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Protectionism in Disguise? EU Anti-Dumping Measures Targeting PRC Iron and Steel Products

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Abstract

As dumping can harm industries by distorting competition, the World Trade Organization holds the option for its members to take anti-dumping measures. The European Union (EU) responds collectively to such threats and adjusts the supposedly dumped goods' prices through tariffs back to their apparent "fair" value. Some critics argue though that the EU's anti-dumping measures reduce economic efficiency and are actually protectionism in disguise. Our analysis of EU anti-dumping measures on Chinese iron and steel products points out that the "fair" value is indeed fair. Using the augmented synthetic control method, we show that the total EU import volume in the sanctioned product class remains constant, the import volume from China after introducing the tariff is significantly reduced, and the increase in total world import price is insignificant. Results thus suggest that supply from China is substituted through imports of countries outside the single market and that claims of protectionism are largely unfounded

Keywords Anti-dumping \cdot Synthetic control method \cdot European Union \cdot Protectionism \cdot Steel

JEL Classification $F13 \cdot F14 \cdot F53$

1 Introduction

Industrial policy can distort functioning markets by supplying them with artificially lowcost products, commonly referred to as "dumping." In recent decades, the number of antidumping measures employed to counter such policies has steadily risen. These measures are generally intended to ensure "fair" markets under the rules-based system of the World Trade Organization. Nevertheless, they can be exploited and turned against free markets in a protectionist manner (Bhagwati 1988). The effectiveness of the levied tariffs and their economic justification has been questioned by economists such as Messerlin (1996) and Deardorff (1989), who have labeled them as a form of "protectionism in disguise."

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Recent empirical studies on anti-dumping measures have primarily focused on their effects on firms and labor markets (e.g., Hakobyan 2018; Jabbour et al. 2019; de Souza and Li 2022). In light of increased state support for domestic industries—particularly, but not limited to, the People's Republic of China (PRC)—the economic justification for anti-dumping measures requires renewed attention. This paper questions the common label of protectionism veiled around them, through an analysis of EU anti-dumping measures on PRC iron and steel products.

From a political economy standpoint, misuse of EU anti-dumping measures for protectionist purposes may seem plausible. The iron and steel industry provides indispensable inputs for a wide range of downstream markets, including, but not limited, to defense products. The EU has seen its global market share in the iron and steel industry shrinking, while suppliers from the PRC have increased production capacity. The rise of PRC steel producers has been supported by the state. Some might argue that another form of support is found in the anti-dumping measures introduced by the EU.

Examining claims of protectionism in disguise requires a fine distinction between effects that promote fair markets and those that harm free markets. We propose that "fair" antidumping measures should decrease the imports from the targeted state but leave overall import quantities and prices largely unchanged. This would indicate that the targeted imports are substituted by other exporters, rather than unduly favored domestic producers.

Our analysis builds upon counterfactuals of import flows and prices, had no anti-dumping measure been introduced. Specifically, we examine the effect of tariffs on import quantities from the PRC as well as total import quantities and prices. We primarily employ the Augmented Synthetic Control Method by Ben-Michael et al. (2021). Here, a synthetic counterfactual is built by weighting a donor pool of unaffected products. Potential imperfect pre-treatment fit is controlled for with ridge regression. In addition, we apply the staggered difference-in-differences approach of Callaway and Sant'Anna (2021) as a robustness check. Our dataset includes annual data from 1989 to the present on HS-6 products of the iron and steel section. We also introduce products of the nickel and copper sections as a second donor pool to improve robustness.

We find empirical evidence that points against the allegation of protectionism in disguise. While anti-dumping measures reduce imports from the PRC, products from China are substituted by imports from other countries rather than increased domestic EU production. The PRC trade share prior to the tariffs explains the variability in import prices' reaction to the introduction of tariffs. Furthermore, our analysis of potential relabeling in third party countries indicates that only limited tariff evasion occurs. While the results lend some empirical economic support to the prevalent use of anti-dumping measures by the European Union, it is important to note that we only covered a specific industry in our paper. The proposed methodology, however, might also provide new insights on matters of anti-dumping with respect to other industries.

2 Industrial Policy and the Legal Foundation of Anti-Dumping Measures

For both the European Union and the People's Republic of China, the iron and steel industry holds immense strategic significance. The defense industry, along with the manufacturing and construction sectors, is among the many downstream industries that are dependent on iron and steel products. In recent decades, we have witnessed a shift in production capacity away from the USA and Europe toward China and other emerging economies. To some extent, this shift has been made possible by large-scale government subsidies as well as outright state ownership. Increased production capacity has faced a stagnating global demand, leading to significant overcapacity in the global iron and steel market (Price et al. 2016). This has been accompanied by reduced profit margins, threatening companies in markets with less government support, such as the USA and the European Single Market. The EU alleges that many Chinese iron and steel products are dumped and thus distort competition.

The European Commission (2013) highlights the necessity for Europe to remain an important steel-producing region for economic, social, and environmental reasons, as well as for security of supply. In the bloc, the sector directly provides for 330,000 jobs, with a total of 2.6 million EU jobs either directly and indirectly provided or induced, according to Oxford Economics (2017). Historically, the EU has not been afraid to employ policies to safeguard the market. Tariffs and import quotas were used in the 1960s to protect the industry from Eastern European competition (Zurstrassen 2022; Spierenburg and Poidevin 1993). Moreover, during the period of global overcapacity in the 1970s and 1980s, the European Community introduced anti-dumping provisions and allowed national subsidies for the sector (Zurstrassen 2022). Although the European iron and steel market has been largely liberalized since then, recent anti-dumping measures against China and other states could be seen as a return to protective policies.

Starting in the early 2000s, the iron and steel industry in the PRC entered a phase of tremendous growth. This development was funded by significant state investment, including support for state-owned enterprises (SOEs) and energy subsidies for private and state companies alike. Moreover, the accession to the WTO opened foreign markets to Chinese steel products, fueling the export orientation of the industry (Dong et al. 2019). By 2015, when many anti-dumping measures were introduced by the EU, the capacity utilization in Chinese steel mills stood at only 70.5% (Brun 2016). The increasing overcapacity permeated to global markets, which put pressure on China to pursue supply-side reform (Choi et al. 2022). The resulting actions by the Chinese government, however, had limited effects on their output, which stands at 52.9% of global production volume, dwarfing the European Union which accounts for 7% (World Steel Association 2022).

Currently, industrial policy in the European Union's iron and steel industry focuses on protecting the domestic market from (artificially) low-cost foreign producers. On the other hand, state support in China has propelled its iron and steel industry to a position of global leadership. This has been accompanied by excess capacity in steel mills, resulting in alleged dumping prices. The EU has reacted with trade remedies, but the question remains whether they are indeed geared toward safeguarding fair markets—or if they serve a protectionist agenda.

