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A gravity analysis of the adverse effects of U.S. sanctions and their after-life

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Abstract

Sanctions have become a frequently used tool of political interactions around the globe, and the U.S. is he leading countries when it comes to imposing economic sanctions. While the intention of economic sanctions is to put pressure on the target to alter its behaviour, research has shown that economic sanctions can have negative effects even on the sender country. Utilising a difference-in-differences approach in a gravity framework, we find evidence of adverse effects of multilateral sanctions on U.S. exports but rather inconclusive results for sanctions in large. As a second estimation focus, we investigate whether the adverse effects linger after the sanctions haven been terminated. That is, do sanctions continue to dampen U.S. exports even after they have been lifted? Our results indicate lingering adverse effects of sanctions and multilateral sanctions up to six years after they have been terminated.

Keywords: U.S., economic sanctions, gravity model, adverse effects, after-life

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1. Introduction

Economic sanctions have come to play an important role of political interactions between states and can be defined as economic measures of political objectives (Barber, 1979). When stronger measures such as military interventions are undesirable, economic sanctions and threat of sanctions can leverage pressure on the target to alter its behaviour accordingly to the objectives. While economic sanctions are generally viewed as an effective, low-cost and low-risk foreign policy tool, the empirical findings on economic sanctions show of more modest results (Baldwin, 2000). Although the rather pessimistic view of sanctions' effectiveness among scholars, there is nothing that indicates that the use of sanctions is declining. The number of sanctions has in fact been rather constant over the past decades and the trend shows of multilateral cooperation becoming more and more anticipated (Bapat and Morgan, 2009). While sanctions' ability of inflicting economic damage is questioned, there is no disagreement that they may inflict costs to the sender (Hufbauer et al. 2009). The reason why they entail sender costs is quite intuitive: by obstructing trade in one direction, it will automatically affect the sender as trade is a two-way relation. Policy makers should therefore account for the adverse effects of sanctions prior to their imposition, but such cost analyses are seldom conducted (Hufbauer et al. 2009).

The United States has been the major country imposing sanctions since the World War II (Caruso, 2005). The frequent use of sanctions has triggered a debate regarding the costs, but the focus tends to still remain on sanctions' effectiveness (Hufbauer et al. 2009). For that reason, we have chosen to study the adverse effects of sanctions by evaluating the causality between U.S. sanctions and U.S. exports. To do so, we have conducted a difference-in-differences analysis in an augmented gravity framework with data on U.S. merchandise exports over the period of 1995-2011. Hence, the study contributes to literature by further evaluate the adverse effects of sanctions. As such, the primary aim of this study is to evaluate the adverse effects of sanctions, but also in a second step evaluate whether the effect may linger after the sanctions have been lifted.

The remainder of this paper proceeds as follows: chapter 2 outlines stylized facts of sanctions and provides a literature review of sanctions' effectiveness and their costs to the sender. Chapter 2 also provides a short overview of the U.S. history of sanctions. The third chapter presents the empirical approach where the gravity model is presented, and potential estimation issues outlined. The chapter also covers the model specifications of the study.

In chapter 4, we present the data and data sources and chapter 5 presents the empirical results. Lastly, chapter 6 concludes.

2. Economic sanctions

2.1 Defining sanctions and their impact on trade

Sanctions are defined as economic measures of political objectives, where the concept embodies both positive and negative sanctions (Barber, 1979). The distinction between the two is, as the names imply, that the intention of the former is to encourage a certain behaviour or to foster cooperation among countries while the intention of the latter is to inflict damage or to put pressure on a country to alter its behaviour (Caruso, 2005). That is, sanctions are a rather diverse foreign policy tool but since this study has its focus on international policy and international trade, we will limit us to negative economic sanctions, henceforth simply denoted as "sanctions".

Inflicting costs on a target can be exercised in mainly three ways: through embargos, boycotts or financial sanctions (Hufbauer et al. 2009). While an embargo restricts exports to the target, a boycott is a restriction of imports of goods from the target. By limiting trade with the target, the sender can inflict costs in terms of lost export markets and disclaimed import goods. Lost export markets will force the target to seek other export destinations, which could result in adjustment costs and reduced profits if the new export market is more competitive than the previous. Likewise, denial of critical imports is likely to raise costs as the target may have to pay a higher price for import substitutes (Hufbauer et al. 2009; Lindsay 1986). Financial sanctions involve restriction or suspension of financials means into the target, but also comprehend freezing of assets and other restrictions of international transactions (Van Bergeijk, 2009). Unlike embargos and boycotts, financial sanctions are not directly linked to trade but can impede trade indirectly. Intuitively, the target may respond to financial sanctions with countermeasures which could involve trade restrictions and thus impede trade. Another implication is that assets freezes does not only concern assets held by the target in the sending country but also its corporations' and residents' assets which self-evidently could affect trade in a negative sense (Hufbauer et al. 2009).

