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Evgenii Monastyrenko

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Centre d'Économie de la Sorbonne

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Soutenue le 24 Septembre 2018 par

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Essays in international trade and energy

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Посвящается Наталии, Лидии и Игорю.

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I am very-very-very grateful for everyone in my jury. Dear Professors: thank you for giving me *a chance*. I consider myself firmly tied with Economics Department of Paris 1. During all these 1+4 years I was very proud to be a part of it. The MSE for me is the direct synonym of Economics. The professional acknowledgements included to each of the three chapters are the integral part of this section.

There is somewhat between 50 to 60 great people, scattered across Eurasia, who has participated in my life between 02/09/2013 and 03/09/2018. Very few of them ever told me that I would complete this document, and none of them doubted that I will. I have been repeatedly trying to expand my life outside this thesis, and I hope that I did it at least partially. I am particularly grateful for everyone who has been supporting me in doing this. This pdf document is not cool enough to handle these great names. If you recognise yourself in these words, it means that you are *my people*. It also means that you may, can and must count on myself, 24/7, in any question/trouble/need that you have or will encounter.

Я считаю более чем уместным поблагодарить себя самого. За эти пять лет я обрел Свободу. Благодарен самому себе за уверенность в своих силах, за стремление к целям, за постоянный адекватный анализ ситуации, за своевременный контроль над своими эмоциями, за поиск нестандартных ходов и людей, за преодоление душевных кризисов, за постоянный рост стрессоустойчивости, за работу над коммуникационными навыками, за постоянные попытки прыгнуть выше головы, за прощение ошибок. Самое главное: За верность самому себе.

(In seven lines above I thank *myself*.)

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Abstract

Résumé

RÉSUMÉ DÉTAILLÉ

L'objectif de cette sous-section est d'introduire la publique non-anglophone dans le contenu de ma thèse du doctorat. Cette thèse comporte 3 chapitres. Elle porte sur l'économie de l'Énergie et fusions-acquisitions, les conséquences de l'embargo et la répartition des responsabilités entre les acheteurs et vendeurs dans les transactions commerciales internationales.

Chapitre 1: Eco-efficiency outcomes of mergers and acquisitions in the European electricity industry

L'Europe est le troisième marché de l'électricité après l'Asie et l'Amérique du Nord. En 2013, l'Union européenne (UE) représentait 19,1% de la capacité mondiale de production d'énergie et produisait 16,4% de l'électricité mondiale. Au début des années 90, le marché européen de l'énergie était fortement réglementé, chaque État cherchait à assurer sa propre sécurité énergétique. Dans la plupart de ces états, la capacité de génération installée dépassait largement les besoins réels. Comme les services publics étaient obligés d'utiliser des ressources internes plutôt que des solutions de rechange à faible coût, ils ne diversifiaient pas leurs sources de carburant, disposaient d'une faible flexibilité opérationnelle et organisationnelle et comptaient sur les prévisions à long terme (Serrallés 2006). Les producteurs d'énergie n'étaient donc pas incités à devenir efficaces. La libéralisation du secteur européen de l'électricité a débuté en 1996 avec la directive 96/92/EC dont l'objectif était la mise en place d'un marché commun et concurrentiel dans l'UE. Les trois objectifs déclarés étaient la liberté des consommateurs de choisir les fournisseurs d'électricité, l'accès des tiers au réseau de transport et de distribution et le dégroupage des réseaux de distribution de la production.

À la suite de cette libéralisation, les producteurs d'électricité de l'UE ont dû faire face à la concurrence accrue et à la turbulence des environnements opérationnels. Ces acteurs du marché ont initié une vague intense de fusions et acquisitions (M&As), ce qui leur a permis de réajuster rapidement leurs allocations de capacités de distribution et de production. Avant la libéralisation, les producteurs d'énergie fonctionnaient entièrement à l'intérieur des frontières nationales et étaient donc communément appelés "champions nationaux". Ces entreprises ont poursuivi les fusions et acquisitions internationale afin d'accroître leur rentabilité, d'intégrer des compétences de gestion étrangers et d'accéder aux réseaux de distribution. Ainsi, la libéralisation a provoqué M&As, dont une grande partie est des transactions transfrontalières. En 2010, le secteur énergétique mondial a conclu de nombreuses transactions, devancé seulement par le secteur financier (Schmid et al. 2012). Les producteurs d'électricité européens ont largement contribué à cette vague. En 2011, ils représentaient environ 35% de la consommation mondiale d'énergie.

Cette étude porte sur la période régie par les deuxième et troisième directives Européennes

sur l'électricité. La deuxième directive (2003/54/EC) a produit les changements de politique les plus liés à la libéralisation. Les changements les plus importants ont été la création de régulateurs nationaux indépendants et la libre entrée dans le secteur de la production d'électricité. La directive a encore renforcé la séparation verticale des activités de distribution, de transmission, de la production et de la vente au détail. La troisième directive (2009/72/EC) a introduit la séparation de la propriété de la production d'énergie de la transmission. La Commission européenne a également promu l'indépendance des régulateurs nationaux et a créé l'Agence de coopération des régulateurs de l'énergie (ACER).

Cette étude appartient à une branche restreinte de la littérature M&A qui vise à évaluer les changements de l'efficacité de l'entreprise après les fusions et acquisitions. Plusieurs études sur la production et la distribution d'électricité méritent d'être mentionnées. La seule tentative antérieure d'analyser les fusions et acquisitions internationales dans le secteur de l'énergie a été menée par Berry (2000), qui n'a trouvé aucun impact significatif. Becker-Blease et al. (2008) a révélé les pertes financières causées par les fusions entre les compagnies d'électricité américaines. Ils ont également constaté que l'intégration aux activités gazières et la diversification dans de nouvelles zones géographiques nuisent à la fois à la performance du marché et à celui de l'exploitation. Kwoka and Pollitt (2010) a appliqué une analyse de l'enveloppement des données (DEA) et évalué les performances de M&As sur le marché de l'électricité aux États-Unis entre 1994 et 2003. Ils n'ont trouvé aucune preuve d'amélioration des coûts. Bagdadioglu et al. (2007) et Çelen (2013b) ont prédit l'amélioration de l'efficacité suit aux réformes du marché de l'électricité en Turquie. Çelen (2013a) a exploité une approche DEA en deux étapes et a révélé les déterminants de l'efficacité des sociétés turques de distribution d'électricité.

À ma connaissance, seules trois études publiées ont évalué les conséquences des fusions et acquisitions dans le secteur européen de l'électricité, et deux de ces études sont consacrées à la phase initiale de la libéralisation. Bednarczyk et al. (2010) a traité 37 cas des fusions et acquisitions transfrontaliers entre les soumissionnaires des pays industrialisés occidentaux et les cibles d'Europe centrale et orientale au cours de la période 1995-2005. Leur étude d'événement a révélé un impact faible et positif sur la richesse des actionnaires cibles à court terme. Datta et al. (2013) a étudié 156 fusions réalisées entre 1990 et 2006 entre des entreprises d'électricité, de gaz, d'eau et de télécommunication. Ces auteurs ont révélé que les services publics combinés de l'UE ont connu des pertes statistiquement significatives à court et à long terme. Saastamoinen et al. (2017) a étudié les gains de concentration dans le secteur de la distribution d'électricité en Norvège. Selon ces auteurs les conséquences des fusions varient considérablement en fonction du modèle réglementaire.

Ce chapitre examine les conséquences de 129 M&As réalisés par les 15 plus grands producteurs européens d'électricité entre 2004 et 2013. Toutes ces entreprises sont des multinationales combinant des sources fossiles, nucléaires et renouvelables pour la production d'électricité. J'utilise la DEA pour calculer l'éco-efficacité des entreprises et isoler les impacts causaux de

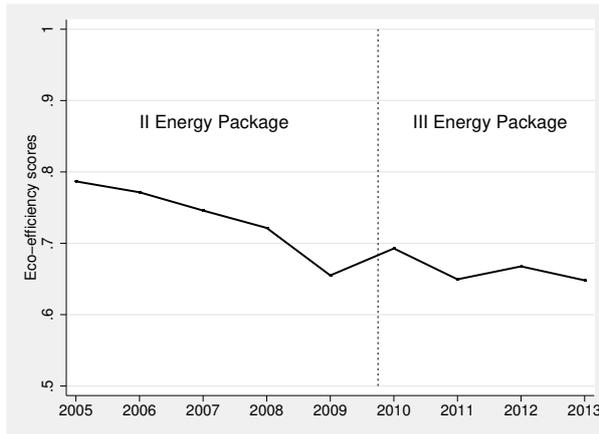


Figure 1. Scores moyens de éco-efficacité de la DEA

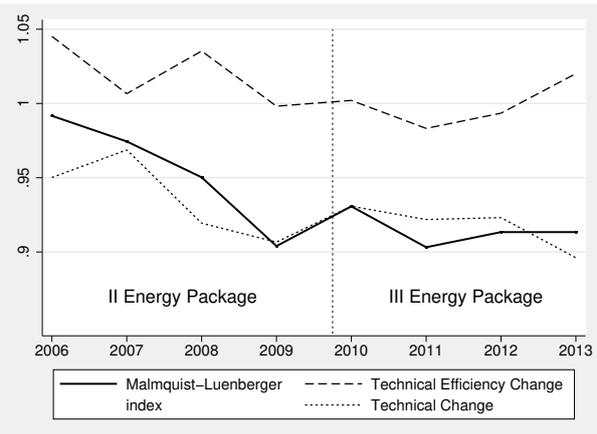


Figure 2. Indice Malmquist-Luenberger moyen

M&As. La DEA est une technique mathématique non paramétrique fréquemment utilisée dans l'évaluation des performances et la recherche opérationnelle dans le secteur financier. Je contribue à une branche d'études sur l'énergie et l'environnement (E&E) exploitant la DEA. Les applications récentes dans le secteur de l'énergie comprennent Yang and Pollitt (2009), Zhang et al. (2013), Arabi et al. (2014), Atkinson and Tsionas (2016) et Duan et al. (2016).

Je calcule les scores d'éco-efficacité (voir Fig. 1) en utilisant un modèle DEA orienté vers la sortie et basé sur une fonction de distance directionnelle radiale (DDF). J'emploie la capacité installée et les dépenses opérationnelles totales en tant qu'intrants et la quantité d'électricité générée et des émissions de dioxyde de carbone (CO₂) en tant que bons et mauvais rendements, respectivement. J'aborde la nature de panel de l'ensemble de données avec deux approches alternatives. L'approche fenêtre DEA suppose l'absence de progrès technologique. J'évalue les scores obtenus pour l'éco-efficacité du DEA à l'aide d'un estimateur fractionnaire du maximum de vraisemblance avec effets aléatoires corrélés. À titre d'alternative, je calcule l'indice de productivité Malmquist-Luenberger (MLPI), qui est récemment devenu une mesure courante dans l'évaluation de l'efficacité intertemporelle (voir Fig. 2). Dans ce cas, j'utilise la méthode des moindres carrés ordinaires (MCO) avec les effets fixes du temps et des entreprises comme estimateur de deuxième niveau.

Les résultats suggèrent que l'éco-efficacité moyenne du secteur énergétique européen a diminué au cours de la période 2005-2009, et cette tendance s'est accélérée en 2008, probablement en raison de la crise financière mondiale. En 2009-2013, l'éco-efficacité était en moyenne au niveau de 2009. Cette tendance contredit les gains d'efficacité modérés précédemment documentés, qui sont spécifiques aux premières étapes de la libéralisation de l'énergie en Europe. La structure des scores individuels d'éco-efficacité suggère que la réglementation de la distribution d'électricité fondée sur les incitations devrait être encouragée.

Cette étude démontre que toute fusion (voir Fig. 3 et Fig. 4) a un effet néfaste sur l'éco-

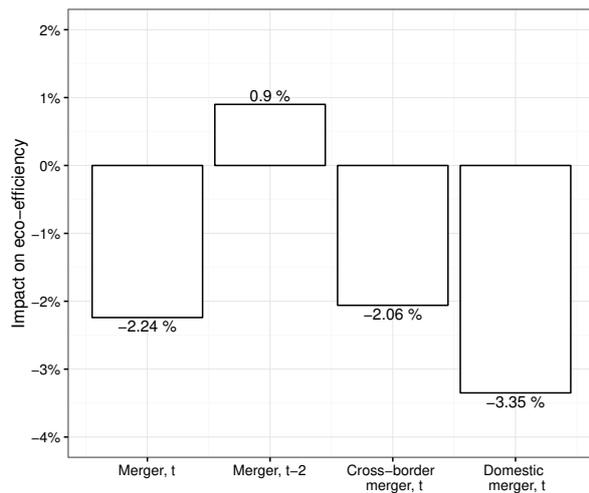


Figure 3. Effets partiels moyens des fusions transfrontalières et nationales sur l'éco-efficacité

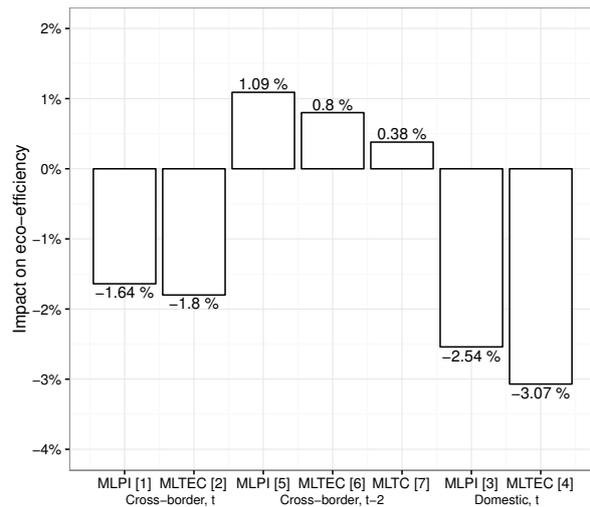


Figure 4. Effets partiels moyens des fusions transfrontalières et nationales sur l'indice Malmquist-Luenberger

efficacité de 2,24% à court terme et un effet positif de 0,9% sur le moyen terme. Je trouve également que les transactions nationales sont systématiquement plus néfastes que les transactions transfrontalières. A court terme, les fusions nationales réduisent l'éco-efficacité de 3,35% en moyenne. Les effets des transactions transfrontalières semblent être plus faibles (-2,06 %). Au total, 93 M&As transfrontaliers ont été analysés, représentant 72,1% de l'échantillon.

Par conséquent, les régulateurs devraient traiter les fusions transfrontalières et nationales de différentes manières. Il convient de prévoir les résultats des fusions potentielles à l'aide d'une analyse ex ante de l'enveloppement des données, bien qu'un tel exercice puisse poser un problème pour des organismes de réglementation nationaux. En effet, Jamasb and Pollitt (2003) a déjà proposé la coordination internationale d'exercices d'analyse comparative. Les régulateurs devraient créer un ensemble de données complet sur les différentes dimensions de la production internationale d'électricité. Sur la base d'un tel ensemble de données, les régulateurs seraient en mesure de prendre des décisions conformément aux objectifs écologiques communs.

Étant donné que cette étude est dédiée au secteur européen de l'électricité, il convient de discuter des implications pour la réglementation européenne des fusions et acquisitions. Conformément à la réglementation en vigueur, la Commission européenne prend ses décisions concernant les fusions potentielles principalement basées sur les résultats en termes de concurrence. La seule manière de prendre en compte les modifications de l'efficacité après la fusion est liée aux déclarations d'efficacité. La procédure correspondante est décrite dans la section VII "Efficacité" de European Commission (2004). Afin de soutenir les fusions potentielles, les entreprises doivent justifier que l'efficacité résultante est spécifique à la fusion, est vérifiable et profitable aux consommateurs. Malgré les objectifs écologiques communs de l'UE, le rè-

glement européen actuel sur les fusions et acquisitions ne prend pas en compte la dimension écologique. En outre, les entreprises qui fusionnent mettent rarement l'accent sur les déclarations d'efficacité, ce qui réduit leur importance dans les décisions des organismes de réglementation. Je suggère que la pratique des déclarations d'efficacité soit retirée et remplacée par une analyse d'éco-efficacité indispensable des fusions potentielles. À cette fin, la Commission européenne devrait collaborer avec ACER.

Cette étude est la deuxième depuis Bednarczyk et al. (2010) pour différencier les fusions des entreprises énergétiques horizontales et non horizontales. Je trouve que les fusions horizontales nationales n'affectent pas l'éco-efficacité. Ce résultat doit être attribué au fait que la Commission européenne règle soigneusement les transactions horizontales. D'une part, un impact néfaste est évité. D'autre part, l'efficacité n'est pas encouragée. Par conséquent, ce résultat confirme la nécessité de fonder la réglementation des fusions et acquisitions dans les estimations d'efficacité.

Je trouve que les fusions horizontales transfrontalières ont des effets négatifs à court terme d'environ 3%. Cependant, à moyen terme, les transactions de ce type augmentent l'éco-efficacité d'environ 1,5%. Une interprétation plausible est que les cibles initialement sous-performantes (citrons) évoluent en entités surperformantes (cerises) après leur acquisition. Ainsi, je suggérerais que les entreprises d'électricité considèrent l'expansion internationale de l'industrie comme une stratégie prioritaire. Une suggestion de politique associée consiste à évaluer systématiquement les résultats d'efficacité obtenus à différents moments après l'achèvement d'une fusion.

J'ai trouvé des preuves, bien que limitées, que les fusions de conglomerats avaient des effets positifs sur l'éco-efficacité. Les producteurs d'électricité européens devraient envisager de fusionner avec des entreprises non liées, car cette stratégie n'est au moins pas préjudiciable. Un résultat intéressant et quelque peu nouveau est que les fusions verticales nuisent à l'éco-efficacité. Plus précisément, les fusions verticales nationales ont la tendance à réduire l'éco-efficacité d'environ 3,6% au cours de l'année de son achèvement. Cet impact ne persiste pas dans le temps. Les fusions verticales transfrontalières réduisent l'éco-efficacité de 2,1% sur un horizon de deux ans (moyen terme). Le règlement actuel sur les concentrations de l'UE ne concerne pas les fusions verticales (paragraphe 25 de European Commission (2008)).

Il convient de souligner les directions de la recherche ultérieure. Premièrement, les effets des fusions sur l'éco-efficacité des petites entreprises d'électricité devraient être étudiés. Deuxièmement, l'application de modèles non radiaux basés sur les slacks devrait être envisagée. Enfin, une attention particulière devrait être accordée à la distinction entre les fusions de tailles différentes.

Chapitre 2: Bearing the cost of politics: Consumer prices and welfare in Russia

En août 2014, la Fédération de Russie a mis en place un embargo sur l'importation de certains produits alimentaires et agricoles en réponse aux sanctions imposées par l'Union européenne et d'autres pays occidentaux à la suite de l'escalade de la crise dans l'est de l'Ukraine. La Russie a interdit l'importation de 48 produits en provenance de l'UE, des États-Unis, de l'Australie, de l'Ukraine et de certains autres pays soutenant les sanctions. La liste des produits interdits comprenait la viande, les produits à base de viande, le lait et les produits laitiers, les fruits et légumes et les noix - des produits de consommation courante pour les consommateurs russes. L'objectif de cet article est de quantifier les effets de l'embargo alimentaire auto-imposé sur les prix à la consommation et le bien-être en Russie.

Dans ce chapitre co-écrit avec Julian Hinz, nous documentons tous d'abord les effets immédiats et à moyen terme de l'embargo sur les prix à la consommation. Nous utilisons la base de données détaillée de 128 produits alimentaires, 332 produits non alimentaires et 127 services dans 279 villes russes, à une fréquence mensuelle. Nous construisons ensuite un modèle théorique avec des liens sectoriels similaires à Caliendo and Parro (2015). Il nous permet d'étudier l'impact de l'embargo sur le bien-être et de calculer des contrefactuels. En utilisant des tableaux d'entrées-sorties du GTAP, nous investiguons comment l'utilisation des outils de politique commerciale aux fins de la politique étrangère affecte les prix et le bien-être des consommateurs.

Malgré des preuves rares de leur efficacité, les embargos et les sanctions ont été des instruments populaires de pression politique (Drezner 1999). Dans la plupart des cas, un ou plusieurs pays mettent en place de telles mesures contre un autre pays. Toutefois, dans de rares cas, un pays peut également décider d'interdire son propre commerce avec d'autres : En 1807-1809, les États-Unis ont imposé un embargo total sur leur commerce international avec les pays européens, visant à nuire à la Grande-Bretagne. Irwin (2005) constate que cette décision, également connue sous le nom de blocus de Jefferson, a coûté aux États-Unis environ 5% du PIB. Pendant la période du blocus, les prix intérieurs des produits exportés ont diminué, tandis que ceux des produits importés ont augmenté. O'Rourke (2007) utilise un modèle d'équilibre général calculable (EGC) pour évaluer les conséquences du blocus pour la Grande-Bretagne, la France et les États-Unis. Il montre que les États-Unis ont connu la plus forte perte de bien-être, équivalant à 4-5% du PIB par an.

La littérature sur les sanctions a suscité un regain d'intérêt à la lumière des récents événements politiques. Haidar (2017) étudie le cas récent des sanctions imposées par l'Occident à l'Iran. Il constate que pour les entreprises iraniennes, les exportations globales ont diminué, en dépit du détournement des échanges vers les pays non sanctionnés. Les entreprises exportatrices ont subi des pertes en raison de la chute des prix, les petites entreprises étant particulièrement touchées. Heilmann (2016) étudie l'effet du boycottage des consommateurs sur

le commerce. Dans plusieurs études de cas utilisant une méthodologie de groupe de contrôle synthétique, il constate une réduction significative des importations à la suite du changement brusque des préférences des consommateurs. Etkes and Zimring (2015) étudie les conséquences sociales du blocus de Gaza en 2007-2010. Leur exercice contrefactuel a révélé des pertes de bien-être de 14% à 24%. Les raisons des pertes identifiées sont la réaffectation des ressources et la baisse de la productivité du travail. En utilisant les données sur les prix à la consommation, ils ont constaté que les ménages plus riches subissaient des pertes plus élevées.

Ce chapitre contribue à la littérature qui analyse l'effet des sanctions contre la Fédération de Russie et son embargo auto-imposé en réponse aux crises dans l'est de l'Ukraine et en Crimée. En relation avec nos travaux, Dreger et al. (2015) évalue l'impact macroéconomique du régime de sanctions à l'aide d'un modèle VAR multivarié. Ils trouvent un impact limité des mesures de sanctions, tout en attribuant la baisse du prix du pétrole au début de 2015 au ralentissement de l'économie russe. Crozet and Hinz (2016), en revanche, estime l'effet des sanctions sur les exportations des pays *sanctionnant*. Ils trouvent un «feu amical» significatif pour les entreprises touchées, en particulier celles touchées par l'embargo russe sur les produits alimentaires et agricoles. Seule une fraction des exportations perdues pourrait être récupérée sur d'autres marchés par le biais d'un détournement commercial.

L'étude la plus proche de notre question de recherche est Boulanger et al. (2016). Dans leur article, ils simulent l'impact à court terme de l'embargo alimentaire russe sur les économies russe et des pays européennes. Selon leurs estimations, la Russie a perdu 3,4 milliards d'euros de revenu réel, ce qui équivaut à un abaissement de 0,24% de son utilité par habitant. Dans le même temps, l'UE-28 a perdu 128 millions d'euros, soit 0,0025% de l'utilité par habitant. Leur modèle estime une hausse des prix en Russie sur les produits ciblés : fruits et légumes (de 9,5%), viande de bovin (0,4%), viande de porc (5,8%) et produits laitiers (6,1%).

Dans cette étude, nous contribuons à la littérature sur les sanctions et les embargos, en mettant l'accent sur les effets pour les consommateurs dans l'économie touchée. Nous estimons les résultats d'un embargo en termes de variation des prix à la consommation et de leurs conséquences sur le bien-être des consommateurs. Nous documentons tout d'abord les effets sur les prix à l'aide de la méthode des différences de différences, en distinguant les effets spécifiques au produit des effets macroéconomiques. Nous utilisons un ensemble complet de données sur les prix à la consommation pour un large éventail de produits, désagrégés par ville et par date, ce qui nous permet de contrôler pour les effets fixes de produits, de régions et du temps. Les données mensuelles sur les prix à la consommation proviennent du Service statistique de l'État fédéral russe et comprennent divers produits alimentaires sous embargo et non soumis à embargo ainsi que divers autres types de biens et services.

Nous observons cependant que les prix à la consommation des produits alimentaires non soumis à un embargo ont également augmenté (voir Fig. 5), laissant entendre une propagation

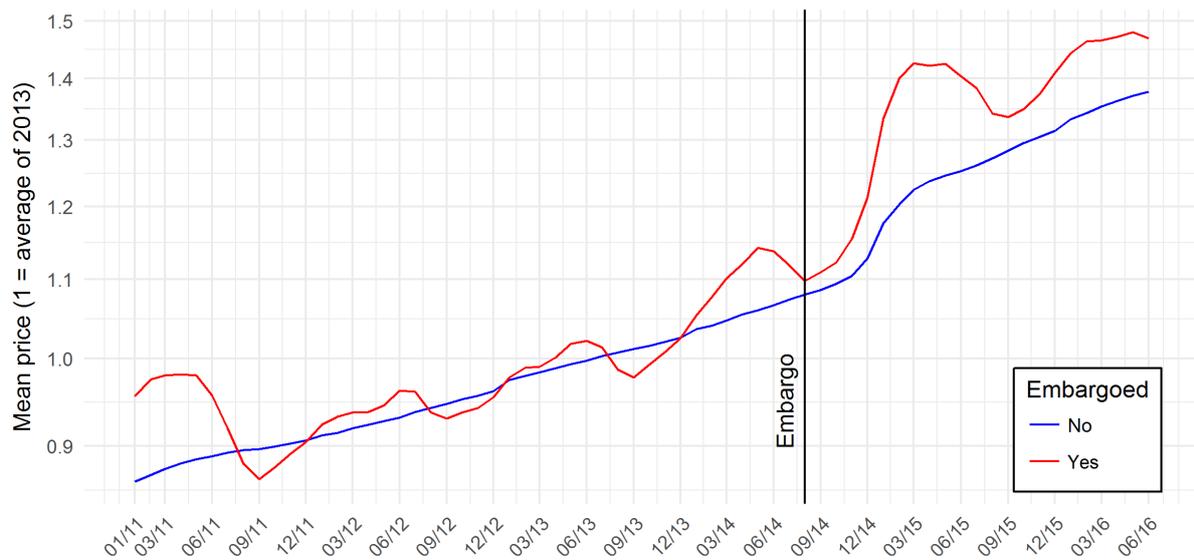


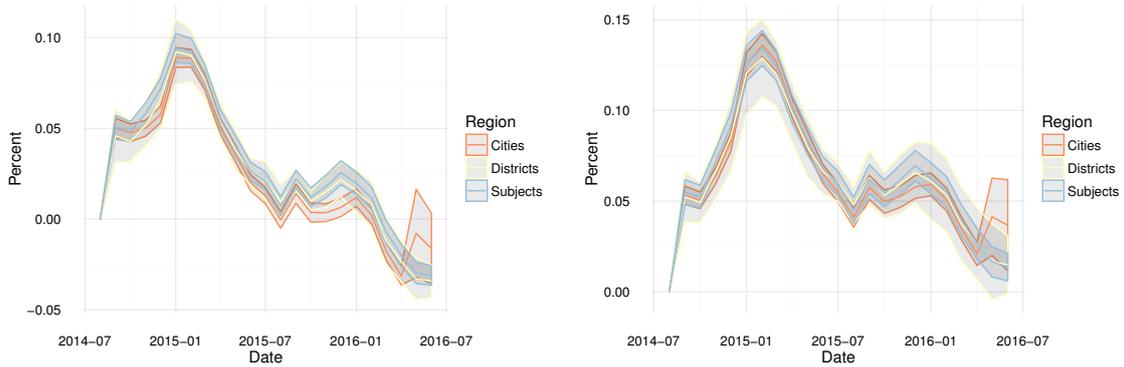
Figure 5. Evolution des prix moyens des produits sous l'embargo et non sous l'embargo

de l'impact via les liens entrées-sorties.

A l'aide de méthode des différences de différence, nous trouvons que l'embargo auto-imposé a entraîné une augmentation moyenne des prix des produits sous embargo d'au moins 2,7% par rapport à ceux qui ne le sont pas.

Nous explorons la manière dont l'impact du choc sur les prix à la consommation varie dans le temps. Nous calculons les coefficients mensuels post-embargo dans Fig. 6(a) (groupe de contrôle alimentaire) et Fig. 6(b) (groupe de contrôle alimentaire et non alimentaire). Dans tous les deux cas, l'effet augmente visiblement jusqu'en janvier 2015 puis diminue en intensité, quel que soit le niveau d'agrégation spatiale. Le coefficient retombe presque entièrement à zéro pour le groupe de contrôle alimentaire un an après le début de l'embargo, soit en août 2015. Les prix de la nourriture sous embargo restent sensiblement plus élevés (environ 5%) par rapport à un groupe du contrôle comprenant des produits et des services non alimentaires. Cela souligne les résultats dans lesquels nous soupçonnons une propagation du choc des prix à d'autres produits alimentaires et agricoles sans embargo.

Nous présentons la divergence des flux commerciaux comme un facteur important qui pourrait atténuer la hausse des prix à la consommation. En fait, les entreprises russes ont commencé à importer les produits agricoles sous embargo de pays non touchés par l'embargo. Fig. 7 suggère une légère augmentation des importations de produits sous embargo provenant de sources non sous embargo à la suite de l'embargo. Ainsi, le détournement des échanges peut avoir contribué à compenser le choc de prix initial. Nous testons le détournement de commerce à l'aide de la technique d'estimation de diff-in-diff. Nos résultats suggèrent que



(a) Produits alimentaires en tant que groupe de contrôle (b) Produits alimentaires et non alimentaires en tant que groupe de contrôle

Figure 6. Coefficients mensuels pour diff-in-diff avec les autres produits alimentaires en tant que groupe de contrôle (a) et produits alimentaires et non alimentaires en tant que groupe de contrôle (b). Intervalles de confiance à 95% en gris.