Answering our research question requires consideration of the legal foundation of antidumping measures. In general, they are regulated by the General Agreement of Tariffs and Trade (GATT). The growing use of these measures in recent decades has been observed by Hartigan and Vandenbussche (2013), who credit the relative speed and simplicity of the measure compared to other WTO remedies. Dumping is defined in the GATT (1947) as the introduction of products by a foreign country into the commerce of another at less than the "normal" value. While such actions are generally not forbidden, affected countries are permitted to defend domestic markets by imposing levies through anti-dumping measures. The Agreement on Implementation of Article VI of the Uruguay GATT (Anti-Dumping Agreement) specifies that their implementation requires a formal investigation that follows the methodology set out by Article VI. Accordingly, the imposition of anti-dumping measures by the EU is governed by GATT rules. After the filing of a formal complaint by relevant producers or an industry association, the European Commission reviews the evidence and decides whether an investigation is merited. In general, it must be demonstrated that export prices of the country targeted by tariffs are below their domestic prices. As prices in the PRC may also be distorted by government interventions, the export prices of Chinese suppliers are compared to prices or costs in a third (surrogate) market economy. While the EU approach is not sanctioned by general WTO law, it draws on Section 15 of the PRC's accession protocol, which was phased out in 2016. From the legal perspective of the European Union, the section remained valid even after the phase-out, which was challenged by China in the dispute settlement body. Although the chair of the body agreed to China's request for a suspension, there has been no official ruling on the general legality of the continued application (Du 2022).

To address this challenge, the European Union amended the Basic Anti-Dumping Regulation in 2017. This amendment gives the Commission the power to determine whether the domestic prices of any country are affected by significant market distortions. Domestic prices are then calculated by comparison with a similar market-oriented economy. While this approach is currently employed by the European Union, the legality continues to be debated among scholars (Du 2022; Tietje and Sacher 2018). From an economic perspective, such an approach can be prone to miscalculations, as the availability of resources and thus the price of input materials, as well as energy costs, the labor market, and numerous other factors influencing domestic prices may differ drastically between countries. Moreover, the legal definition of dumping appears rather vague and might not always meet the necessary threshold of a market-distorting practice that economically justifies a specifically targeted tariff.

3 Empirical Analysis of Anti-Dumping Measures

The prevalence of anti-dumping measures has resulted in increasing scholarly attention. Limited consideration, however, has been placed on the issue of protectionism in disguise. Similar to our research design, studies are often focused on individual products. Moreover, a wide range of literature has covered firm- and labor-specific effects. We present the gravity framework and a difference-in-differences methodology as suitable approaches for our empirical analysis. Considering their respective strengths and weaknesses, we propose the Augmented Synthetic Control Method, a recent advancement of classic difference-in-differences, as a suitable methodology for our exploration of protectionism in disguise.

The legal definition of dumping appears rather vague and might not always reach the necessary threshold of a market-distorting practice that justifies a specifically targeted tariff. Economists such as Messerlin (1996) and Deardorff (1989) raised worries that anti-dumping measures are actually protectionist, but followed a more policy-oriented case study approach instead of an empirical investigation on markets after anti-dumping measures had been introduced. Messerlin (1996) argues that anti-dumping measures are only economically advisable in situations of predatory pricing and "strategic" dumping. Through predatory pricing, products are dumped to achieve a monopolistic position through a price reduction that drives other producers out of the market, in order to raise prices later. The process of strategic dumping benefits from a situation that is described by Marshall (1879) as external economies of scale. Through initial protectionism and subsidies, a foreign country can nurture an industry and achieve cost advantages by raising output. While the foreign industry is now able to sell at comparably cheap prices internationally, the domestic industry is up the average cost curve,

as it is not allowed market access to the foreign country and thus unable to achieve similar returns on scale. Whether predatory pricing or strategic dumping is indeed present poses a great challenge for economists. For example, foreign firms might sell their stock just above marginal cost to reduce overcapacity and thereby reduce losses. Especially in a market shaped by worldwide overcapacity, this is obviously an economically sound move but hard to distinguish from predatory pricing. As insight on market and individual firm behavior inside the PRC is hard to fathom and challenging to verify, we refrain from analysis on Chinese behavior; instead, we strive to evidence whether the EU anti-dumping measures have reduced economic efficiency within the European market.

Many research designs revolve around the effect of anti-dumping measures on individual products and commodities. In general, their impact can be expected as trade destruction and diversion in the affected country, as well as trade deflection and depression in third-party markets (Bown and Crowley 2006). Among others, empirical evidence for these trends has been presented by Asche (2001), reviewing the effects of US anti-dumping measures on Norwegian salmon through comparison with the import markets of the EU and Japan and further by Hakobyan (2018) in a study on EU anti-dumping measures against aluminum foil from Armenia, Brazil, and China.

Mixed results have been produced by studies on the labor and firm effects of anti-dumping measures. Positive employment effects of Brazil's anti-dumping measures in the protected sectors are unveiled by de Souza and Li (2022). Bown et al. (2021), on the other hand, found no evidence of a positive impact on employment in protected industries, considering US anti-dumping measures against China. Jabbour et al. (2019) suggested a negative employment effect on both EU producers and importers, with positive effects on the remaining Chinese exporters, thus raising doubts about the effectiveness of tariffs. Their study also indicates that the benefits of duties only extend to the least productive import-competing companies. Moreover, Felbermayr and Sandkamp (2020) pointed out that anti-dumping measures hurt affected Chinese exporters, in particular smaller firms.

While these studies offer valuable insights, they do not address our broader inquiry into whether anti-dumping measures contribute to the establishment of "fair markets" or undermine the principles of the "free market." Investigating the market reaction to tariffs presents an empirical challenge. The majority of studies on the impact of anti-dumping measures rely on either gravity approaches or difference-in-differences methodology.

The theoretical foundation of the gravity methodology has made it a popular tool in international trade analysis. Therefore, it has also been used in studies on anti-dumping measures. A comprehensive exploration was presented by Egger and Nelson (2011), who analyzed the effect of anti-dumping measures on global trade patterns. Covering a similar scope, Vandenbussche and Zanardi (2010) found some evidence for a reduction of overall imports due to the spillover effects of anti-dumping measures. A recent advancement was presented by Nagengast and Yotov (2023) with the Extended Two-Way Fixed Effects (ETWFE) analysis, which is integrated into a gravity model. Starting from the ETWFE estimator originally proposed by Wooldridge (2021, 2023), their contribution allows for a heterogeneity-robust application of the classic structural gravity model. In staggered settings, however, a potential bias arises from considering not-yet-treated items in the control group. Like other gravity models, this method assumes trade flows based on parametric specifications. Among other conditions, Larch and Yotov (2016) specify that an estimation of supply elasticity in the targeted markets is necessary for reliable results. Given the unreliable data in the case of the PRC, this proves difficult. Additionally, estimation biases may arise from our granular focus on singular products, and the prevalent industrial policy in the iron and steel sector can distort parameters.

