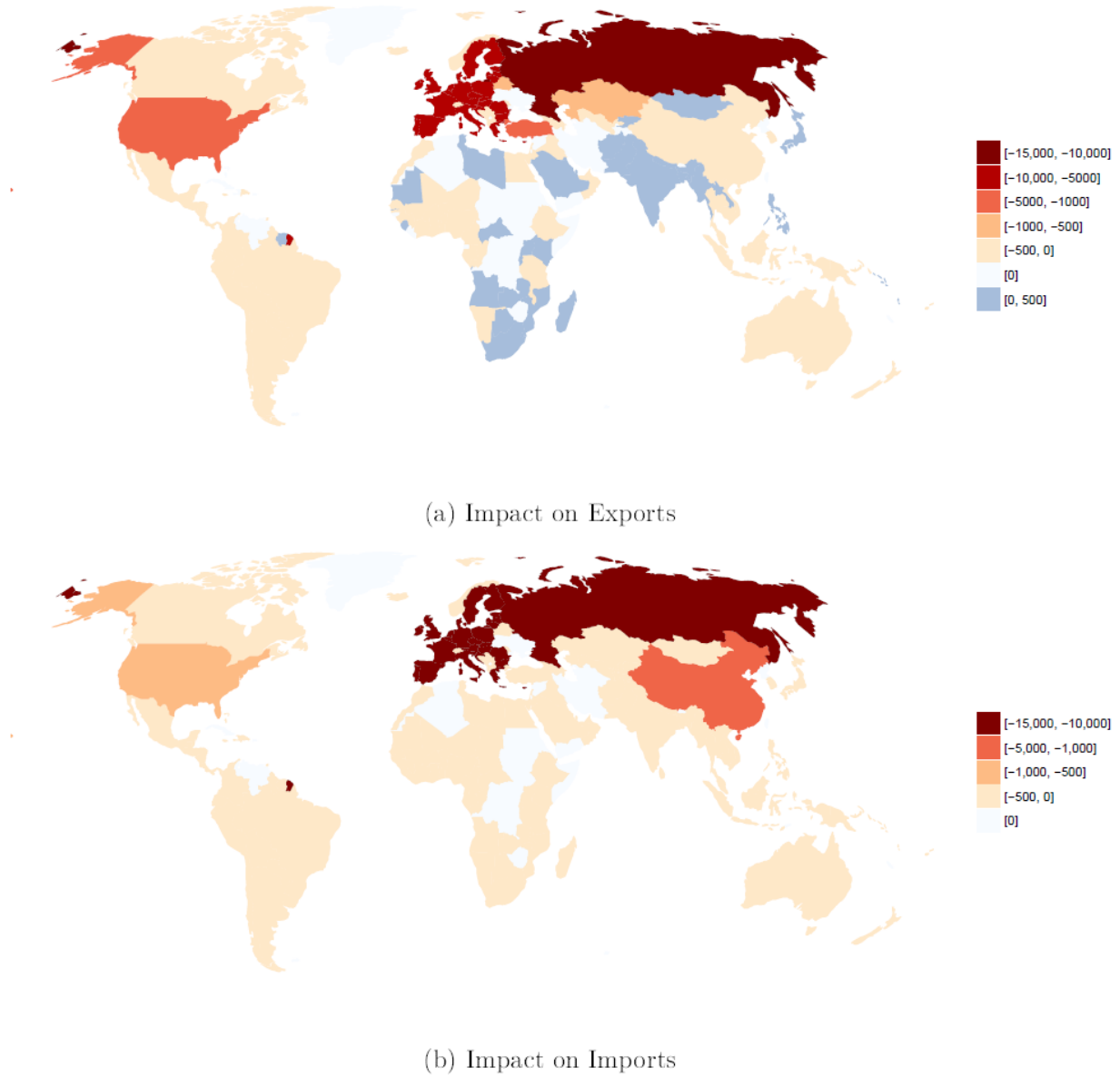
Note: Figure 4 shows the country-level impacts (million USD) of regime change for exports (panel a) and imports (panel b) for year 2019. As described in Section 3.1, these impacts are assessed by aggregating the value of change in Ukrainian trade experienced for a given trade partner across all sectors.