2.2 Effectiveness of sanctions

While sanctions are widely considered as a powerful tool of foreign policy, the view among scholars is rather the contrary (Besedeš et al. 2017). These conflicting views have motivated scholars to devote their effort to evaluate the effectiveness of sanctions and in particular determinants of success. One of the major contributions of the field of economic sanctions is the work of Hufbauer, Schott and Elliot (1990), whose extensive work comprehends sanctions spanning over the time period 1914-1990. By reviewing the material, they find that approximately 34 percent of the sanctions were successful (Hufbauer et al. 1990). This finding contrasted the research of the 1960's and 1970's which were marked by pessimism and thus were these new findings received with astonishment (Pape, 1998). However, the validity of their methodology has been a subject for debate in the literature and it is not without criticism (Drury 1998; Dreger et al. 2016; Pape 1997; Pape 1998). Although there have been a few cases where sanctions have been successful, later research has shown little or no evidence of sanctions being effective policy instruments (Bapat et al. 2013). In a try to identify the reasons why sanctions tend to fail, Hufbauer et al. (2009) have outlined four potential shortcomings with sanctions: (i) the type of sanction imposed may not be adequate in order to achieve its goals and the objective could be too subtle and the means too gentle, (ii) in cases when the objective is to destabilise an autocratic regime, sanctions could in fact weld together the targeted country leaving it stronger and less recipient to change, (iii) wealthy allies coming to the target's aid can largely offset the negative effect of the sanction and (iv) sanctions could possible turn the sender against its allies if the sanction goes against the allies' self-interests.

Rather than focusing on what limits the effect of sanctions, many scholars have instead turned their focus to identifying determinants of success. While the literature has identified numerous of potential determinants, the empirical findings have been rather inconclusive (Lindsay, 1986). Notwithstanding, fundamental for success if the ability of inflicting severe costs on the target. As stated by Van Bergeijk: "a sanction simply cannot be expected to succeed if […] economic linkages are too low so that no or hardly any damages can ever be done" (2009, p. 119). The line of thought is backed by a numerous of scholars including Drury (1998), Allen (2005), Doxey (1980) and Hufbauer et al. (2009). Furthermore, Hufbauer et al (2009) stress the importance of trade linkages and relative size for success of sanctions: the effectiveness largely depends on the trade linkages between the target and

sender as well as their relative size. The more they are integrated and the larger the difference in size is, the higher potential the sanctions have of inflicting significant economic damage (Bayard et al. 1983; Hufbauer et al. 2009; Caruso 2005).

Another necessary for success that is often emphasised is the duration of sanctions: a constant pressure of the sanctions is essential in order to achieve compliance according to Barber (1979). On the same note, Van Bergeijk (2009) founds that the majority of successful sanctions that were imposed post 1945 required two years or more while sanctions of shorter duration tend to fall short. However, Torbat (2005) finds in his case study on U.S. sanctions on Iran that an excessively long duration may lead to a decreased effect of trade sanctions. Although he finds that the sanctions have damaged the Iranian economy over the years, the empirics show that the effectiveness of the trade sanctions has decreased tremendously since first imposed while the effect of the financial sanctions have been more constant (Torbat, 2005). Torbat addresses the initial effect of the trade sanctions to the theories presented above and argues that the decrease of their effectiveness is due to their long-term presence. Altogether, the presented findings suggest that while medium-term duration is an important determinant for success, excessively long duration may have the opposite effect in the instance of trade sanctions as substitution and flexibility increases over time (Van Bergeijk, 2009).

Another main feature of focus is the number of senders. While the empirics show of weak effectiveness of unilateral sanctions, the empirical findings on multilateral sanctions are more optimistic (Caruso 2005; Lekzian and Souva 2007; Allen 2008). The success of multilateral sanctions is in general attributed to their ability of reducing or entirely eliminating alternative suppliers but also the fact that cooperation lends moral legitimacy to the objective (Lekzian and Souva, 2007). The assumption of multilateral cooperation being a necessary for success has however been questioned and there are those who claim that cooperation is overvalued and that it may in fact yield a negative net result for the primary sender (Drezner, 2000). Bapat and Morgan (2009) find in their study that the success of sanctions does not depend so much on the number of senders but rather whether an international institution is involved in the sanction.

As laid out above, there are quite diverse views on sanctions' effectiveness and the determinates of success, but altogether, the overall view among scholars is that the

effectiveness of sanctions is rather limited but that sanctions are more likely to be successful if there are multiple sender countries.