Many studies on anti-dumping measures have used a difference-in-differences method, as the levied tariffs can be considered policy treatments on specific products. Although they lack the theoretical foundation of the gravity framework, their empirical application has been proven as robust in a wide range of previous studies. The parsimonious design as well as the ability to capture heterogeneity are key factors in their popularity. In an application of a classic difference-in-differences methodology, Cheng et al. (2021) demonstrated trade destruction and deflection in their research on US anti-dumping measures against China. Closely related to our approach is an analysis by Sandkamp (2020), who studied the effects of EU antidumping measures with the 2004 enlargement as a natural experiment setting. Differencein-differences methods, however, are not without shortcomings. They often suffer from large pre-treatment differences between observed values and the counterfactual. Improving pretreatment fit usually involves the dropping of inputs from the donor pool, raising concerns about selective variable picking. Additionally, they rely on the parallel trends assumption. While our empirical results do establish parallel trends, this limits their application to other products. Remedies for both problems exist in the contemporary difference-in-differences literature; however, alternative approaches that are less prone to these concerns are available.

The augmented synthetic control method (ASCM) by Ben-Michael et al. (2021) offers an improvement over the classic difference-in-differences estimator. ASCM compares the actual observable values with a counterpart that resembles a situation without tariffs, built from nonaffected products within the same trade pairing. Compared to the difference-in-differences methodology, ASCM assigns individual weights to the donor pool based on predictive power. This enhances the analysis of heterogeneous datasets, such as the iron and steel trade data analyzed in this paper. Furthermore, the weighting algorithm of ASCM eliminates selection bias, and pre-treatment fit is improved by applying ridge regression. ASCM also includes a built-in sensitivity analysis using the jackknife leave-one-out method. Potential spillover effects might arise in the donor pool, which consists of non-treated products from the iron and steel sector. We control for this by using a separate donor pool from other metals. Moreover, the method is best suited for individual product groups, as negative weights could potentially skew average results with different treatment times. To support our findings on individual CIRs with evidence of general trends, we employ the staggered difference-in-differences model of Callaway and Sant'Anna (2021). In contrast to similar methods for staggered analysis, such as ETWFE, not-yet-treated products are excluded from the controls.

4 Data

The dataset considered in this study is provided by the Directorate General Trade of the European Commission and is available for public access on the Eurostat platform under the term "Database on International Trade in Goods." As we are interested in the impact of anti-dumping measures on Chinese iron and steel products, we include only those products in our analysis that fall within section 72 ("Iron and Steel") of the Harmonized System. The dataset contains information on import quantities and values for each trading partner country of the European Union. From this input, we are able to calculate the overall import prices as well as those of selected trading partners. Data points are available from 1988 onwards on a monthly basis, segmented by individual products which are identifiable by their 8-digit Harmonized Commodity Description and Coding System (HS) indicator. To improve data completeness, we aggregate into annual data points and adjust the timeframe of the respective analysis according to the availability of sufficient data in the respective product class.

The ASCM requires a donor pool to determine the covariates of the synthetic product. This pool comprises all products within section 72 that have not been targeted by an antidumping measure. For an additional robustness check, we have also built a second donor pool with products from sections 74 and 75, covering copper and nickel products, respectively. To prepare the data for analysis, we distinguish between unaffected and affected products. A product is unaffected if it has not been targeted by an anti-dumping measure at any time and vice versa. Further, products are assigned as treated when they have been targeted by an anti-dumping measure in the respective timeframe and untreated, indicating that no measure was in force. This distinction also serves as the indicator of the introduction of a treatment on the product, which is necessary when comparing the actual observations against the synthetically constructed values.

Anti-dumping measures of the European Union are published through so-called Commission Implementing Regulations (CIRs), which, among other details, specify the targeted products. A complication arises from the fact that the definition is made at the HS-8 level. As laid out before, the dataset can provide such granular data, but such a narrow specification introduces problems with data completeness, which would hamper our synthetic control analysis. Nevertheless, in almost all cases, the measures cover all sub-items of the HS-6 level, where data is reliably available. It is therefore possible to aggregate the measures on the higher 6-digit level without reducing the validity of results. Out of 72 affected products on the HS-6 level, 16 are not wholly covered by anti-dumping measures and are therefore excluded; thus, 56 product classes remain for our analysis. Further, the donor pool covers 176 unaffected HS-6 product so fact and the respective CIR, is available in the appendix.

We also extend our analysis to potential rerouting of targeted Chinese goods into the European Union through third-party countries, a process often called "relabeling." To render the analysis congruent with our ASCM approach, we rely on HS6 data of countries considered to be likely hubs for rerouting. That is, those countries that were able to gain significant market share after the introduction of tariffs. We have gathered data of their imports from China, considering all HS-6 level products within section 72. The dataset is collected via the UN Comtrade platform.

5 Methodology

The ASCM is based on the synthetic control method (SCM) by Abadie and Gardeazabal (2003). In general, the SCM is an empirical tool to analyze the introduction of a policy measure by comparing the actual observations with an artificial counterpart. It constructs a synthetic time series, with unaffected products individually weighted in order to render the synthetic and actual time series before the introduction of the tariff as congruent as possible. While previous studies in the anti-dumping realm have made limited use of the approach employed in this paper, it has been used extensively in other settings of economic policy evaluation (e.g., Born et al. 2019; Gabriel and Pessoa 2024; McCloud and Taylor 2022; Ponnusamy 2021; Seiler et al. 2022). As the dataset consists of multiple product classes observed over a time span, we consider a panel with $i = 1, \ldots, N$ units observed over $t = 1, \ldots, T$ periods. In each analysis of the tariff's effect on properties (quantity imported from China, total EU imports, and world market price) of the product classes, we indicate the treated HS-6 code as $W_i = 1$ and units never receiving this or another treatment as $W_i = 0$.

The remaining $N_0 = N - 1$ product classes belong to the donor pool, and $T_0 < T$ represents the point in time when the tariff was introduced. The potential outcomes $Y_{it}(0)$ and $Y_{it}(1)$ for unit *i* in period *t* under control and treatment are thus defined as

$$Y_{it} = \begin{cases} Y_{it}(0) & \text{if } W_i = 0 \lor t \le T_0 \\ Y_{it}(1) & \text{if } W_i = 1 \land t > T_0. \end{cases}$$
(1)

The donors' outcomes are assumed to be the sum of a fixed part m_{it} and a white noise component with a zero-mean ϵ_{it} , formal as $Y_{it}(0) = m_{it} + \epsilon_{it}$. The treated outcome is represented as $Y_{it}(1) = Y_{it}(0) + \tau_{it}$, with τ_{it} assigned to the treatment effect, in our case the impact of the imposed tariff. For simplicity, it is assumed that the first unit receives the treatment; therefore,0 the treatment effect formally results in $\tau = \tau_{1T} = Y_{1T}(1) - Y_{1T}(0)$. The pre-treatment outcomes in the SCM, which serve as covariates, are represented by X_{it} for $t \leq T_0$. \mathbf{X}_0 then represents the $N_0 \times T_0$ matrix of pre-treatment outcomes within the donor pool. \mathbf{Y}_{0T} is the N_0 vector of control unit outcomes in period T. The synthetic control unit, the counterfactual, is constructed by a weighted average of the control outcomes $\mathbf{Y}'_{0T} \boldsymbol{\gamma}$. The goal is to choose these weights $\boldsymbol{\gamma}$ to get as close as possible to the actual observation in the pre-treatment period. In technical terms, the choice is defined by an optimization problem with \mathbf{V}_X as an identity matrix and $\zeta \geq 0$ as a parameter penalizing the dispersion of weights.