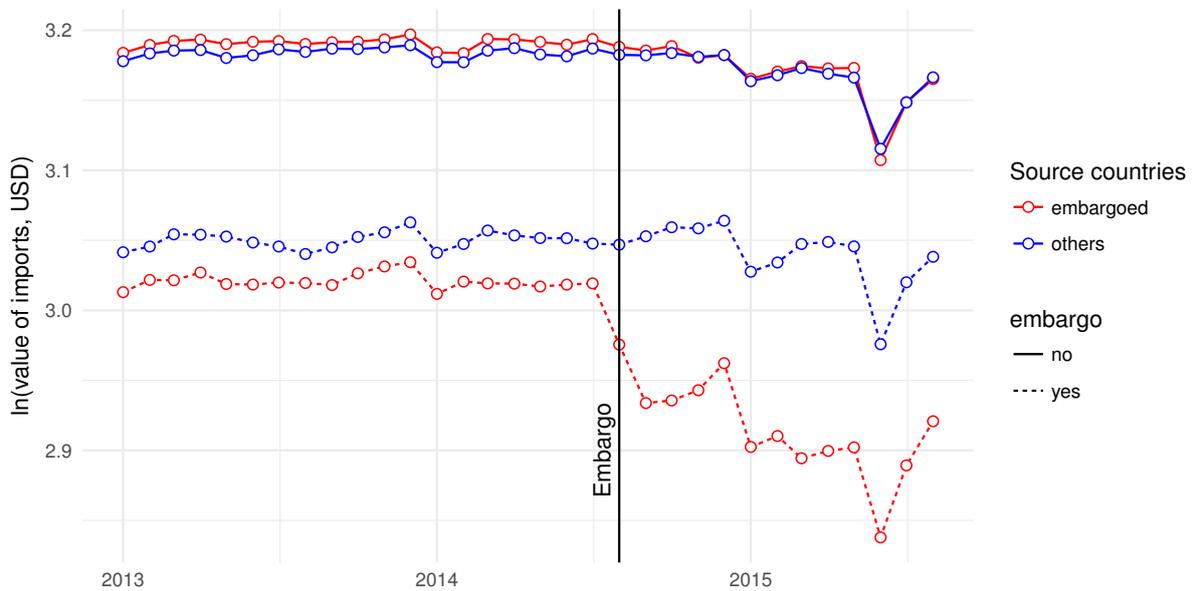


Figure 7. Importations agrégées de produits sous embargo et non sous embargo en Russie

l'importation d'un produit sous embargo en provenance d'un pays sous embargo a sensiblement diminué, tandis que les importations en provenance d'autres origines ont augmenté. Ces preuves confirment que la divergence des échanges a eu lieu.

Ce chapitre contribue à une littérature florissante qui quantifie les conséquences de la politique commerciale. Costinot and Rodriguez-Clare (2014) résume les recherches récentes sur la quantification des résultats de la mondialisation. Dhingra et al. (2017) estime les effets du Brexit sur le bien-être à moyen et long terme avec un certain nombre de scénarios contre-factuels. Mayer et al. (2018) estiment les pertes potentielles de bien-être des pays européens à la suite de la rupture de l'Union européenne.

Tous les articles mentionnés utilisent des données d'entrées-sorties pour l'étalonnage des modèles d'équilibre général. Nous évaluons de la même manière les effets de l'embargo alimentaire russe sur le bien-être et les prix. Nous adoptons un modèle ricardien à la Caliendo and Parro (2015), qui suppose des liens sectoriels, des échanges de biens intermédiaires et une hétérogénéité sectorielle dans la production. A cet égard, cette étude avance méthodologiquement par rapport à un article étroitement lié de Boulanger et al. (2016). Ils modélisent l'interdiction d'importation russe dans un cadre d'équilibre général calculable en tant que perte de préférences commerciales existantes, entraînant une réduction de l'utilité pour le consommateur. Dans notre recherche, nous exploitons largement la structure des entrées-sorties des économies modernes. Le changement brusque des frictions commerciales est modélisé comme un coût commercial prohibitif des importations de produits sous embargo en provenance de pays sous embargo. Nous calibrons le modèle avec des données sur la production et l'utilisation des intrants intermédiaires de 42 pays dans le cadre du projet d'analyse du commerce mondial (GTAP).

Un aperçu des flux commerciaux bilatéraux pour la période précédant les sanctions est tiré de l'ensemble de données BACI fourni par le CEPII. Pour calculer les effets de bien-être, nous suivons l'approche dite de "l'algèbre de chapeau exact" de Dekle et al. (2008). Nos simulations suggèrent que la Russie a subi une perte de bien-être de 0,21% due à cet embargo auto-imposé. En outre, on estime que les prix moyens en Russie ont augmenté de 0,25%. Ce résultat est conforme à la littérature établie qui prévoit que l'introduction des frictions bilatérales dans le commerce international devrait nécessairement entraîner une augmentation des prix intérieurs.

Les résultats suggèrent que la plupart des grands importateurs sous embargo ont subi des pertes mineures, qui sont inférieures à celles de la Russie. Une forte augmentation du bien-être de la Biélorussie (4,71%) mérite plus de discussion. Plusieurs preuves anecdotiques ont été documentées qu'une partie des produits alimentaires sous embargo, initialement importés en Biélorussie, ont été réétiquetés et réexportés en Russie. La Biélorussie participe à l'Union douanière eurasiennne, avec la Russie, l'Arménie, le Kazakhstan et le Kirghizistan. La quasi-absence de barrières commerciales entre la Biélorussie et la Russie largement facilite les divergences commerciales post-embargo. Il convient en outre de noter que l'embargo russe devrait rapporter 2,8% de bien-être à l'Ukraine. Ce scénario n'intègre évidemment pas les graves conséquences économiques du conflit dans l'est de l'Ukraine. Selon notre exercice contrefactuel, cela est une conséquence de la divergence des flux commerciaux survenus après le début de l'embargo.

Nous examinons les résultats pour les pays qui sont les "petits" importateurs en Russie. Tous les résultats négatifs pour les petits importateurs sont proches de zéro, ce qui pourrait indiquer l'inefficacité de l'embargo en tant que politique commerciale. On estime que les pays d'Europe orientale (Bulgarie, Estonie, République tchèque, Roumanie, Slovaquie, Hongrie et

Slovénie) ont connu des résultats *positifs* pour son bien-être. Ces pays ont très probablement profité de la divergence des flux d'importation, qui étaient auparavant dirigés vers la Russie. Deux facteurs favorisent ce scénario. Premièrement, la distance relativement faible entre les pays d'Europe orientale et la frontière russe implique des coûts commerciaux similaires à ceux de la Russie. Deuxièmement, la structure des importations alimentaires de ces pays ressemble à celle de la Russie.

Il est intéressant de comparer les résultats des simulations précédemment discutés avec des tarifs nuls à ceux des tarifs observés. Ainsi, nous utilisons les «tarifs d'accès au marché» pour les taux de droits bilatéraux pour 2007. En effet, les données pour les années les plus récentes n'étaient pas disponibles. En maintenant les autres hypothèses du modèle, nous reproduisons les mêmes étapes de simulation. Nous concluons que le résultat en termes de bien-être pour la Russie atteint environ -1,45 %, les prix augmentant de 0,24 %. Globalement, les résultats simulés pour les autres pays sont similaires à ceux des tarifs nuls. En attendant, il convient de noter que les résultats pour l'Ukraine sont considérablement moins importants.

Les trois quarts de la population russe vivent dans des zones urbaines. Ils ne sont pas en mesure de produire de la nourriture et sont donc des acheteurs nets de produits agricoles. Ainsi, la grande majorité des citoyens sont vulnérables aux chocs de prix négatifs des produits alimentaires. L'analyse nous permet de conclure que l'embargo imposé par le gouvernement russe a nui au bien-être des consommateurs russes. Notre recommandation est de suspendre la pratique de cet embargo.

Chapitre 3: Risk- and Cost-Sharing in Firm-to-Firm Trade

Les vendeurs et les acheteurs transfrontières sont soumis à des risques et des coûts importants tout au long du processus d'expédition. Ils subissent de longues procédures douanières, sont exposés à de mauvaises infrastructures, à des services de communication et de transport, et sont confrontés à des environnements commerciaux incertains sur le marché de destination. Par exemple, Carballo et al. (2016) montre que les coûts de traitement des frontières varient entre 17% et 35%, tandis que les tarifs appliqués sont d'environ 9%. En ce qui concerne le transport, Hummels and Schaur (2013) estime que chaque jour en transit se traduit par un tarif ad valorem de 0,6 à 2,1%. En outre, il a également été démontré que le coût du transport routier à une seule voie est supérieur de 70% au coût du transport sur autoroute à grande capacité pour un envoi moyen (Coşar and Demir 2016).

Ces risques et coûts liés aux transactions pourraient être supportés soit par le vendeur, soit par l'acheteur, soit par les deux. Comme ils ne sont pas négligeables, afin de réduire l'incertitude liée aux contrats, les partenaires commerciaux décident généralement de "séparer" les responsabilités tout au long du processus d'expédition. Ils le font sur la base des schémas de risques et de coûts existants, connus sous le nom d'Incoterms et introduits par la Chambre

de commerce internationale (CCI) pour faciliter le commerce international. Plus précisément, les Incoterms sont des instruments contractuels définissant *de facto* un cadre juridique uniforme. Ils sont largement utilisés dans les transactions internationales et sont acceptés par les gouvernements et les entreprises du monde entier. Au lieu de rédiger des pages entières d'explications susceptibles de faire l'objet d'interprétations, grâce à une abréviation de trois lettres incorporée dans le contrat de vente, les sociétés commerciales délimitent clairement leurs responsabilités pour chaque transaction (International Chamber of Commerce 2010).

Pour illustrer comment les Incoterms diminuent l'incertitude des contrats, considérons l'exemple suivant. Un acheteur situé à Buzău (Roumanie) commande cinq palettes de composants radio-électroniques à un vendeur situé à Ekaterinburg (Russie). L'acheteur veut que le vendeur transporte les marchandises jusqu'à la frontière roumaine. Les partenaires commerciaux acceptent d'utiliser des termes qui placent les risques et les coûts à la frontière roumaine sur le vendeur et décident que la propriété des biens est transférée une fois que l'envoi atteint les locaux de l'acheteur. Le camionneur employé par le vendeur collecte les marchandises. Après avoir quitté le territoire russe et pénétré en Ukraine en raison de la mauvaise infrastructure, le camion est impliqué dans un accident. Après l'accident, les marchandises se retrouvent dans le Dniestr. Les composants radioélectroniques sont trempés et deviennent inutiles. Les deux parties étant convenues que le vendeur supporte tous les risques et tous les coûts jusqu'au point de livraison à la frontière roumaine, l'acheteur a le droit de demander une compensation ou un envoi de remplacement. Supposons maintenant que les parties contractantes décident d'utiliser des termes impliquant que les risques et les coûts sont partagés entre le vendeur et l'acheteur. La propriété des marchandises est toujours transférée une fois que les marchandises arrivent chez l'acheteur. Le même accident que celui-ci discuté précédemment se produit. En utilisant ces termes, les parties acceptent implicitement que le vendeur organise et paie le transport principal, alors que l'acheteur supporte tous les risques. Dans ce cas, l'acheteur n'a pas le droit de demander une compensation ou un envoi de remplacement. Par conséquent, en indiquant clairement qui, entre le vendeur et l'acheteur, supporte les risques et les coûts liés à la transaction, ces conditions réduisent l'incertitude des contrats.

Ce chapitre analyse empiriquement les facteurs déterminant la manière dont les vendeurs et les acheteurs divisent les risques et les coûts dans les transactions commerciales internationales. Pour ce faire, nous nous appuyons sur un ensemble de données très détaillé incluant l'univers des expéditions quotidiennes entre les exportateurs russes et leurs clients internationaux, sur la période 2012-2015. Pour chaque transaction, nous observons l'entreprise exportatrice, l'entreprise importatrice dans une destination donnée, le produit commercialisé et la règle relative aux Incoterms qui régit le contrat de vente. Notre analyse est effectuée au niveau de la transaction, en exploitant toutes ces dimensions.

Plus précisément, en s'appuyant sur les règles Incoterms, nous construisons trois catégories de risques et de coûts pour les partenaires commerciaux : des responsabilités portées par

l'acheteur, des responsabilités partagées et des responsabilités portées par le vendeur. Nous commençons par fournir des faits stylisés concernant la répartition des coûts et des risques entre les vendeurs, les acheteurs, les destinations et les produits. Ensuite, en nous basant sur des tendances générales révélées par l'analyse des données, nous examinons comment les caractéristiques des différents vendeurs, acheteurs, destinations et produits influent sur la répartition des responsabilités dans les transactions commerciales internationales.

Les caractéristiques du vendeur et de l'acheteur semblent expliquer en grande partie la variation dans l'utilisation des différentes catégories de responsabilités. Nous montrons que les grandes entreprises et les entreprises connectées à de nombreux partenaires sont plus susceptibles de supporter les risques et les coûts tout au long du processus d'expédition. Plus intéressant, les gros acheteurs semblent assumer davantage de responsabilités, quelle que soit la taille du vendeur, tandis que les gros vendeurs n'assument des responsabilités que lorsque l'acheteur international est petit. Bien que les caractéristiques des produits et des pays de destination expliquent une plus petite partie de la variation dans l'utilisation des différentes catégories de risques et de coûts, elles affectent de manière significative la répartition des risques et des coûts entre vendeurs et acheteurs. Par exemple, les acheteurs sont plus susceptibles d'assumer des risques et des coûts lors de l'importation de produits intermédiaires et de matières premières que lorsqu'ils importent des produits finis. Enfin, les acheteurs sont moins enclins à assumer des responsabilités si leur pays se caractérise par un bon environnement commercial.

Cette étude contribue à plusieurs domaines de la littérature. Tout d'abord, il ajoute au travail sur les contrats incomplets. Les contrats de vente sont incomplets par leur nature même, car les entreprises ne peuvent pas prévoir tous les états futurs possibles et. En effet, conditionner les contrats sur tous les états futurs entraînerait des coûts prohibitifs. En général, les contrats incomplets ont principalement servi à expliquer *les limites des entreprises* (nombre et taille des entreprises existantes). L'état actuel de la littérature générale sur les contrats incomplets est résumé par Hart (2017) L'approche des droits de propriété, développée par Grossman and Hart (1986) et Hart and Moore (1990), analyse si les acheteurs sous-traitent la production d'un bien intermédiaire à un fournisseur ou l'intègrent. Antràs (2015) et Chor (2018) donnent un aperçu de la théorie des contrats incomplets dans le commerce international. Les applications récentes de l'approche des droits de propriété sur le commerce international incluent Antràs and Chor (2013) et Alfaro et al. (2018). Dans l'approche des coûts de transaction, introduite pour la première fois par Coase (1937), les entreprises décident du montant de la sous-traitance et de la production interne. Cette approche a été récemment appliquée au commerce international par Fally and Hillberry (2015) et Kikuchi et al. (2018).

Plus récemment, plusieurs études analysent la manière dont les vendeurs et les acheteurs, dont l'objectif est de réduire le caractère incomplet des contrats, décident des conditions régissant leurs contrats. En général, les partenaires commerciaux écrivent des contrats *ex ante* étab-

lissant des règles sur la manière dont les problèmes doivent être résolus, qui a un pouvoir de négociation, etc. Ainsi, avant d'établir un contrat, les entreprises impliquées dans des transactions commerciales internationales négocient sur le transfert de coûts, transfert de risques, transfert de propriété et conditions de paiement (O'Meara 2017). La grande majorité des articles examinant les conditions du contrat se concentrent sur les conditions de paiement. Par exemple, en s'appuyant sur les caractéristiques des marchés financiers et de l'exécution des contrats dans les pays d'origine et de destination, Schmidt-Eisenlohr (2013) étudie comment les entreprises sélectionnent de manière optimale les conditions de paiement. Antràs and Foley (2015) documente l'utilisation des conditions de financement en se basant sur les données d'un exportateur américain de produits avicoles et crée un modèle pour expliquer les choix des entreprises. Niepmann and Schmidt-Eisenlohr (2017) explorent dans quelles conditions et dans quelle mesure les entreprises utilisent des termes exigeant l'intermédiation bancaire pour atténuer les risques liés aux transactions commerciales. Enfin, Demir and Javorcik (2018) analyse comment les entreprises s'adaptent aux pressions concurrentielles à l'aide des conditions de financement. Dans l'ensemble, ces études montrent que les caractéristiques du marché de destination, en particulier les conditions juridiques, ont tendance à jouer un rôle important dans le choix des conditions de paiement.

Cependant, selon O'Meara (2017), les négociations entre vendeurs et acheteurs sont centrées sur les conditions relatives au transfert des risques et des coûts (c.-à-d. Les Incoterms), car elles réduisent dans une large mesure l'incertitude des contrats. Une fois qu'ils ont été sélectionnés, les autres conditions (à savoir le transfert de titre et les conditions de paiement) suivent. Malgré leur large utilisation et leur importance reconnue, les termes axés sur la répartition des risques et des coûts dans les transactions commerciales internationales ont été peu étudiés. Au mieux de notre connaissance, cette étude est le premier travail dans le commerce international à évaluer la manière dont les entreprises exportatrices et importatrices se divisent risques et coûts tout au long du processus d'expédition. Seules quelques études de cas existent dans la littérature sur la gestion de la logistique. Les études suivantes devraient être répertoriés. Del Rosal (2016) évalue les facteurs influençant le choix des conditions de livraison utilisées dans le commerce conteneurisé maritime espagnol. Schaefer (2017) analyse comment les décisions de gestion logistique sont prises par les dyades vendeur-acheteur. En outre, Shangina (2007) étudie les déterminants des Incoterms dans les exportations de fruits de mer de la Norvège vers la Russie. Ying Szu (2014) en se basant sur une enquête explore les déterminants du choix des Incoterms et leur impact sur la performance des opérations de l'export.

Notre étude contribue également à la littérature en plein essor sur les liens entre entreprises dans le commerce international. Cette branche de la recherche microéconomique a abordé les aspects suivants : le rôle de la transmission d'informations complexes dans le commerce entre entreprises (Cristea 2011), l'appariement entreprise à entreprise dans la structure de la chaîne logistique mondiale (Dragusanu 2016), l'hétérogénéité et la granularité des relations individu-

elles acheteur-vendeur (Eaton et al. 2016). Une grande partie des études associées explorent le rôle des entreprises hétérogènes soit du côté des exportateurs, en s'appuyant sur Melitz (2003), soit du côté des importateurs, comme dans Antras et al. (2017). Un corpus de recherche naissant et croissant analyse l'hétérogénéité des exportateurs et des importateurs et les diverses implications pour les relations entre exportateur et importateur. Entre autres, Bernard et al. (2009), Castellani et al. (2010) et Muûls and Pisu (2009), explorent l'hétérogénéité des vendeurs et des acheteurs entre les entreprises américaines, italiennes et belges, respectivement. Une image détaillée de la littérature actuelle est fournie par Bernard and Moxnes (2018). Nous contribuons à ce volet de la recherche en analysant comment les caractéristiques des vendeurs et des acheteurs façonnent les décisions relatives à la répartition des responsabilités tout au long du processus d'expédition.

Les résultats clés de ce chapitre sont suivants. Tout d'abord, conformément à la littérature sur l'hétérogénéité bilatérale, nous montrons que les entreprises plus efficaces et celles comptant un nombre important de partenaires sont plus susceptibles de supporter les risques et les coûts tout au long du processus d'expédition. Plus précisément, la probabilité que des transactions se produisent sous les responsabilités *Sur l'acheteur* augmente pour les gros acheteurs et pour les acheteurs liés à de nombreux fournisseurs, mais diminue pour les gros vendeurs et pour les vendeurs connectés à plusieurs clients étrangers. Nous montrons également que les responsabilités *Sur l'acheteur* sont plus susceptibles d'être utilisées dans les transactions entre gros acheteurs et tout type de vendeur et entre les gros vendeurs et les petits acheteurs.

Deuxièmement, nos résultats indiquent une plus grande probabilité de s'appuyer sur les responsabilités de type *Sur l'acheteur* dans les transactions de biens intermédiaires et de biens d'équipement, par rapport aux transactions de biens finis. Nous montrons également que les responsabilités *Sur l'acheteur* sont plus susceptibles d'être utilisées pour des produits homogènes par rapport aux produits différenciés. Troisièmement, après avoir pris en compte d'autres facteurs de confusion potentiels, nous montrons que si un pays de destination se caractérise par un bon environnement commercial, c'est moins probable que les transactions de produisent sous les responsabilités *Sur l'acheteur*.

Bien que ce chapitre présente une première analyse de la répartition des risques et des coûts entre les entreprises impliquées dans les transactions internationales, des recherches supplémentaires sont nécessaires. Par exemple, il serait particulièrement intéressant d'explorer comment les entreprises exportatrices et importatrices se comportent en matière de gestion des risques et des coûts tout au long du processus d'expédition. Cela permettrait également d'analyser les conséquences pour les entreprises en dynamique.



INTRODUCTION

This thesis contains three chapters that are barely connected to each other. The diversity and number of reported keywords particularly well mirrors this fact. The objects of this research are both micro and macro: firms, countries, mergers and acquisitions and prices. Meanwhile, this dissertation fits into two global branches of the science "Economics". They are International trade and Energy economics.

The principal objective of this work is contribute to investigation of *real-life* problems. The leitmotif of applicability connects all of these three chapters. The first chapter of this thesis was published in 2017 in a journal that is intended to grasp the attention of energy researchers and international institutions. I dare to suppose, and hope, that the other two chapters would attract the attention not only of academic researchers, but also of decision makers and practitioners. In what follows I summarise: (a) research questions of the three chapters, (b) my contribution to various branches of the literature, (c) most interesting results. I further point to the aspects of these research questions that would deserve investigation of junior and senior researchers.

Efficiency, performance, productivity – all of these terms have been repeatedly appearing in academic research, "grey" and technical publications and reports of international organizations and well-reputed media such as "The Economist". The interest of international institutions to the efficiency of individual firms is fuelled by a well-established causal link between micro-level efficiency and macro-level growth. The first chapter of this thesis contributes to understanding of the firm-level efficiency, and particularly the one of biggest European energy producers.

The recent liberalization of EU electricity market is the reason of the surge of M&As. The first chapter is about the outcomes of mergers and acquisitions (M&As) between energy producers for their efficiency. I contribute to the understanding of consequences of the policy of liberalisation. I compute eco-efficiency of European electricity producers in 2005-2013. I employ data envelopment analysis (DEA) and the Malmquist-Luenberger productivity index, which are both based on radial directional distance function. The environmental production technology comprises CO₂ emissions as an undesirable output. I observe a decreasing trend in average eco-efficiency, which contradicts the previously documented moderate efficiency gains of liberalization. This difference might be explained by the inclusion to the analysis of

the ecological component.

The effects of M&As are isolated using second-step fractional regression. The domestic horizontal M&As, which are systematically regulated by the European Commission, have no impact. Although one cross-border horizontal deal has a same-year effect of roughly -3%, this effect becomes approximately +1.5% over a two-year timespan. Vertical domestic M&As have a short-run negative impact of 3.6% that does not persist over time. Vertical international M&As reduce the eco-efficiency by 2.1% two years after their completion. Limited evidence suggests that the conglomerate deals are at least not harmful.

This chapter has the value added for the policy analysis at the different levels. First, I suggest that the merger regulation should be based on DEA eco-efficiency measures. Second, I demonstrate that the vertical mergers might be detrimental for the efficiency. In fact, most of the attention of regulators has been devoted to horizontal and domestic M&As. I conclude that cross M&As and particularly vertical mergers should be carefully addressed.

The bridge between first and second chapters of this thesis is that both address policy outcomes. In August 2014, the Russian Federation implemented an embargo on select food and agricultural imports from Western countries in response to the economic sanctions. The measure was designed to harm producers in United States, European Union, Norway, Ukraine, along other Western countries. In the second chapter, which is based on a paper co-written with Julian Hinz, we quantify the effect of the embargo for welfare and consumer prices in Russia.

We first provide evidence for the direct effect on consumer prices with a difference-in-differences approach with a highly detailed monthly dataset of consumer prices in Russia between 2011-2016. The results suggest that the embargo caused consumer prices of embargoed goods to rise in the short run by 8.9% - 12.6%. Regions of Russia with previously above-average levels of food imports from sanctioned countries experienced a stronger impact. In the medium run the effect is softer (1.2% - 6.3%).

The results indicate that the policy shock has been transmitted to non-embargoed sectors by means of domestic input-output production linkages. We then build a Ricardian model of trade with domestic sectoral linkages, trade in intermediate goods and sectoral heterogeneity in production. We use this model to perform counterfactual simulations, isolate the direct and indirect price effects, and compute welfare measures for a situation without embargo. Our simulations suggest that the self-imposed embargo caused a decline in Russian welfare by 0.21% and a rise in price index by 0.25%.

It is worth to position the chapter 2 of this manuscript with respect to the literature on embargo and sanctions. Most of related recent studies discuss bilateral or unilateral effects of the

outward directed sanctioning policy. In this research, we demonstrate that the self-imposed embargo, even on limited number of sectors, is a self-harmful policy. The welfare simulations and counterfactual exercises are common in the sanctions literature. This chapter is an application of the novel exact hat algebra approach overall and framework of Caliendo and Parro (2014) in particular to the real-life case of the abrupt negative policy shock.

The chapter 3 is co-written with Cristina Herghelegiu. In common with the second chapter, it is devoted to the Russian trade. This time, we address the trade flows at the level of individual firms. Sellers and buyers are exposed to important risks and costs when trading across borders. Thus, based on a set of standardized rules known as International commercial terms (Incoterms), they decide *ex ante* how to divide responsibilities throughout the shipping process. Chapter 3 analyzes the factors determining how sellers and buyers divide risks and costs in international trade transactions.

We rely on a highly detailed dataset covering the universe of Russian export shipments during 2012-2015. We proceed to substantial data cleaning and matched individual exporters to their foreign customers. We show that big firms in terms of size and number of partners are more likely to take on responsibilities. More interestingly, big buyers bear more responsibilities regardless of the seller size, whereas big sellers do so only when their partner is small. The probability that buyers bear more risks and costs is higher for transactions of intermediate products and capital goods, compared to final goods. Also, the likelihood that buyers take on responsibilities decreases if they are located in a country with a good business environment.

The modern trade contracts are incomplete by their nature. In fact, None of them incorporates complete description of what might happen with goods at each stage of the shipment. Incoterms largely contribute to the overcoming of the contract incompleteness by delimiting costs and risks between contracting parties. The incomplete contracts have been recently introduced to the international trade and global value chains literature. Numerous subsequent studies belong either to the property rights approach or the transactions costs approach. The property rights approach assumes that a buyer owns an important fraction of seller's shares and participates in the management. The transaction costs approach assumes that the primal goal of the buyer is to minimize the costs of the individual transactions. To support our empirical analysis, we sketch a model based on the transaction costs approach and derive testable empirical implications.

To the best of my understanding, this chapter is the first systematic attempt in the academic literature to understand the patterns in the use of Incoterms. Meanwhile, Incoterms rule is an integral part of every trade contract. Sellers and buyers enter to the bargain over the exact split of costs and risks between them. The winner in such bargain most likely profits from the increase in their profits. Meanwhile, mutually optimal decision might lead to the increase in trade flows. The next step of the research agenda on the Incoterms should be the investigation

of their impact on trade flows.

The remainder of this manuscript is organized as follows. Chapter 1 is devoted to outcomes of mergers and acquisitions between EU energy producers. Chapter 2 addresses the consequences of Russian food embargo. Chapter 3 describes how trading firms choose Incoterms rule in their practice.

ECO-EFFICIENCY OUTCOMES OF MERGERS AND ACQUISITIONS IN THE EUROPEAN ELECTRICITY IN- DUSTRY

1.1 Introduction

Europe is the third-most important electricity market after Asia and North America. In 2013, the European Union (EU) represented 19.1% of worldwide energy-generation capacity and produced 16.4% of global electricity. In the early 1990s, the European energy market was highly regulated, as each state aimed to ensure its own energy security. In most of these states, the installed generation capacity largely overlapped with actual needs. Because utilities were forced to use internal resources instead of low-cost alternatives, they did not diversify their fuel sources, had low operational and corporate flexibility and relied on long-term forecasting (Serrallés 2006). Thus, energy producers had no incentives to become efficient. The liberalization of the European electricity sector started in 1996 with Directive 96/92/EC whose objective was the establishment of a common, competitive EU market. The three declared aims were consumer choice in electricity suppliers, third-party access to the transmission and distribution system, and unbundling distribution networks from generation.

As a consequence of this liberalization, EU electricity producers have faced the challenges of drastically increased competition and turbulent operational environments. These market players initiated an intense wave of mergers and acquisitions (M&As), which allowed them to swiftly readjust their allocations of distribution and production capacities. Prior to liberalization, energy producers functioned entirely within national borders and, hence, were commonly referred to as "national champions". These firms pursued cross-border M&As to increase their cost efficiency, incorporate foreign managerial expertise and gain access to distribution networks. Thus, liberalization has induced M&As, a high share of which are cross-border deals. In 2010, the global energy industry completed many deals, second only to the financial sector (Schmid et al. 2012). European electricity producers have greatly contributed to that wave. In 2011, they accounted for approximately 35% of global energy intakes.