2.3 Costs of sanction to sender

Sanctions does in general entail domestic costs of the sender – costs which could leave the sender with a negative net result even though the sanction is successful (Drezner, 2000). As trade is a two-way relation, the adverse effect of trade sanctions is self-evident: limiting trade in one direction will automatically result in lost revenues or alternatively increased costs in the opposite direction. Regarding financial sanctions, besides limiting trade through obstruction of financial flows, financial sanctions may also have a negative backward effect in terms of declining capital inflows into the sender country, so neither financial sanctions are without drawbacks for the sender (Besedeš et al. 2017). How noticeable these costs are, is according to Hufbauer et al. (2009), due to the size of the sender: for large countries the costs can be rather trivial while smaller countries are more vulnerable for the same reasons as why small targets are more vulnerable for sanctions. Since most senders are relatively large, the costs are often considered as bearable for the sender economy as a whole. But as sanctions often involve sector-specific goods and services, it is the industries whose goods are being concerned that will pay for the sanctions as they will face harder foreign competition (Hufbauer et al. 2009).

A further implication of the cost of sanctions outlined by Morgan and Schwebach (1997) is that the effectiveness of sanctions appears to be a decreasing function of sender costs. For this reason, smaller countries are less likely to initiate sanctions but are today more frequently involved in multilateral sanctions (Hufbauer et al, 2009). Although multilaterals sanctions have become an increasingly more popular instrument and more feasible for smaller countries, they do also encompass costs and in particular for the primary sender. As Martin (1992) notes, even though multilateral sanctions turn out to be more effective in term of reaching its objectives, it could leave the primary sender with a negative net result as multilateral support requires diplomatic expenses which could entail the gains from a successful sanction. Despite the knowledge about costs of sanctions to the sender, the costs have rarely been quantified empirically. In the U.S. however, the matter of sanction costs has been up for debate where the Peterson Institute for International Economics (PIIE) has estimated the cost of U.S. sanctions in 1997. As a follow up to the report of PIIE, Hufbauer and Oegg (2003) studied U.S. sanctions of 1999 and found that the sanctions

indeed supressed trade but also that the sanctions had a lingering adverse effect. As the lingering effects of sanctions is a rather unexplored branch of sanction research, this paper aims to contribute to the literature by further study the adverse effects of sanctions and in particular lingering effects of sanctions.

2.4 Sanctions and the U.S.

The U.S. has a long history of sanctions, with the first sanction dating back to 1812[1] (U.S. Department of the Treasury, 2018). By being one of the world's leading economies, it is not surprising that the U.S. has been the primary user of sanctions since the World War II and still is. It follows naturally that the use of sanctions is tied to the foreign policy conducted and in this sub-section, we will highlight major turning points in the U.S. history of sanctions.

Before 1985, the U.S. legislation required that import restrictions could only be imposed if the U.S. faced a national threat or a national emergency, which led to few import sanctions were imposed (Hufbauer et al. 2009). Sanctions qualifying under these premises were the embargo against Cuba in 1960 and Iran 1979 (U.S. Department of the Treasury, 2018). During the period prior to 1985, export sanctions were a more common feature and to such an extent that U.S. Export Administration issued a bill in 1979 with the intention of protecting industries whose goods were frequently covered in the sanctions list from foreign competition (Hufbauer et al. 2009). The legislation concerning import restrictions changed with time in line with the foreign policy, but the export sanctions have kept dominating (Hufbauer et al. 2009)

With the Cold War ending, the U.S. foreign policy changed and as the U.S. began to cooperate with the UN in the early 1990's, the number of sanctions sky rocked. In fact, Hufbauer and Oegg (2003) refer to this period as the "sanction decade". Moving towards more cooperation of sanctions, the number of unilateral sanctions decreased during the second half of the 1990's and the majority of U.S. sanctions today are of multilateral nature (U.S. Department of the Treasury, 2018). In the war against terrorism after the 9/11 attacks in 2001, financial sanctions became more anticipated as the U.S. aimed to disturb infrastructure sponsoring terrorism (Bapat et al., 2016). This line of policy is still present,

[1] The war of 1812: US against the British Empire

and the majority of U.S. sanctions is of multilateral nature and concerning financial measures (U.S. Department of the Treasury, 2018).

3. Empirical approach

To assess adverse effects of U.S. sanctions on U.S. export and possible lingering effects, we have conducted a difference-in-differences (DiD) analysis in a gravity framework. The gravity model is one of the most robust empirical models to estimate bilateral trade and DiD allows us to isolate the effect of sanctions without other trending factors biasing the result (Meyer, 1995). Both the gravity model and DiD are well-used economic tools to estimate casual relationships of policy implications on trade. In this section, we will present the gravity model and potential issues of gravity model estimations but also our model specifications.