$$\min_{\gamma} ||\mathbf{V}_{X}^{0.5} \left(\mathbf{X}_{1} - \mathbf{X}_{0}^{\prime} \boldsymbol{\gamma} \right) ||_{2}^{2} + \zeta \sum_{W_{i}=0} f(\gamma_{i}), \ s.t. \sum_{W_{i}=0} \gamma_{i} = 1; \ \gamma_{i} \ge 0; \ i: W_{i} = 0$$
(2)

The specific constraints ensure that no extrapolation is possible outside the control units (the convex hull). This can become particularly problematic if the values of the treated unit contain the maximum values of the data set itself. Then, any possible weighting of the other donor units does not reach the values needed. Following that, proper pre-treatment between the treated unit, in our case the product class observed, and the counterfactual, created by weighting untreated product classes within the steel industry, is not always possible. The greater the pre-treatment divergence, the less suitable the SCM. To address this issue and improve the overall fit, Ben-Michael et al. (2021) and other authors suggested to augment SCM to control for the bias due to the deviation between the treatment unit and the donors. The ASCM adjusts results accordingly with an ASCM estimator for $Y_{1T}(0)$

$$\hat{Y}_{1T}^{aug}(0) = \sum_{W_i=0} \hat{\gamma}_i^{scm} Y_{iT} + \left(\hat{m}_{1T} - \sum_{W_i=0} \hat{\gamma}_i^{scm} \hat{m}_{iT} \right)$$
(3)

$$= \hat{m}_{1T} + \sum_{W_i=0} \hat{\gamma}_i^{scm} \left(Y_{iT} - \hat{m}_{iT} \right), \qquad (4)$$

where γ_i^{scm} denotes the SCM weights and \hat{m}_{iT} is an estimator for m_{iT} . Standard SCM implies a constant \hat{m}_{iT} , whereby the ASCM uses estimators that are functions of pre-treatment outcomes, $\hat{m}_{iT} \equiv \hat{m}$ (**X**_i). Among other specifications, Ben-Michael et al. (2021) suggest the usage of ridge regression (Hoerl and Kennard 1970), which has proven to be a robust extension. It optimizes the pre-treatment fit by relaxing one of the basic assumptions, allowing for negative weights. Furthermore, ridge regression minimizes the extrapolation outside the convex hull and leads to an estimator for the post-treatment outcome

$$\hat{m}\left(\mathbf{X}_{i}\right) = \hat{\eta}_{0}^{ridge} + \mathbf{X}_{i}' \hat{\boldsymbol{\eta}}^{ridge},\tag{5}$$

where $\hat{\eta}_0^{ridge}$ and $\hat{\eta}^{ridge}$ are the coefficients resulting from the ridge regression of control post-treatment outcomes \mathbf{Y}_{0T} on centered pre-treatment outcomes \mathbf{X}_0 , formally

$$\left\{\hat{\eta}_{0}^{ridge}, \,\hat{\eta}^{ridge}\right\} = \operatorname{argmin}_{\eta_{0},\eta} \frac{1}{2} \sum_{W_{i}=0} \left[Y_{i} - \left(\eta_{0} + X_{i}^{\prime}\eta\right)\right]^{2} + \lambda^{ridge} ||\eta||_{2}^{2}, \tag{6}$$

with the penalizing parameter λ^{ridge} controlling both the improvement of the pre-treatment fit compared to SCM and the degree of extrapolation. The ridge ASCM estimator in our study is

$$\hat{Y}_{1T}^{aug}(0) = \sum_{W_i=0} \hat{\gamma}_i^{scm} Y_{iT} + \left(\mathbf{X}_1 - \sum_{W_i=0} \hat{\gamma}_i^{scm} \mathbf{X}_i \right) \cdot \hat{\boldsymbol{\eta}}^{ridge}.$$
(7)

To make our examination robust to technique-specific biases, we have extended our analyses within the augmented synthetic control method by using further estimators based on the elastic net (see Zou and Hastie 2005, random forest (Ho 1995; Breiman 2001), and matrix completion methods (Athey et al. 2021). The results of these analytical extensions are available in the annex. Further, we extend our analysis with a classic difference-in-differences approach

$$\hat{Y}_{it} = \beta_0 + \beta_1 A_i + \beta_2 P_t + \beta_3 A_i P_t + e_{it},$$
(8)

where \hat{Y}_{it} represents the dependent variable—either EU import quantity from China, EU total import quantity, or EU import price, each in logarithmic value, for product *i* at time *t*. *A* denotes whether product *i* is affected by an anti-dumping measure, and *P* reflects whether the product is in a treated period (pre (0) vs. post (1)). The combination of the parameters *A* and *P* is the difference-in-differences estimator. In addition, we make use of a staggered difference-in-differences analysis, whereby multiple treatment times can be considered together. Here, we compare the treated products with those products that have never been treated, in line with our ASCM analysis. For more technical details on the staggered approach, see Callaway and Sant'Anna (2021)). Furthermore, we also include an ASCM analysis with a separate donor pool to control for potential spillover effects.

To investigate relabeling, we present an approach that is inspired by Liu and Shi (2019). Our contribution develops on their methodology by using ASCM to investigate potential significant changes in trade patterns. As an additional robustness check, we also employ their standard difference-in-differences setting, which is specified as follows:

$$\hat{Y}_{it} = \beta_0 + \beta_1 A_i + \beta_2 P_t + \beta_3 A_i P_t + \beta_4 Q_i + \beta_5 Q_i A_i + \beta_6 Q_i P_t + \beta_7 Q_i A_i P_t + G_{it} + e_{it}$$
(9)

Here, \hat{Y}_{it} denotes the import quantity from a potential rerouting hub. Additionally, Q represents the import quantity of the rerouting hub from China, for product *i* at time *t*. The formula also includes the gravity estimator *G*, representing the time-sensitive GDP of the potential rerouting hub in purchasing power parity terms. \hat{Y}_{it} , Q, and *G* are analyzed in their respective logarithmic value.

6 Results

The imposition of anti-dumping measures on Chinese iron and steel products by the European Union has started in 2009, with the most recent Commission Implementing Regulation stemming from 2020. In terms of targeted product classes, CIR 2016/1778, which is plotted in Fig. 1, represents the most wide reaching act. Our investigation focuses on the effect of tariffs on the import quantity from China, the total import quantity, and the overall import prices. We observe a negative effect of the anti-dumping measures on bilateral imports, which is significant when considering the plotted confidence interval. Further, total import quantities are largely unchanged, and changes in import prices remain mostly insignificant.

In technical terms, Fig. 1 shows the result of the ASCM analysis, with the synthetic value on the horizontal zero line, which represents the reference if no tariff were introduced. Then, the plot depicts the deviation of actually observed data against the synthetic values. To enhance the exploration, we add a jackknife confidence interval to the aggregates. Since the traded volumes of the different product classes differ greatly, we employ a logarithmic analysis. This simplifies the exploration in terms of comparability and depiction, but also makes the results more sensitive to changes based on the introduction of the anti-dumping measure at respective time points. The depicted estimates give us a first impression of the similarities, but also the heterogeneity of the treatment effects. The relevant observation period is shortened to 2010 to 2021 and is shown on the horizontal axis, while the logarithmic effects of the anti-dumping measure on each of the three variables are plotted on the vertical axis.