This study addresses the period governed by the second and third EU electricity directives. The second directive (2003/54/EC) has produced the most liberalization-related policy changes. The most significant changes were the establishment of independent national regulators and free entry into electricity generation. The directive further strengthened the vertical unbundling of distribution and transmission activities from generation and retail. The third directive (2009/72/EC) introduced ownership unbundling of energy production from transmission. The European Commission further promoted the independence of national regulators and established the Agency for the Cooperation of Energy Regulators (ACER).

This paper belongs to a narrow branch of the M&A literature that aims to assess post-merger alterations in firm-level efficiency. Several studies on electricity generation and distribution are worth mentioning. The only previous attempt to address international M&As in the energy sector was conducted by Berry (2000), who did not find any impact. Becker-Blease et al. (2008) revealed the financial losses caused by mergers between US electric utilities. They also found that integration with gas activities and diversification into new geographic areas are detrimental to both market and operating performance. Kwoka and Pollitt (2010) applied data envelopment analysis (DEA) and assessed the performance outcomes of M&As in the US electricity market between 1994 and 2003. They did not find any evidence that M&As improve cost performance. Bagdadioglu et al. (2007) and Çelen (2013b) predicted efficiency outcomes of electricity market reforms in Turkey. Çelen (2013a) exploited a two-stage DEA approach and revealed the determinants of the efficiency of Turkish electricity distribution companies.

To the best of my knowledge, only three published studies have assessed firm-level post-merger outcomes in the European electricity industry, and two of these studies are devoted to the initial stage of the liberalization. Bednarczyk et al. (2010) addressed 37 cross-border M&As between bidders from Western industrialized countries and targets from Central and Eastern Europe over the 1995–2005 period. Their event study revealed a small, positive impact on target shareholder wealth in the short run. Datta et al. (2013) studied 156 mergers completed from 1990–2006 among electricity, gas, water and telecommunication firms. These authors revealed that combined EU utilities experienced statistically significant losses over both the short and long run. Saastamoinen et al. (2017) studied merger gains in the electricity distribution sector of Norway. These authors argue that merger outcomes significantly vary with respect to the regulatory model.

This paper investigates the outcomes of 129 M&As that were completed by the 15 largest European electricity producers between 2004 and 2013. All of these firms are multinationals that combine fossil, nuclear and renewable sources for electricity generation. I employ DEA to compute firm-level eco-efficiency and isolate the causal impacts of M&As. DEA is a nonparametric mathematical technique that is frequently applied in performance evaluation and operational research in the financial sector. I contribute to a growing strand of energy

and environmental (E&E) studies exploiting DEA. Recent applications in the energy sector include Yang and Pollitt (2009), Zhang et al. (2013), Arabi et al. (2014), Atkinson and Tsionas (2016) and Duan et al. (2016). I compute eco-efficiency scores using an output-oriented DEA model based on a radial directional distance function (DDF). I employ installed capacity and total operational expenditure as inputs and generated electricity and carbon dioxide (CO₂) emissions as good and bad outputs, respectively. I address the panel nature of the dataset with two alternative approaches. The window DEA approach assumes the absence of technological progress. I assess the obtained DEA eco-efficiency scores using a fractional quasi-maximum likelihood estimator with correlated random effects. As an alternative, I compute the Malmquist-Luenberger productivity index (MLPI), which has recently become a common measure in intertemporal efficiency evaluation. In this case, I use OLS with time and firm fixed effects as the second-stage estimator.

The results suggest that in the short run, domestic mergers reduce eco-efficiency by an average of 3.35%. The effects of cross-border deals appear to be weaker (-2.06%). In total, 93 cross-border M&As are analyzed, representing 72.1% of the sample. This study is the second since Bednarczyk et al. (2010) to differentiate between horizontal and non-horizontal energy mergers. I find that carefully regulated domestic horizontal mergers do not have a statistically significant impact. Cross-border horizontal mergers hamper eco-efficiency in the short run but stimulate it two years after completion. An interesting and somewhat new result is that vertical mergers are detrimental to eco-efficiency. More precisely, domestic vertical mergers have a short-run negative impact of 3.63%, but this impact does not persist over time. Cross-border vertical mergers dampen eco-efficiency by 2.1% over a two-year horizon. Regulatory authorities should adapt efficiency-promoting merger regulation using this study as a reference.

This chapter proceeds as follows. In Section 1.2.1, the pattern of M&As among EU electricity producers is characterized. I describe the DEA model in Section 1.2.2, and I explain the comprehensive second-stage fractional regression analysis in Section 1.2.3. Then, I report the computed eco-efficiency scores in Section 1.3.1. The effects of cross-border and domestic mergers and acquisitions are quantified in Section 1.3.2. I further distinguish among the eco-efficiency outcomes of horizontal, vertical, and conglomerate M&As in Section 1.3.3. Finally, Section 1.4 summarizes the research and discusses the policy implications.

1.2 Data and methodology

1.2.1 M&As

In this study, I use panel data for the 15 largest European electricity producers over the 2005–2013 period. In 2005, the firms of interest represented 54.2% of installed EU capacity and produced 55.1% of total electricity. In 2013, they generated 62.3% of all European energy and

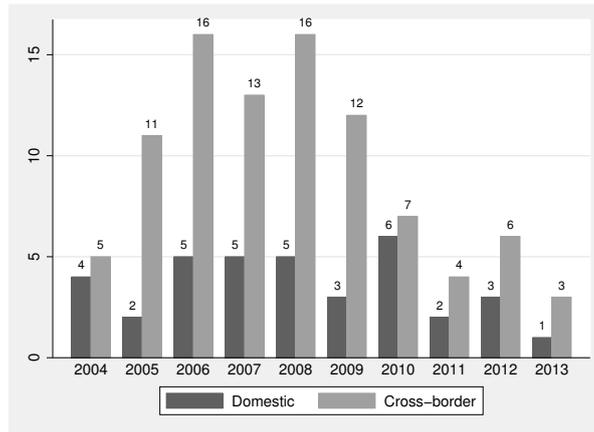


Figure 1.1. Evolution of domestic and cross-border M&As

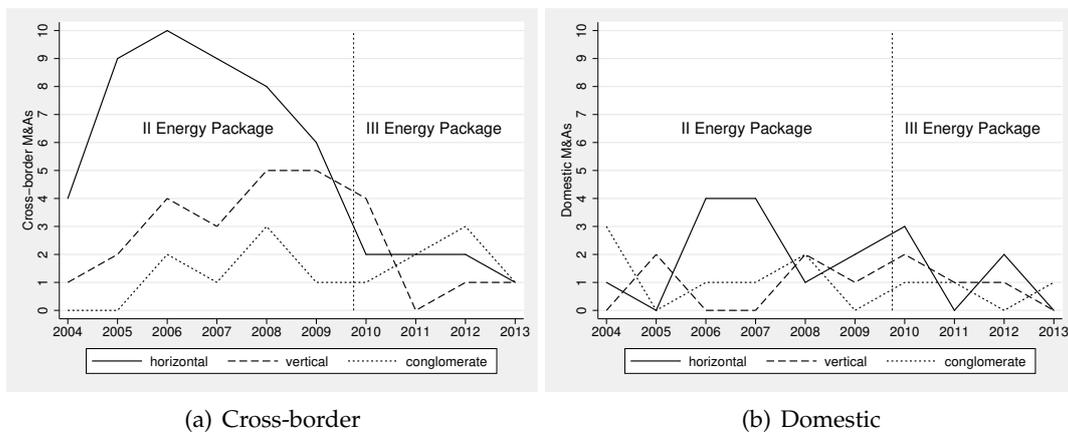


Figure 1.2. Repartition of M&As by types

represented 53.2% of the region's capacity. The complete list of firms is presented in Table 1.A1.

The data on M&As were extracted from the Thomson Reuters SDC Platinum database. The sample is composed of 129 M&As. Hereinafter, I employ the term "mergers".¹ Note that all deals in the sample are cases where one large EU electricity producer acquires a smaller entity. Mergers included in the sample satisfy the following conditions: First, the date of completion was between January 2004 and December 2013; second, the acquisition was realized by one of the studied energy firms rather than by an affiliate, associate or subsidiary company; and third, the acquirer's stake was initially below 50%, but after completion of the acquisition, the stake was 50% or higher.

The total sample is composed of 93 cross-border (72.1%) and 36 domestic (27.9%) deals. I classify a merger as a cross-border deal if the headquarters of the target and acquirer are not

¹For instance, the European Merger Regulation (European Commission 2004, 2008) is dedicated exclusively to mergers. In the M&A literature, the terms "merger" and "acquisition" are often used synonymously. However, they have different definitions. A merger occurs when two entities of similar size are combined into one new entity. An acquisition occurs when a larger firm purchases a smaller firm or entity. In practice, mergers per se are quite rare.

Table 1.1
Types of mergers

Types	Domestic	Cross-border	Targets' principal activities	U.S. SIC codes
Horizontal	17	53	Energy utility	4911, 4931, 4939
Vertical	9	26	Electricity generators, gas and oil extraction	1221, 1311, 3511, 3621, 499A
Conglomerate	10	14	Non-related to electricity generation and distribution	1522, 1731, 2813, 3433, 3674, 4922, 4923, 4924, 4941, 5172, 6512, 6719, 7389, 8711, 8742, 8748

Notes: Table reports classification of M&As in the sample.

located in the same country. In some cases, the firms of interest finalized both international and domestic mergers in the same year. The number of deals of each type is reported separately for each firm-year observation. A timeline of M&A activity is shown in Fig. 1.1. European energy firms merged most intensively in 2006 and 2008, whereas the highest share of international mergers was observed in 2005. In 2004 and 2010, nearly as many domestic as international mergers occurred.

I further differentiate among horizontal, vertical and conglomerate mergers (see Fig. 1.2). Whereas horizontal mergers occur between electricity utilities, the vast majority of targets in vertical mergers are separate power plants that co-generate heat and electricity or use alternative energy sources. Other vertical targets operate in the extraction of fossil fuel or in the production of turbines and generators. The targets in conglomerate mergers are not related to any stage of energy generation or to energy distribution. I report the number of deals in each category in Table 1.1. Disaggregation at the sector level is presented in the appendix (Table 1.A2).

1.2.2 DEA

DEA has been frequently applied to assess the performance of various industries. This non-parametric technique was introduced by Charnes et al. (1978). It is based on the observed inputs and outputs of decision-making units (DMUs). An important advantage over parametric techniques is that DEA does not require specification of a cost function; nor are strong assumptions about the exact form of the production function needed.² DEA has recently gained a widespread attention in E&E studies.³

²See, e.g., Jamasb and Pollitt (2003) for a comparison of DEA to corrected ordinary least squares (COLS) and stochastic frontier analysis (SFA) approaches. They estimated the efficiency of regional European electricity distribution utilities.

³See the comprehensive literature surveys in Zhou et al. (2008), Zhang and Choi (2014) and Sueyoshi et al. (2017).

Assume that the market consists of $j = 1, \dots, N$ electricity firms. They make use of the input vector $x \in \mathbb{R}_+^m$ to produce desirable output $y^d \in \mathbb{R}_+^s$ and undesirable output $y^u \in \mathbb{R}_+^j$. The results of DEA efficiency studies are sensitive to the choice of inputs and outputs. I rely on previous E&E studies, data availability and the specificity of electricity generation to make these choices.

In this study, the vector of inputs x is composed of two inputs: installed production capacity (in MW) and total operational expenditures (in millions of euros). Jamasb and Pollitt (2003) argued that operational expenditures and installed capacity are common inputs in studies on electricity distribution. Vaninsky (2006) and Sueyoshi et al. (2010) incorporated operating expenses into an assessment of the US electric power generation industry. Pérez-Reyes and Tovar (2009) summarized the DEA components of 14 studies of electricity distribution. The majority of them employ installed capacity, together with operational costs, to proxy for physical capital. The survey of Arabi et al. (2014) revealed the same pattern in plant-level eco-efficiency studies of energy producers. Saastamoinen et al. (2017) employed total costs as the single input in an efficiency assessment of the Norwegian electricity distribution industry.

Labor is another potential input that is exploited in a significant share of DEA efficiency studies. I do not consider this input due to data limitations. The studied European electricity producers are large multinationals that operate in several areas alongside electricity generation.⁴ Explicit reports of the number of employees engaged in power production occurs only in a few cases. The inclusion of total labor as an input would lead to the underestimation of eco-efficiency for firms that have more non-generation activities. It is worth noting that labor is a particularly appropriate input for efficiency studies of electricity generation at the plant level (e.g., Yang and Pollitt 2009; Färe et al. 2014).

The desirable output y^d is generated electricity (TWh), the principal physical output in the energy sector. The quasi-totality of previous studies on the eco-efficiency of generators targets the amount of generated power (e.g., Arabi et al. 2014). I consider total CO₂ emissions (tons) produced during electricity generation as the undesirable output y^u . The most common undesirable outputs considered in previous DEA studies of electricity generation are CO₂, sulfur dioxide (SO₂) and mono-nitrogen oxides (NO_x). Sözen et al. (2010) and Sueyoshi et al. (2010) introduced all of these as separate undesirable outputs. I include neither SO₂ nor NO_x emissions because these data are unavailable. Moreover, similar recent studies of energy generation (e.g., Bai-Chen et al. 2012; Zhang et al. 2013; Duan et al. 2016) employ CO₂ emissions as the only bad output. In 2013, the public electricity and heat-generation EU sector was responsible for approximately 28.9% of total EU28 greenhouse gas emissions (Guerreiro et al. 2014).

I source the inputs and outputs from the energy utility data provided by Enerdata.⁵ For

⁴Examples include heat generation, gas production and power distribution.

⁵Enerdata is an independent research and consulting agency that specializes in energy market forecasting,

Table 1.2
DEA input and output components

Variable	Definition	Data sources
Capacity	Total installed capacities involved in electricity generation (MW)	Enerdata and reports
TOPEX	Total operational expenditures (M) €	Thomson One
PowerGen	Physical amounts of generated electricity (TWh)	Enerdata and reports
Emissions	Total CO2 emissions from electricity generation (tons)	Enerdata, reports and PricewaterhouseCoopers (2013)

Notes: Table describes inputs and outputs used in the setup of DEA model.

some observations, I retrieve data on CO2 emissions and electricity production from PricewaterhouseCoopers (2013). The definitions and sources of the DEA components are summarized in Table 1.2.

The multi-output production function can be described by:

$$T = \{(x, y^d, y^u) : x \text{ can produce } (y^d, y^u)\} \quad (1.1)$$

Färe et al. (1989) formulated assumptions of weak disposability and null-jointness that are imposed on the production technology T . These assumptions can be represented as follows:

$$\text{If } (x, y^d, y^u) \in T \text{ and } 0 \leq \theta \leq 1, \text{ then } (x, \theta y^d, \theta y^u) \in T \quad (1.2a)$$

$$\text{If } (x, y^d, y^u) \in T \text{ and } y^u = 0, \text{ then } y^d = 0 \quad (1.2b)$$

Weak disposability ((1.2a)) requires that reduction of the undesirable output y^u is costly in terms of the proportional reduction of desirable output y^d . The null-jointness assumption ((1.2b)) states that undesirable outputs are not avoidable. The only way to produce zero CO2 emissions is to stop electricity generation. The production function in eq. (1.1) is defined conceptually, and it must be specified for further empirical estimation. This study employs a nonparametric DEA piecewise linear framework, as in Zhou et al. (2012) and Zhang et al. (2013). The environmental production technology with constant returns to scale (CRS) can be

policy assessment and efficiency evaluation. Their discontinued Energy Market Intelligence dataset is the source of data until 2010, which includes financial data and production highlights for the major European energy producers. Information since 2010 is extracted from Power Plant Tracker. This database records the characteristics of power plants worldwide. I employ the "Company Dashboard" tool, which contains aggregate information on the assets and footprints of the main power companies.

represented in generalized form as follows:

$$\begin{aligned}
T = \{(x, y^d, y^u) : & \sum_{n=1}^N \lambda_n x_{mn} \leq x_m, m = 1, \dots, M, \\
& \sum_{n=1}^N \lambda_n y_{sn}^d \geq y_s^d, s = 1, \dots, S, \\
& \sum_{n=1}^N \lambda_n y_{jn}^u = y_j^u, j = 1, \dots, J, \\
& \lambda_n \geq 0, n = 1, \dots, N.\}
\end{aligned} \tag{1.3}$$

The DDF for eco-efficiency estimation was introduced by Chung et al. (1997). The principal advantage of this approach is that it allows simultaneous increases in desirable outputs and decreases in undesirable outputs and/or inputs. Färe and Grosskopf (2004) argue that traditional radial efficiency models represent a special case of the DDF, which can be articulated as follows:

$$\vec{D}(x, y^d, y^u, \vec{g}) = \sup\{\beta : (y^d, y^u) + \beta \vec{g} \in T(x)\} \tag{1.4}$$

The directional vector \vec{g} defines the orientation in which the outputs are scaled.⁶ I use the vector $\vec{g} = (y^d, -y^u)$ which is frequently applied in E&E studies.⁷ The feasible increase in the amount of produced electricity is intended to be consistent with a simultaneous reduction of CO2 emissions. I assume that the inputs remain constant. Thus, my model is output-oriented. The assumption that the electricity firms could not alter their installed capacities is realistic since almost all of the relevant electric plants were operating throughout the whole period of interest. The "classical" radial DDF has an underlying assumption that desirable and undesirable outputs can be adjusted at the same rate β . A potential issue with radial DDF is that it might overestimate efficiency when the slacks are non-zero. Non-radial slack-based DEA models are good alternatives for radial ones.⁸ The major difference relative to the radial approach is that inputs, desirable outputs and undesirable outputs can be adjusted at different rates that are predefined by the directional vector.

Sahoo et al. (2011) summarizes the discussion of the choice between radial and non-radial functions. The superior mathematical properties of the radial function and the simplicity of applications in management should be noted. Moreover, the radial approach has been more frequently employed (see Zhang and Choi (2014)). Recent applications include, e.g.,

⁶Atkinson and Tsionas (2016) proposed to use Bayesian methods to estimate optimal firm-specific directions for each particular input and output. They demonstrated an application based on the dataset of 77 US electricity utilities. Note that the data requirements include prices of inputs.

⁷See Zhang and Choi (2014) for a comprehensive overview of the evolution of DDF through 2013. These authors discovered only two input-oriented E&E studies.

⁸One of the first applications of such a model is Zhou and Ang (2008) in which the energy efficiency of 21 Organisation for Economic Co-operation and Development (OECD) countries was measured. In addition, Zhang et al. (2013) studied the cross-sectional efficiency of Korean power generators using a meta-frontier non-radial DDF.

Beltrán-Esteve and Picazo-Tadeo (2015) and Beltrán-Esteve and Picazo-Tadeo (2017). However, Sueyoshi and Yuan (2016) note that determining which approach is preferable in terms of efficiency measurement is not straightforward.

In this study, the environmental production technology is estimated using A radial DDF model. I reshape the broadly defined undesirable-measure DEA framework (eq. (1.3)) so that it includes the radial directional eco-efficiency measure β_{CRS}^* . I assume an increase in the desirable output and a reduction in the undesirable output given constant quantities of inputs. Following Aparicio et al. (2013) and Färe et al. (2014), I introduce an upper bound on the optimal level of CO2 emissions, which is equal to the maximum observed value of this undesirable output. Such an approach prohibits counter-intuitive cases in which additional electricity could be produced with a reduction of emissions.

The final optimization program is as follows:

$$\begin{aligned}
\vec{D}(x, y^d, y^u) &= \max \beta \\
s.t. \sum_{n=1}^N \lambda_n x_{mn} &\leq x_m, m = 1, \dots, M, \\
\sum_{n=1}^N \lambda_n y_{sn}^d &\geq y_s^d + \beta y_s^d, s = 1, \dots, S, \\
\sum_{n=1}^N \lambda_n y_{jn}^u &\geq y_j^u - \beta y_j^u, j = 1, \dots, J, \\
\max\{y_j^u\} &\geq y_j^u - \beta y_j^u \\
\lambda_n &\geq 0, n = 1, \dots, N, \beta \geq 0
\end{aligned} \tag{1.5}$$

This study employs a panel dataset of 15 energy producers over 9 years. Most DEA studies utilize cross-sectional datasets, but they fail to address changes in efficiency over time. The so-called window analysis approach can be used with panel data. The DMUs are regarded as separate in each period.⁹ I selected the entire 9-year period as the window. The underlying assumption is that the technological frontier does not move within the window. The farther an electricity producer is from the best-practice frontier, the less efficient it is. Eco-efficiency is achieved when $\beta_{CRS}^* = 0$, whereas $\beta_{CRS}^* > 0$ signals inefficiency. For the sake of simplicity, I compute the direct eco-efficiency scores as follows: $efficiency_{it} = 1 - \beta_{it}$. The values are on an interval (0,1]. A firm has a score of unity in a given year if, at that moment, it is the most efficient of the firms over the entire period. Values below 1 indicate inefficiency.

To examine the robustness of the obtained results, it is worth relaxing the aforementioned assumption of the absence of technological progress. The Malmquist productivity index (MPI) is a common non-parametric approach that addresses intertemporal productivity change. It

⁹Examples of relevant applications include Wang et al. (2013), Kao and Liu (2014) and Rahman et al. (2016).

can be decomposed into technical change (frontier shift) and efficiency change (position relative to the frontier). These components are also referred to as the technical and allocative efficiencies. Recent E&E studies employ the Malmquist-Luenberger productivity index (MLPI) that is based on the DDF and incorporates both desirable and undesirable outputs. The MLPI was introduced by Chung et al. (1997) and has been further developed, e.g., in Zhou et al. (2010) and Zhou et al. (2012).

In this study, I make use of the refined version of the MLPI proposed by Aparicio et al. (2015). The authors argue that when decomposing the overall efficiency, the allocative efficiency should be derived first. In order to maintain comparability with the window DEA approach, I use the same set of inputs, outputs and constraints.¹⁰ For the sake of interpretability, I follow the fixed-reference Malmquist model (Berg et al. 1992), which captures the change in the efficiency of a DMU relative to a previous or baseline period. The year 2005 is chosen as the baseline period. I compute the MLPI for each firm-year observation over the 2006–2013 period, and the values reflect changes in eco-efficiency in the current period relative to the 2005 values. MLPI values above unity indicate a rise in eco-efficiency, whereas values below unity indicate a decline. I further decompose the aggregate MLPI into technical efficiency change (MLTEC) and technical change (MLTC).

1.2.3 Regression analysis

I conduct a two-stage DEA, which allows the computation of eco-efficiency values and the isolation of the causal influences of contextual factors. Yang and Pollitt (2009) summarizes a number of the advantages of two-stage DEA. First, no strong prior judgment about the direction of the relationship between efficiency and the regressors is required. Second, both categorical and continuous variables can be included without increasing the sample size. Finally, the analysis is relatively straightforward to apply and the results easy to interpret compared to three- or four-stage approaches. Pombo and Taborada (2006), Pérez-Reyes and Tovar (2009) and Çelen (2013a) apply two-stage DEAs to study the efficiency of electricity distribution companies.

The appropriate selection of the second-stage estimator should build on the properties of the obtained measures of eco-efficiency. In the principal DEA approach, I compute the eco-efficiency scores that belong to the unity interval. The linear estimation models are not pertinent for explaining variation in the proportional or fractional response variables, since the predicted values can exceed unity (see, e.g., Yang and Pollitt 2009; Ramalho et al. 2011). Note that the logit and probit models are not the best alternatives (see, e.g., Murteira and Ramalho 2016). McDonald (2009) has demonstrated that the Tobit estimator is not appropriate either. The two classes of fractional regression models are practically exploited. Papke and Wooldridge

¹⁰The optimization programs for both window DEA and MLPI are solved using the Data Envelopment Analysis Toolbox for MATLAB (Alvarez et al. 2016).

(1996) introduce a quasi-maximum likelihood estimator (QMLE) based on the Bernoulli quasi-likelihood function. It is employed to estimate conditional mean models. An alternative is a fully parametric model that is conventionally estimated by maximum likelihood (ML).¹¹

I use a correlated random effects probit QMLE that has been previously applied to fractional outcome models, e.g., in Papke and Wooldridge (2008) for balanced panels and Wooldridge (2009) for unbalanced panels.¹² The values of the Malmquist-Luenberger index can exceed unity. In the corresponding second-stage models, I employ an OLS estimator with time and firm fixed effects.

The following general form describes the estimation strategy:

$$\begin{aligned}
 DEAscores_{it} = & \alpha_0 + \alpha_k NumM\&As_{it} + \beta_1 GenToSales_{it} + \beta_2 TwoMergers_{it} + \\
 & + \beta_3 TwoCBMergers_{it} + \gamma_1 K/S_{it} + \gamma_2 I/K_{it} + \gamma_3 Y/S_{it} + \\
 & + \gamma_4 Leverage_{it} + \gamma_5 Leverage_{it}^2 + \gamma_6 CurrentRatio_{it} + \gamma_7 CurrentRatio_{it}^2 + \\
 & + \Sigma \theta_m Location_{it} + \Sigma_{2005}^{2013} \delta_t Year_t + \varepsilon_{it}
 \end{aligned} \tag{1.6}$$

The variables of interest are the numbers of mergers of a certain type completed in each year.¹³ First, I estimate the effects of all types of mergers. Next, I distinguish between domestic and cross-border M&As, and I further differentiate them with respect to acquirer-target industry relatedness as horizontal, vertical and conglomerate mergers. Each estimated model contains time averages for all explanatory variables because their inclusion controls for correlations between the regressors and time-invariant unobservables. The definitions of the control variables are summarized in Table 1.3. The financial and managerial controls are computed based on data from the Orbis by Bureau van Dijk and Thomson One by Thomson Reuters databases.¹⁴

Recently merged firms must integrate their management systems and practices with the systems and practices of their targets. In the context of the electricity industry, the production structure might be adapted to a new fuel mix. Furthermore, experienced acquirers should be better able to efficiently negotiate the terms of a deal. Firms that have recently experienced an

¹¹See the recent contribution of Murteira and Ramalho (2016) for a comprehensive survey of both conditional mean and parametric models. They also propose several specification tests.

¹²Fixed effects estimators have recently attracted widespread attention. However, they often fail to produce unbiased estimates in non-linear models because of the incidental-parameter issue. Greene (2004) demonstrated that different varieties of ML fixed effects models are inconsistent in cases with finite samples. The existing approaches to correcting this bias (e.g., Hahn and Newey 2004; Fernández-Val 2009) often require long panels. Furthermore, strong assumptions of stationarity and serial independence are needed, which drastically limits the practical applications of these adjustments.

¹³A possible alternative approach estimates separate categories of M&As. It consists of introducing categorical dummies indicating the type of acquisition. I refrain from using this approach because of the complexity inherent in interpreting its results. Indeed, ambiguity can arise from "mixed" categories in which, e.g., both cross-border and domestic mergers are completed.

¹⁴Three firms report their financial highlights in currencies other than the euro: CEZ A.S. uses Czech crowns, E.ON SE uses US dollars, and Vattenfall AB uses Swedish crowns. I obtain the values in euros using the year-averaged exchange rates provided by the European Central Bank.

Table 1.3
Control variables

Variable	Definition	Data sources
GenToSales	The share of own generation in total amounts of sold energy	Enerdata and reports
TwoMergers	Dummy that takes unity value if a firm completed M&As both in the period of interest and one year ago	SDC Platinum
TwoCBMergers	Dummy that takes unity value if a firm is involved in cross-border M&As both in the period of interest and one year ago	SDC Platinum
Location	Installed capacities (MW) in separate countries: Germany, France, UK, Italy, Portugal, Spain, Czech Republic, Poland, Benelux and Nordic EU countries	Enerdata and reports
K/S	The ratio of long term tangible assets (property, plant, and equipment) to net sales	Thomson One
Y/S	The ratio of operating income to net sales	Thomson One
I/K	The ratio of capital expenditures to tangible long term assets (property, plant, and equipment)	Thomson One
Leverage	Financial leverage computed as the ratio of total liabilities to shareholders' equity	Thomson One
Current ratio	The ratio of current assets to current liabilities	BvD Orbis

Notes: Table represents definitions and sources of included control variables.

M&A may be able to undertake these adjustments more quickly and at lower costs.¹⁵ I control for merger experience via the TwoMergers dummy, which is equal to one if a firm has finalized M&As in two consecutive years.

Cross-border merger experience should impact eco-efficiency differently. Firms must integrate entities that function under different macroeconomic conditions and in another regulatory environment. Markides and Ittner (1994) stated that acquirers with prior international experience should gain more from cross-border mergers. Such firms are better able to use their experience to integrate and efficiently manage the acquisition process. However, an energy utility that has previously engaged human and financial resources in cross-border re-adjustments could be more vulnerable during a merger in the next year. I introduce the TwoCBMergers dummy, which is equal to one if a utility underwent an international merger in the current and the prior year.

Mainstream theories of industrial organization and economics predict that vertical integration should promote firm efficiency. Kwoka (2002) revealed that large cost savings are associated with coordination between energy generation and distribution. Kwoka and Pollitt (2010) confirmed this result and demonstrated that vertical integration positively influences the overall performance of electricity producers. In this study, I control for vertical integration using the GenToSales variable, which is equal to the share of the distribution output generated by the utility itself.

¹⁵Kamien and Zang (1993) found that the synergetic gains are amplified in serial acquisitions. These authors demonstrated theoretically that such deals allow a firm to monopolize the sector. Bertrand and Betschinger (2012) argued that serial acquirers could face larger organizational challenges and higher financial constraints.