4.2.1 Aggregate impacts on exports

Panel (a) of Figure 4 shows these aggregate country-level impacts on exports for year 2019. As expected, the largest export losses are into the Russian market, which saw a loss of $12.1 billion in trade. Perhaps surprisingly, the second-largest export losses were into the EU, which

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experienced a $8.4 billion loss in trade. Since the composition of exports to many countries is largely based in agro-food products, exports into some countries increased as a result of the policy regime change. The largest export gains were experienced in the Saudi Arabian market ($227.4 million gain), India ($110.7 million gain), and Japan ($104.6 million gain).

4.2.2 Aggregate impacts on imports

Panel (b) of Figure 4 shows the aggregate import impacts at the country-level for year 2019. In contrast to exports (panel a of Figure 4), we observe a contraction from all markets for Ukraine's imports. Imports from Russia experienced the largest reduction, with a decline of $14.7 billion, followed by the EU with a loss of $13.2 billion. Other major losses include imports from China ($1.9 billion loss), the USA ($550.8 million loss), and Turkey ($408.6 million loss).

4.3 Aggregate impacts by economic sector

As with trade with different partner countries, the policy regime change had heterogenous impacts across different economic sectors. Recall that, although Ukraine exported similar amounts to the EU and Russia before the war, a larger share of exports to Russia consisted of manufactures during all the years of the sample period. Also, the combat zones during the sample period have been located in the Donbas which is a key industrial region of Ukraine, so it can be expected that the industrial export sectors faced especially significant losses due to Russia's war and occupation.[11] In Figure 5, we assess the aggregate sector-level impacts (evaluated across all trade partners) for year 2019.

4.3.1 Aggregate impacts on exports

Panel (a) of Figure 5 shows these aggregate sector-level impacts for exports for year 2019. For

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[11] Nonetheless, it is important to note that the Russian invasion of Ukraine also caused major losses in the Ukrainian agro-food sector.

Figure 5: Sector- and Economy-Wide Impacts

(a) Impacts on Exports by Sector (2019)

(b) Impacts on Imports by Sector (2019)

(c) Impacts on Total Exports

(d) Impacts on Total Imports

Note: Figure shows the sector-level impacts of regime change for exports (panel a) and imports (panel b) for year 2019. As described in Section 3.1, these impacts are assessed by aggregating the value of change in Ukrainian trade experienced across all trade partners for a given sector. Panels (c) and (d) reports impacts aggregated across all sectors and trade partners for the total value of lost Ukrainian exports (panel c) and imports (panel d).

agro-food exports, the increase in trade with the EU and third-country partners outweighed the reductions in the trade with Russia. Across all markets, Ukrainian agro-food exports totaled $23.2 billion in 2019, compared to $16.1 billion in the no-policy-regime-change counterfactual scenario, for a net increase of $7.1 billion. In contrast to the agro-food sector, actual trade values for manufactures and fuels in 2019 are substantially less than their respective counterfactual

estimates. As shown in panel (a) of Figure 5, actual manufactures exports in light of the policy regime change were $27.3 billion compared to $52.3 billion had the regime change not occurred, for a net loss of $25.0 billion. Similarly, actual fuel exports amounted to $1.7 billion versus $6.8 billion in the counterfactual, for a net loss of $5.2 billion.