The import quantity of Chinese iron and steel products targeted by EU anti-dumping measures has significantly decreased, as shown by Fig. 1. This holds true across the majority of product classes considered in this study. In contrast to the general trend, imports targeted by CIR 2017/1444 were not significantly reduced. This might be due to the fact that the dumping margins of this CIR were rather modest, with a tariff rate between 17.2 and 28.5%. Moreover, the prices of EU imports from China for the respective product classes have risen in line with the tariff rate. Further exploration is needed regarding the results of CIR 2016/181. While the insignificant reduction in quantity 1 year after the treatment can be explained by a



Fig. 1 Impact of CIR 2016/1778 on import quantities from China, the world and world import prices

slight rebound effect, amplified by the sensitivity of the logarithmic analysis, the rise visible 5 years after the treatment's introduction is accompanied by a drastic increase in Chinese import prices. This suggests that the policy was effective even if import volumes do not fall significantly or show a rebound. The calculated dumping margins which govern the tariff rate that is published in the CIR seem to be on target.

The anti-dumping measures do not appear to reduce overall imports of targeted products. Affected Chinese products have been substituted by other foreign suppliers, signaling trade diversion. A common allegation against anti-dumping measures is that they are intended to increase domestic market share. We find evidence against this claim. Figure 2 reveals no significant deviation between the actually observed values and the respective synthetic counterpart. Across all considered Commission Implementing Regulations, import quantities remain flat. In this sense, the adjustment behavior points to a functioning market, which is not rigged to unduly protect EU producers.

As overall iron and steel import prices have not increased, EU producers have not been able to improve their profit margins. This provides evidence against the claims of critics, who assert that anti-dumping measures are intended to shore up domestic industries through a reduction of market price pressure. Moreover, they argue that the targeting of dumped goods is detrimental to import-relying downstream industries that would suffer from price increases. In contrast, Fig. 3 shows that the deviation between actually observed import prices and their respective synthetic counterparts is limited and predominantly insignificant. One can observe a rise in prices in the first year after the treatment is introduced, which points to market adjustment effects. In an industry shaped by long-term contracts and high investment costs, such repercussions on the market are to be expected though. Moreover, the price is shortly thereafter oriented towards its synthetic value, indicating that the treatment effect of anti-dumping measures on import prices is minimal.



Fig. 2 Significant change in import quantities from China after the introduction of tariffs



Fig. 3 Total import quantities remain flat

The Chinese share of total imports before the treatment can explain much of the variation in the reaction of import prices to the introduction of tariffs. For example, there has been a significant increase after tariffs were imposed on HS720852 (CIR 2016/1778) and HS720916 (CIR 2016/181). Both are product classes where China's supply has accounted for a large market share which renders substitution by third-party countries more difficult and thus expensive. With the introduction of an additional tariff in 2015 on product classes 721931 and 721935, where market share is limited, the effects on the world market price are not significant. Thus, the anti-dumping measures appear to have a limited impact on economic efficiency, as observable price fluctuations are contingent on Chinese market shares and do not apply indiscriminately.

A core argument against protectionism in disguise is the substitution effect observed in this study. This trade diversion, however, might be hard to distinguish from circumvention through "relabeling." Here, tariffs can be avoided by channeling the targeted goods through third countries so that they are imported without the tariff. We analyze potential relabeling through an augmented synthetic control analysis on those countries that were able to gain market share. This approach is inspired by Liu and Shi (2019), who originally used a difference-in-differences analysis on US anti-dumping measures targeting Chinese products. Our design enables a more granular analysis, as we can focus on singular countries and point out where exactly potential relabeling might have happened. In a first step, we analyze changes in EU import share after the introduction of anti-dumping measures based on EU trade data. Figure 4 shows how the EU imports have been diversified away from China. Values are relative to 1 year before the treatment, with an exemption for 2017/1444, for displaying reasons.

The bilateral trade flows of countries gaining market share are then analyzed with ASCM. Relabeling can be indicated by a deviation of imports from China relative to the synthetic value. While the results reveal no significant effect on average, there is a large variance



Fig. 4 Overall import prices display adjustment effects

of individual treatment effects. In Fig. 5, we show that EU anti-dumping measures had nonsignificant effects on Turkish imports from China. Since Turkey is the largest single benefactor in terms of import shares with regard to CIR 2016/1778 and 2017/1444, these results bear considerable weight. Exemptions exist, though. For CIR 2015/501, we find a significant spike



Fig. 5 Absolute changes in EU import shares for selected countries

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of Korean imports from China. Similarly, we can find a deviation for Ukrainian imports in CIR 2016/1778. This indicates that South Korea and Ukraine were used for relabeling of affected iron and steel products. To provide further robustness checks, we also extend this examination with the classic difference-in-differences setting. Only the analysis of CIR 2016/1778 displays a significant positive effect, thus confirming our previous results, which overall point against relabeling. The results of our ASCM analysis and the regression table can be found in the annex.

We provide a robustness check on the results produced by the ASCM with a staggered difference-in-differences analysis based on Callaway and Sant'Anna (2021). This enables us to consider the whole set of sanctioned products, even though they differ regarding their treatment time. Overall, the results confirm our previous granular analysis. As shown by Fig. 6, targeted imports from China are significantly affected, although the impact is reduced over time. Moreover, overall import quantity appears non-significantly affected by anti-dumping measures. With one timeframe bearing an exemption, these results are also visible in our analysis of import prices. To check our results for validity, we confirm the parallel trends assumption with a Wald test. The parallel trends assumption is further supported by the plotted confidence intervals, which fall within zero in all pre-treatment time periods (Figs. 7 and 8).

Furthermore, additional robustness is provided by a classic difference-in-differences methodology, an unrelated donor pool for the ASCM and a consideration of absolute changes. It has to be noted that the staggered approach of Callaway and Sant'Anna assumes that treatments induced at the same time are homogeneous. As some CIRs are passed in the same year but differ in their tariff rate, this is not the case in the considered dataset. Therefore, we also include a standard difference-in-differences estimation to check on the effects of anti-dumping measures on individual CIRs. This examination, which can be found in the annex,



Fig. 6 No significant deviation in Turkish imports of Chinese products affected by EU anti-dumping measures



Fig. 7 Staggered difference-in-differences robustness check

confirms our previous results. To control for potential spillover effects in the ASCM, we provide a robustness check using a different donor pool. We have included products from HS section 74, covering copper, and HS section 75, covering nickel. While these are unrelated

- Pre - Post



Fig. 8 Distribution of difference between pre- and post-treatment global EU import quantity

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to the original HS72 section considered in this study, they are metallic commodities and can therefore be assumed to follow comparable trading patterns. The results of this extension, which can be found in the annex, confirm our original analysis. Furthermore, we improved the robustness of the analysis outside the ASCM, displayed in Fig. 5. We find no decrease in total imports after the anti-dumping measure, which shows that the reduction of PRC market share has been substituted by third country producers. In our examination, we subtract the total EU import quantity 3 years before the introduction of tarriffs from the quantity 3 years after the introduction. Results of these calculations are presented on the horizontal axis in 15 equidistant bins ranging from minus 5 mn to plus 25 mn. The bin around zero is observed most frequently, and bins below have no observation at all. Accordingly, there is no decrease in imports after the anti-dumping measure. While results in Fig. 5 are based on a 3-year consideration due to the rather recent publication of some anti-dumping measures, an extension of the analysis with different timeframes yields similar results.