A firm's efficiency is largely influenced by its management. An enormous amount of the literature (see, e.g., Jose et al. 1996) is related to the principal-agent problem.¹⁶ Exposure to the principal-agent problem is proportional to the degree of information asymmetry between the involved parties. Physical assets can be relatively easily observed and monitored. This vulnerability to the principal-agent problem is proxied by the capital-to sales (K/S) ratio. This ratio is equal to long-term tangible assets (property, plants, and equipment) divided by net sales. The more a firm uses hard capital, the easier it is for shareholders to monitor the firm. Physical capital is a key production factor in the electricity industry. Electricity producers make intensive capital investments in two cases, with the main case being the construction and launch of new capacity. Alternatively, production capacity may be replaced or renovated, e.g., to comply with ecological norms. Such alterations are expected to strongly influence the eco-efficiency of electricity producers. In the present study, I control for the ratio of capital expenditures to tangible long-term assets (I/K), as in Himmelberg et al. (1999). These authors argue that firms with higher investment rates have more opportunities to implement discretionary projects, and consequently, these firms grow more quickly.

The inelastic nature and seasonality of energy demand are important particularities of the electricity industry and provide energy firms with great opportunities to exploit their market power. Producers can use two mechanisms to control energy prices (Helman 2006). The first mechanism is physical withholding, which consists of holding electricity generation below productive capacity. The alternative is to employ financial withholding by setting an excessively high price. Therefore, market power is expected to influence firm-level eco-efficiency, which depends on the production capacity in use and on the generated electricity. I follow Himmelberg et al. (1999) and control for the ratio of operating income to net sales (Y/S).

Leverage is an important measure of financial sustainability and reflects the extent to which a firm's activities are financed by creditors. The trade-off theory of the optimal capital structure describes the choice of leverage as the equilibrium between the costs and benefits of debt (see, e.g., Kraus and Litzenberger 1973). The performance of low-leverage firms is a positive function of the debt-to-capital ratio because agency problems have been overcome. The performance of high-leverage firms deteriorates as the amount of leverage increases for two reasons. First, they have fewer incentives to further invest in capital. Second, servicing such debts requires excessive cash flows (Coricelli et al. 2012). In the present study, I control for leverage using linear and quadratic terms, where leverage is defined as the ratio of total liabilities to shareholder equity.

A firm's daily activities require a sufficient level of working capital, and the amount of cash on hand must be sufficient to cover current debts and other obligations. This indicator is often

¹⁶Top management team members (agents) could make decisions that would enhance their wealth but largely diverge from the objectives of the principals (shareholders), leading to poor firm performance.

Table 1.4
Correlations and descriptive statistics

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12
1 Capacity	39204.3	34670.5	1											
2 TOPEX	31864.8	29933.6	0.52*	1										
3 PowerGen	159.2	153.8	0.97*	0.48*	1									
4 Emissions	56621068.8	49796889.1	-0.09	0.17*	-0.11	1								
5 TwoMergers	0.24	0.43	0.14	0.06	0.12	0.08	1							
6 TwoCBMergers	0.17	0.38	0.17*	0.14	0.15	0.09	0.81*	1						
7 GenToSales	0.77	0.20	0.37*	-0.09	0.38*	-0.03	-0.04	-0.03	1					
8 K/S	1.29	0.60	0	-0.54*	0.02	-0.51*	0	-0.03	0.46*	1				
9 I/K	0.12	0.067	-0.15	0.35*	-0.12	0.35*	0.04	0.06	0.03	-0.34*	1			
10 Y/S	0.15	0.087	-0.33*	-0.56*	-0.3*	-0.21*	-0.05	-0.08	0.34*	0.71*	-0.09	1		
11 Leverage	2.90	1.95	0.52*	0.15	0.57*	0.07	0	-0.03	0.04	-0.12	-0.05	-0.35*	1	
12 CurrentRatio	1.10	0.24	0.02	0.10	0.07	-0.05	0	0.06	0.04	-0.03	0.04	0.01	-0.03	1

Notes: Table reports correlation matrix and descriptive statistics. * indicates significance at 5 percent level.

referred to as liquidity. An inverted U-shaped relationship between liquidity and profitability has been confirmed empirically by Baños-Caballero et al. (2012) and Aktas et al. (2015).¹⁷ In this study, the current ratio is computed as current assets divided by current liabilities. I introduce linear and quadratic terms of this ratio as a second-stage, right-hand-side variable. The functioning of energy firms is subject to national regulations. Despite substantial efforts by the European Commission, EU members still differ in their level of control over electricity production. A good example is nuclear phase-out in Germany. Tax legislation is another dimension of cross-country variation. Therefore, some of the variation in the eco-efficiency of firms can be attributed to their locations. I proxy for the locations of energy firms using the installed generation capacities of the following countries: Czech Republic, France, Italy, Poland, Portugal, Spain and the United Kingdom. I sum (by firm) the capacity in use in the Benelux countries. Similarly, the capacities of the Nordic EU states are aggregated. Since 1996, the functioning of the energy firms in these Nordic countries has been subject to the common Nord Pool legislation.

Simar and Wilson (2007) argue that a two-stage DEA approach could be biased in the case of a high correlation between the first-stage input-output variables and the second-stage controls. The actual correlation matrix is reported in Table 1.4. Note that the absolute values of the correlations between the controls and the DEA components do not exceed 0.6. Thus, all of the included second-stage regressors are appropriate. For each set of results, I compute the average partial effects (APEs) of one completed merger. These effects vary across the range of tested models. For the sake of simplicity, I exclusively report the APEs resulting from the model with included controls of vertical integration, merger experience, management and finance. It is also worth to note that I define the short-run effects as the ones of the same-year mergers. The medium-run effects correspond to the ones of the mergers that have been completed two years ago.

¹⁷Firms with more liquidity are better protected against the risk of default. However, a trade-off exists between liquidity and operating performance. Whereas profitability increases with lower investments in working capital (Jose et al. 1996; Wang 2002; García-Teruel and Martínez-Solano 2007), if the level of working capital is too low, the firm will lose its ability to adjust sales in accordance with the actual market situation (see, e.g., Wang 2002).

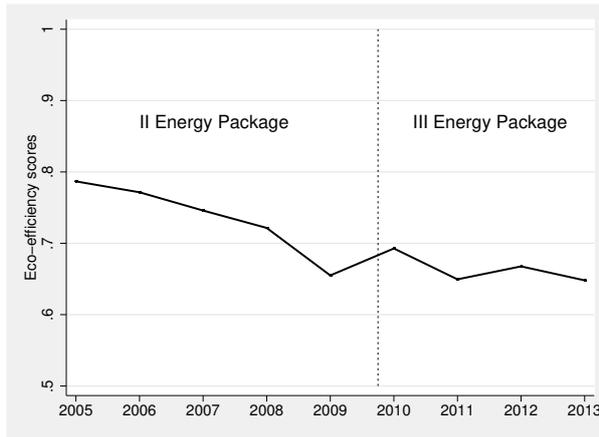


Figure 1.3. Average eco-efficiency DEA scores

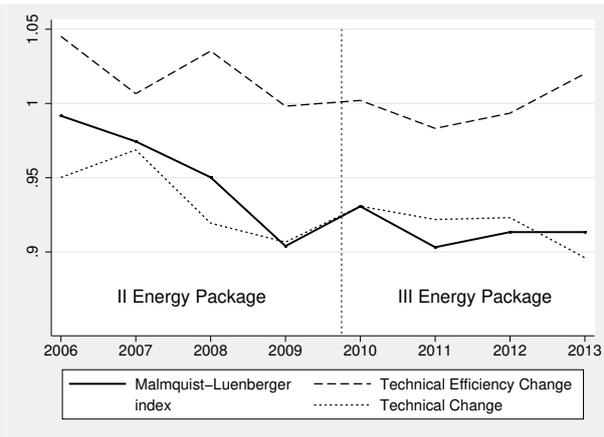


Figure 1.4. Average Malmquist-Luenberger index

1.3 Results and discussion

1.3.1 A first look at the eco-efficiency of the European energy sector

The eco-efficiency of European electricity producers over the 2005–2013 period ranges from 0.1832 to 1. The computed DEA eco-efficiency scores are reported in Table 1.A1 in the appendix. The mean score was 0.7043, which suggests that, on average, electricity firms could increase their eco-efficiency by approximately 29.57%. The evolution of the entire sector's eco-efficiency is particularly interesting for policymakers. This trend can be captured by the yearly averages of the eco-efficiency scores, which are represented graphically in Fig. 1.3. It is worth comparing these to the average values of the MLPI (Fig. 1.4). Note that the trend predicted by the MLPI is quite similar, despite minor differences for 2011–2013. The same graph shows the decomposition of the MLPI into MLTEC and MLTC. Note that the sector's technical efficiency declines over the entire period of interest. This trend contradicts previously documented moderate efficiency gains that are specific to the early stages of the European energy liberalization.¹⁸ Between 2005 and 2009, the overall eco-efficiency of the sector, as well as its technical efficiency, decreased consistently. Meanwhile, allocative efficiency has changed ambiguously. This period was governed by the second electricity directive. It is worth comparing the eco-efficiency pattern to the patterns of mergers of different types (see Fig. 1.2). Horizontal cross-border mergers prevailed during this period. Meanwhile, the number of vertical cross-border mergers was steadily growing. Pollitt (2009) argues that vertical mergers reverse the unbundling policy implemented by the European Commission. Therefore, I hypothesize that vertical mergers have a negative impact on eco-efficiency.

The period from 2010 to 2013 was governed by the third EC electricity directive. Its adop-

¹⁸See, e.g., Steiner (2001), Hattori et al. (2005) and Fiorio et al. (2007).

tion in September 2009 is a probable cause of the observed short-run eco-efficiency improvement. Note the sharp decrease in the number of vertical mergers, which was triggered by a more stringent policy of ownership unbundling. Allocative efficiency increases by the end of the period, which was mitigated by a downward shift of the sector's efficiency frontier. Thus, aggregate eco-efficiency over the 2010–2013 period has experienced marginal growth above the 2009 values.

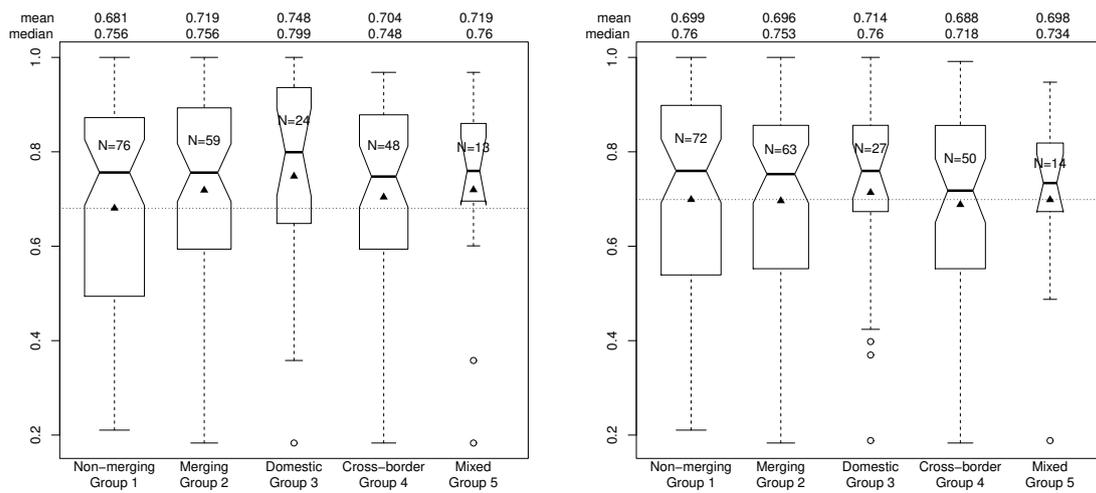
The evolution of the eco-efficiency of separate utilities warrants investigation. I plot the computed individual scores in Fig. 1.A1. Électricité de France and Fortum were typically close to the best-practice frontier throughout the study period. The lowest average efficiency values were exhibited by Edison, Enel and Energias de Portugal. Overall, the eco-efficiency of individual firms is rather ambiguous. However, some patterns can be identified by classifying utilities in terms of the regulatory environment. National-level regulation is expected to affect ecological, environmental and financial aspects of the functioning of energy utilities.

Perrin (2013) classifies the national regulatory models applied in Europe. Incentive-based regulatory models are in place in the Czech Republic, France and Germany (among other countries). The eco-efficiency scores of utilities with headquarters in these countries are illustrated in Fig. 1(a) in the appendix; they have demonstrate convergence to the interval [0.7,0.8]. I further distinguish firms with headquarters in Italy, Spain and Finland. These firms are exposed to the combined type of regulation, which is a mixture of the incentive-based and income-cap models. Greater dispersion in eco-efficiency scores is observed among these utilities. However, I find some convergence to the interval [0.3,0.5]. Thus, incentive-based regulation may favor eco-efficiency.

1.3.2 Distinguishing domestic and cross-border M&As

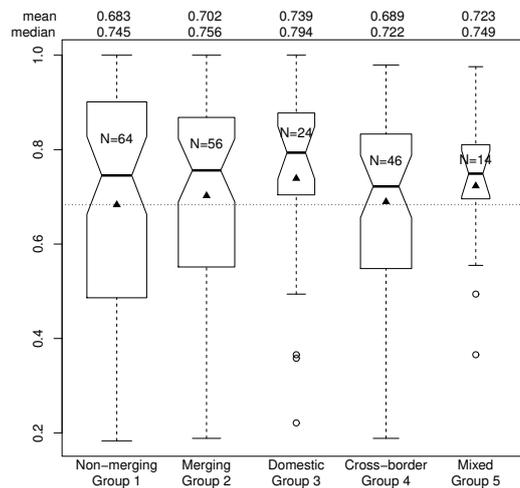
The distribution of eco-efficiency scores should guide preliminary predictions regarding the impacts of mergers. I divide all observations into groups based on the type of completed merger. For each group, I construct a box plot whose width is proportional to the number of observations. Each box plot has notches corresponding to the 95% confidence interval of the median. First, I compare the eco-efficiency of merging and non-merging utilities (group 1 and group 2 in Fig. 1.5). Non-merging utilities constitute the baseline group in further regression analyses. Mergers and non-mergers have almost identical median scores across the three periods of interest. The mean eco-efficiency of merged firms is marginally higher in the year the deal is completed.

The regression results suggest that any merger reduces the same-year eco-efficiency of electricity producers by an average of 2.24%. The corresponding coefficients are, in most cases, significant at the 1% level (Table 1.A3a in the appendix). I find that a merger that was com-



(a) Mergers in t

(b) Mergers in t-1



(c) Mergers in t-2

Figure 1.5. Distribution of eco-efficiency scores with respect to completed domestic and cross-border M&As

pleted one year ago does not influence the eco-efficiency (results not reported). Instead, such a merger exerts a positive but limited impact in the medium run. The estimated coefficients are reported in Table 1.A3b in the appendix, and the corresponding average partial effect is 0.9%.

I further compare the eco-efficiency of electricity producers that have engaged in domestic and cross-border mergers. Approximately twice as many firms finalized international deals. The mean and median eco-efficiency values of firms that merged domestically are higher over all periods of interest (see Fig. 1.5). In the mixed type merger, both domestic and cross-border mergers are completed in the same year. Note that median eco-efficiency value in such cases

Table 1.5
Short-run impact of domestic and cross-border mergers on eco-efficiency

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CB mergers t	-0.05** (0.025)	-0.052*** (0.019)	-0.044** (0.019)	-0.076*** (0.026)	-0.067*** (0.02)	-0.058*** (0.014)	-0.052** (0.021)	-0.075*** (0.014)
Dom. mergers t	-0.061* (0.032)	-0.064 (0.04)	-0.089** (0.041)	-0.098*** (0.034)	-0.12*** (0.04)	-0.11** (0.041)	-0.1** (0.043)	-0.12*** (0.043)
Vertical integration			YES		YES	YES	YES	YES
Merger experience			YES			YES	YES	YES
Management				YES	YES	YES		YES
Finance				YES	YES		YES	YES
Location		YES						
Observations	135	135	135	135	135	135	135	135

Notes: Table reports estimations of Quasi maximum likelihood probit model. Dependent variable is DEA eco-efficiency score. All models contain year dummies for 2004 through 2013 and time averages of all explanatory variables. Standard errors are clustered on firm level. *, ** and *** indicate significance at the 10, 5 and 1 percent levels.

is similar to the corresponding figure for non-mergers, whereas the mean eco-efficiency value is higher.

The results of the fractional regression model suggest that both cross-border and domestic mergers are detrimental to eco-efficiency in the year of their completion. The estimated coefficients are reported in Table 1.5. The impact of a finalized international merger is -2.06%. Each domestic merger decreases eco-efficiency by 3.35%, on average. Note that the overall short-run negative effect of mergers is confirmed. The magnitudes are compared in Fig. 1.6. I observe positive but non-significant impacts of both cross-border and domestic mergers over a two-year horizon (see Table 1.A4b in appendix).

The estimation results of the short-run impact of mergers on the MLPI are reported in Table 1.6. The negative impacts of both cross-border and domestic mergers are confirmed. I also found statistically significant effect of cross-border mergers on the MLPI. I illustrate the average partial effects in Fig. 1.7. Note that the magnitudes of the short-run effect from the MLPI are smaller compared to those of the DEA eco-efficiency. The decomposition of the MPLI reveals that in the short run, the aggregate effect is mainly attributed to technical efficiency changes (results not reported). However, the position of the best-practice frontier captured by technical changes (i.e., the MLTC) is influenced by cross-border merger activity in the medium run.

The short-run negative impact of mergers is in line with the results established in the broad and heterogeneous general M&A literature. Firm-level efficiency changes have been systematically proxied by alterations in shareholder wealth. The cross-industry empirical results suggest that, at best, mergers do not impact the acquirers (e.g., Asquith 1983; Agrawal et al. 1992; Loderer and Martin 1992), but they are often detrimental (e.g., King et al. 2004; Moeller et

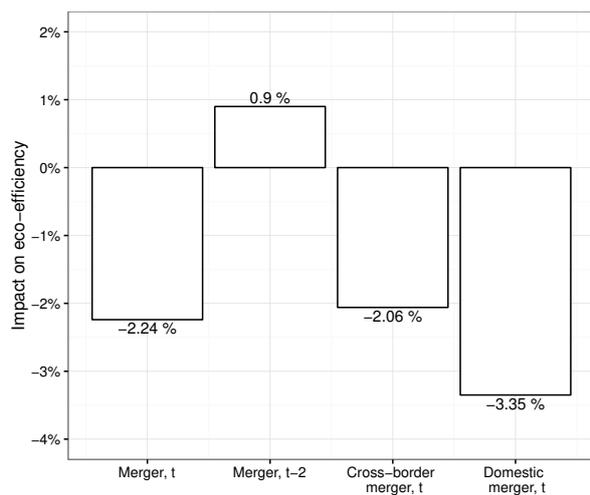


Figure 1.6. Average partial effects of cross-border and domestic mergers on DEA eco-efficiency

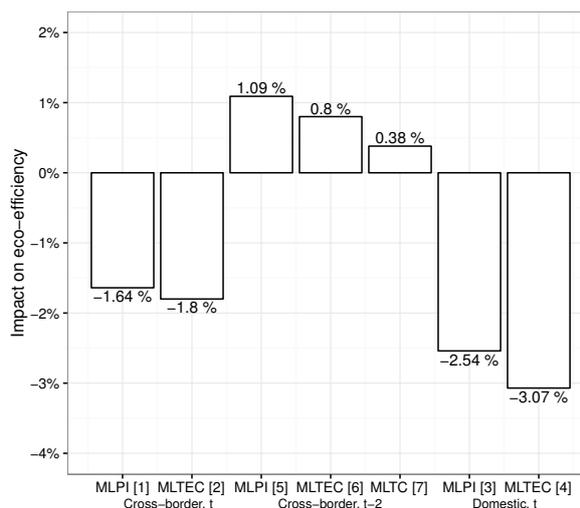


Figure 1.7. Average partial effects of cross-border and domestic mergers on Malmquist-Luenberger index

al. 2004). A relevant theoretical explanation is provided by the concept of "lemons" for sale, whereby poorly performing firms are targeted for M&As (e.g., Jensen and Ruback 1983; Lichtenberg et al. 1987). The recent theoretical models of Neary (2007) and Nocke and Yeaple (2007) support this hypothesis. McGuckin and Nguyen (1995) argued that large, inefficient plants are more likely to be sold than closed. Balsvik and Haller (2010) revealed that decrease in total factor productivity usually precedes acquisition. Blonigen et al. (2014) reported that recent negative productivity shocks significantly increase the likelihood that a firm will be acquired by a foreign multinational.

Berry (2000) provided the following interpretation of the negative outcomes of domestic electric utility mergers. Domestic acquirers are less uncertain about the target's future performance than bidders in international mergers. Domestic acquirers are more familiar with the national market and legislation and are better able to predict risks. They are more likely to pay a deal premium, which could be in terms of shareholders wealth or firm efficiency. Therefore, domestic acquirers tend to absorb less-efficient targets first.

Cross-border M&As remain relatively understudied compared to domestic mergers. Modern theory is ambiguous regarding their effects on efficiency. On the one hand, international M&As should be beneficial to firm-level efficiency because of newfound access to the country-specific capabilities of a foreign target. Nocke and Yeaple (2007) theoretically demonstrated that M&As are caused by heterogeneity in firms' intangible assets. Cross-border mergers are motivated by complementarities between internationally mobile and non-mobile capabilities.¹⁹ On the other hand, a number of theoretical channels suggest that cross-border mergers

¹⁹Other studies have listed specific benefits of international mergers. Servaes and Zenner (1994) argued that such deals allow firms to exploit differences in tax systems and to absorb rents from market inefficiency. Spillovers from corporate governance standards could improve corporate governance (Martynova and Renneboog 2008).

Table 1.6
Short-run impact of domestic and cross-border mergers on Malmquist-Luenberger index

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CB mergers	-0.013*	-0.011***	-0.014**	-0.017**	-0.015**	-0.015***	-0.015**	-0.016***
	(0.0072)	(0.0033)	(0.0053)	(0.0071)	(0.0052)	(0.0038)	(0.0061)	(0.0041)
Dom. mergers	-0.0071	-0.0084	-0.018	-0.015*	-0.016	-0.021**	-0.023*	-0.025**
	(0.0082)	(0.0095)	(0.011)	(0.0074)	(0.0092)	(0.0095)	(0.012)	(0.010)
Vertical integration			YES		YES	YES	YES	YES
Merger experience			YES			YES	YES	YES
Management				YES	YES	YES		YES
Finance				YES	YES		YES	YES
Location		YES						
Observations	120	120	120	120	120	120	120	120
R square	0.25	0.35	0.33	0.41	0.41	0.43	0.35	0.45

Notes: Table reports estimations of OLS model. Dependent variable is Malmquist-Luenberger productivity index. All models contain year dummies for 2006 through 2013 and firm fixed effects. Robust standard errors are clustered on firm level. *, ** and *** indicate significance at the 10, 5 and 1 percent levels.

could hamper a firm's performance (Bertrand and Betschinger 2012). First, acquirers could experience greater informational asymmetry: They could overvalue the potential gains from synergy and, consequently, overpay for target shares. Second, international bidders face the costs of adapting to the macroeconomic, legislative and cultural conditions of the destination country. Finally, acquirers must overcome the increased complexity of coordinating with foreign affiliates.

The result that cross-border mergers are detrimental to acquirers is in line with empirical M&A studies that have found negative effects on bidders' wealth.²⁰ However, researchers in this area are far from reaching a consensus. An important body of literature documents positive wealth effects of cross-border acquisitions for bidders.²¹ Bertrand and Betschinger (2012) found that both domestic and cross-border M&As negatively influence the financial efficiency of acquirers. They argue that cross-border mergers can have weaker anti-competitive effects. Because partners in international deals are more remote, their mutual pre-merger competition is lower, which implies lower efficiency alterations following cross-border mergers.

1.3.3 Distinguishing among horizontal, vertical, and conglomerate M&As

The next step in this study is to differentiate among the effects of horizontal, vertical and conglomerate mergers. The distributions of eco-efficiency scores (see Fig. 1.8) indicate that hori-

Shimizu et al. (2004) found that national cultural differences and organizational learning induce post-merger value creation. Kiyamaz and Mukherjee (2000) argued that an acquirer is better able to make use of its strategic advantages when it engages in cross-border acquisitions. Targets can benefit from the optimization of their business processes and novel access to cheaper external resources.

²⁰See, e.g., Eckbo and Thorburn (2000), Denis et al. (2002), Aw and Chatterjee (2004), Moeller et al. (2005), Aybar and Fici (2009), Chen and Young (2010).

²¹See, e.g., Markides and Ittner (1994), Akhigbe and Martin (2000), Boateng et al. (2008), Francis et al. (2008), «The Value of Control in Emerging Markets» (2010), Gubbi et al. (2010), Bhagat et al. (2011).

Table 1.7
Short-run impact of Horizontal, Vertical, and Conglomerate M&As on eco-efficiency

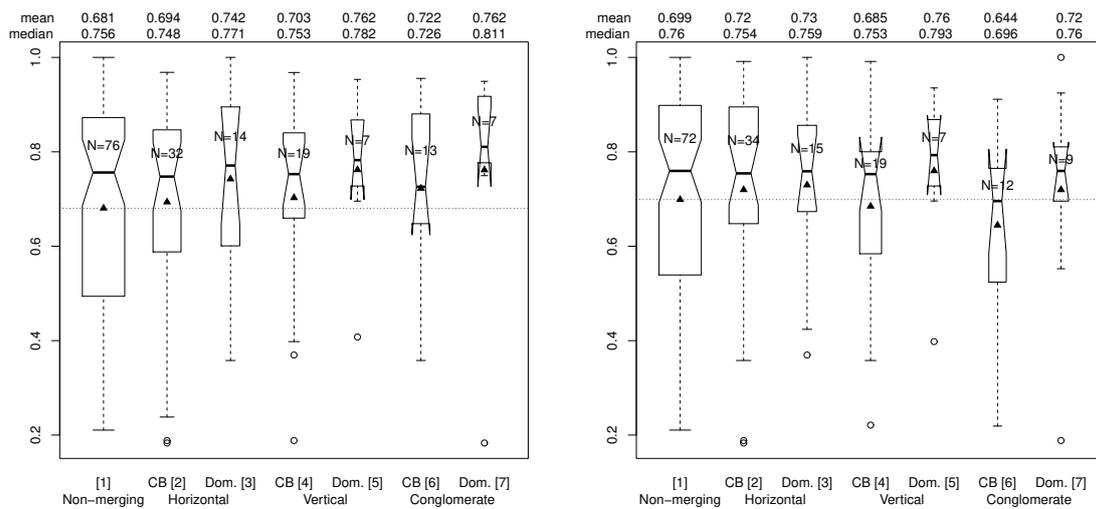
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Horizontal CB	-0.096** (0.043)	-0.089** (0.044)	-0.077* (0.045)	-0.12*** (0.036)	-0.11*** (0.03)	-0.078** (0.036)	-0.092*** (0.034)
Horizontal Dom.	-0.044 (0.049)	-0.1 (0.069)	-0.1 (0.071)	-0.05 (0.052)	-0.12* (0.061)	-0.084 (0.056)	-0.11 (0.082)
Vertical CB	0.0042 (0.035)	-0.028 (0.04)	-0.012 (0.035)	-0.049 (0.052)	-0.053 (0.049)	-0.031 (0.043)	-0.011 (0.039)
Vertical Dom.	-0.14* (0.072)	-0.14* (0.071)	-0.12 (0.092)	-0.15*** (0.05)	-0.13** (0.053)	-0.13*** (0.05)	-0.12 (0.074)
Conglomerate CB	0.043 (0.054)	0.12* (0.069)	0.15* (0.078)	0.035 (0.063)	0.11* (0.066)	0.12** (0.058)	0.19** (0.086)
Conglomerate Dom.	-0.014 (0.1)	-0.066 (0.088)	-0.058 (0.081)	-0.12 (0.11)	-0.2* (0.11)	-0.18** (0.072)	-0.082 (0.11)
Vertical integration		YES	YES		YES	YES	YES
Merger experience			YES			YES	YES
Management				YES	YES	YES	
Finance				YES	YES		YES
Observations	135	135	135	135	135	135	135

Notes: Table reports estimations of Quasi maximum likelihood probit model. Dependent variable is DEA eco-efficiency score. All models contain year dummies for 2004 through 2013 and time averages of all explanatory variables. Standard errors are clustered on firm level. *, ** and *** indicate significance at the 10, 5 and 1 percent levels.

zontal and conglomerate mergers should positively contribute to eco-efficiency. Vertical deals should have positive outcomes over the short run. In the medium run, vertical cross-border mergers should cause a decline in eco-efficiency, whereas vertical domestic ones should have a positive impact. The regression results suggest that horizontal domestic mergers do not have any statistically significant effects on eco-efficiency (see Tables 1.7 and 1.8). Therefore, I conclude that electricity producers do not obtain the expected synergy gains from domestic mergers. It is worth noting that current European Merger regulation primarily concerns domestic horizontal mergers.²² Since I do not find any negative effects of such deals, I conclude that the European Commission successfully protects the electricity industry from some eco-efficiency losses.