4.3.2 Aggregate impacts on imports

Panel (b) of Figure 5 reports the aggregate sector-level impacts for imports in year 2019. Referring to the Figure, we observe a loss in imports for all economic sectors. Actual imports of manufactures were $37.5 billion in 2019 compared with a counterfactual of $48.7 billion, for a sectoral loss of $11.1 billion. Similarly, fuel and agro-food imports were $12.6 billion and $5.7 billion in 2019, respectively, versus counterfactual values of $18.9 billion and $7.7 billion, for sectoral losses of $6.3 billion and $2.0 billion. With regard to fuel imports, the implication is that although Ukraine temporarily lost access to fuel reserves and production assets in Crimea and a part of the Donbas due to Russian occupation, there was still a net reduction in Ukraine's imports of foreign fuels. A possible explanation for this result is that commercial demand for fuels may have decreased since the war and Russian occupation led to losses in Ukrainian production assets and disruptions in economic production, especially fuel-intensive production, and supply chains across Ukraine. Also, Ukraine lost a portion of its population due to war and occupation which may have caused a decrease in total consumer demand for fuels. The same reasoning may explain the losses in imports for all economic sectors.

4.4 Aggregated total impacts

Finally, we aggregate across all sectors and trade partners to assess the total value of lost Ukrainian exports and imports. Panel (c) of Figure 5 shows these aggregate impacts for years 2014–2019 for exports. As shown in the Figure, the policy regime change resulted in total

exports for all years increasing from a loss of $22.2 billion ($53.3 billion actual compared to a counterfactual of $75.6 billion) in 2014 to a loss in exports of $24.4 billion in 2019 ($59.3 billion actual versus $83.7 billion counterfactual). Panel (d) of Figure 5 shows the total value of lost imports for years 2014–2019. Consistent with the results for exports, the policy regime change resulted in a reduction in total imports for all years, starting with a loss of $17.4 billion ($52.9 billion actual compared to a counterfactual of $70.3 billion) in 2014 and rising to a loss of $21.2 billion in 2019 ($57.6 billion actual versus $78.7 billion counterfactual).

Overall, the net trade effects of the EU-Ukraine AA/DCFTA and Russia's aggression were substantial reductions in Ukrainian imports and exports. Importantly, these outcomes were negative for *both* of Ukraine's historically main trade partners: the EU and Russia. The negative effects on trade extend to other major trade partners, including exports to the U.S. and imports from China. For imports, we observe this reduction across all economic sectors. For exports, as predicted by Dabrowski, Zachmann and Domínguez-Jiménez (2020), most of the losses were driven by a reduction in manufactured exports of which a substantial portion, historically, was produced in Ukraine's Donbas region and, in the past, was also largely exported to the Russian market. These results further demonstrate the highly destructive impacts of Russia's war against Ukraine (in the Donbas during the sample period), and that time and investments are needed to redirect to the EU those manufactured goods that were traditionally produced for the Russian market.

We do observe a positive impact on agricultural exports destined for the EU market. This is consistent with the fact that Ukrainian producers gained favorable access to the EU market under the EU-Ukraine AA/DCFTA. We also see in Figure 4 signs that Ukrainian agricultural producers are increasing their exports to countries beyond those in the EU, such as India and

several countries in the Middle East. However, as seen in Figure 4, the positive impacts on exports of agro-food and "other goods" into the EU were outweighed by net negative impacts on other sectors, which led to an overall negative impact on exports into the EU market.

5. CONCLUSION

In this research, we estimate the net international trade effects of the EU-Ukraine Association Agreement and Russia's contemporaneous war against Ukraine. To do so, we construct a dataset with annual, bilateral export and import flows for Ukraine and a set of comparator countries at the 6-digit level of the Harmonized Tariff Schedule for years 2000–2019. Using this data, we nest a difference-in-difference design within a series of econometric gravity models to estimate the net effects of the EU-Ukraine AA/DCFTA and Russia's concurrent aggression on the sectoral and geographic composition of Ukrainian trade.