3.1 Gravity model of international trade

With foundation in physical science, the gravity model has become the work-horse of international trade analysis. Analogy with Newton's law of universal gravitation, the gravity model builds on the theory of countries' trade being proportional to their economic mass and proximity (WTO and UNCTAD, 2012). In other words, the larger the countries are in terms of GDP and the closer geographical distance, the more they are assumed to trade. As an empirical model, the gravity model has been applied to analyse bilateral trade since the 1960's and has proved to be extraordinary stable but the general form of the gravity equation has received criticism for lacking theoretical foundation[2]. A first attempt to provide a theoretical basis for the gravity model was made by Anderson (1979) in which he based the gravity equation on the concepts of constant elasticity of substitution (CES) and the Armington assumption. Further attempts have been made by Krugman (1980) and Bergstrand (1985, 1989) among others, but the work of Anderson and van Wincoop (2003) is considered as the far most important contribution to the research on the gravity model. Their contribution regards the inclusion of multilateral-trade resistance (MTR) terms, which capture relative trade costs between countries. That is, MTR is the barriers to trade that each country faces with all its trading partners and without controlling for such, gravity

[2] General form of the gravity equation: $X_{ij} = GS_iM_j\phi_{ij}$ where X_{ij} is the value of exports from i to j, S_i denotes exporter-specific factors, M_j denotes import-specific factors and ϕ_{ij} captures exporter i access to market j (UNCTAD and WTO 2012)

model estimations are likely to be biased (Anderson and van Wincoop, 2003). Hence, the gravity model presented by Anderson and van Wincoop (2003) takes the form:

$$X_{ij} = \frac{Y_i Y_j}{Y}\left(\frac{t_{ij}}{\Pi_j P_j}\right)^{1-\sigma} \quad (1)$$

where X_{ij} denotes monetary value of exports from *i* to *j*, Y the world GDP, Y_i and Y_j the GDP of country *i* and *j* respectively, t_{ij} is the trade cost between partners *i* and *j* and $\sigma > 1$ is the elasticity of substitution. The denominator of the parenthesis of equation (1) constitute of the two MTR-terms where Π_j and P_j measures the exporter and importer ease of market access. The unobserved trade costs can be captured by various variables, but most common is to use bilateral distance as a proxy for trade cost. In terms of sanctions, they will enter the model as trade costs such that the trade cost variable takes the form of:

$$t_{ij} = d_{ij}^{\delta i} \cdot \exp(sanc_{ij}) \quad (2)$$

Where d_{ij} is bilateral distance and $sanc_{ij}$ is a dummy denoting sanctions between country *i* and *j*.

Regarding MTR, there are several ways of controlling for MTR and a common approach to obtain unbiased estimates is to replace the MTR-terms with importer and exporter dummies, which will capture country-specific characteristics and control for the countries overall exports and imports (Anderson and van Wincoop, 2004). This study has however controlled for MTR by including bilateral fixed effects, which according to Freenstra "might be considered to be the preferred empirical method [to account for MTR]" (2016, p. 143). Furthermore, bilateral fixed effects do not only capture all country-specific effects such as MTR but also bilateral-specific effects such as distance.

3.3 Potential estimation issues

In addition to the previously discussed issue of MTR, there are several concerns that may arise when estimating the gravity model. A common issue when working with trade data is the presence of zero observations. As the gravity equation is non-linear, linear estimations models such as Ordinary Least Squares (OLS) require the gravity equation to be in a linear form. This causes problems since the log of zero is not defined and in practice, the OLS log-linear gravity equation as used by Anderson and van Wincoop (2003) will result in zero

trade flows being omitted. The zero observations may be due to measurement errors or it could simply be that there is no trade between the country pairs. Whether to treat zero observations as informative or not is up to the researcher's judgement, but if the observations are dropped while being informative, it will result in sample selections bias and hence inconsistent estimates (Helpman et al. 2008). It is therefore of importance to address the issue of zero observations thoughtfully when modelling the gravity model as it will impact the result. One approach to overcome this issue is to add a small constant to the value of such observations. Retaining zero observations in this way could however result in inconsistent estimates as WTO and UNCTAD puts it: "there is no guarantee that it reflects the underlying expected values" (2012, p. 112). Santos Silva and Tenreyro (2006) therefore recommend using the Poisson estimator as it can directly estimate the non-linear form of the gravity equation and hence account for zero trade observations. The same further withhold that the Poisson estimator is to be preferred over log-linearized models as the latter yield severely biased estimates in presence of heteroscedasticity (Santos Silva and Tenreyro, 2006)

Endogeneity bias is a further issue that may arise when estimating the impact of policy changes on trade. The most critical problem is according to Baldwin and Taglioni (2006) omitted variables causing endogeneity and they observe that policy variables such as MTR are in particular exposed for such implications due to the difficulty of including all cost factors. In case of endogeneity, the first choice would be to use an instrumental variable approach but finding proper instruments is often difficult when dealing with trade estimations. The endogeneity problem can to some extent be corrected by the use of fixed effects but there may still be problems with time-invariant omitted variables (WTO and UNCTAD, 2012). Another technique to deal with potential endogeneity is to apply the difference-in-differences estimator. By comparing the performance of a treatment group before and after being treated with an untreated control group, one can stage a natural experiment and, in this way, capture the true effect of the exogenous treatment which is in our case are the sanctions (Verbeek, 2012). Due to its merits of overcoming potential ambiguities of single-difference studies, we have chosen to handle potential endogeneity issues by using the DiD estimator.