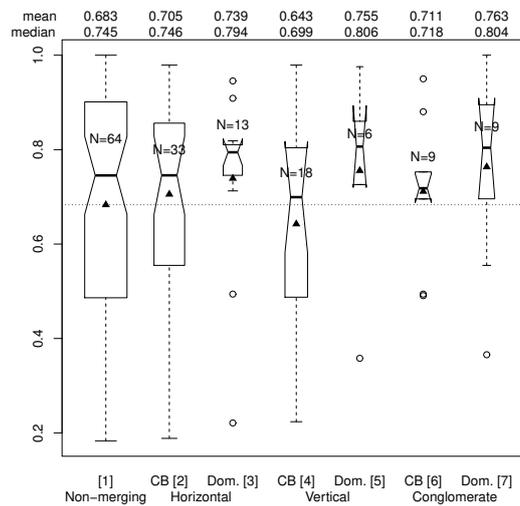
The results suggest that horizontal cross-border mergers damage eco-efficiency over the short run, and the corresponding average partial effect is -2.98%. The corresponding magnitude for the MLPI is -2.6% (compare Fig. 1.9 to Fig. 1.10). It is worth noting that a merger of this type is more detrimental to eco-efficiency than an average merger (-2.24%). Horizontal cross-border mergers start to positively affect eco-efficiency in the medium run. The average partial effect of such a merger is 1.52% (1.7% for MLPI). This result is similar to the findings

²²See European Commission (2004) and European Commission (2008)



(a) Mergers in t

(b) Mergers in t-1



(c) Mergers in t-2

Figure 1.8. Distribution of eco-efficiency scores with respect to completed Horizontal, Vertical, and Conglomerate M&As

of Becher et al. (2012), who report a gain of 1.75% in the wealth of combined firms. Datta et al. (2013) study the long-run effects of EU energy mergers over the 1990–2006 period, and they come to the opposite conclusion, revealing losses of 6.6% in the shareholder wealth of combined utilities. Becker-Blease et al. (2008) find a similar negative effect (-6.77%) for 3-year buy-and-hold returns.

The previous M&A literature devoted to the electricity industry has generally identified negative short-run effects of domestic horizontal mergers but has not captured any effects of

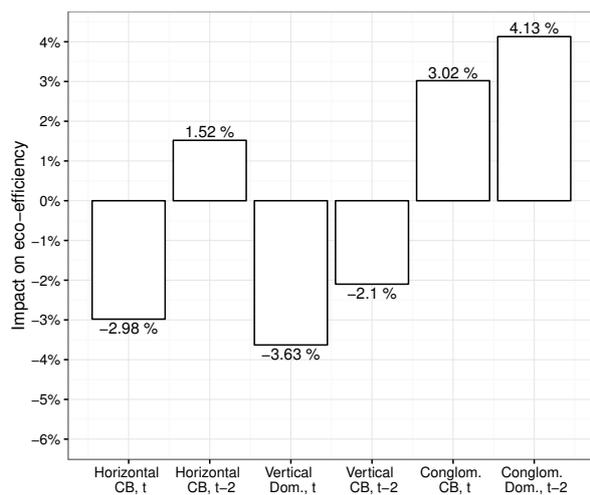


Figure 1.9. Average partial effects of mergers on DEA eco-efficiency

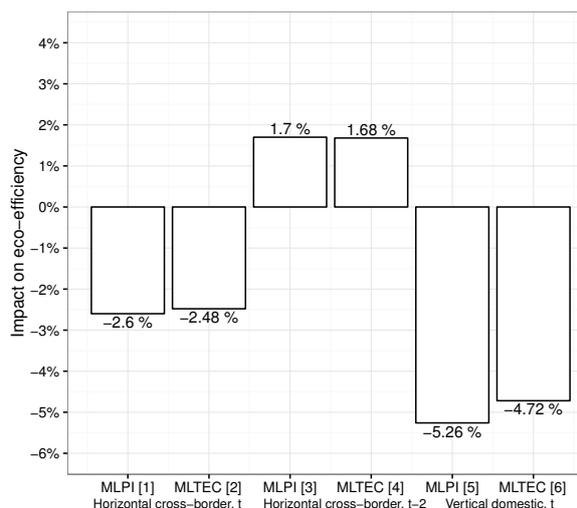


Figure 1.10. Average partial effects of mergers of different types on Malmquist-Luenberger index

cross-border horizontal deals. Leggio and Lien (2000) found that US acquirers experienced a short-term wealth loss of 0.79% around the announcement of electric mergers over 1994–1996. Datta et al. (2013) confirmed short-run losses of 0.1% in the shareholder wealth of combined utilities. Similarly, Becher et al. (2012) addressed horizontal mergers in the US electricity market in 1993-2004, and they revealed short-run losses of 1.36% for acquirers. The two papers are outliers. Berry (2000) finds positive short-run cumulative abnormal returns for acquirers' shareholders of 0.9% but finds no statistically significant excess returns for the shareholders of acquirers in cross-border mergers. Becker-Blease et al. (2008) addresses post-merger alterations in terms of both the wealth and the financial performance of merged US energy utilities. They documented a post-merger loss of 8.7% in net present value.

A delayed-in-time positive effect can be interpreted based on the idea that acquired underperforming lemons later evolve into overperforming "cherries". This reasoning is based on the dynamic model of cross-border M&A activity elaborated by Blonigen et al. (2014). They argue that multinationals aim to acquire promising assets immediately after a negative productivity shock because their price is relatively low at that point. Once the integration of an underperforming energy utility (a lemon) in the production structure is finalized, and it becomes an overperforming cherry. The two-year delay can be explained in terms of the time needed to perform internal post-merger adjustments. The studied firms attempt to adapt their managerial practices and administrative structures to fully integrate a new entity. A plausible industry-specific interpretation is that a certain amount of time is required to reshape the energy mix utilized for electricity production.

Despite the evidence that vertical mergers represent a significant mode of foreign direct investment (e.g., Carr et al. (2001)), they still have not received proper attention in the M&A

Table 1.8
Medium-run impact of Horizontal, Vertical, and Conglomerate M&As on eco-efficiency

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Horizontal CB t-2	0.062*** (0.024)	0.074*** (0.027)	0.079*** (0.029)	0.045 (0.032)	0.054** (0.025)	0.049* (0.029)	0.083*** (0.024)
Horizontal Dom. t-2	0.02 (0.054)	0.03 (0.046)	-0.0068 (0.051)	0.026 (0.047)	0.034 (0.039)	-0.023 (0.048)	0.0066 (0.043)
Vertical CB t-2	-0.11*** (0.037)	-0.11*** (0.037)	-0.1*** (0.035)	-0.099** (0.04)	-0.075** (0.036)	-0.081*** (0.026)	-0.077** (0.033)
Vertical Dom. t-2	-0.057 (0.082)	-0.059 (0.081)	0.0029 (0.074)	-0.072 (0.08)	-0.073 (0.075)	0.00021 (0.076)	-0.027 (0.069)
Conglomerate CB t-2	0.019 (0.052)	0.054 (0.05)	0.081 (0.059)	0.044 (0.046)	0.072 (0.057)	0.079 (0.074)	0.14** (0.065)
Conglomerate Dom. t-2	0.1 (0.068)	0.13* (0.068)	0.15** (0.073)	0.13** (0.062)	0.15* (0.076)	0.16** (0.065)	0.23*** (0.075)
Vertical integration		YES	YES		YES	YES	YES
Merger experience			YES			YES	YES
Management				YES	YES	YES	
Finance				YES	YES		YES
Observations	120	120	120	120	120	120	120

Notes: Table reports estimations of Quasi maximum likelihood probit model. Dependent variable is DEA eco-efficiency score. All models contain year dummies for 2004 through 2013 and time averages of all explanatory variables. Standard errors are clustered on firm level. *, ** and *** indicate significance at the 10, 5 and 1 percent levels.

literature. Alfaro and Charlton (2009) were the first to address vertical and horizontal mergers at the deal level and developed an approach to differentiating between these types of mergers. The previous M&A literature reveals no impact of diversifying energy mergers (Leggio and Lien 2000; Becker-Blease et al. 2008). Becher et al. (2012) found that the effect of a non-horizontal utility deal is similar in magnitude to that of a horizontal deal, although this effect is not significant. Bednarczyk et al. (2010) argued that horizontal energy acquisitions induce stronger positive market reactions than do vertical or diversifying deals.

The regression results suggest that, in general, vertical mergers negatively impact the eco-efficiency of European electricity producers. Vertical domestic mergers are detrimental in the short run, with an average partial effect of -3.63% (see Fig. 1.9), but in the medium run, the effect is no longer statistically significant. The corresponding effect for the MLPI is -5.26% (see Fig. 1.10). The opposite pattern is observed for international mergers, which do not affect eco-efficiency in the year of their finalization. The average partial effect of a cross-border vertical merger two years after its completion is -2.1% (see Table 1.8). Thus, domestic and cross-border vertical mergers differ in the timing of their effects.

Firms that engage in vertical mergers expect gains arising from supply chain coordination. However, recent studies sharply conflict with this view. Atalay et al. (2014) argues that vertical ownership stimulates efficient intra-firm transfers of organizational capabilities and other

intangible inputs rather than physical shipments alone. Ramondo et al. (2016) revealed that vertical relatedness does not determine intra-firm trade in goods. Alfaro et al. (2016) argued that the administrative cost of integration is the limiting factor for productivity gains from vertical integration. They further proved empirically that price-takers can compensate for excessive administrative expenditures exclusively through higher output prices. Thus, the revealed negative impact of vertical mergers may be attributable to important integration costs.

The theory predicting gains from conglomerate M&As dates to the 1970s. Lewellen (1971) argued that conglomerate acquisitions could generate financial synergy due to co-insurance effects. If the cash flows of merging entities are imperfectly correlated, their combined volatility will decrease, leading to a lower default risk for the consolidated company. However, empirical evidence of this effect remains scarce. Breinlich (2008) found that conglomerate mergers constitute a significant part of total M&As activities. He underlined two principal motives behind acquiring assets in unrelated industries: access to new export markets and cheaper assets because of high import competition. Herger and McCorrison (2016) highlighted the empirical importance of horizontal and vertical FDI in a sample of cross-border acquisitions for the 1990–2011 period. In addition, they discovered that more than 20% of all M&As are conglomerate mergers. Furthermore, conglomerate mergers were proven to induce waves of international M&As.

My regression results suggest that conglomerate mergers positively impact the DEA eco-efficiency. The short-run effect of a cross-border merger of this type is 3.02% (see Fig. 1.9). Over a two-year horizon, domestic conglomerate mergers increase eco-efficiency by 4.13%. Thus, the effects of conglomerate mergers are the opposite of those produced by vertical mergers. However, the regression results for the MLPI (see Table 1.A5 and Table 1.A5 in the appendix) do not confirm the statistical significance of conglomerate mergers. Thus, there is limited empirical evidence regarding conglomerate mergers.

1.4 Conclusions and policy implications

Since the 1990s, the European electricity industry has undergone extensive liberalization. Market players reacted by engaging in waves of M&As. This paper addresses how this surge of M&As influenced the eco-efficiency of energy producers in the short run (same year) and medium run (two years later). This is the first attempt (to the best of my knowledge) to quantify the eco-efficiency outcomes of the late stages of EU electricity market reforms. The results suggest that the average eco-efficiency of the European energy sector decreased over the 2005–2009 period, and this trend accelerated in 2008, possibly because of the global financial crisis. For 2009–2013, eco-efficiency was, on average, at the 2009 level. This trend contradicts previously documented moderate efficiency gains that are specific to the early stages of European energy liberalization. The pattern of individual eco-efficiency scores suggests that incentive-

based regulation of electricity distribution should be promoted.

This study demonstrates that a merger of any type has a detrimental effect on eco-efficiency of 2.24% in the short run and a positive effect of 0.9% in the medium run. I also find that the domestic deals are systematically more detrimental than the cross-border deals. Therefore, the regulators should treat cross-border and domestic mergers in different ways. It is appropriate to predict the outcomes of potential mergers using ex-ante Data envelopment analysis, although such an exercise might be an issue for particular national regulatory bodies. Regulators should create a common cross-country comprehensive dataset on the various dimensions of electricity production.²³ Based on such a dataset, regulators would be able to make decisions that are consistent with common ecological objectives.

Since this study is dedicated to the European electricity sector, it is pertinent to discuss the implications for EU merger regulation. According to the regulations in place, the European Commission builds its decisions regarding potential mergers primarily based on outcomes for competition. The only way to account for post-merger efficiency alterations is related to efficiency claims.²⁴ Despite the common EU ecological objectives, current European merger regulation does not take into account the ecological dimension. Furthermore, efficiency claims are rarely emphasized by merging firms, which reduces their importance in regulator's decisions. I suggest that the practice of efficiency claims should be withdrawn and replaced with an indispensable eco-efficiency analysis of potential mergers. To this end, the European Commission should collaborate with ACER.

This paper represents one of the first attempts to distinguish between the effects of horizontal and non-horizontal mergers in the electricity industry. Horizontal domestic mergers do not affect eco-efficiency. This result should be attributed to the close scrutiny of the European Commission of horizontal domestic deals. On the one hand, a harmful impact is avoided. On the other hand, efficiency is not promoted. Therefore, this result confirms the need to ground merger regulation in efficiency estimates.

I find that horizontal cross-border mergers have negative short-run effects of approximately 3%. However, over the medium run, deals of this type increase eco-efficiency by roughly 1.5%. A plausible interpretation is that initially underperforming targets (lemons) evolve into overperforming entities (cherries) after being acquired. Thus, I would suggest that the electricity firms consider international intra-industry expansion as a priority strategy. An associated policy suggestion is to systematically address the efficiency outcomes arising at different points of time after the completion of a merger.

²³Jamasb and Pollitt (2003) has previously proposed the coordination of international benchmarking exercises.

²⁴See Section VII "Efficiencies" in European Commission (2004). In order to support potential mergers, firms should justify that any resulting efficiency is simultaneously beneficial to consumers, merger-specific and verifiable.

I found evidence, albeit limited, that conglomerate mergers have positive effects on eco-efficiency. European electricity producers should consider merging with unrelated businesses because this strategy is at least not harmful. Meanwhile, A vertical domestic merger tends to reduce eco-efficiency by approximately 3.6% in the year of its completion. Over the medium term, cross-border vertical mergers reduce eco-efficiency by 2.1%. Current EU merger regulation is not concerned with vertical mergers.²⁵ I suggest that the vertical mergers deserve the special attention of regulators, especially in industries that are responsible for important shares of emissions.

It is worth emphasizing directions of further research. First, the effects of mergers on the eco-efficiency of small electricity firms should be studied. Second, the application of non-radial slack-based models should be considered. Finally, attention should be paid to differentiating among mergers of different sizes.

Acknowledgements for Chapter 1

This chapter is based on the paper "Eco-efficiency outcomes of mergers and acquisitions in the European electricity industry" published in *Energy Policy* (August 2017). The author would like to acknowledge Lionel Fontagné, Katrin Millock, Sandra Poncet and Farid Toubal for their insights into and discussions of early versions of the paper. Special thanks are owed to David Thesmar for providing access to the SDC Platinum, Thomson One and BvD Orbis databases. The author is particularly grateful to LABEX OSE, the Paris School of Economics and Paris 1 Panthéon Sorbonne University for funding access to the Enerdata datasets.

²⁵See paragraph 25 European Commission (2008).

Appendix

Table 1.A1
DEA eco-efficiency scores

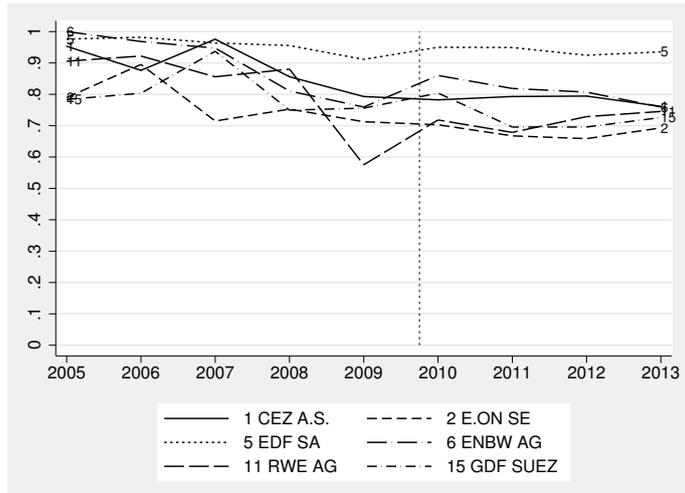
Firm name	Headquarter location	2005	2006	2007	2008	2009	2010	2011	2012	2013	mean
CEZ A.S.	Prague, Czech Republic	.9533	.8764	.9757	.8561	.7929	.7824	.793	.7944	.7616	.8429
E.ON SE	Dusseldorf, Germany	.7895	.8951	.7149	.7528	.7126	.7029	.6675	.6587	.6928	.7319
EDISON S.P.A.	Milan, Italy	.7562	.7781	.7419	.714	.4884	.4725	.2888	.4692	.219	.5476
EDP S.A.	Lisbon, Portugal	.5524	.5549	.3696	.2211	.2237	.2785	.2353	.2105	.2498	.3218
EDF SA	Paris, France	.976	.9819	.9638	.9555	.9113	.95	.9493	.9246	.9353	.9497
ENBW AG	Karlsruhe, Germany	1	.9683	.9475	.8105	.7595	.8601	.8186	.807	.7596	.859
ENDESA S.A.	Madrid, Spain	.7173	.7661	.652	.6478	.5481	.4907	.5423	.5869	.5	.6057
ENEL SPA	Rome, Italy	.2382	.1832	.1884	.3656	.289	.392	.3709	.3676	.3269	.3024
FORTUM OYJ	Espoo, Finland	.9314	.9321	.9551	.8724	.8289	.886	.8706	.891	.783	.8834
IBERDROLA SA	Bilbao, Spain	1	1	1	.9455	.9395	.968	.9914	.979	.9134	.9708
RWE AG	Essen, Germany	.7837	.8033	.9372	.7495	.7559	.804	.6956	.6958	.726	.7723
VATTENFALL AB	Stockholm, Sweden	.4077	.398	.358	.4875	.494	.5715	.4709	.3809	.424	.4436
VERBUND AG	Vienna, Austria	.9056	.922	.8559	.8803	.5753	.7182	.6786	.7288	.7454	.7789
ENI SPA	Rome, Italy	1	.9088	.9273	.8911	.7599	.8269	.833	.9134	.8877	.8831
GDF SUEZ	Courbevoie, France	.79	.6042	.6008	.6734	.7456	.6873	.5362	.6066	.7962	.6711

Notes: Table reports calculated DEA eco-efficiency scores. A firm has the unity score in a given year if in this year it is most efficient comparing to all other utilities over 9-year period.

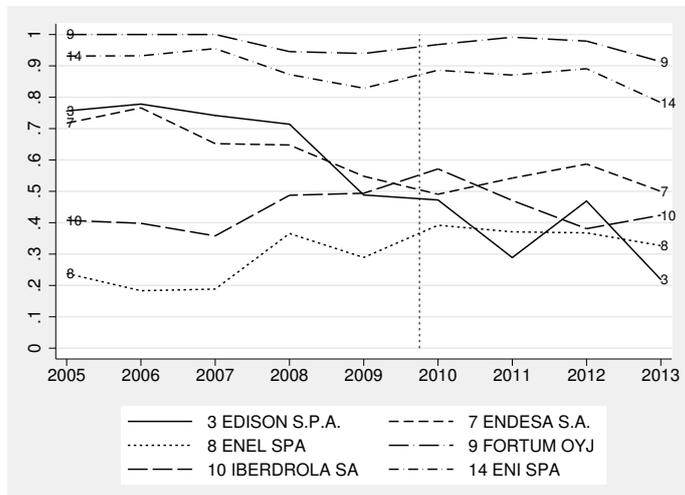
Table 1.A2
Repartition of targets by sectors

U.S. SIC	Sector of activity	Relatedness	Domestic	Cross-border
1221	Bituminous coal and lignite surface mining	vertical	2	0
1311	Crude petroleum and natural gas	vertical	0	8
1522	General contractors-residential buildings other than single-family	conglomerate	0	1
1731	Electrical work	conglomerate	1	0
2813	Industrial gases	conglomerate	0	1
3433	Heating equipment except electric and warm air furnaces	conglomerate	1	0
3511	Steam gas and hydraulic turbines and turbine generator set units	vertical	0	3
3621	Motors and generators	vertical	0	1
3674	Semiconductors and related devices	conglomerate	1	0
4911	Electric services	horizontal	16	52
4922	Natural gas transmission	conglomerate	4	2
4923	Natural gas transmission and distribution	conglomerate	1	1
4924	Natural gas distribution	conglomerate	0	2
4931	Electric and other services combined	horizontal	1	0
4939	Combination utilities not elsewhere classified	horizontal	0	1
4941	Water supply	conglomerate	1	0
499A	Cogeneration, alternative energy sources	vertical	7	14
5172	Petroleum and petroleum products wholesalers except bulk stations and terminals	conglomerate	0	1
6512	Operators of nonresidential buildings	conglomerate	1	0
6719	Offices of holding companies not elsewhere classified	conglomerate	0	1
7389	Business services not elsewhere classified	conglomerate	0	1
8711	Engineering services	conglomerate	0	2
8742	Management consulting services	conglomerate	0	1
8748	Business consulting services not elsewhere classified)	conglomerate	0	1

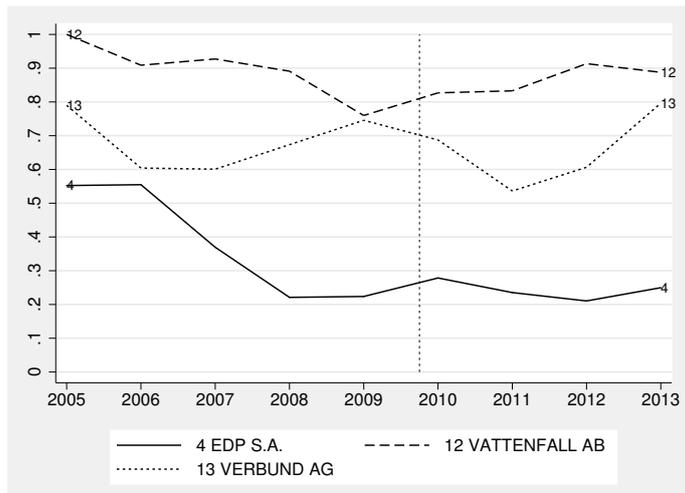
Notes: Table reports primary sectors of target firms' activities.



(a) Incentive-based regulatory model



(b) Incentive and revenue cap combined regulatory model



(c) Other types of regulation

Figure 1.A1. Individual eco-efficiency scores

Table 1.A3a
Short-run impact of any-type mergers on eco-efficiency

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mergers t	-0.052** (0.022)	-0.052*** (0.02)	-0.05*** (0.016)	-0.081*** (0.023)	-0.08*** (0.017)	-0.062*** (0.015)	-0.064*** (0.02)	-0.081*** (0.015)
GenToSales			0.87** (0.38)		0.76** (0.34)	0.8*** (0.3)	0.94** (0.4)	0.77** (0.32)
TwoMergers			-0.067 (0.066)			-0.029 (0.057)	-0.086 (0.085)	-0.034 (0.061)
TwoCBMergers			0.032 (0.062)			-0.011 (0.065)	0.057 (0.076)	-0.0082 (0.077)
K/S				0.47*** (0.096)	0.31*** (0.051)	0.25*** (0.054)		0.31*** (0.046)
I/K				-1.3*** (0.42)	-1.7*** (0.38)	-1.3*** (0.4)		-1.6*** (0.38)
Y/S				-2.4*** (0.54)	-2.7*** (0.48)	-2.7*** (0.47)		-2.6*** (0.43)
Leverage				-0.02 (0.06)	-0.044 (0.07)		-0.095 (0.098)	-0.066 (0.067)
Leverage square				0.0017 (0.0061)	0.0039 (0.0074)		0.012 (0.0094)	0.0058 (0.007)
CurrentRatio				0.91* (0.5)	0.8* (0.47)		0.45 (0.58)	0.74* (0.41)
CurrentRatio square				-0.38** (0.16)	-0.34** (0.15)		-0.2 (0.2)	-0.32** (0.14)
Observations	135	135	135	135	135	135	135	135

Notes: Table reports estimations of Quasi maximum likelihood probit model. Dependent variable is DEA eco-efficiency score. All models contain year dummies for 2004 through 2013 and time averages of all explanatory variables. Standard errors are clustered on firm level. *, ** and *** indicate significance at the 10, 5 and 1 percent levels.

Table 1.A3b
Medium-run impact of any-type mergers on eco-efficiency

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mergers t-2	0.014 (0.015)	0.018 (0.019)	0.028** (0.014)	0.0077 (0.02)	0.022 (0.015)	0.022 (0.015)	0.041** (0.017)	0.032** (0.016)
GenToSales			0.86** (0.38)		0.9** (0.38)	0.73** (0.32)	0.94** (0.39)	0.66** (0.33)
TwoMergers			-0.08 (0.092)			-0.095 (0.073)	-0.082 (0.12)	-0.12 (0.082)
TwoCBMergers			-0.11 (0.083)			-0.12 (0.081)	-0.14 (0.11)	-0.15 (0.1)
K/S				0.32** (0.15)	0.12 (0.11)	0.2** (0.096)		0.25*** (0.066)
I/K				-1.1 (0.68)	-1.3* (0.67)	-0.68 (0.47)		-0.64 (0.53)
Y/S				-2.1** (1)	-2.2** (0.89)	-2.2*** (0.65)		-2.1*** (0.76)
Leverage				0.00051 (0.071)	-0.0079 (0.086)		-0.12* (0.067)	-0.14** (0.072)
Leverage square				-0.0036 (0.0084)	-0.0036 (0.0093)		0.0071 (0.0067)	0.0083 (0.0081)
CurrentRatio				0.67 (0.64)	0.65 (0.58)		0.024 (0.57)	0.11 (0.54)
CurrentRatio square				-0.28 (0.21)	-0.27 (0.19)		-0.0096 (0.2)	-0.049 (0.19)
Observations	120	120	120	120	120	120	120	120

Notes: Table reports estimations of Quasi maximum likelihood probit model. Dependent variable is DEA eco-efficiency score. All models contain year dummies for 2004 through 2013 and time averages of all explanatory variables. Standard errors are clustered on firm level. *, ** and *** indicate significance at the 10, 5 and 1 percent levels.

Table 1.A4a
Short-run impact of domestic and cross-border mergers on eco-efficiency

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CB mergers t	-0.05** (0.025)	-0.052*** (0.019)	-0.044** (0.019)	-0.076*** (0.026)	-0.067*** (0.02)	-0.058*** (0.014)	-0.052** (0.021)	-0.075*** (0.014)
Dom. mergers t	-0.061* (0.032)	-0.064 (0.04)	-0.089** (0.041)	-0.098*** (0.034)	-0.12*** (0.04)	-0.11** (0.041)	-0.1** (0.043)	-0.12*** (0.043)
GenToSales			0.95** (0.38)		0.84** (0.34)	0.93*** (0.3)	0.95** (0.39)	0.83*** (0.31)
TwoMergers			-0.058 (0.087)			-0.016 (0.081)	-0.062 (0.098)	-5.3e-05 (0.077)
TwoCBMergers			0.0037 (0.072)			-0.051 (0.073)	0.025 (0.081)	-0.033 (0.083)
K/S				0.47*** (0.095)	0.28*** (0.046)	0.23*** (0.058)		0.3*** (0.043)
I/K				-1.2*** (0.43)	-1.7*** (0.38)	-1.3*** (0.42)		-1.5*** (0.35)
Y/S				-2.5*** (0.59)	-2.8*** (0.53)	-2.8*** (0.36)		-2.7*** (0.4)
Leverage				-0.037 (0.062)	-0.053 (0.065)		-0.1 (0.095)	-0.085 (0.063)
Leverage square				0.0037 (0.0066)	0.0046 (0.0069)		0.012 (0.0087)	0.0077 (0.0068)
CurrentRatio				0.89* (0.5)	0.82* (0.47)		0.5 (0.56)	0.82** (0.4)
CurrentRatio square				-0.38** (0.16)	-0.35** (0.15)		-0.22 (0.2)	-0.36*** (0.13)
Observations	135	135	135	135	135	135	135	135

Notes: Table reports estimations of Quasi maximum likelihood probit model. Dependent variable is DEA eco-efficiency score. All models contain year dummies for 2004 through 2013 and time averages of all explanatory variables. Standard errors are clustered on firm level. *, ** and *** indicate significance at the 10, 5 and 1 percent levels.

Table 1.A4b
Medium-run impact of domestic and cross-border mergers on eco-efficiency

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CB mergers t-2	0.013 (0.019)	0.013 (0.023)	0.023 (0.022)	0.0084 (0.029)	0.024 (0.025)	0.013 (0.023)	0.043* (0.026)	0.029 (0.026)
Dom. mergers t-2	0.014 (0.021)	0.03 (0.032)	0.027 (0.031)	0.004 (0.022)	0.014 (0.027)	0.027 (0.031)	0.028 (0.036)	0.032 (0.037)
GenToSales			0.89** (0.39)		0.91** (0.38)	0.78** (0.34)	0.94** (0.39)	0.68** (0.34)
TwoMergers			-0.078 (0.099)			-0.1 (0.071)	-0.082 (0.12)	-0.12 (0.085)
TwoCBMergers			-0.13 (0.089)			-0.14* (0.079)	-0.15 (0.11)	-0.15 (0.1)
K/S				0.32** (0.15)	0.12 (0.11)	0.21** (0.098)		0.25*** (0.071)
I/K				-1 (0.69)	-1.3* (0.67)	-0.68 (0.51)		-0.5 (0.47)
Y/S				-2.1** (1)	-2.2** (0.9)	-2.2*** (0.62)		-2.2*** (0.73)
Leverage				-0.016 (0.073)	-0.014 (0.091)		-0.14* (0.084)	-0.15* (0.078)
Leverage square				-0.0019 (0.0082)	-0.0029 (0.0095)		0.0093 (0.0078)	0.0093 (0.0082)
CurrentRatio				0.65 (0.64)	0.64 (0.57)		-0.0058 (0.58)	0.16 (0.53)
CurrentRatio square				-0.28 (0.21)	-0.27 (0.19)		0.0015 (0.2)	-0.07 (0.19)
Observations	120	120	120	120	120	120	120	120

Notes: Table reports estimations of Quasi maximum likelihood probit model. Dependent variable is DEA eco-efficiency score. All models contain year dummies for 2004 through 2013 and time averages of all explanatory variables. Standard errors are clustered on firm level. *, ** and *** indicate significance at the 10, 5 and 1 percent levels.