Summing up, our results regarding the impact of EU anti-dumping measures on import quantity from the PRC, total imports, and market prices paint a clear-cut picture. While Chinese imports are—as expected—significantly reduced, indicating some trade destruction, the total import quantities remain flat when compared against the synthetic counterpart. This indicates a trade diversion effect: missing Chinese imports are largely substituted by thirdparty countries. Further, our analysis shows that there is only limited relabeling. Moreover, we can point out that domestic producers have not been unduly favored in terms of higher margins, as the effect on import prices has been minimal.

7 Conclusion

This paper examined whether the EU's anti-dumping measures targeting China's iron and steel industry follow a protectionist approach. The conditions for such measures are set out in EU law, based upon WTO rules. Their application is heavily debated among legal scholars and follows questionable economic reasoning. Further, the political importance of the sector could make it prone to protectionism in disguise. Nevertheless, we present empirical evidence that refutes the allegation of protectionism, when considering EU anti-dumping measures against the PRC's iron and steel industry.

Our empirical analysis is focused on the treatment effects of anti-dumping measures on import levels and import prices. We use the augmented synthetic control method to provide counterfactuals on the individual Commission Implementing Regulations. The individual weighting and ridge regression optimization of ASCM provide benefits for the analysis of heterogeneous iron and steel products. Moreover, it avoids selection bias and improves pre-treatment fit. To avoid potential spillover effects, a robustness check involving a donor pool separate from iron and steel products is introduced. We provide additional support for our findings with a staggered difference-in-differences estimator. The chosen methodology, put forward by Callaway and Sant'Anna, is a robust application to capture multiple treatment times, as it avoids negative weights and excludes not-yet-treated items from controls.

Results point against the allegation of protectionism in disguise, as EU iron and steel companies have not been unduly favored by anti-dumping measures. We find a significant decrease in imports from the PRC for all product classes. On the other hand, total import quantities have not been significantly affected. This suggests that overall demand in Europe is inelastic, which appears logical when considering that iron and steel products are an essential part of a wide range of downstream industries. Moreover, there appears to be a high elasticity of substitution between foreign suppliers, as targeted Chinese producers are

substituted with imports from countries outside of the European Union. A question arises from the apparent supply inelasticity of domestic producers, which would open the route for future research, based on production capacity data, which was not available to us in this study. The iron and steel market thus appears to be globally competitive, with minimal switching costs. For some products, we have found a short-lived increase in import prices, which points against the creation of lasting economic inefficiency and indicates market adjustment effects. The price changes are assumed to be a result of short-lived volatility. This supports our finding of sufficiently elastic supply from non-EU countries, as foreign companies were able to provide production capacity without significant long-term price increases. Moreover, it signals that margins for domestic producers are only minimally improved. Our ASCM analysis reveals granular trends, which are supported by the provided robustness checks. The separate donor pool based on nickel and copper products confirms initial findings, and the staggered difference-in-differences analysis provides further evidence on general trends.

These results call into question the policy goals of the EU anti-dumping measures. Considering our findings, it seems more likely that tariffs were levied to reduce dependency on China, which held significant shares of the EU import markets in the affected product classes before the introduction of the treatment. Our results lend some economic credibility to the use of anti-dumping measures by the European Union. However, our notion that there appears to be no protectionism in disguise in EU anti-dumping measures against PRC iron and steel products might be limited to the considered market. The global overcapacity could provide for high elasticity of substitution between foreign suppliers, which would explain why domestic companies were not able to gain market share. In order to generalize findings, we suggest applying the proposed methodology to other product sets and include domestic production output statistics, where available.

Appendix A. Relevant HS codes and Commission Implementing Regulations

HS-code	Description	Complete?	CIR
7208	Flat-rolled products of iron or non-alloy steel, of a width $>= 600 \text{ mm}$, hot-rolled, not clad, plated or coated		
720810	In coils, with patterns in relief directly due to the rolling process	Yes	2016/1778
720825	In coils, of a thickness of $>=$ 4,75 mm, pickled, with- out patterns in relief	Yes	2016/1778
720826	In coils, of a thickness of $>= 3 \text{ mm}$ but $< 4,75 \text{ mm}$, pickled, without patterns in relief	Yes	2016/1778
720827	In coils, of a thickness of $< 3 \text{ mm}$, pickled, without patterns in relief	Yes	2016/1778
720836	In coils, of a thickness of $>= 10$ mm, not pickled, without patterns in relief	Yes	2016/1778
720837	In coils, of a thickness of $>= 4,75 \text{ mm}$ but $< 10 \text{ mm}$, not pickled, without patterns in relief	Yes	2016/1778
720838	In coils, of a thickness of $>= 3 \text{ mm}$ but $< 4,75 \text{ mm}$, not pickled, without patterns in relief	Yes	2016/1778

Table 1 HS-code, description, data completeness, and CIR of affected products

Та	bl	e	1	continued

HS-code	Description	Complete?	CIR
720839	In coils, of a thickness of < 3 mm, not pickled, without patterns in relief	Yes	2016/1778
720840	Not in coils, with patterns in relief directly due to the rolling process	Yes	2016/1778
720851	Not in coils, of a thickness of > 10 mm, without patterns in relief	Yes	2016/1777
720852	Not in coils, of a thickness of $>= 4,75 \text{ mm}$ but $<= 10 \text{ mm}$, without patterns in relief	Yes	2016/1778
720853	Not in coils, of a thickness of $>= 3 \text{ mm}$ but $< 4,75 \text{ mm}$, without patterns in relief	Yes	2016/1778
720854	Not in coils, of a thickness of $< 3 \text{ mm}$, without patterns in relief	Yes	2016/1778
720890	Further worked	Yes	2016/1777
7209	Flat-rolled products of iron or non-alloy steel, of a width of $>= 600$ mm, cold-rolled "cold-reduced", not clad, plated or coated		
720915	In coils, of a thickness of $>= 3 \text{ mm}$	Yes	2016/181
720916	In coils, of a thickness of $> 1 \text{ mm}$ but $< 3 \text{ mm}$	Yes	2016/181
720917	In coils, of a thickness of $>= 0.5 \text{ mm}$ but $<= 1 \text{ mm}$	Yes	2016/181
720925	Not in coils, of a thickness of $>= 3 \text{ mm}$	Yes	2016/181
720926	Not in coils, of a thickness of $> 1 \text{ mm}$ but $< 3 \text{ mm}$	Yes	2016/181
720927	Not in coils, of a thickness of $>= 0.5 \text{ mm}$ but $<= 1 \text{ mm}$	Yes	2016/181
720928	Not in coils, of a thickness of $< 0.5 \text{mm}$	No	2016/181