3.3 Model specification

Estimating the effect of sanctions on bilateral merchandise export flows, the following augmented gravity equation has been applied:

$$\ln EXP_{jt} = \beta_0 + \beta_1 \ln MASS_{ijt} + \beta_2 \ln (GDPpc_{it} * GDPpc_{jt}) + \alpha\, SANC + \\ + \mu_{ij} + \gamma_t + \varepsilon_{ijt} \quad (3)$$

where the dependent variable EXP_{jt}, is U.S. bilateral merchandise export flows to country *j* at time *t*. As for the independent variable provided by the gravity model, $MASS_{ijt}$ measures the economic mass of the country pairs at time t and is constructed as the product of the countries' GDPs. As proposed by Bergstrand (1985), we have included per capita GDP as a proxy for the capital-endowment ratio of the bilateral country pair and thus a measure of the purchasing power of the trading countries. As such, we expect to find a positive relationship between per capita GDP and exports. Moreover, SANC is a dummy variable taking value of unity if a sanction is present, and zero otherwise. As our ambition is to identify possible adverse effects of sanctions on U.S. exports, the coefficient of interest is therefore α. Apart from economic mass, we have excluded other traditional gravity variables since we can account for such by including bilateral fixed effects (μij). We have furthermore included time-fixed effects (γ_t) in order to control for factors varying with time and we have run robust standard errors (ε_{ijt}) to control for heteroscedasticity.

$$EXP_{jt} = \beta_0 + \beta_1 \ln MASS_{ijt} + \beta_2 \ln (GDPpc_{it} * GDPpc_{jt}) + \alpha_1\, SANC + \\ + \alpha_2\, (SANC * MULTI) + \mu_{ij} + \gamma_t + \varepsilon_{ijt} \quad (4)$$

While equation (3) is estimated with OLS and thus is in log-linear form, we regress equation (4) by the Poisson estimator as recommended by Santos Silva and Tenreyro (2006). To test whether the skew, discrete distribution of the error terms is a better fit of our model, we have applied both estimation methods on our data. A further addition in equations (4) is an interaction variable between the two dummies SANC and MULTI, where the latter takes the value of unity if presence of a multilateral sanction, and zero otherwise. As such, we are able to identity whether sanctions have a greater adverse effect on U.S. exports if they are of multilateral nature. As the literature have found that multilateral sanctions tend to have a greater impact on the target, it is of interest to study whether they also have a greater adverse effect on the sender as well.

$$EXP_{jt} = \beta_0 + \beta_1 \ln MASS_{ijt} + \beta_2 \ln (GDPpc_{it} * GDPpc_{jt}) + \alpha_1 SANC + \quad (5)$$
$$+ \alpha_2 SANC1 + \alpha_3 SANC2 + \alpha_4 SANC3 + \alpha_5 SANC4 +$$
$$+ \alpha_6 SANC5 + \alpha_7 SANC6 + \alpha_8 SANC7 + \alpha_9 SANC8 +$$
$$+ \mu_{ij} + \gamma_t + \varepsilon_{ijt}$$

To evaluate a possible lingering adverse effect of sanctions, we have estimated equation (5). In this specification, SANC[3] is the same as in equation (3) while SANC1-8 are yearly dummies one to eight years after the sanction has been terminated. We expect to find some lingering effects of sanctions as we assume it to take some time to reestablish trade and financial relations with the former target, but the question is for how long the adverse effects are present. And once again, we further test if the effect of multilateral sanctions differs from sanctions in large.

In order to test the robustness of our DiD analysis, alteration of the control group has been made for specifications of particular interest. Inclusion of countries with different characteristics than the treatment group enables us to test whether certain country characteristics are driving factors and hence bias the result. That is, if the regression output remains unchanged when we include the different control groups, we can confirm that our estimates are robust.

4. Data

The treatment group consists of 17 countries facing U.S. sanctions over the period 1995-2011 and the sample of targeting countries is based on the material provided by the comprehensive work of Hufbauer et al. (2009), which provides a thoroughly description of sanctions and hence a sound ground to base the study on (see table A1 for treatment group). As for the control group, 16 countries with similar characteristics[4] as the treatment group has been selected and for robustness purposes, a second control group consisting of 37 additional countries has been constructed where the additional countries are randomly chosen and hence may differ in characteristics compared with the treatment group. The

[3] A binary variable taking the value of unity when the U.S. has implemented a sanction, and zero otherwise
[4] Similar characteristics in terms of export flows, GDP, per capita GDP, export as percent of GDP and human development

dependent variable in question is net bilateral merchandise export flows between the U.S. and the treated/control countries, measured in millions USD. The export data have been assembled from UN Comtrade database and do surprisingly not contain zero observations (see table A5). However, due to data limitations, exports in services have been excluded and since service trade often if affected by sanctions, it could thus result in an underestimation of the impact of sanctions (Hufbauer and Oegg, 2003).