Table 1.A5*Short-run impact of Horizontal, Vertical, and Conglomerate M&As on Malmquist-Luenberger index*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Horizontal CB t	-0.027*** (0.0073)	-0.023*** (0.0047)	-0.029*** (0.0060)	-0.025*** (0.0074)	-0.025*** (0.0057)	-0.024*** (0.0058)	-0.030*** (0.0071)	-0.026*** (0.0059)
Horizontal Dom. t	-0.0015 (0.014)	-0.011 (0.018)	-0.0079 (0.015)	-0.0058 (0.013)	0.00049 (0.012)	-0.0072 (0.012)	-0.012 (0.016)	-0.011 (0.012)
Vertical CB t	0.0023 (0.011)	0.0026 (0.010)	-0.00030 (0.0079)	-0.0091 (0.013)	-0.0071 (0.012)	-0.0082 (0.0077)	-0.00099 (0.0083)	-0.0085 (0.0081)
Vertical Dom. t	-0.027*** (0.0089)	-0.018 (0.014)	-0.054*** (0.014)	-0.029*** (0.0073)	-0.045*** (0.015)	-0.051** (0.017)	-0.056*** (0.016)	-0.053*** (0.017)
Conglomerate CB t	0.0082 (0.017)	0.0051 (0.018)	0.031 (0.020)	0.000018 (0.017)	0.0092 (0.018)	0.024 (0.018)	0.026 (0.020)	0.019 (0.018)
Conglomerate Dom. t	0.017 (0.033)	0.024 (0.022)	-0.0022 (0.034)	-0.0045 (0.029)	-0.011 (0.029)	-0.025 (0.025)	-0.0038 (0.039)	-0.028 (0.030)
Vertical integration			YES		YES	YES	YES	YES
Merger experience			YES			YES	YES	YES
Management				YES	YES	YES		YES
Finance				YES	YES		YES	YES
Location		YES						
Observations	120	120	120	120	120	120	120	120
R square	0.30	0.38	0.39	0.42	0.43	0.47	0.41	0.48

Notes: Table reports estimations of OLS model. Dependent variable is Malmquist-Luenberger productivity index. All models contain year dummies for 2006 through 2013 and firm fixed effects. Robust standard errors are clustered on firm level. *, ** and *** indicate significance at the 10, 5 and 1 percent levels.

Table 1.A6*Medium-run impact of Horizontal, Vertical, and Conglomerate M&As on Malmquist-Luenberger index*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Horizontal CB t-2	0.020*** (0.0048)	0.026*** (0.0053)	0.021*** (0.0045)	0.014** (0.0058)	0.016** (0.0061)	0.015** (0.0056)	0.024*** (0.0036)	0.017*** (0.0050)
Horizontal Dom. t-2	0.0030 (0.012)	0.0061 (0.016)	-0.0016 (0.012)	0.00097 (0.012)	-0.0065 (0.016)	-0.0064 (0.013)	0.00011 (0.012)	-0.0047 (0.013)
Vertical CB t-2	-0.022** (0.010)	-0.022* (0.011)	-0.018** (0.0079)	-0.015 (0.012)	-0.011 (0.0095)	-0.011 (0.0095)	-0.013 (0.0089)	-0.0080 (0.0098)
Vertical Dom. t-2	-0.011 (0.015)	-0.015 (0.023)	-0.0058 (0.016)	-0.0088 (0.014)	-0.00032 (0.015)	0.00081 (0.016)	-0.0072 (0.015)	-0.0013 (0.015)
Conglomerate CB t-2	0.017 (0.017)	-0.0023 (0.027)	0.030* (0.017)	0.017 (0.017)	0.029 (0.021)	0.025 (0.019)	0.037** (0.017)	0.031 (0.020)
Conglomerate Dom. t-2	0.0056 (0.029)	-0.0029 (0.020)	0.014 (0.034)	0.00014 (0.026)	0.012 (0.029)	0.013 (0.031)	0.012 (0.034)	0.011 (0.032)
Vertical integration			YES		YES	YES	YES	YES
Merger experience			YES			YES	YES	YES
Management				YES	YES	YES		YES
Finance				YES	YES		YES	YES
Location		YES						
Observations	120	120	120	120	120	120	120	120
R square	0.28	0.41	0.36	0.37	0.41	0.42	0.39	0.44

Notes: Table reports estimations of OLS model. Dependent variable is Malmquist-Luenberger productivity index. All models contain year dummies for 2006 through 2013 and firm fixed effects. Robust standard errors are clustered on firm level. *, ** and *** indicate significance at the 10, 5 and 1 percent levels.

Table 1.A7*Medium-run impact of domestic and cross-border mergers on Malmquist-Luenberger index*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CB mergers t-2	0.0079 (0.0049)	0.011* (0.0052)	0.011** (0.0044)	0.0060 (0.0052)	0.0088* (0.0044)	0.0082 (0.0048)	0.014*** (0.0039)	0.011** (0.0045)
Dom. mergers t-2	0.00025 (0.0073)	-0.0017 (0.0073)	0.0023 (0.0086)	-0.0014 (0.0065)	0.00095 (0.0083)	0.0015 (0.0082)	0.0022 (0.0086)	0.0012 (0.0083)
Vertical integration			YES		YES	YES	YES	YES
Merger experience			YES			YES	YES	YES
Management				YES	YES	YES		YES
Finance				YES	YES		YES	YES
Location		YES						
Observations	120	120	120	120	120	120	120	120
R square	0.23	0.35	0.32	0.35	0.39	0.40	0.35	0.42

Notes: Table reports estimations of OLS model. Dependent variable is Malmquist-Luenberger productivity index. All models contain year dummies for 2006 through 2013 and firm fixed effects. Robust standard errors are clustered on firm level. *, ** and *** indicate significance at the 10, 5 and 1 percent levels.

BEARING THE COST OF POLITICS: CONSUMER PRICES AND WELFARE IN RUSSIA

2.1 Introduction

In August 2014, the Russian Federation implemented an import embargo on certain food and agricultural products in response to the sanctions implemented by the European Union and other Western countries over the escalating crisis in eastern Ukraine. Russia banned imports of 48 products from the EU, the US, Australia, Ukraine and some other countries that supported the sanctions. The list of banned products included meat, products of meat, milk and dairy products, fruits and vegetables, and nuts—everyday products for Russian consumers. The aim of this paper is to quantify the effects of the self-imposed food embargo on consumer prices and welfare in Russia.

We first document the immediate and medium term price hikes caused by the embargo using a detailed micro-level dataset of 128 food products, 332 non-food products and 127 services in 279 Russian cities, at monthly frequency. We then construct a theoretical trade model with sectoral linkages similar to Caliendo and Parro (2015). The model allows us to study the effect of the embargo on welfare and compute counterfactuals. Using input-output tables from GTAP, the paper addresses the question of how consumer prices and welfare are affected by employing trade policy tools for the purpose of foreign policy objectives.

Despite sparse evidence for their effectiveness, embargoes and sanctions have been popular instruments of political pressure (Drezner 1999). In most cases, one or more countries put in place such measures against another country. However, in rare cases a country may also decide to ban its own trade with others: In 1807-1809 the United States introduced a full embargo on their international trade with European countries, aiming to harm Great Britain. Irwin (2005) finds that this decision, also known as Jefferson's blockade, cost the United States around 5% of GNP. During the period of the blockade domestic prices of exported goods declined, whereas those of imported goods increased. O'Rourke (2007) employs a computable general

equilibrium (CGE) model to assess the consequences of the blockade for Britain, France, and the United States. He shows that the U.S. experienced the strongest welfare loss, equivalent to 4-5% of GDP per annum.

The literature on sanctions has seen renewed interest in light of the recent political events. Haidar (2017) studies the recent case of Western-imposed sanctions on Iran. He finds that for Iranian firms the aggregate export has decreased, despite the diversion of trade to non-sanctioning countries. Exporting firms experienced losses due to the fall in prices, with small firms being particularly badly hit. Heilmann (2016) studies the effect of consumer boycotts on trade. In multiple case studies using a synthetic control group methodology he finds a significant reduction imports following the abrupt shift of consumer preferences. Etkes and Zimring (2015) investigate the welfare outcomes of the Gaza blockade in 2007-2010. Their counterfactual exercise revealed welfare losses of 14%-24%. The identified reasons of the losses are reallocation of resources and drop in labor productivity. Using the consumer prices data, they found that wealthier households experienced higher losses.

This paper contributes to the strand of literature that analyzes the effect of the sanctions against the Russian Federation and its self-imposed embargo in response to the crises in eastern Ukraine and Crimea. Related to our work, Dreger et al. (2015) evaluate the macroeconomic impact of the sanctions regime using a multivariate VAR model. They find a limited impact of the sanctions measures, while attributing the decline of the oil price in early 2015 to downturn of the Russian economy. Crozet and Hinz (2016), on the other hand, estimate the effect of sanctions on exports of the *sanctioning* countries. They find significant "friendly fire" for affected firms, in particular those affected by the Russian embargo on food and agricultural products, as only a fraction of lost export could be recuperated on other market by way of trade diversion.

The research most closely related to our research question is Boulanger et al. (2016). In their paper they simulate the short-run impact of the Russian food embargo on the Russian and European economies. According to their estimations, Russia lost 3.4 billion EUR of real income, equivalent to a 0.24% reduction in per capita utility. At the same time, the EU-28 lost 128 million EUR, or 0.0025%, of per capita utility. Their model estimates a rise of prices in Russia on targeted products: fruits and vegetables (by 9.5%), cattle meat (0.4%), pork (5.8%) and dairy (6.1%).

In this study, we contribute to the literature on sanctions and embargoes, focusing on the effects on consumers in the affected economy. We estimate the outcomes of an embargo in terms of changes in consumer prices and the resulting effect on consumer welfare. We first document the price effects in a difference-in-differences framework, disentangling product-specific from macroeconomic effects. We do so by employing a comprehensive dataset of consumer prices for a broad set of product, disaggregated by city and date, allowing us to control for vari-

ous product-, regional- and time-specific effects. The dataset of monthly consumer prices is sourced from the Russian Federal State Statistics Service and includes a variety of embargoed and non-embargoed food items and various other types of goods and services. We conclude that the self-imposed embargo lead to an average increase of prices of embargoed products of at least 2.7%, relative to non-embargoed ones. We observe, however, that consumer prices on non-embargoed food products have also risen, hinting at a propagation of the impact via input-output linkages.

This paper contributes to a flourishing strand of the literature that quantifies the consequences of the trade policy. Costinot and Rodriguez-Clare (2014) summarises recent research on the quantification of outcomes of globalisation. Dhingra et al. (2017) estimates the welfare effects of Brexit in the medium to long run with a number of counterfactuals. Mayer et al. (2018) estimate potential welfare losses from Non-Europe. All of the mentioned papers employ input-output data to the calibration of general equilibrium models. We assess the welfare and price effects of the Russian food embargo in a similar manner. We adopt a Ricardian model à la Caliendo and Parro (2015), which assumes sectoral linkages, trade in intermediate goods and sectoral heterogeneity in production.¹ The abrupt change in trade frictions is modelled as a prohibitive import trade costs on embargoed goods from embargoed countries. We calibrate the model with data on production and use of intermediate inputs of 42 countries from Global Trade Analysis Project (GTAP).

A snapshot of bilateral trade flows for the pre-sanction period, is taken from the BACI dataset provided by CEPII. To compute the welfare effects, we follow the so-called "exact hat algebra" approach by Dekle et al. (2008). Our simulations suggest that Russia experienced a welfare loss of 0.21% due to this self-imposed embargo. Furthermore, average prices in Russia are estimated to have increased by 0.25% as a result.

The remainder of this chapter is organized as follows. In section 2.2 we provide first empirical evidence of the changes to consumer prices due to the self-imposed embargo. In section 2.3 we then introduce the trade model with sectoral linkages, trade in intermediate goods and sectoral heterogeneity in production. We demonstrate the solution of the model in changes, which allows us to easily compute the welfare outcomes for the trade frictions introduced by the embargo. We describe the calibration of the model and discuss the counterfactual simulations in section 2.4. Finally, section 2.5 concludes.

¹In this regard this study advances methodologically compared to a closely related paper of Boulanger et al. (2016). They model the Russian import ban within a CGE framework as a loss in existing trade preferences, leading to a reduction in consumer utility. In our research, we extensively exploit the realistic input-output structure of modern economies.

2.2 Consumer prices in Russia

We first document the effects of the self-imposed embargo on prices of everyday products and services for Russian consumers. The dataset we employ records average monthly prices between January 2011 and May 2016 of these goods. It is constructed by Federal State Statistics Service, also known as Rosstat. Previous studies using this dataset on consumer prices in Russia were dedicated to effects of the so-called Big Bang economic reforms, which were implemented in January 1992.²

The list of prices includes 128 food products, 332 non-food products and 127 services. Each of them accounts for at least 0.1% of aggregated consumer expenditures in Russia.³ Regional offices of the Federal State Statistics Service monitor prices between the 21st and 25th day of each month. They examine large, medium and small-sized retailers on both organized and non-organized markets.

The dataset is split into three levels of aggregation based on the administrative organization of the Russian Federation. The monitoring is carried out in its lowest disaggregation in 279 selected cities.⁴ In total there are 3,547,171 observations at the city level. At the intermediate level of aggregation, 87 subjects, the prices are calculated as the population-weighted averages of prices of corresponding products at the city level. There are 1,510,280 product-month-subject observations. At the highest level of aggregation, 9 federal districts, average prices are computed using the shares of the corresponding products' consumption of each region in total consumption of the federal district as weights.⁵ In total there are 143,682 observations at the level of federal districts.

As discussed above, the embargo targeted a variety of everyday products ranging from meat and fish products to vegetables. Table 2.A1 in appendix 2.5 shows the list of goods, including our mapping to the targeted HS codes.

We explore the importance of the effect of the embargo on prices for Russian consumers. We plot the evolution of prices of a targeted product, pork, and a non-targeted products, bread, in Appendix (see figures 2.1(b) and 2.1(a)). Both of these common food products follow an

²E.g., De Masi and Koen (1995) and Gardner and Brooks (1994), exploiting weekly retail food prices in 132 cities in the Russian Federation, reveal significant persistent differences in prices between regions.

³See http://www.gks.ru/bgd/free/meta_2010/IssWWW.exe/Stg/2015/met-734.docx for a detailed documentation of the survey methodology in Russian.

⁴The cities are selected according to the following criteria: (1) in each region 2–4 cities are chosen to account for spatial variations; (2) communities close to each other are included only if they have “fundamental differences” in levels and dynamics of prices; (3) consumer in selected cities must be consistently supplied with monitored goods; (4) the total population of monitored communities is at least 35% of the total urban population of the Russian Federation. The price for each product is then computed as the mean of 5–10 prices registered in different parts of selected cities.

⁵The dataset has average prices for 8 districts until 2015, and when it also started recording the data for a Crimean Federal District. We restrict our analysis to the 8 previous federal districts.

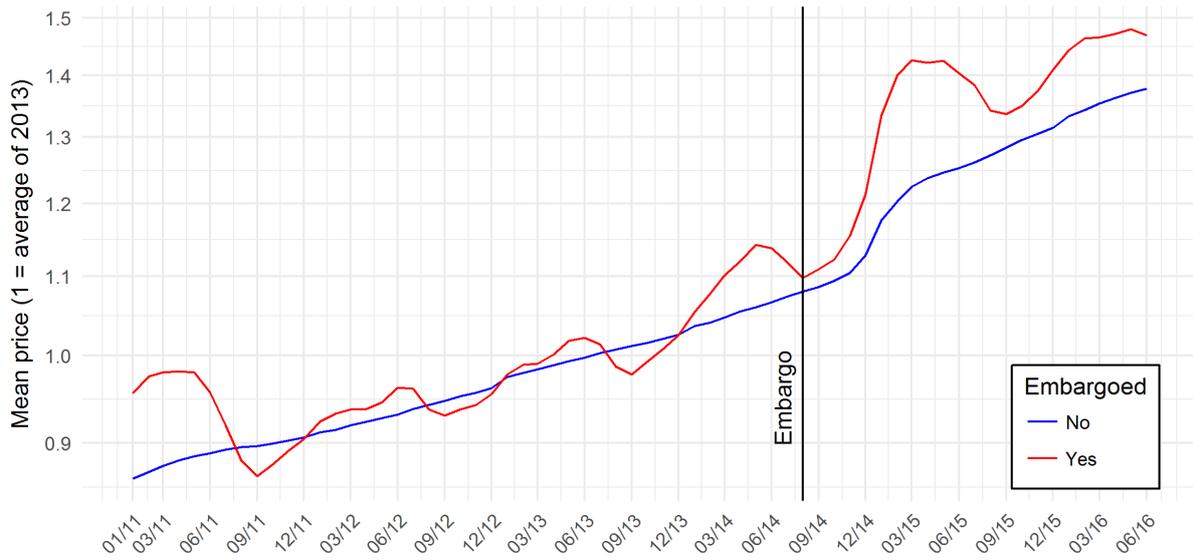


Figure 2.1. Evolution of average prices of embargoed and non-embargoed products

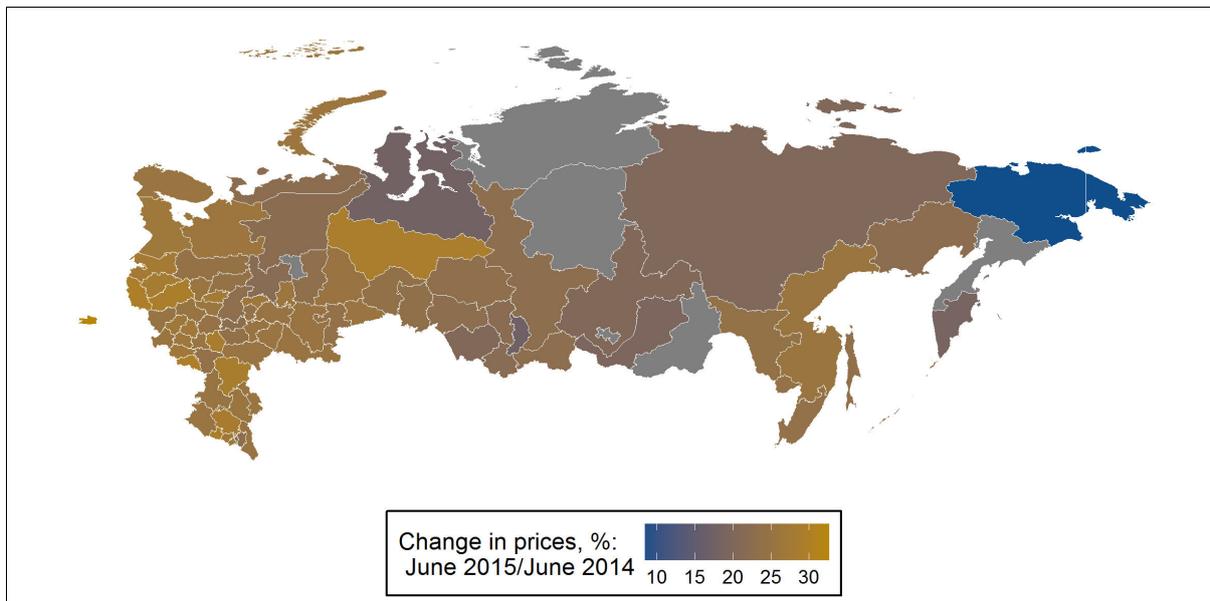


Figure 2.2. Change in average prices of embargoed products by region, June 2014 to June 2015

overall increasing trend, while the increase in the price of pork accelerated right after the ban in 2014.

To generalize the picture, in Fig. 2.1 we plot a simple average of the prices of embargoed and non-embargoed (both food and non-food) products over time. Prices for both types of products have been increasing during the entire period of interest, in addition to a visible seasonality of food prices. An abrupt shock in the prices of embargoed, and less so of non-embargoed goods can be observed following the introduction of the embargo in August 2014.

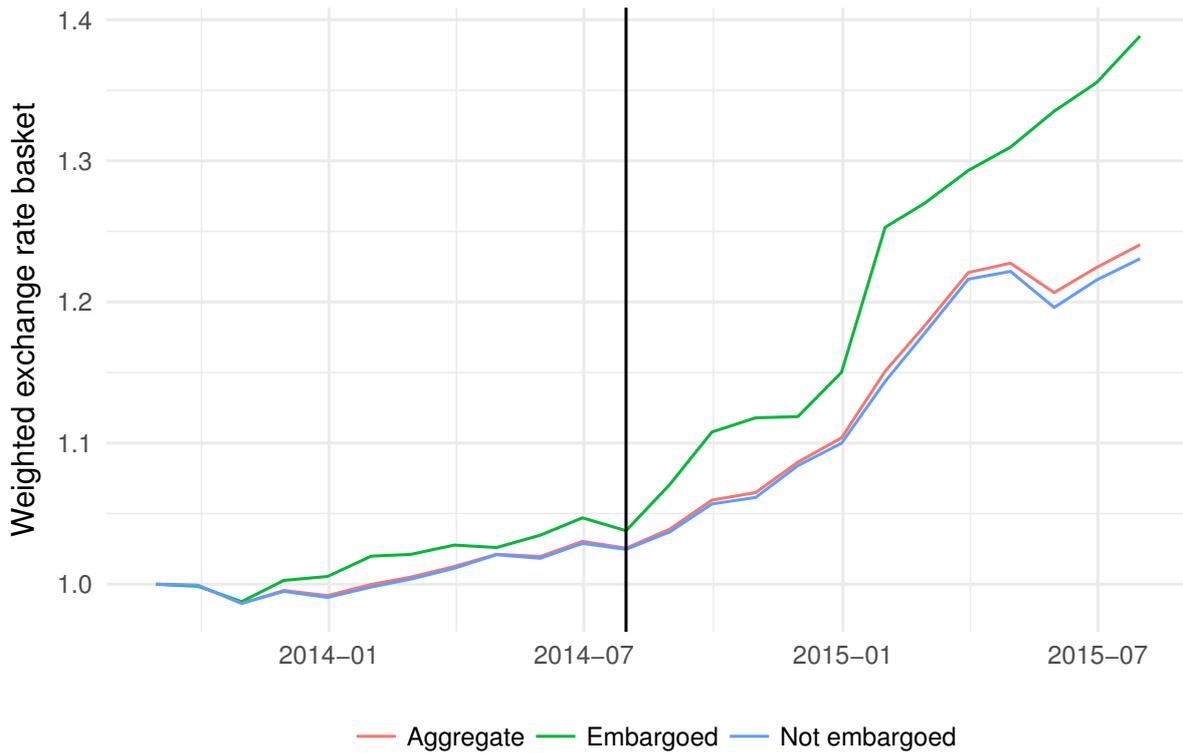


Figure 2.3. Embargoed vs. non-embargoed weighted exchange rate basket

As we suspect that imports (or rather the ban thereof) are resulting in increased consumer prices, we further expect that those parts of the country that imported relatively more of the embargoed products from targeted origin countries to have seen a relatively higher increase in prices. Fig. 2.2 shows that the Western regions of Russia indeed experienced higher price growth.

In 2014-2015 the Russian Ruble has sharply depreciated. One would expect that this should cause the rise of ruble-denominated prices of imported products. In Fig. 2.3 we illustrate the exposure of embargoed and non-embargoed imports to the decline of exchange rate. We construct the import-weighted exchange rate basket. We adjust the exchange rate between Russia and the origins of imports with respect to the share of these imports in total imports of each region. We conclude that the exchange rate of ruble adjusted to the import of embargoed has larger depreciated, compared to non-embargoed imports. This observation should be explained by the fact that Russia trades with origins of embargoed products in Euro (EU) and U.S. dollar.

Russian ruble has depreciated the most with respect to these two stable international currencies. We further look at the exposure of distinct regions to the change in exchange rate. In Fig. 2.B1 (see Appendix 2B) we compare import-value weighted baskets for Kaliningrad region, which is the most Western region of Russia and Eastern region – Transbaikal Terri-

Table 2.1*Benchmark regression: Diff-in-diff of prices by spatial aggregation and control group*

	Dependent variable:					
	(1)	(2)	(3)	log(prices) (4)	(5)	(6)
Sanction period × Embargoed product	0.027*** (0.004)	0.065*** (0.007)	0.030*** (0.002)	0.067*** (0.003)	0.028*** (0.002)	0.069*** (0.002)
Spatial agg.	district	district	subject	subject	city	city
Control group	F	F+NF	F	F+NF	F	F+NF
Number treated	16572	16572	174611	174611	456446	456446
Observations	42,884	140,670	453,164	1,477,892	1,117,395	3,460,386
Adjusted R ²	0.991	0.998	0.988	0.997	0.987	0.995

Notes: F stands for non-targeted food products and NF stands for non-food items. All regression include region × date and region × product × month fixed effects. Robust standard errors in parentheses are clustered by region. Significance levels: *: p<0.1, **: p<0.05, ***: p<0.01.

tory. We conclude that the depreciation of the ruble is particularly strong for Western regions, which are closer to European Union and trade with these countries in Euro. Eastern regions exchange with non-embargoed partners for the other currencies, such as CNY (yuan).

To underline the difference in the shock for embargoed and non-embargoed goods in Fig. 2.1, we perform a simple difference-in-difference analysis inspired by these first visual explorations into the data.⁶ The control and treatment group are well defined: specific products, as described above, can be directly mapped to HS codes that have been banned from being imported from certain countries. We first estimate is

$$\log(\text{price}_{irt}) = \alpha_0 + \alpha_1 \text{Product}_i + \alpha_2 \text{Period}_t + \alpha_3 \text{Product}_i \times \text{Period}_t + \varepsilon_{irt} \quad (2.1)$$

where price_{it} is the price of a product i at time t , Product_i a dummy variable that indicates the treated product and Period_t the treatment period. The interaction of both therefore captures the coefficient of interest. We control for structural regional variations, as indicated by Fig. 2.1(b) and Fig. 2.1(a), as well as seasonality, as indicated in Fig. 2.1 by including region × date and region × product × month fixed effects, where region is district, subject or city respectively. It is worth noting that the inclusion of region × product × allows to account for the depreciation of ruble. The sensitivity of consumer prices to the shock in exchange rate is expected to vary between regions, with respect to the share of imported goods in a region's consumption.

Table 2.1 displays the results for our benchmark regression. Across all different specifications the estimated effect of the embargo on prices of embargoed food and agricultural products is economically and statistically significant, as well as being similar in magnitude. Columns (1) and (2) report the coefficient for the diff-in-diff at the spatial aggregation of the

⁶Interestingly, the Kremlin stands with the official talking point that Russian consumer prices did not react to the self-imposed import ban on food and agricultural products (compare speech by Dmitry Medvedev on the meeting of Russia government, 26 August 2014). The difference-in-differences analysis can be seen as an empirical test of this statement.

Table 2.2*Diff-in-diff of prices interacted with share of sanctioning countries in imports*

	Dependent variable: log(prices)			
	(1)	(2)	(3)	(4)
Sanction period × Embargoed product	0.014 (0.014)	0.015 (0.026)	0.024*** (0.006)	0.058*** (0.007)
Sanction period × Embargoed product × Share of sanctioning country in imports	0.024 (0.023)	0.100** (0.044)	0.011 (0.010)	0.020* (0.012)
Spatial agg.	district	district	subject	subject
Control group	F	F+NF	F	F+NF
Number treated	14520	14520	155159	155159
Observations	37,582	123,395	402,540	1,313,613
Adjusted R ²	0.991	0.998	0.988	0.997

Notes: F stands for non-targeted food products and NF stands for non-food items. All regression include region × date and region × product × month fixed effects. Robust standard errors in parentheses are clustered by region. Significance levels: *: p<0.1, **: p<0.05, ***: p<0.01.

district (there are 8 districts in total). Columns (3) and (4) report those for the estimation at the subject level (87 subjects) and (5) and (6) at the least aggregated city level (279 cities). For each we alternate between control groups: either only other non-embargoed food products, denoted by (F), in columns (1), (3) and (5); or in columns (2), (4) and (6) we additionally include non-food products, denoted (NF).

The results of diff-in-diff with non-embargoed food items as the control group are the principal results of our empirical analysis. In fact, the group of food products is largely more homogeneous than all non-food items taken together. We conclude that the prices of embargoed food products grew on average by 3% following the onset of the embargo. We note that this result is systematically lower comparing to the diff-in-diff with non-food products in the control group (7%). Thus, one could hypothesize that other non-embargoed food prices also increased relative to non-food prices.