Our results indicate a substantial contraction in Ukraine's international trade. In 2019, the total value of lost exports was $24.4 billion. Imports fell by approximately $21.2 billion. However, the Ukrainian agro-food sector prevailed with a net export gain of $7.1 billion. In contrast, the industrial export sector faced a net loss. Net trade reduction effects were found not only in the trade with Russia, but also with the EU and major third-country trade partners, including the USA, China, and Turkey.

Of course, as with any research, our findings are not without limitations. Importantly, because we observe trade flows in only six years of the Russia-Ukraine war and the EU-Ukraine AA/DCFTA, our estimates are necessarily "short-term" impacts. The long-term redirection of trade requires exporters in Ukraine to find new buyers for their goods and requires Ukrainian buyers to identify new sellers of their imports. These acts of economic search may play out over a longer time horizon than our sample allows. Furthermore, the transitional period for the full liberalization of import tariffs in Ukraine is up to ten years, compared to seven years for the EU (European Commission, 2014a). In the long run, the DCFTA may increase Ukraine's imports from the EU and have additional positive impacts on various Ukrainian export sectors in their

trade with the EU and third countries. Such increases in exports to these markets could be facilitated by the further alignment of Ukraine's legislation and standards with those of the EU, as set forth in the AA. For instance, the EU and Ukraine agreed to eventually adopt an Agreement on Conformity Assessment and Acceptance of Industrial Products (ACAA) as a Protocol to the AA (European Commission, 2014). The ACAA aims to eliminate the technical barriers to Ukraine's exports of industrial goods to the EU (Ministry of Foreign Affairs of Ukraine, 2021). Therefore, in the future, the ACAA may increase Ukraine's industrial exports to the EU, as well as to third countries (Ministry of Foreign Affairs of Ukraine, 2021). Further research is needed to assess the long-term trade impacts of the AA/DCFTA.

Moreover, alongside the ongoing implementation of the EU-Ukraine AA/DCFTA reforms, Ukraine has also passed other domestic reforms and government programs. For instance, a land reform was passed in 2020, lifting the ban on the sale and purchase of agricultural land since July 2021 (discussed in the following section). These reforms may incentivize and facilitate new investments in agriculture and other sectors, potentially increasing output and bringing more goods into compliance with EU regulations and standards.

However, the net effects on Ukraine's exports and imports will also depend on the duration and extent of destruction of Russia's war against Ukraine which has caused major losses in all Ukrainian economic sectors, including the agro-food sector. For instance, the Ukrainian infrastructure and production assets that were stolen and destroyed by Russia will need to be rebuilt in order for Ukraine's production and exports to recover to pre-war or higher levels, especially in the capital-intensive industrial sectors. Above all, note that while this research considers the destructive trade effects of Russia's invasion, it is important to remember

that Russia has inflicted a large number of deaths and immense suffering on the Ukrainian people, which are the most tragic effects of Russia's war against Ukraine.

Finally, we stress that our trade findings do not imply that the pursuit of Ukraine's self-determination was ill-conceived. Our estimates are "short-term" net impacts and trade outcomes are only one of the many considerations that govern Ukraine's pursuit of EU integration, while Russia's unprovoked, illegal, and unjustified contemporaneous war against Ukraine has had destructive impacts on the net trade outcomes. In addition to trade policy, the EU-Ukraine Association Agreement fosters the adoption of several political, legal, and socio-economic reforms and technical standards (Aslund, 2015), which aim to strengthen Ukraine's institutions and economy and integrate Ukraine into the EU. The redirection of the trade with Russia to the EU and third countries in the agro-food and "other goods" export sectors and the strategic fuels import sector may signal that Ukraine had already become more resilient in the face of Russia's punitive measures. Most notably, Ukraine continues to prove its strong and unwavering commitment to EU integration and the defense of Western values and principles, all while facing Russia's aggression.