As for the gravity variable, economic mass, GDP data have been assembled from the World Development Index (WDI) database provided by the World Bank, and from which we also collected data on per capita GDP. Lastly, treatment is a dummy variable taking the value of unity if the bilateral partner face a (multilateral) sanction, and zero otherwise. The information about sanctions has been assessed from Hufbauer et al. (2009).

Table 1: variables

Variables	Definition	Unit
EXP	Value of merchandise exports to destination *j* at time *t*	Millions USD
MASS	Economic mass, $GDP_{it} * GDP_{jt}$	USD
GDPpc	GDP per capita of country *i* and *j* at time *t*, ($GDPpc_{it}$*GDP_{jt})	USD
SANC	Dummy taking the value of 1 if sanction, 0 otherwise	Dummy (0/1)
MULTI	Dummy taking the value of 1 if multilateral sanction, 0 otherwise	Dummy (0/1)

5. Empirical results

To estimate the adverse effect of U.S. sanctions and possible lingering effects, we have utilised a difference-in-differences analysis with different specifications. Our primary aim is to evaluate whether sanctions have a negative adverse effect on U.S. exports, and in a second step study whether the adverse effect linger after the sanctions have been lifted. As such, the study can be viewed as consisting of two parts and we will hence address and discuss the results accordingly.

Table 2 reports our findings of evaluating the adverse effects of sanctions on U.S. exports. Column (1) and (2) reports the regression output from our two baseline specifications, where the former is estimated by OLS and the latter by Poisson. None of the specifications show of significant coefficients of SANC and thus cannot provide evidence of sanctions having adverse effects on U.S. exports. As for the gravity variable, MASS is normally expected to take a value of one as the gravity model assumes that trade increases proportionally with mass (WTO and UNCTAD, 2012). The results of specification (1) and (2) show on the contrary that U.S. exports would increase by only 71,9 % respectively 45,8 % if the economic mass would to be doubled. Given that our data only cover one-way merchandise export flows to smaller countries, it is not too surprising to find a value below one of the mass coefficients. More interesting is the fact that the two estimation methods yield different coefficients of mass. Having concluded that our data do not contain zero observations, we can eliminate that specification (1) suffers from sample selections bias and hence inconsistent estimates. Although the OLS estimation has a coefficient of determination of 0,603, we have chosen to proceed with the Poisson estimator in line with the recommendations of Santos Silva and Tenreyro (2006). As for per capita GDP, the baseline regressions report a positive coefficient which is in line with theory, but only specification (2) reports a coefficient of significance. This we interpret as a further indication of Poisson being a better estimation method for our model.

Having concluded that our data fail to provide evidence of sanctions having adverse effects on U.S. exports in large, we further test whether sanctions have adverse effects if being multilateral. The variable of interest of the third specifications is thus the interaction variable between the sanction dummies; SANC*MULTI. As can be seen in column (3), we find an unexpected positive and significant coefficient of sanctions, which implies that sanctions do in fact have a positive adverse effect on U.S. exports by approximately 22,8 %[5]. However, the coefficient of the interaction variable shows of a negative sign on a five percent significance level and thus implying a negative marginal effect of sanctions if they were multilateral.

To test the robustness of the results, we regress the same specification while including the altered control group. The inclusion of the larger control group yields a coefficient of mass

[5] Transformation of coefficient to obtain percentage value: (e^coeff -1)*100

that is more in line with the gravity assumption of proportional trade to economic mass (see column 4). The larger coefficient of MASS might be due to the use of bilateral fixed effects, since it captures a lot for the country-level variables. Hence, by increasing the size of the sample, we get a larger variation of MASS within bilateral partners and thus a higher value. Henceforth, the coefficient of per capita GDP shows now of a highly significant and negative value. A possible explanation for this could be the inclusion of rich countries in the control group as an increased income level may reflect lower trade with low-medium income countries since they have less raw material compared to poorer countries. As for the variables of interest: while the coefficient of the interaction variable continues to be negative and significant, specification (4) does not yield a significant coefficient of SANC. Hence, we can draw the conclusion that the robustness of sanctions' positive adverse effect on U.S. exports is reduced while we can confirm a robust negative adverse effect of multilateral sanctions, although slightly lower than first found.