Fig. 2.2 indicates significant geographical heterogeneity in the price increases, potentially due to the heterogeneous exposure to the embargo. We explore this spatial variation by estimating

$$\begin{aligned}
\log(\text{price}_{irt}) = & \beta_0 + \beta_1 \text{Product}_i + \beta_2 \text{Period}_t + \beta_3 \text{Region}_r + \\
& \beta_4 \text{Product}_i \times \text{Period}_t + \beta_5 \text{Product}_i \times \text{Region}_r + \\
& \beta_6 \text{Period}_t \times \text{Region}_r + \beta_7 \text{Product}_i \times \text{Region}_r \times \text{Period}_t \quad (2.2)
\end{aligned}$$

where in addition to the previously mentioned dummies we now include and interact an additional variable, Region_r , that incorporates regional characteristics, more specifically, the share imports of sanctioned countries in the region prior to the embargo. In order to tie the increase in prices of embargoed products to the embargo itself, we test whether a previous reliance on food imports from currently sanctioning countries in the respective region lead to systemat-

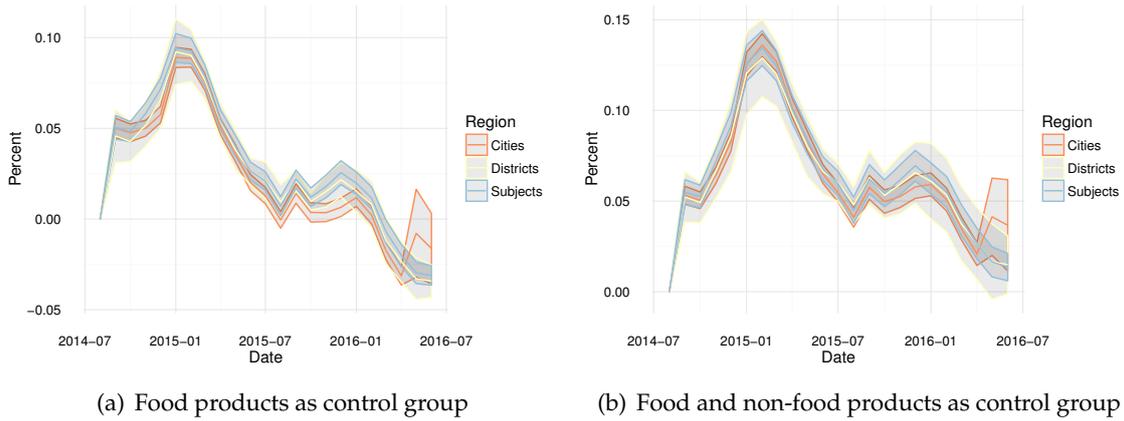


Figure 2.4. Monthly coefficients for diff-in-diff with other food items as control group (a) and food and non-food items as control group (b). 95% confidence intervals in grey shading.

ically higher food prices in the aftermath. Table 2.2 reports the findings. Columns (1) and (2) display the coefficients at the district level and (3) and (4) at the subject level.⁷ While the point estimate for the triple interaction is positive in all specifications, it is only statistically significant for the control group that includes non-food products. This suggests on the one hand that regions which previously relied on banned food imports indeed experienced higher prices post-embargo, and, on the other hand, that other food prices in these regions were also affected indirectly. The impact is not statistically different among these products.

We account for the geographical position of the regions. For each region, we compute the distance between the capital of the region and the capital of Ukraine (Kiev). We assume that such distance is a proxy for the proximity to the European Union, which is a major embargoed destination. We reiterate the diff-in-diff estimation of prices, this time interacting with distance to Europe. The results are reported in Table 2.D2. We conclude that remoteness of regions from embargoed countries might partially mitigate the impact on prices.

We further explore how the impact of shock to consumer prices varies in time. We plot monthly post-embargo coefficients in figures 2.4(a) (food control group) and 2.4(b) (food and non-food control group). For both plots, the effect is visibly steadily increasing until January '15 and then decreasing in intensity, irrespective of the level of spatial aggregation. Visibly again is the difference for the control group picked: While the coefficient drops almost entirely back to zero for the food control group a year after the beginning of the embargo, i.e. August '15, embargoed food prices remain significantly higher (about 5%) when comparing to a control group that includes non-food products and services. This underlines earlier results in which we suspect a propagation of the price shock to other non-embargoed food and agricultural products.

⁷Note that we rely on import data from the Russian Customs Administration that provides its data at the level of subject. We therefore restrict our analysis to district and subject-level aggregations of the price data.

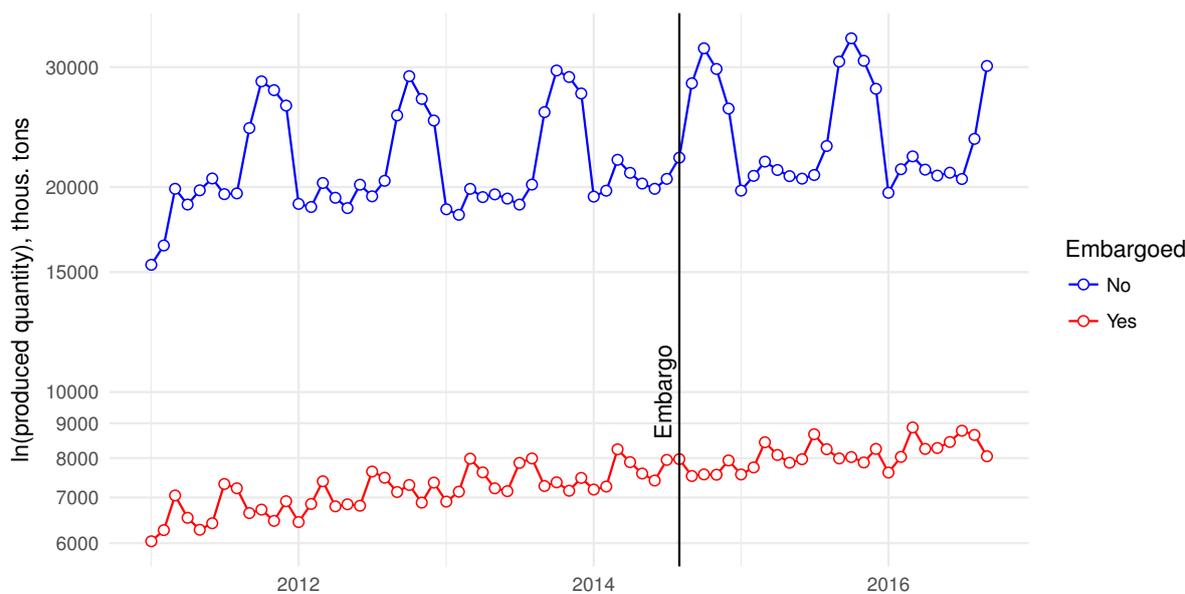


Figure 2.5. Evolution of aggregate production of embargoed and non-embargoed products in Russia

One might seek to explain the reversion of the price shock from the peak in January 2015 back towards lower prices by increased domestic production of embargoed products. Alongside with the policy of embargo, the Russian government has declared the reinforcement of agricultural import substitution. Furthermore, new programmes of support for national agricultural producers entered into force in 2014 and 2015.

Based on monthly production data from the Federal State Statistics, we compare production of embargoed and non-embargoed food items. The global picture for all embargoed and non-embargoed products is obtained by aggregating produced quantities. Such aggregation is possible because most of agricultural production data are reported in the same statistical unit (thousands of tonnes). Fig. 2.5 suggests that the production of embargoed products was steadily growing between January 2011 and July 2016, i.e. also during the period well before the import embargo was imposed.⁸ Thus, the aggregate picture does not support the hypothesis of a rapid growth of domestic production following the imposition of the embargo.

The rise of consumer prices is expected to cause the the shrink of domestic consumption. Using the data on wholesales provided by Rosstat, we test this prediction. We hypothesize that the total retail consumption equals to the total wholesales. We employ diff-in-diff analysis to isolate the impact of embargo on consumption of embargoed products. The results are reported in table 2.D1 in Appendix. We conclude that the domestic consumption decreased by at least 8.7%, depending on the specification. This results further supports the conclusion of the inefficiency of the policy of import substitution.

⁸It is worth noting the marked seasonality in the production of non-embargoed food products, with peaks in the fall of each year.

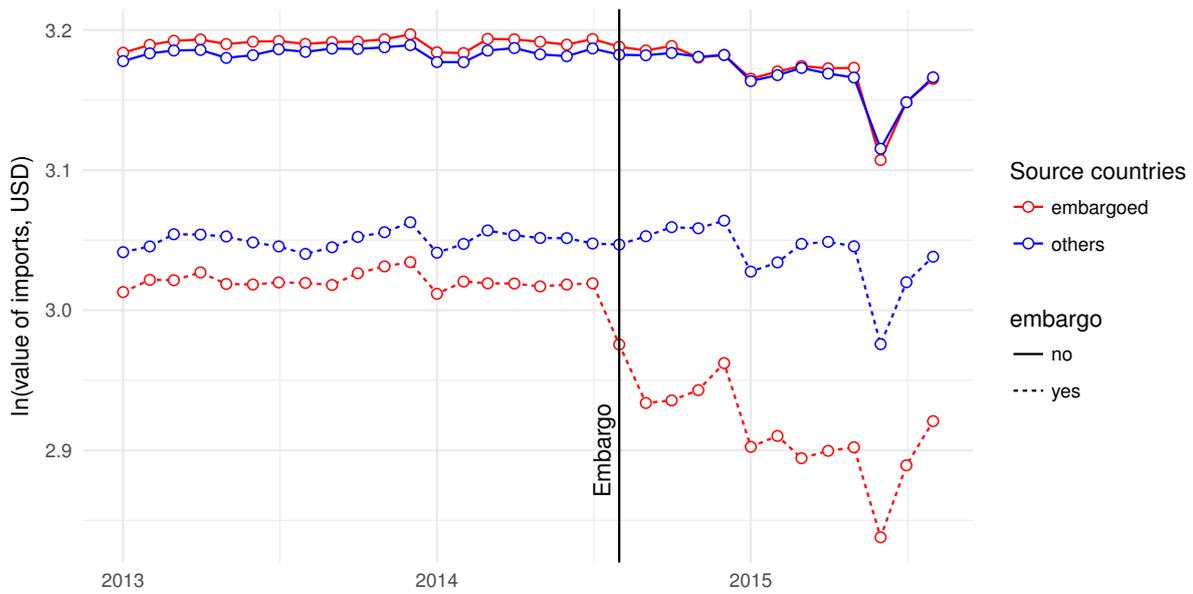


Figure 2.6. Aggregate import of embargoed and non-embargoed products to Russia

Another important factor that could mitigate the increase in consumer prices over time is trade diversion. In fact, Russian firms have started to import the embargoed agricultural products from non-embargoed countries. Fig. 2.6 suggests a slight increase in the imports of embargoed products from non-embargoed sources following the embargo. Thus, the trade diversion may have contributed to the compensation of the initial price shock. We further test for the trade diversion with diff-in-diff estimation technique. In Table 2.E1 we report the results for the imports. As expected, the imports of embargoed products has significantly decreased following the onset of embargo. In Table 2.E2 we introduce the interaction term with a dummy for embargoed origin. Our results suggest that the import of an embargoed product from embargoed country has significantly decreased, whereas the import from other origins increased. This evidence confirms that the trade divergence took place.

Overall, the data paint a picture in which the embargo hit consumer prices of those goods directly targeted. However, other food and agricultural products not directly targeted, i.e. not being banned from being imported from targeted countries, appear to have been indirectly hit. This is clearly observed on the graph of average prices on Fig. 2.1: the blue line (non-embargoed goods) has also shifted up. The food sector has upstream connections to the other sectors.⁹ Thus, we hypothesize that the shock was translated to nonembargoed sectors via input-output linkages.

⁹Antràs et al. (2012) suggested a comprehensive measure of upstreamness of sectors across countries. In table 2.F2 (see Appendix) we reproduce their results for the European Union. The sector of food products has a non-negligible value of 1.73. One should note that the more this measure is further from unity, the more the output of the corresponding sector is used as the input in the production of other sectors.

2.3 Theory

In order to account for these indirect effects displayed by the data, we now construct a structural model of international trade, that exhibits domestic input-output linkages that transmit sectoral *international* shocks across the affected *domestic* economy. In the current context this allows us—under plausible assumptions common in the related literature—to compute a counterfactual scenario in which the embargo of the Russian Federation on certain food and agricultural products had not taken place. We compute prices and welfare effects for this scenario and contrast it to the observed situation, allowing us to evaluate the direct and indirect effects of the use of this instrument of foreign policy on Russian consumers.

We sketch a model in the spirit of Caliendo and Parro (2015) that displays the mechanisms at play. There are N countries, indexed i and n , and J sectors, indexed j and k . Sectors are either tradable or non-tradable. Production uses labor as sole factor, mobile across sectors but not across countries. All markets are perfectly competitive.

There are L_n representative households in each country that maximize their utility by consuming final goods C_n^j in familiar Cobb-Douglas fashion.

$$u(C_n) = \prod_{j=1}^J C_n^{\alpha_n^j} \quad \text{with} \quad \sum_{j=1}^J \alpha_n^j = 1. \quad (2.3)$$

Household income I_n is derived from the supply of labor L_n at wage w_n .

A continuum of intermediate goods $\omega^j \in [0, 1]$ is produced in each sector j using labor and *composite* intermediate goods (or material) from all sectors. Producers of intermediate goods differ in efficiency in the production, $z_n^j(\omega^j)$, so that the production function is

$$q_n^j(\omega^j) = z_n^j(\omega^j) \left[l_n^j(\omega^j) \right]^{\gamma_n^j} \prod_{k=1}^J \left[m_n^{k,j}(\omega^j) \right]^{\gamma_n^{k,j}} \quad (2.4)$$

where $l_n^j(\omega^j)$ is labor and $m_n^{k,j}(\omega^j)$ are the composite intermediate goods from sector k used for the production of the intermediate good ω^j . $\gamma_n^{k,j}$ is the share of materials used in the production, so that $\sum_{k=1}^J \gamma_n^{k,j} = 1 - \gamma_n^j$, where γ_n^j is the share of value added. Both vary across countries and sectors.

As production is at constant returns to scale and markets are perfectly competitive, firms price at unit cost $c_n^j/z_n^j(\omega^j)$, where c_n^j denotes the cost of an input bundle

$$c_n^j = Y_n^j w_n^{\gamma_n^j} \prod_{k=1}^J P_n^k \gamma_n^{k,j} \quad (2.5)$$

where P_n^k is the price of a composite intermediate good from sector k and the constant $Y_n^j = \prod_{k=1}^J (\gamma_n^{k,j})^{-\gamma_n^{k,j}} (\gamma_n^j)^{-\gamma_n^j}$. Hence, the cost of the input bundle depends on wages and the

prices of *all* composite intermediate goods in the economy.

Producers of composite intermediate goods supply Q_n^j at minimum costs by purchasing intermediate goods ω^j from the lowest cost supplier across countries, so that

$$Q_n^j = \left[\int r_n^j(\omega^j)^{1-1/\sigma^j} d\omega^j \right]^{\sigma^j/(\sigma^j-1)} \quad (2.6)$$

$\sigma^j > 0$ is the elasticity of substitution across intermediate goods within sector j and $r_n^j(\omega^j)$ the demand of intermediate goods ω^j from the lowest cost supplier. The demand for good ω^j is then

$$r_n^j(\omega^j) = \left(\frac{p_n^j(\omega^j)}{P_n^j} \right)^{-\sigma^j} Q_n^j \quad (2.7)$$

where P_n^j is the unit price of the composite intermediate good

$$P_n^j = \left[\int p_n^j(\omega^j)^{1-\sigma^j} d\omega^j \right]^{1/(1-\sigma^j)} \quad (2.8)$$

where $p_n^j(\omega^j)$ denotes the lowest price of intermediate good ω^j across all locations.

Composite intermediate goods are used in the production of intermediate goods ω^j and as final good in consumption as C_n^j , so that the market clearing condition is written as

$$Q_n^j = C_n^j + \sum_{k=1}^J \int m_n^{j,k}(\omega^j) d\omega^j \quad (2.9)$$

So far the model is identical to Caliendo and Parro (2015). It differs slightly in the following. Trade in good is costly, such that

$$\kappa_{ni}^j = \tau_{ni}^j \epsilon_{ni}^j \quad (2.10)$$

where τ_{ni}^j are sector-specific *iceberg* trade costs and ϵ_{ni}^j , which takes $\epsilon_{ni}^j = \infty$ in case of an embargo on sector j by n towards i and $\epsilon_{ni}^j = 1$ otherwise.¹⁰ A unit of a traded intermediate good ω^j produced in country i therefore in country n costs $c_i^j \kappa_{ni}^j / z_i^j(\omega^j)$. As only the lowest cost one is actually procured, the price of ω^j in country n is

$$p_n^j = \min_i \left\{ \frac{c_i^j \kappa_{ni}^j}{z_i^j(\omega^j)} \right\} \quad (2.11)$$

Ricardian comparative advantage à la Eaton and Kortum (2002) is induced through a probabilistic productivity distribution. Each country draws an idiosyncratic productivity z^j for

¹⁰This is akin to Caliendo and Parro (2015)'s treatment of non-tradable goods, with the difference that with an embargo the respective goods remain traded goods with all other non-embargoed goods.

each sector j , independent across sectors and countries, from a Fréchet distribution

$$F_n^j(z) = e^{-\lambda_n^j z^{-\theta^j}} \quad (2.12)$$

where the scale parameter $\lambda_n^j \geq 0$ determines average productivity for country n and the shape parameter θ^j controls the dispersion of productivity across sectors and $1 + \theta^j > \sigma^j$. The price of the composite good is then given as

$$P_n^j = A^j \left[\sum_{i=1}^N \lambda_i^j (c_i^j \kappa_{ni}^j)^{-\theta^j} \right]^{-1/\theta^j} \quad (2.13)$$

which, for the non-tradable sector collapses to

$$P_n^j = A^j (\lambda_n^j)^{-1/\theta^j} c_n^j \quad (2.14)$$

where $A^j = \Gamma(\xi^j)^{1/(1-\sigma^j)}$ with $\Gamma(\xi^j)$ a Gamma function evaluated at $\xi^j = 1 + (1 - \sigma^j)/\theta^j$.

Total expenditure on goods from sector j in country n are given by $X_n^j = P_n^j Q_n^j$. The expenditure on those goods originating from country i is called X_{ni}^j such that the share of j from i in n is $\pi_{ni}^j = X_{ni}^j / X_n^j$. This share can also be expressed as

$$\pi_{ni}^j = \frac{\lambda_i^j (c_i^j \kappa_{ni}^j)^{-\theta^j}}{\sum_{h=1}^N \lambda_h^j (c_h^j \kappa_{nh}^j)^{-\theta^j}} \quad (2.15)$$

As in Caliendo and Parro (2015), an embargo on a certain sector j has a direct impact on trade between n and i through κ_{ni}^j , and an indirect one through c_n^j due to cross-sector linkages.

Total expenditure on goods from sector j are the sum of the firms' and households' expenditures on the composite intermediate good, either as input to production or for final consumption

$$X_n^j = \sum_{k=1}^J \gamma_n^{j,k} \sum_{i=1}^N X_i^j \frac{\pi_{in}^k}{\kappa_{in}^k} + \alpha_n^j I_n \quad (2.16)$$

with $I_n = w_n L_n + D_n$, i.e. labor income and trade deficit. Sectoral trade deficits are simply the difference between imports and exports

$$D_n^j = \sum_{i=1}^N X_{ni}^j - X_{in}^j \quad (2.17)$$

and $D_n = \sum_{j=1}^J D_n^j$ and $\sum_{n=1}^N D_n = 0$, with D_n being exogenously determined. The trade balance can then be expressed as

$$\sum_{j=1}^J \sum_{i=1}^N X_n^j \frac{\pi_{ni}^j}{\kappa_{ni}^j} - D_n = \sum_{j=1}^J \sum_{i=1}^N X_i^j \frac{\pi_{in}^j}{\kappa_{in}^j} \quad (2.18)$$

As in Dekle et al. (2008) and following Caliendo and Parro (2015) the equilibrium is solved for in changes. Let for any variable x the relative change to x' be denoted as $\hat{x} = x'/x$. The equilibrium conditions are defined as follows.

Cost of input bundles:

$$\hat{c}_n^j = \hat{w}_n^{\gamma_n^j} \prod_{k=1}^J \hat{P}_n^k \gamma_n^{k,j} \quad (2.19)$$

Price index:

$$\hat{P}_n^j = \left[\sum_{i=1}^N \pi_{ni}^j (\hat{\kappa}_{ni}^j \hat{c}_i^j)^{-\theta^j} \right]^{-1/\theta^j} \quad (2.20)$$

Bilateral trade shares:

$$\hat{\pi}_{ni}^j = \left[\frac{\hat{c}_i^j \hat{\kappa}_{ni}^j}{\hat{P}_n^j} \right]^{\theta^j} \quad (2.21)$$

Total expenditure on sector j in country n :

$$X_n^{j'} = \sum_{k=1}^J \gamma_n^{j,k} \sum_{i=1}^N \frac{\pi_{in}^{j'}}{\kappa_{in}^{k'}} X_i^{k'} + \alpha_n^j I_n^j \quad (2.22)$$

Trade balance:

$$\sum_{j=1}^J \sum_{i=1}^N X_n^{j'} \frac{\pi_{ni}^{j'}}{\kappa_{ni}^{j'}} - D_n = \sum_{j=1}^J \sum_{i=1}^N X_i^{j'} \frac{\pi_{in}^{j'}}{\kappa_{in}^{j'}} \quad (2.23)$$

where $\kappa_{ni}^{j'} = \epsilon_{in}^{j'}/\epsilon_{in}^j$ and $I_n^j = \hat{w}_n w_n L_n + D_n$. Relative changes in welfare are given by:

$$\ln \hat{W}_n = \ln \frac{\hat{w}_n}{\hat{P}_n} = - \sum_{j=1}^J \frac{\alpha_n^j}{\theta^j} \ln \hat{\pi}_{nn}^j \quad (\text{final goods}) \quad (2.24)$$

$$- \sum_{j=1}^J \frac{\alpha_n^j}{\theta^j} \frac{1 - \gamma_n^j}{\gamma_n^j} \ln \hat{\pi}_{nn}^j \quad (\text{intermediate goods}) \quad (2.25)$$

$$- \sum_{j=1}^J \frac{\alpha_n^j}{\gamma_n^j} \ln \prod_{k=1}^J \frac{\hat{P}_n^k \gamma_n^{k,j}}{\hat{P}_n^j} \quad (\text{sectoral linkages}) \quad (2.26)$$

We solve the model in changes for the exogenous shock (embargo). First, we compute the equilibrium in the base year with aggregate trade deficits. Second, we re-compute this equilibrium imposing trade deficits equal to zero: $D_n = 0$. Next, we construct counterfactual equilibrium without aggregate trade deficits. Finally, the model is solved in differences, and the welfare effects are computed.

2.4 Counterfactuals

In this section we describe how the elaborated model is employed to simulate the outcomes of embargo. An important feature of the model is that its calibration and application for simulations does not require the use of sophisticated or extensive datasets. The first piece of employed data is the data on production and use of intermediary inputs. It is sourced from 8th version of Global Trade Analysis Project (GTAP) database.¹¹ Table 2.3 summarizes definitions of employed variables.

Table 2.3
Employed GTAP variables

Employed variable	Definition
Gross output	Total sales of domestic products at market prices
Share of value added in gross output	Value added divided by gross output
Input-output coefficients	Sum of domestic purchases by firms and import purchases by firms divided by gross output by sector

Notes: Table reports definitions of variables that are employed in the calibration of the model and are sourced from GTAP dataset.

The second ingredient is the trade data. We source the bilateral flows from BACI.¹² We take trade elasticities for 33 GTAP sectors from Ossa (2014) and complement the selection of sectors by the sectors of fishing, extraction of crude petroleum and natural gas¹³, petroleum and coke, coal and other mining. We source the elasticities for the six aforementioned sectors from Imbs and Mejean (2015), from the part where they follow the estimation technique of Feenstra (1994). The complete list of tradable sectors with corresponding elasticities is reported in table 2.4. The non-tradable GTAP sectors are following: Electricity, Gas Distribution, Water, Construction, Trade, Other Transport, Water transport, Air transport, Communications, Other Financial Intermediation, Insurance, Other Business Services, Recreation and Other Services, Other Services (Government), and Dwellings.

Finally, the data on Russian food embargo is needed. The following countries were subject to the import ban: Albania, Australia, Austria, Belgium, Bulgaria, Canada, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Ukraine, United Kingdom, and the United States.

¹¹See the recent application of GTAP e.g. in Johnson and Noguera (2012).

¹²It is a harmonized dataset on global trade developed by CEPII. It contains highly disaggregated yearly trade flows.

¹³In fact, the oil and gas sectors are major pillars of the Russian economy.

Table 2.4
Tradable sectors

Sector	Elasticity	Embargoed	Sector	Elasticity	Embargoed
Oil	15.37		Beverages, etc.	2.93	
Gas	15.37		Textiles	2.90	
Wheat	12.37		Wool, etc.	2.89	
Fishing	12		Oil seeds	2.89	
Petroleum and coke	8.5		Metal products	2.79	
Dairy	5.60		Other food products	2.78	
Wearing apparel	5.31		Paper products, etc.	2.73	
Vegetable oils, etc.	4.98		Bovine cattle, etc.	2.58	
Rice	4.87		Other crops	2.54	
Bovine meat products	4.39	Yes	Sugar	2.52	
Other metals	4.38		Electronic equipment	2.49	
Leather products	4.11		Other mineral products	2.47	
Coal	3.77		Chemical products, etc.	2.37	
Other mining	3.77		Other machinery, etc.	2.37	
Other manufactures	3.52		Plant-based fibres	2.33	
Other cereal grains	3.29		Forestry	2.33	
Other meat products	3.14	Yes	Wood products	2.29	
Motor vehicles, etc.	3.13		Vegetables and fruits	2.19	Yes
Ferrous metals	3.01		Other animal products	2.12	
Other transport equipment	2.99				

Notes: Table reports list of all tradable sectors in the data.

The exhaustive list of all embargoed products was published by the Russian government in August 2014. In order to match them with GTAP sectors, we employ World Integrated Trade Solution (WITS) product concordance tables. The mapping of embargoed sectors to the GTAP classification is reported in table 2.A1. It is important to properly choose GTAP sectors that were the most exposed to the studied bilateral shock. We take this decision with respect to the share of embargoed products in total number of products constituting each of GTAP sectors. Thus, our selection includes the following sectors: "Vegetables and fruits", "Bovine meat products" and "Other meat products". It is worth noting that the sectors "Dairy", "Fishing" and "Other food products" are not treated as embargoed for the purposes of simulations. In fact, products belonging to the official prohibitive list constitute minor shares of all products of these GTAP sectors. Furthermore, sector "Raw milk" is excluded because BACI dataset does not report any data on its trade flows.

From the final counterfactual analysis we exclude the following sectors: "Other machinery", "Ferrous metals", "Other transport equipment", "Oil seeds", "Motor vehicles", "Other mining", "Coal", "Other cereal grains" and "Other food products". We found that the results for three countries (Ukraine, Belarus and Bulgaria) are sensitive to the inclusion of the above listed sectors. The results for Belarus are particularly related to the sector "Other cereal grains".

The model predicts that Russian Federation experienced welfare losses of the magnitude of 0.21%. This effect is, perhaps unsurprisingly so, the most severe among countries that are included in our analysis. At the same time, the price index in Russia increased by 0.25%. Thus, we conclude that the import embargo has been destructive to the country, and lead to higher

average prices across the Russian economy.¹⁴

We further compute the contribution of individual sectors to the total welfare outcomes of the Russian embargo. We plot the results for Russia in Fig. 2.G1 in appendix 2.5. The sector of oil is responsible for 20.9% of the magnitude of welfare outcome. The other two important contributors are sectors of chemical products (11.2%) and electronic equipment (9.4%). In fact, none of these sectors are subject to the trade embargo. The initial policy shock was transmitted by means of the input-output linkages.

In table 2.5 we report the outcomes for countries that are the biggest importers to Russia.¹⁵ The countries in this table are ranked in the decreasing order of their shares in total Russian imports. The results suggest that most of big embargoed importers experienced minor losses, which are smaller than those of Russia.

A large increase in welfare of Belarus (4.71%) deserves particular discussion. The anecdotal evidence was repeatedly documented that a portion of embargoed food items, which were initially imported to Belarus, has been further relabeled and re-exported to Russia. Belarus participates in the Eurasian Customs Union, together with Russia, Armenia, Kazakhstan and Kyrgyzstan. The quasi-absence of trade barriers between Belarus and Russia largely facilitates post-embargo trade divergence. It is further worth noting that Ukraine is estimated to gain from Russian embargo 2.8% of their welfare. This scenario obviously does not incorporate the severe economic effect of the conflict in eastern Ukraine. The simulation exercise however yields this outcome as the consequence of divergence of trade flows that occurred after the onset of embargo.

In table 2.6 we report the outcomes for countries that are "small" importers to Russia. All of the negative outcomes for small importers are close to zero, which might be a sign of the inefficiency of embargo as the trade policy. Embargoed Eastern European countries (Bulgaria, Estonia, Czech Republic, Romania, Slovakia, Hungary, Slovenia) are estimated to have experienced *positive* welfare outcomes. These countries most likely profited from the divergence of import flows, which were previously directed to Russia. Two factors are favouring this scenario. First, relatively small distance between Eastern European countries and Russian border implies trade costs that are similar to those with Russia. Second, the structure of food import of these countries resembles the one of Russia.

One should also note that the reliability of the data in the input-output tables might be heterogeneous across countries. For instance, Timmer et al. (2015) note that the official input-

¹⁴This result is in line with the findings of O’rourke (2007) and Irwin (2005) for the case of the American economy under Jefferson’s blockade.

¹⁵We classify an importer as "big" if its share in Russian total import is 2% or more. Thus, 13 of them are "big" and their total share of Russian imports is 67.7%. The only "big" importer – South Korea – is not included to the simulation outcomes due to the insufficiency of the data.