6. LONG-TERM AGRO-FOOD OPPORTUNITIES

The growth of the agro-food sector in Ukraine has been accompanied by the adoption of land reform in 2020 which removed the moratorium on the sale of arable land. Therefore, since July 2021, Ukrainian citizens are allowed to sell and buy land, while Ukrainian legal entities will be able to participate in the land market from 2024 (International Trade Administration, 2020). A desired goal of this policy is to increase agro-food output through greater investments in agricultural capital and land. For instance, since farmers will gain ownership over their land, they will be able to use it as collateral. This provides farmers with greater access to credit which can be used for investments into agricultural production, such as through purchases of technologically advanced farming machinery and equipment. Such an improvement in the access to domestic credit is important because cheaper foreign credit has been more difficult to attract due to the war in Ukraine (International Trade Administration, 2020). Land ownership also produces incentives for direct investments into the land, such as the installment of irrigation and drainage systems (International Trade Administration, 2020). Since Ukraine has a comparative advantage in agriculture, such investments into the agro-food sector are expected to promote the growth and further modernization of Ukraine's economy.

In addition, the EU-Ukraine AA/DCFTA may potentially have a larger positive effect on Ukrainian agro-food exports to the EU, as well as to third countries, in the long run when Ukraine will have further aligned its SPS legislation with that of the EU and when Ukrainian producers will have obtained additional funds and have had more time to adjust their production to EU standards and regulations. Note that this alignment of Ukraine's legislation and domestic production is a costly and lengthy process which is still ongoing. On the production side, the ability to more fully take advantage of the DCFTA benefits partially depends on the speed at

which Ukrainian producers adjust their production to EU standards and market requirements and

on the level of access to credit, investments, business partners in EU countries, and knowledge

about EU legislation and markets (Institute of Economic Research and Policy Consulting, 2016).

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APPENDIX

Table 2: Coefficient Estimates for Control Variables

	(1)	(2)
VARIABLES	Exports	Imports
MTR_{dist}	-2.4e-6	-1.1e-6
	(4.2e-6)	(1.1e-6)
MTR_{FTA}	0.0004*	-0.001**
	(0.0003)	(0.0007)
MTR_{colony}	0.002**	0.002**
	(0.001)	(0.001)
MTR_{contig}	-4.4e-5	-0.003*
	(0.0002)	(0.001)
$MTR_{comlang}$	-0.001**	-0.001
	(0.0003)	(0.002)
$Ln(GDP)_{et}$	0.395**	0.390***
	(0.172)	(0.070)
$Ln(GDP)_{it}$	0.316***	0.075
	(0.110)	(0.109)
$Ln(FX)_{et}$	-0.154**	-0.057
	(0.078)	(0.061)
$Ln(FX)_{it}$	-0.044	-0.132**
	(0.092)	(0.058)
FTA	0.512***	0.359***
	(0.129)	(0.091)
Constant	-0.884	4.612
	(5.551)	(3.856)
Panel FE	Yes	Yes
Year FE	Yes	Yes
Observations	14,695,942	17,441,315