Notes: Since each HS-6 code is a sub-category of an HS-4 code, we have arranged them numerically and shortened the *Description* of the HS-6 codes so that the overall description of the parent category applies to each underlying code. The column *Complete*? refers to whether the HS-6 code is affected by the anti-dumping measure in each of its HS-8 subcategories. *CIR* refers to the code of the Commission Implementing Regulation

Table 2	Continued: HS-code,	description, data	completeness, and	d CIR of affected	products
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HS-code	Description	Complete?	CIR
7210	Flat-rolled products of iron or non-alloy steel		
	of a width >= 600 mm, hot-rolled or cold-rolled ""cold-reduced"", clad, plated or coated		
721041	Corrugated, plated or coated with zinc (excl. elec- trolytically plated or coated with zinc)	Yes	2017/1444
721049	Not corrugated, plated or coated with zinc (excl. elec- trolytically plated or coated with zinc)	Yes	2017/1444
721050	Plated or coated with chromium oxides or with chromium and chromium oxides	Yes	2022/802
721061	Plated or coated with aluminum-zinc alloys	Yes	2017/1444
721069	Plated or coated with aluminum (excl. products plated or coated with aluminum-zinc alloys)	Yes	2017/1444
721070	Painted, varnished or coated with plastics	No	845/2012
7211	Flat-rolled products of iron or non-alloy steel		

Table 2 continued

HS-code	Description	Complete?	CIR
	of a width of < 600 mm, hot-rolled or cold-rolled "cold-reduced", not clad, plated or coated		
721113	Simply hot-rolled on four faces or in a closed box pass, of a width of $> 150 \text{ mm}$ but $< 600 \text{ mm}$ and a thickness of $>= 4 \text{ mm}$, not in coils, without patterns in relief, commonly known as "wide flats"	Yes	2016/1778
721114	Not further worked than hot-rolled, of a thickness of $>= 4,75 \text{ mm} (\text{excl. "wide flats"})$	Yes	2016/1778
721119	Of a thickness < 4,75 mm (excl. "wide flats")	Yes	2016/1778
721123	Containing by weight $< 0.25\%$ of carbon	Yes	2016/181
721129	Containing by weight $>= 0.25\%$ of carbon	Yes	2016/181
7212	Flat-rolled products of iron or non-alloy steel		
	of a width of < 600 mm, hot-rolled or cold-rolled "cold-reduced", clad, plated or coated		
721230	Tinned (excl. electrolytically plated or coated with zinc)	Yes	2017/1444
721240	Painted, varnished or coated with plastics	No	845/2012
721250	Excl. tinned, plated or coated with zinc, painted, var- nished or coated with plastics	No	2017/1444
7213	Bars and rods of iron or non-alloy steel, hot-rolled, in irregularly wound coils		
721310	With indentations, ribs, grooves or other deformations produced during the rolling process	Yes	112/2009
721320	Of non-alloy free-cutting steel (excl. bars and rods containing indentations, ribs		
	grooves or other deformations produced during the rolling process)	Yes	112/2009
721391	Of circular cross-section measuring $< 14 \text{ mm}$ in diameter (excl. bars and rods of free-cutting steel		
	and bars and rods with indentations, ribs, grooves or other deformations produced during the rolling pro- cess)	Yes	112/2009
721399	Excl. products of circular cross-section measuring < 14 mm in diameter, bars and rods of free-cutting steel		
	and bars and rods with indentations, ribs, grooves or other deformations produced during the rolling pro- cess	Yes	112/2009

Table 3 Continued: HS-code, description, data completeness, and CIR of affected products

HS-code	Description	Complete?	CIR
7214	Bars and rods, of iron or non-alloy steel, not further worked than forged, hot-rolled		
	hot-drawn or hot-extruded, but incl. those twisted after rolling (excl. in irregularly wound coils)		
721420	With indentations, ribs, groves or other deformations produced during the rolling process	Yes	2016/113

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Table 3 continued

HS-code	Description	Complete?	CIR
7217	Wire of iron or non-alloy steel, in coils (excl. bars and rods)		
721710	Not plated or coated, whether or not polished	No	1129/2008
721720	Plated or coated with zinc	No	1129/2008
7219	Flat-rolled products of stainless steel, of a width of >= 600 mm, hot-rolled or cold-rolled "cold-reduced"		
721911	Not further worked than hot-rolled, in coils, of a thickness of $> 10 \text{ mm}$	Yes	2020/508
721912	Not further worked than hot-rolled, in coils, of a thickness of $>= 4,7$ mm and $<= 10$ mm	Yes	2020/508
721913	not further worked than hot-rolled, in coils, of a thickness of $>= 3 \text{ mm}$ and $< 4,75 \text{ mm}$	Yes	2020/508
721914	Not further worked than hot-rolled, in coils, of a thickness of $< 3 \text{ mm}$	Yes	2020/508
721922	Not further worked than hot-rolled, not in coils, of a thickness of $>= 4,75$ mm and $<= 10$ mm	Yes	2020/508
721923	Not further worked than hot-rolled, not in coils, of a thickness of $>= 3 \text{ mm}$ and $< 4,75 \text{ mm}$	Yes	2020/508
721924	Not further worked than hot-rolled, not in coils, of a thickness of $< 3 \text{ mm}$	Yes	2020/508
721931	Not further worked than cold-rolled "cold-reduced", of a thickness of $>= 4,75 \text{ mm}$	Yes	2015/501
721932	Not further worked than cold-rolled "cold-reduced", of a thickness of $> = 3 \text{ mm}$ but $< 4,75 \text{ mm}$	Yes	2015/501
721933	Not further worked than cold-rolled "cold-reduced", of a thickness of $> 1 \text{ mm}$ but $< 3 \text{ mm}$ "	Yes	2015/501
721934	Not further worked than cold-rolled "cold-reduced", of a thickness of $>= 0.5$ mm but $<= 1$ mm"	Yes	2015/501
721935	Not further worked than cold-rolled "cold-reduced", of a thickness of $< 0.5 \text{ mm}$ "	Yes	2015/501
7220	Flat-rolled products of stainless steel, of a width of < 600 mm, hot-rolled or cold-rolled "cold-reduced"		
722011	Not further worked than hot-rolled, of a thickness of $>= 4,75 \text{ mm}$	Yes	2020/508
722012	Not further worked than hot-rolled, of a thickness of $< 4,75 \text{ mm}$	Yes	2020/508
722020	Not further worked than cold-rolled "cold-reduced"	Yes	2015/501

Table 4 Continued: HS-code, description, data completeness, and CIR of affected products

HS-code	Description	Complete?	CIR
7225	Flat-rolled products of alloy steel other than stainless		
	of a width of >= 600 mm, hot-rolled or cold-rolled "cold-reduced"		
722511	Silicon-electrical steel, grain-oriented	Yes	2015/763
722519	Silicon-electrical steel, non-grain-oriented	No	2016/1778