Although the result reports evidence of sanctions having a positive adverse effect on export, one should not be too fast to jump to conclusions as the robustness appears weak. Sanctions having a positive adverse effect goes against our theory but there are possible explanations for this unexpected finding. First and foremost, the exclusion of service trade is, as discussed in previous chapter, likely to cause an underestimation of sanctions' impact (Hufbauer and Oegg, 2003). Secondly, as argued by Hufbauer et al. (2009), the cost of the sender can be trivial if the country being large. As the U.S. is a world economy and the second largest exporter in the world[6], it is quite reasonable to find limited adverse effects of sanctions. A further explanation of the left-out negative adverse effect could be that U.S. exporters whose goods are covered in the sanction list, may circumvent embargos by exporting via a third country. On the same note, this could also be an explanation to multilateral sanctions having a negative adverse effect: the more countries that are involved in the sanction, the harder it may be to export via a third country. Nevertheless, while the findings of sanctions' adverse effects are rather inconclusive, we can conclude that our data provide evidence of multilateral sanctions having adverse effects on U.S. exports.

[6] U.S. exports of 2016 is estimated to 1,42 trillion USD (At a glance, IMF.org)

Table 2: estimation results of sanctions' adverse effects

VARIABLES	(1) OLS ln EXP	(2) Poisson EXP	(3) Poisson EXP	(4) Poisson EXP
ln MASS	0.719***	0.458***	0.357***	1.057***
	(0.142)	(0.136)	(0.134)	(0.174)
ln GDPpc	0.0450	0.310*	0.304*	-0.325***
	(0.112)	(0.181)	(0.175)	(0.106)
SANC	0.0389	0.0938	0.206**	0.160
	(0.0437)	(0.0676)	(0.0850)	(0.132)
MULTI				
SANC*MULTI			-0.466***	-0.284*
			(0.166)	(0.165)
Constant	-25.85***			
	(6.141)			
Observations	697	697	697	1,311
R-squared	0.603			
Number of bilateral pairs	41	41	41	78

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Turning to the estimations of sanctions' afterlife, table 3 presents the regression output of the specifications in which we include the yearly sanction dummies. As for the lingering adverse effects of sanctions, column (5) reports significant, negative coefficients of sanctions for one to six years after being lifted, with an average of -40,15 %[7]. The coefficients of the variables representing the period at which the sanctions were in force (SANC) and the seventh and eighth year after termination (SANC7, SANC8), are found insignificant. The results of specification (5) thus imply that sanctions have a lingering adverse effect during the six years after being terminated, while the lingering effect cease after six years. Like the previous specifications (1)-(4), specification (5) cannot provide evidence of sanctions having an adverse negative effect while being in force. Specification (6) is identical to the former with exception of the altered control group. The insignificant coefficients of the majority of the yearly sanction dummies in specification (6) weakly support our expectations of a lingering effect.

[7] Average of transformed significant coefficients

Table 3: estimation results of sanctions' afterlife

VARIABLES	(5) EXP	(6) EXP	(7) EXP	(8) EXP
ln MASS	0.313**	1.073***	0.432**	1.046***
	(0.140)	(0.167)	(0.142)	(0.183)
ln GDPpc	0.309**	-0.335***	0.298*	-0.322***
	(0.151)	(0.103)	(0.176)	(0.108)
SANC	-0.171	-0.0449		
	(0.128)	(0.113)		
SANC1	-0.244**	-0.0698		
	(0.116)	(0.117)		
SANC2	-0.326**	-0.123		
	(0.133)	(0.128)		
SANC3	-0.359**	-0.180		
	(0.173)	(0.200)		
SANC4	-0.297**	-0.160		
	(0.148)	(0.170)		
SANC5	-0.327***	-0.215		
	(0.126)	(0.240)		
SANC6	-0.475***	-0.417**		
	(0.0788)	(0.201)		
SANC7	-0.0694	-0.0686		
	(0.0794)	(0.191)		
SANC8	-0.0263	-0.191		
	(0.0734)	(0.203)		
MULTI			-0.502**	-0.0750
			(0.207)	(0.213)
MULTI1			-0.244	0.134
			(0.199)	(0.252)
MULTI2			-0.246	0.105
			(0.193)	(0.217)
MULTI3			-0.594**	-0.330
			(0.274)	(0.288)
MULTI4			-0.380	-0.138
			(0.253)	(0.295)
MULTI5			-0.236***	0.158
			(0.0787)	(0.195)
MULTI6			-0.308***	0.0546
			(0.0988)	(0.0819)
MULTI7			-0.0414	0.266
			(0.0504)	(0.164)
MULTI8			0.0232	0.240
			(0.0778)	(0.219)
Observations	697	1,311	697	1,311
Number of bilateral pairs	41	78	41	78

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The same specifications but for multilateral sanctions have been regressed, which results can be seen in column (7) and (8). Column (7) reports negative adverse effects of multilateral sanctions while being in force and rather various results of their lingering adverse effects. Similar to the case of sanctions, it appears that the lingering effect of multilateral sanctions also cease after six years. Performing the same robustness test of including the altered control group for MULTI, we however find our estimates of specification (7) being weakly robust as specification (8) reports insignificant coefficients of all yearly multilateral dummy variables.