Standard errors (reported in parentheses) are clustered by importer-exporter.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Figure 6: Model Robustness—Estimated Treatment Effects of Regime Change
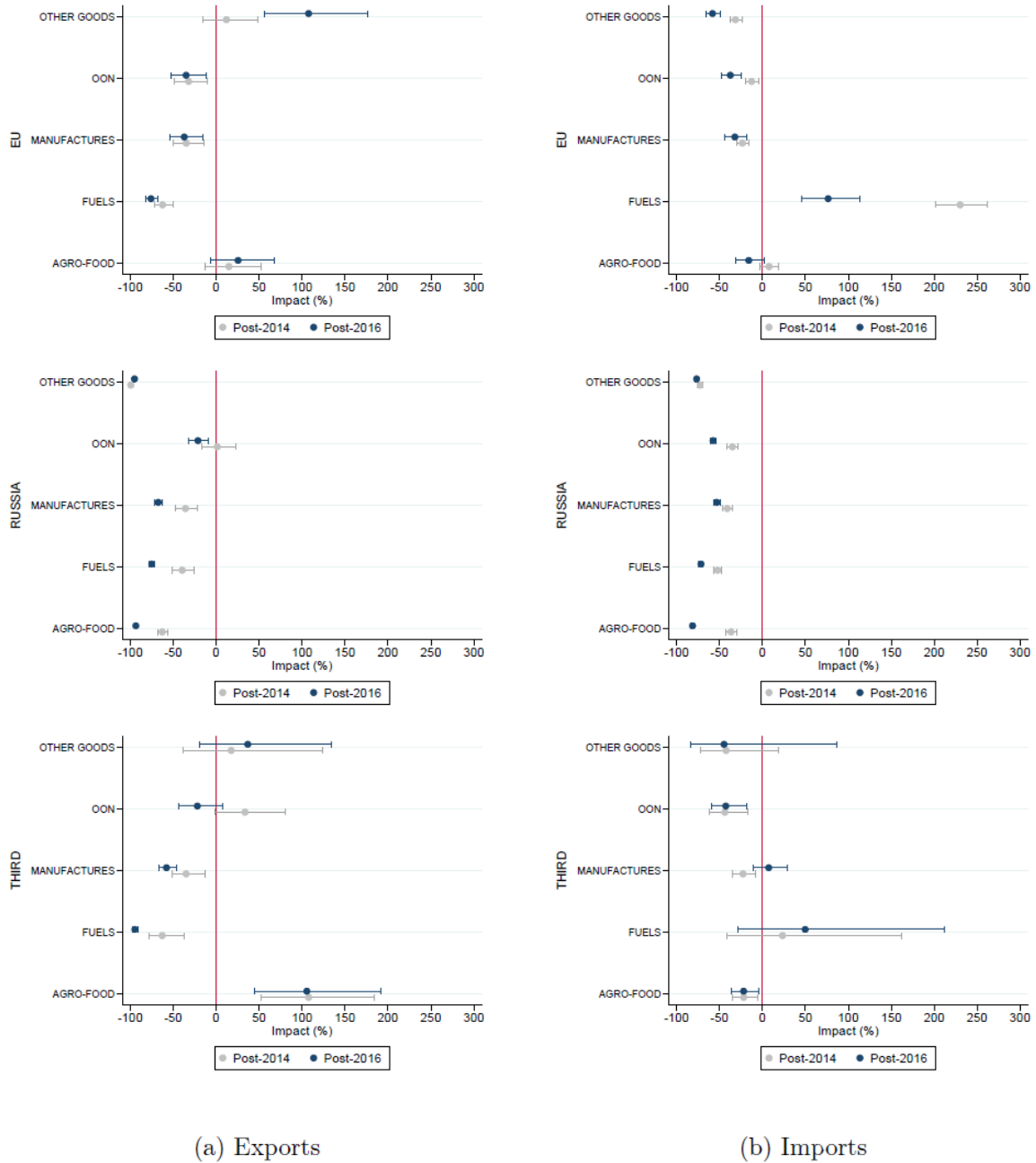
(a) Exports

(b) Imports

Note: Figure reports the estimated treatment effects of regime change from the base period (2000–2014) to Regime 1 (2014–2016) and to Regime 2 (2016–2019) for Ukrainian exports (panel a) and imports (panel b). Regime 2 treatment effects are "net" effects interpreted relative to a no-regime-change counterfactual. In each quadrant of the Figure, the dots characterize point estimates for the corresponding treatment effect and the whiskers represent the 95% confidence intervals.

Model Specification: These results are for a model that controls for the major natural gas supply cuts by Russia to Ukraine in 2006, 2009, 2014, and 2015 by including an additional indicator variable (cut_t), which is interacted with sectoral dummies for Ukrainian manufactures, fuels and OON based on the assumption that industrial production and exports may have been negatively impacted by these shutoffs.