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Table 4 continued

HS-code	Description	Complete?	CIR
722530	Not further worked than hot-rolled, in coils (excl. products of silicon-electrical steel)	No	2016/1778
722540	Not further worked than hot-rolled, not in coils (excl. products of silicon-electrical steel)	No	2016/1778
722550	Not further worked than cold-rolled "cold-reduced" (excl. products of silicon-electrical steel)"	No	2016/181
722592	And plated or coated with zinc (excl. electrolytically plated or coated and products of silicon-electrical steel)	No	2017/1444
722599	And further worked (excl. plated or coated with zinc and products of silicon-electrical steel)	No	845/2012
7226	Flat-rolled products of alloy steel other than stainless		
	of a width of < 600 mm, hot-rolled or cold-rolled "cold-reduced"		
722611	Silicon-electrical steel, grain-oriented	No	2015/763
722619	Silicon-electrical steel, non-grain-oriented	No	2016/1778
722691	Not further worked than hot-rolled (excl. products of high-speed steel or silicon-electrical steel)	No	2016/1778
722692	Not further worked than cold-rolled "cold-reduced"		
	(excl. products of high-speed steel or silicon- electrical steel)	Yes	2016/181
722699	Hot-rolled or cold-rolled "cold-reduced" and further worked (excl. products of high-speed steel or silicon- electrical steel)"	No	845/2012
7227	Bars and rods of alloy steel other than stainless, hot- rolled, in irregularly wound coils		
722710	High-speed steel	Yes	112/2009
722720	Silico-manganese steel	Yes	112/2009
722790	Excl. products of high-speed steel or silicon-electrical steel	Yes	112/2009

Table 5Difference-in-differences analysis, EU importquantity from China		2016/181	2016/1778	2015/501	2017/1444
	(Intercept)	9.12***	9.12***	9.15***	9, 13***
		(0.10)	(0.10)	(0.10)	(0.10)
	А	0.12	0.44*	-0.05	-0.08
		(0.17)	(017)	(0.18)	(0.19)
	Р	-0.36*	-0.36^{*}	-0.32^{*}	-0.32^{*}
		(0.16)	(0.17)	(0.15)	(0.16)
	A*P	-0.81^{**}	-1.68^{***}	0.01	-0.07
		(0.28)	(0.28)	(0.27)	(0.28)
	R^2	0.01	0.04	0.00	0.00
	Adj. <i>R</i> ²	0.01	0.04	0.00	0.00
	Num. obs	2086	2197	2086	2022

 $\boxed{***p < 0.001; **p < 0.01; *p < 0.05}$

Table 6 Difference-in- differences analysis, total EU		2016/181	2016/1778	2015/501	2017/1444
import quantity	(Intercept)	12.79***	12.79***	12.79***	12.79***
		(0.07)	(0.07)	(0.08)	(0.08)
	А	0.07	0.39**	-0.06	-0.07
		(0.13)	(0.12)	(0.14)	(0.14)
	Р	0.10	0.10	0.08	0.08
		(0.12)	(0.12)	(0.12)	(0.12)
	A*P	-0.02	-0.06	0.08	0.03
		(0.21)	(0.20)	(0.21)	(0.21)
	R ²	0.00	0.01	0.00	0.00
	Adj. R ²	-0.00	0.01	-0.00	-0.00
	Num. obs	2086	2197	2086	2022

 $\boxed{ ***p < 0.001; **p < 0.01; *p < 0.05 }$

Table 7	Difference-in-
differen	ces analysis, EU import
price	

	2016/181	2016/1778	2015/501	2017/1444
(Intercept)	4.79***	4.79***	4.80***	4.79***
	(0.03)	(0.03)	(0.03)	(0.03)
А	-0.16^{**}	-0.27^{***}	0.01	-0.08
	(0.05)	(0.05)	(0.06)	(0.06)
Р	-0.01	-0.01	-0.02	-0.02
	(0.05)	(0.05)	(0.05)	(0.05)
A*P	0.07	0.07	0.03	0.05
	(0.09)	(0.08)	(0.09)	(0.09)
R ²	0.00	0.02	0.00	0.00
Adj. R ²	000	0.02	-0.00	-0.00
Num. obs	2086	2197	2086	2022

*** p < 0.001; ** p < 0.01; * p < 0.05

Table 8 Classic difference-in-differences		2015/501	2016/181	2016/1778	2017/1444
analysis, relabeling	(Intercept) Q A	-10.49^{***} (0.96) 0.04^{***} (0.01) -0.15 (0.65)	-8.97*** (0.96) 0.04*** (0.01) 1.99*** (0.36)	-7.39*** (0.96) 0.05*** (0.01) 3.06*** (0.28)	-10.30^{***} (0.97) 0.04^{***} (0.01) -0.97^{*} (0.48)
		(0.03)	(0.50)	(0.28)	(0.48)

 $\overline{***p < 0.001}; **p < 0.01; *p < 0.05$

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Table 8 continued					
		2015/501	2016/181	2016/1778	2017/1444
	Р	0.25	0.32*	0.34*	0.25
		(0.15)	(0.15)	(0.15)	(0.15)
	A*P	1.51	-0.38	-1.47^{***}	0.52
		(0.89)	(0.52)	(0.39)	(0.76)
	G	0.48***	0.43***	0.37***	0.48***
		(0.04)	(0.04)	(0.04)	(0.04)
	Q*A	0.20***	-0.05	-0.16^{***}	0.14***
		(0.05)	(0.03)	(0.02)	(0.04)
	Q*P	-0.03^{*}	-0.04^{**}	-0.04^{**}	-0.04^{**}
		(0.01)	(0.01)	(0.01)	(0.01)
	Q*A*P	-0,04	0.08	0.16***	0.10
		(0.07)	(0.05)	(0.03)	(0.06)
	R ²	0.05	0.03	0.03	0.04
	Adj. R ²	0.05	0.03	0.03	0.03
	Num. obs	10, 584	10,908	11, 556	10, 476

***p < 0.001; **p < 0.01; *p < 0.05



Fig. 9 Robustness check with donor pool consisting of products from HS74 (copper) and HS75 (nickel) confirms significant effect on EU imports from China



Fig. 10 Robustness check with donor pool consisting of products from HS74 (copper) and HS75 (nickel) confirms no effect on total import quantity



Fig. 11 Robustness check with donor pool consisting of products from HS74 (copper) and HS75 (nickel) lends some support to market adjustment effects on overall import prices



Fig. 12 ASCM robustness check with elastic net method confirms results



Fig. 13 ASCM robustness check with random forest method confirms results



Fig. 14 ASCM robustness check with matrix completion method confirms results



Fig. 15 No indication for relabeling in India



Fig. 16 For products targeted by CIR 2016/181, ASCM analysis provides some indication for relabeling in Ukraine



Fig. 17 For products targeted by CIR 2015/501, ASCM analysis indicates relabeling in South Korea



Fig. 18 No indication for relabeling on products targeted by CIR 2017/1444

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Data Availability The dataset used in this study has been compiled from Eurostat and UN Comtrade https:// ec.europa.eu/eurostat/databrowser/product/view/DS-045409 https://comtradeplus.un.org/TradeFlow.

Declarations

Ethical Approval N/A.

Conflict of interest The authors declare no Conflict of interest.

Informed Consent N/A.

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