Furthermore, the specifications of table 3 show of a similar pattern as the specifications of table 2 regarding the coefficients of economic mass and per capita GDP: the coefficient of economic mass is amplified when the altered control group is included while the per capita GDP coefficient takes a negative sign. As previously discussed, the higher value of mass may be due to the use of bilateral fixed effects and the negative coefficient of per capita GDP to the negative relationship between high income levels and trade.

Altogether, the findings of sanctions' and multilateral sanctions' lingering adverse effects are roughly in line with our expectations. Since we in the first part of the study find significant negative effects of multilateral sanctions while the result of sanctions is more inconclusive, we expected to find a stronger lingering adverse effect of multilateral sanctions compared with sanctions in general. However, the estimations of table 2 show of the contrary: the lingering adverse effect of sanctions is more pronounced than for multilateral sanctions. A possible explanation could be that the trade relationship between U.S. and the target does not deteriorate in the same way with multilateral sanctions compared with unilateral sanctions. If that is the case, it is reasonable to find a more modest lingering effect of multilateral sanctions when isolating them from unilateral sanctions. However, since the findings of sanctions' after-life are found to be non-robust, one should interpret these results with caution.

6. Conclusion

The primary aim of this study is to evaluate the adverse effects of sanctions, and in a second step evaluate whether the effect may linger after the sanctions have been lifted. To do so, we have utilised a difference-in-differences analysis in an augmented gravity framework with data on U.S. merchandise export data over the period 1995-2011. The empirical results show of a robust negative adverse effect of multilateral sanctions while the result regarding sanctions in general, is more inconclusive. For the afterlife of sanctions, the empirics show evidence of sanctions and multilateral sanctions having a lingering adverse effect up to six years after being lifted, although only weakly robust. Our data can thereby confirm that, at least multilateral sanctions, inflict costs to sender while being in force and that the effect actually may linger up to six years after resolution. It is however likely that the impact of our estimates of sanctions is underestimated as trade in service has been excluded due to data limitations. That fact that we despite this are able to identify lingering adverse effects of sanctions brings us to the conclusion that further research is needed and highly relevant as it could help with future policy decisions and the understanding of sanctions.

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Appendix

Table A1: target countries

Sanction years	**Country**
95-02	Azerbaijan
03-05*	Central African Republic
96-98	Colombia
99-02*	Côte d'Ivoire
95-97*	Democratic Republic of the Congo
95-98, 00	Ecuador
95-98*	Gambia, The
95-05	Guatemala
01-05*	Haiti
98-01	India
95-97*, 99-02*	Indonesia
95-97	Lebanon
95-98*	Nigeria
95-01, 99-01*	Pakistan
96*	Paraguay
95-98	Peru
96-98*	Zambia

* multilateral sanction

Table A2: control group 1

Bangladesh, Bulgaria, Chile, Croatia, Cuba, Egypt, Ethiopia, Iran, Kazakhstan, Kyrgyzstan, Laos, Madagascar, Mali, Nicaragua, Romania, Venezuela

Table A3: control group 2

Argentina, Australia, Bahrain, Brazil, Brunei Darussalam, Canada, China, Djibouti, Dominican Republic, Estonia, Finland, France, Gabon, Germany, Guinea, Hungary, Italy, Jamaica, Japan, Kenya, Kuwait, Latvia, Mexico, New Zealand, Norway, Oman, Qatar, Saudi Arabia, Singapore, Sweden, Tanzania, Tunisia, Turkey, United Kingdom, Uganda, Ukraine, Vietnam

Table A4: data sources

Variable name	**Source**
EXP	UN Comtrade
MASS	WDI
GDPpc	WDI
SANC	Hufbauer et al. 2009
MULTI	Hufbauer et al. 2009

Table A5: descriptive statistics

Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Control group 1					
EXP	697	4809,104	8834,449	0,055971	65 111 ,14
ln EXP	697	6,659132	2,328872	-2,882922	11,08385
ln MASS	697	53,89527	1,75124	50,07815	58,60455
ln GDPpc	697	17,68279	1,175545	14,73635	20,46097
SANC	697	0,2467719	0,4314424	0	1
MULTI	697	0,0602582	0,2381356	0	1
Control group 2					
EXP	1 326	22233,43	67803,39	0,055971	599 964,1
ln EXP	1 326	7,491656	2,543482	-2,882922	13,10463
ln MASS	1 326	54,5862	2,131891	49,69312	60,02857
ln GDPpc	1 326	18,47444	1,639081	14,73625	22,33559
SANC	1 326	0,1297134	0,3361146	0	1
MULTI	1 326	0,0316742	0,1751973	0	1