Table 2.5
Outcomes of Russian embargo for Russia and big importers

Countries	Embargoed	$\Delta Welfare$	$\Delta Prices$
Russian Federation		-0.21%	0.25%
China	no	0.33%	2.12%
Germany	yes	-0.1%	-0.19%
Belarus	no	4.71%	11.01%
Italy	yes	0%	0.27%
United States of America	yes	-0.03%	-0.39%
France	yes	0%	0.31%
Japan	no	-0.02%	-0.29%
Poland	yes	0.23%	1.01%
Ukraine	yes	2.79%	7.14%
Netherlands	yes	0.01%	0.25%
Kazakhstan	no	0.1%	0.93%
United Kingdom	yes	-0.06%	-0.25%

Note: This table reports simulated post-embargo outcomes in terms of changes in welfare and prices.

output tables for some countries account for the net value added of processing trade flows, whereas for other countries gross trade flows are reported. Thus, we hypothesize that the discrepancies in results of simulations for Ukraine and Bulgaria might be attributed to the "noise" in the input-output tables.

It is worth to compare previously discussed results of simulations with zero tariffs to the ones with observed tariffs. Thus, we source the bilateral tariff rates for 2007 from "Market Access Map".¹⁶ Keeping the other assumptions of the model unchained, we replicate the same steps of simulations. The results are reported in tables 2.H1 and 2.H2 in appendix 2.5. We conclude that the predicted welfare outcome for Russia gets to about -1.45% with prices to rise by 0.24%. Overall the simulated outcomes for other countries are similar to the ones with zero tariffs. Meanwhile, one should note that the results for Ukraine are drastically smaller in magnitude.

We further demonstrate how the version of the model without input-output linkages predicts the outcomes of embargo. Corresponding results are reported in table 2.H3. We observe that relaxing of the crucial assumption of the model leads to completely different prediction of welfare outcomes for most countries. In this specification the welfare outcomes for most countries are marginally different from zero. We conclude that the inter-sectoral linkages are an important transmitting mechanism.

¹⁶Data for more recent years were unavailable.

Table 2.6
Outcomes of Russian embargo for small importers

Countries	Embargoed	Δ Welfare	Δ Prices
Bulgaria	yes	2.1%	3.9%
Estonia	yes	1.15%	2.78%
Czech Republic	yes	0.93%	2.42%
Belgium	yes	0.59%	1.46%
Romania	yes	0.59%	1.68%
Slovakia	yes	0.44%	1.62%
Hungary	yes	0.28%	1.24%
Slovenia	yes	0.26%	1.06%
Sweden	yes	0.21%	1.25%
Malta	yes	0.11%	0.24%
Finland	yes	0.09%	0.93%
Portugal	yes	0.04%	0.14%
Turkey	no	0.03%	0.4%
India	no	-0.02%	0.14%
Brazil	no	-0.02%	0.01%
Canada	yes	-0.02%	-0.2%
Ireland	yes	-0.03%	-0.14%
Indonesia	no	-0.04%	0.18%
Australia	yes	-0.06%	-0.28%
Switzerland	no	-0.06%	-0.13%
Argentina	no	-0.07%	-0.37%
Croatia	yes	-0.07%	0.07%
Austria	yes	-0.08%	-0.1%
Spain	yes	-0.08%	-0.83%
Norway	yes	-0.09%	-0.15%
Denmark	yes	-0.11%	-0.22%
Greece	yes	-0.11%	-0.95%
Egypt	no	-0.17%	0%

Note: This table reports simulated post-embargo outcomes in terms of changes in welfare and prices.

2.5 Conclusion

In August 2014, the Russian government put in place an embargo on certain food and agricultural imports from Western countries. This paper assesses the role of the embargo for the welfare and prices of consumers in the Russian Federation. We provide evidence for the heterogeneity of the direct impact of the embargo on prices of affected food products, and a potential indirect impact on linked sector. In a difference-in-differences setup for the period between August 2014 and July 2016 we find that the embargo's net effect on consumer prices of embargoed products has been an increase of at least 2.7% relative to other (non-embargoed) food products, and even more relative to non-food items. The maximum effect of 8.9% (relative to non-sanctioned food products) was observed in January 2015, and has been subsiding in the subsequent months.

To disentangle the observed effects we sketch and calibrate a suitable Ricardian trade model that exhibits domestic intersectoral linkages. The trade embargo is modelled as a rise in trade costs to a prohibitive level. Our simulations suggest that Russia faced a decrease in wel-

fare of 0.22%. The domestic prices are simulated to have risen by 0.29%. This result is in line with the established trade literature predicting that the introduction of these bilateral frictions to international trade should necessarily cause a surge in domestic prices.

Three quarters of the Russian population live in urban areas. They are not able to produce food and therefore are net buyers of agricultural products. Thus, the vast majority of citizens are vulnerable to the negative price shocks of food products. The analysis allows us to conclude that the trade embargo imposed by the Russian government has been detrimental for the welfare of Russian consumers. Our takeaway policy recommendation would be to suspend the practice of this embargo.

Acknowledgements for Chapter 2

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Appendix

Appendix 2A. List of products embargoed by the Russian Federation

Table 2.A1

Mapping of embargoed HS codes to GTAP classification and ROSSTAT Price data

HS code	GTAP sector	HS description	Linked consumer products (English translation)
0201	Bovine meat products	Meat of bovine animals, fresh or chilled	Meat of bovine animals fresh, cooled down, chilled; Beef (except for boneless meat), kg; Beef boneless, kg; Beef offal other than; Beef, including offal; Beef, except offal
0202	Bovine meat products	Meat of bovine animals, frozen	Beef (except for boneless meat), kg; Beef boneless, kg; Beef offal other than; Beef, including offal; Beef, except offal; Meat cattle frostbitten, frozen, deep frozen and defrosted
0203	Other meat products	Meat of swine, fresh, chilled or frozen	Pork (except for boneless meat), kg; Boneless Pork kg; Pork steam, cooled down, chilled; Pork frostbitten, frozen, deep-frozen and thawed; pork Offal
0207	Other meat products	Meat and edible offal, fresh, chilled or frozen	Poultry; Meat and edible offal of poultry; Meat fresh, cooled down, chilled edible offal and poultry; Meat frostbitten, frozen, deep-frozen and defrosted food and offal of poultry; By-products of poultry food; By-products of poultry food frostbitten, frozen, deep frozen and defrosted; By-products of poultry, fresh or chilled food; Chickens chilled and frozen, kg
0210*	Other meat products	Meat and edible offal, salted, in brine, dried or smoked	Products (semi-finished) balyk salted; Products balyk; Products cured balyk (provesnye); Meat and meat offal of food, salted, in brine, dried or smoked; food meal of meat or meat offal; Pork meat, including offal; Pork other than offal
0301*	Fishing	Live fish	live fish; Live fish, fresh or chilled; Fish and fish products are processed (excluding canned fish), t
0302	Fishing	Fish, fresh or chilled	Live fish, fresh or chilled; Fish and fish products are processed (excluding canned fish), t; Fish, fresh or chilled; Fish chilled and frozen salmon in split, kg
0303	Other food	Fish, frozen	Fish and fish products are processed (excluding canned fish), t; Fish, fresh or chilled; Fish chilled and frozen salmon in split, kg; Fish, frozen, not cleaned, kg; Fish (except herring), frozen; Fish (except herring), frozen, livers and roes Frozen Fish; Split frozen fish (except salmon), kg; frozen herring
0304	Other food	Fish fillets and other fish meat, etc	Fish fillets, kg; Minced Fish, fresh or chilled; Fish fillets cream; Fish fillets, fresh or chilled; Fish fillets, other fish meat, livers and roes of fish, fresh or chilled; Fish meat (including beef), fresh or chilled Other; Herring salted, kg; Fish meat (including beef), ice cream etc.

HS code	GTAP sector	HS description	Linked consumer products (English translation)
0305	Other food	Fish, dried, salted, smoked or in brine	Fish, salted, pickled, smoked, kg; Fish (except herring), smoked; Fish (except herring), smoked; Fish (except herring) krepkosolenaya; Fish (except herring) salted; Fish (except herring) salt; Fish (except herring) srednesolenaya; For semi-smoked fish (except herring); Fish salting semuzhny; The fish special salting (except herring); Fish, dried; Fish, dried, and dried; Cold smoked fish (except herring); Herring all processes; Herring krepkosolenaya; Herring salted; Herring srednesolenaya; Products Cold smoked (without herring) balyk; Products made of herring, balyk; Herring for semi-smoked and hot; Herring cold smoked; Fish, dried; Herring salted, kg
0306	Fishing	Crustaceans, etc.	Crustaceans frozen; Crustaceans, not frozen; Crustaceans, not frozen; oysters; Other aquatic invertebrates, live, fresh or chilled; Molluscs and other aquatic invertebrates, frozen, dried, salted or in brine; Molluscs, crustaceans and aquatic invertebrates, live, fresh or chilled Other
0307	Fishing	Molluscs, etc.	Crustaceans, not frozen; oysters; Other aquatic invertebrates, live, fresh or chilled; Molluscs and other aquatic invertebrates, frozen, dried, salted or in brine; Molluscs, crustaceans and aquatic invertebrates, live, fresh or chilled Other; oysters
0308	Fishing	Other aquatic invertebrates	Crustaceans, not frozen; oysters; Other aquatic invertebrates, live, fresh or chilled; Molluscs, crustaceans and aquatic invertebrates, live, fresh or chilled Other
0401*	Dairy	Milk and cream	Liquid milk processed; Raw milk cattle; Drinking milk, t; Cream; fermented milk products,; Fermented milk products, heat-treated fermented products; Drinking milk, pasteurized 2.5-3.2% fat l; Drinking milk, sterilized 2.5-3.2% fat l
0402*	Dairy	Milk and cream, concentrated or containing sweetening matter	Cream; fermented milk products,; Fermented milk products, heat-treated fermented products; Condensed milk; Condensed milk with sugar, 400 g; Fermented milk products (kisloslivochnye) Dry, granular and other particulate forms than curd; Fermented milk products, other, including fortified; Condensed milk products; Condensed milk products with food and food additives; condensed cream; Milk powder, granular or other solid forms with a fat content of not more than 1.5%; Milk powder, kg; Powdered milk, t; Cream dry granular or other solid forms; Milk powder, granular or other solid forms with a fat content of 2.0% to 18.0%; Milk powder, granular or other solid forms, with a fat content of 20.0%; Canned milk, ths. Conv. cans; Milk powder, granular or other solid forms etc.; Milk and cream in solid forms

HS code	GTAP sector	HS description	Linked consumer products (English translation)
0403*	Dairy	Buttermilk, yogurt and other fermented milk and cream	fermented milk products,; Fermented milk products, heat-treated fermented products; Types of milk or cream, or fermented sour, not included in other categories, other; Sour, including mechnikovskaya; Soured cream.; Sour cream with fat content more than 35.0%; Sour cream with a fat content of 10.0% to 14.0%; Sour cream with a fat content of 15.0% to 34.0%; Yogurt; Yogurt without food and food additives; Yogurt and other kinds of milk or cream, fermented or acidified; Yogurt, 125 g; Kefir; Dairy products, kg; Kefir without food and food additives; Sour cream, kg; Ryazhenka
0404*	Dairy	Whey ; products consisting of natural milk constituents	fermented milk products,; Fermented milk products, heat-treated fermented products; Serum
0405*	Dairy	Butter and fats derived from milk; dairy spreads	Butter and oily paste; Butter; Butter, cream and sour cream with fat content from 50% to 79%; Butter, cream and sour cream with fat content from 80% to 85%; Butter, cream cheese; Butter sweet butter with a mass fraction of fat from 50% to 79%; Butter sweet butter with fat content from 80% to 85%; Sterilized with butter fat content from 50% to 79%; Butter sterilized with fat content from 80% to 85%; Butter, kg; heating oil
0406*	Dairy	Cheese and curd	fermented milk products,; Fermented milk products, heat-treated fermented products; Cheese, t; cheese Products; cheese products; Cheese and curd; smoked Cheese; soft cheese; Blue cheese; fresh Cheese; Cheese superhard; Cheese slime; Hard cheese; Cheese and cheese products; Cottage cheese; Curd zerneny; National cheese and feta cheese, kg; Cheese brine; Cottage cheese fat, kg; Low-fat cottage cheese, kg; Curd cheese, glazed with chocolate 50g; Cheeses grated cheeses and powdered; Cheese, kg; cheese; Cheese rennet hard and soft, kg; Cheese semisolid; other Cheeses; mature Cheese
0701*	Vegetables and fruits	Potatoes, fresh or chilled	Kaptofel; Potatoes, kg; Unprocessed vegetables and potatoes
0702	Vegetables and fruits	Tomatoes, fresh or chilled	Unprocessed vegetables and potatoes; Fresh Tomatoes, kg; Tomatoes (tomatoes); tomatoes (tomatoes) closed ground; tomatoes (tomatoes) of open ground
0703*	Vegetables and fruits	Onions, leeks and other alliaceous vegetables, fresh or chilled	Unprocessed vegetables and potatoes; Bow pepchaty; Onions, kg; Garlic
0704	Vegetables and fruits	Cabbages and similar edible brassicas, fresh or chilled	Unprocessed vegetables and potatoes; Cabbage
0705	Vegetables and fruits	Lettuce and chicory , fresh or chilled	Unprocessed vegetables and potatoes
0706	Vegetables and fruits	Carrots and similar edible roots, fresh or chilled	Unprocessed vegetables and potatoes; Carrot dining; Carrots, kg; Beets and carrots Dinner

HS code	GTAP sector	HS description	Linked consumer products (English translation)
0707	Vegetables and fruits	Cucumbers and gherkins, fresh or chilled	Unprocessed vegetables and potatoes; cucumbers; cucumber greenhouses; cucumbers open ground; Fresh cucumbers, kg
0708	Vegetables and fruits	Leguminous vegetables, fresh or chilled	Unprocessed vegetables and potatoes
0709	Vegetables and fruits	Other vegetables, fresh or chilled	Unprocessed vegetables and potatoes; Vegetables, fresh or chilled, not included in other categories
0710	Other food	Vegetables, frozen	Unprocessed vegetables and potatoes; Frozen vegetables, kg; Vegetables and Mushrooms frozen; Frozen vegetables, not included in other categories
0711	Other food	Vegetables provisionally preserved	
0712*	Other food	Dried vegetables, whole, cut, sliced, broken or in powder	Dried Vegetables and Mushrooms
0713*	Vegetables and fruits	Dried leguminous vegetables, shelled	Dried Vegetables and Mushrooms
0714	Vegetables and fruits	Manioc, arrowroot and similar roots	
0801	Vegetables and fruits	Coconuts, Brazil nuts and cashew nuts	Nuts, kg; Unprocessed fruits, except citrus, t
0802	Vegetables and fruits	Other nuts, fresh or dried	Nuts, kg; Unprocessed fruits, except citrus, t
0803	Vegetables and fruits	Bananas, including plantains, fresh or dried	Unprocessed fruits, except citrus, t; Bananas, kg
0804	Vegetables and fruits	Dates, figs, pineapples, avocados, guavas, mangoes	Unprocessed fruits, except citrus, t
0805	Vegetables and fruits	Citrus fruit, fresh or dried	Oranges, kg; Lemons, kg
0806	Vegetables and fruits	Grapes, fresh or dried	Unprocessed fruits, except citrus, t; grapes; Grapes, kg
0807	Vegetables and fruits	Melons (including watermelons) and papaws (papayas), fresh	Unprocessed fruits, except citrus, t; Culture melons food
0808	Vegetables and fruits	Apples, pears and quinces, fresh	Unprocessed fruits, except citrus, t; The fruits of pome crops; The fruits of pome, stone and berry crops; Apples kg; Pears, kg
0809	Vegetables and fruits	Apricots, cherries, peaches, plums and sloes, fresh	Unprocessed fruits, except citrus, t; Fruits stone fruits
0810	Vegetables and fruits	Other fruit, fresh	Unprocessed fruits, except citrus, t; The fruit and berry crops
0811	Other food	Fruit and nuts, frozen	Fruits and berries (fresh or pre-cooked), frozen
0813	Vegetables and fruits	Fruit and nuts, provisionally preserved	Fruits, berries and nuts dried; Fruits, berries and nuts, dried, other except bananas
1601	Other meat products	Sausages and similar products, of meat, meat offal or blood	sausage; Smoked sausage, kg; Sausage, t; Cooked sausage I grade, kg; Cooked sausage premium, kg; Cooked sausage, kg; Sausage semi-smoked and cooked-smoked, kg; Sausages, small kg

HS code	GTAP sector	HS description	Linked consumer products (English translation)
1901*	Other food	Malt extract; food preparations of flour, groats, meal, starch or malt extract, etc.	
2106*	Other food	Food preparations not elsewhere specified or included	

Appendix 2B. Import-weighted exchange rate basket

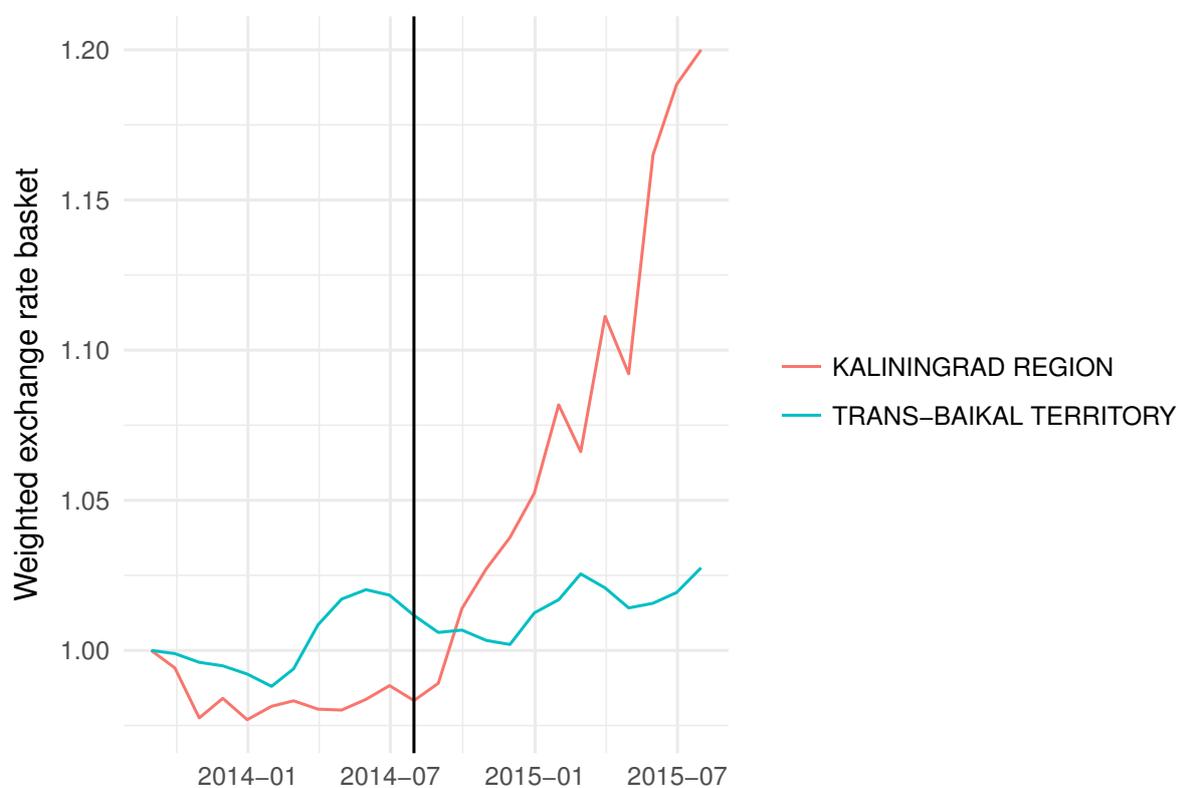
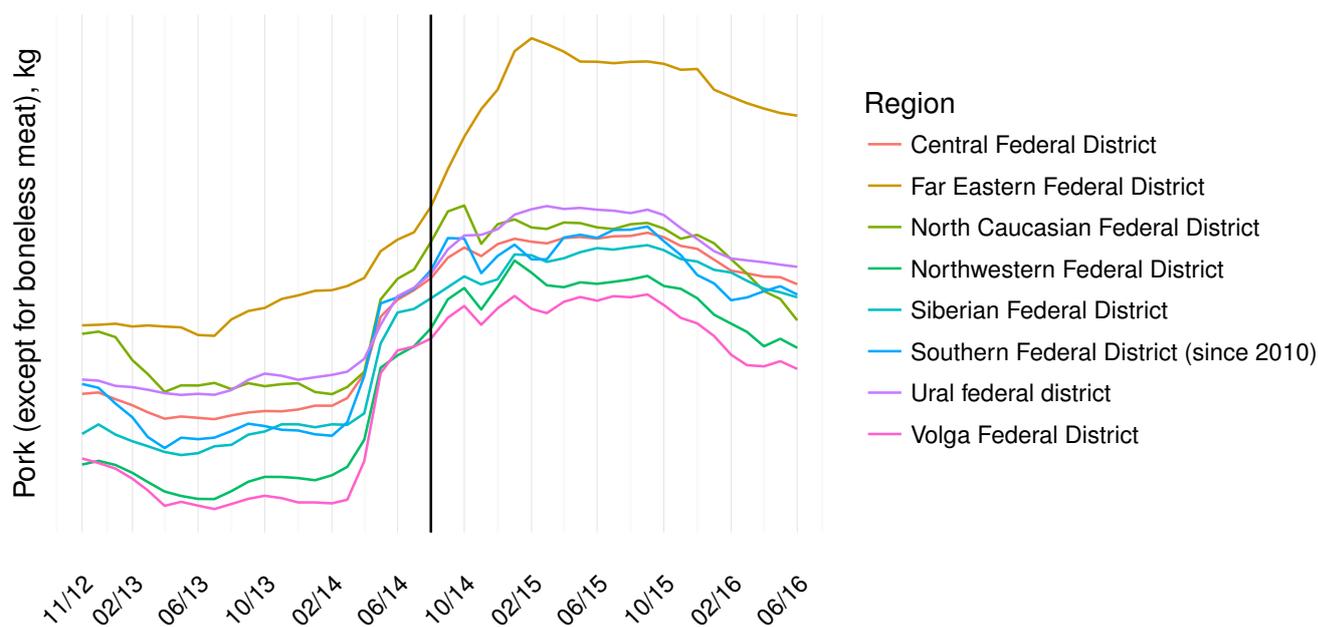
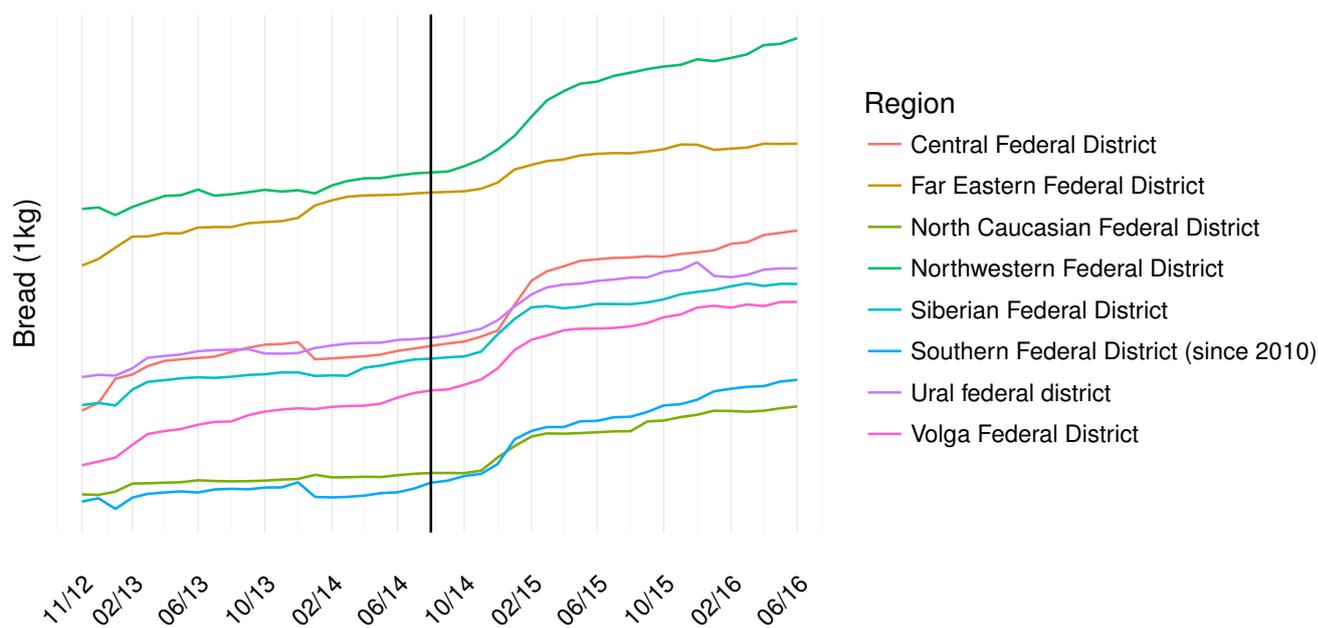


Figure 2.B1. Import-value weighted exchange rate basket for a Western (Kaliningrad region) and an Eastern (Transbaikal Territory) regions.

Appendix 2C. Consumer prices



(a) Evolution of the price of 1 kg of pork by federal district



(b) Evolution of the price of 1kg of bread by federal district

Figure 2.C1. Evolution of prices of an embargoed product (a) and non-embargoed product (b)

Appendix 2D. Additional regression results

Table 2.D1
Impact of embargo on wholesales in Russia

	Dependent variable:					
	log(value of sales)					
	(1)	(2)	(3)	(4)	(5)	(6)
Sanction period × Embargoed product	-0.501*** (0.114)	-0.536*** (0.040)	-0.146* (0.088)	-0.087** (0.038)	-0.012 (0.017)	-0.087*** (0.032)
Spatial agg.	district	subject	district	district	subject	district
Control group	F+NF	F+NF	F	F+NF	F+NF	F
Fixed effects	R × D	R × D	R × D	R × P × M	R × P × M	R × P × M
Observations	18,441	118,028	7,338	18,441	118,028	7,338
Adjusted R ²	0.090	0.098	0.206	0.937	0.905	0.922

Notes: F stands for non-targeted food products and NF stands for non-food items. The regressions include either region × date (R × D) or region × product × month (R × P × M) fixed effects. Robust standard errors are reported in parentheses. Significance levels: *: p<0.1, **: p<0.05, ***: p<0.01.

Table 2.D2
Diff-in-diff of prices interacted with distance to Europe

	Dependent variable:			
	log(prices)			
	(1)	(2)	(3)	(4)
Sanction period × Embargoed product	0.089*** (0.023)	0.114** (0.047)	0.101*** (0.021)	0.140*** (0.028)
Sanction period × Embargoed product × distance to Europe	-0.008*** (0.003)	-0.006 (0.006)	-0.009*** (0.003)	-0.009** (0.004)
Spatial agg.	district	district	subject	subject
Control group	F	F+NF	F	F+NF
Number treated	16572	16572	174611	174611
Observations	42,884	140,670	453,164	1,477,892
Adjusted R ²	0.991	0.998	0.988	0.997

Notes: F stands for non-targeted food products and NF stands for non-food items. All regression include region × date and region × product × month fixed effects. Robust standard errors in parentheses are clustered by region. Significance levels: *: p<0.1, **: p<0.05, ***: p<0.01.

Appendix 2E. Trade diversion

Table 2.E1

Change in imports of embargoed vs. non-embargoed goods

	<i>Dependent variable:</i>	
	log(value) (1)	log(weight) (2)
Sanction period × Embargoed product	-0.168** (0.084)	-0.078 (0.091)
Observations	28,715	28,715
R ²	0.915	0.921
Adjusted R ²	0.912	0.917
Residual Std. Error (df = 27490)	0.771	0.919

Note: All regressions include date and product fixed effects. Standard errors clustered on date, partner country and product. *p<0.1; **p<0.05; ***p<0.01

Table 2.E2

Change in imports of embargoed vs. non-embargoed goods by sanctioning/non-sanctioning country

	<i>Dependent variable:</i>	
	log(value) (1)	log(weight) (2)
Sanction period × Embargoed product	0.932*** (0.215)	0.878*** (0.224)
Sanction period × Embargoed product × Embargoed country	-1.114* (0.569)	-1.032* (0.612)
Observations	592,885	592,885
R ²	0.382	0.480
Adjusted R ²	0.380	0.478
Residual Std. Error (df = 591422)	2.485	2.923

Note: All regressions include date, partner country and product fixed effects. Standard errors clustered on date, partner country and product. *p<0.1; **p<0.05; ***p<0.01

Appendix 2F. Input-output linkages

Table 2.F1

Use of inputs from embargoed sectors in Russian production

Sector	<i>Vegetables and fruits</i>		<i>Other meat products</i>		<i>Bovine meat products</i>	
	domestic	foreign	domestic	foreign	domestic	foreign
Wheat	0.01%	0.11%	0.00%	0.42%	0.06%	0.02%
Other cereal grains	0.01%	1.68%	0.00%	6.30%	0.05%	0.28%
Vegetables and fruits	11.85%	1.35%	0.01%	3.88%	0.19%	0.17%
Oil seeds	0.02%	0.48%	0.01%	1.78%	0.18%	0.08%
Plant-based fibres	0.01%	0.53%	0.01%	1.83%	0.13%	0.10%
Other crops	0.10%	0.31%	0.05%	0.86%	0.64%	0.04%
Bovine cattle, etc.	0.00%	0.00%	0.01%	0.00%	99.04%	98.34%
Other animal products	9.40%	4.24%	3.56%	0.45%	30.22%	2.01%
Raw milk	0.01%	0.01%	0.00%	0.00%	37.73%	1.70%
Wool, etc.	0.01%	0.00%	0.00%	0.00%	7.98%	1.30%
Wood products	0.13%	0.14%	0.11%	0.07%	0.10%	0.10%
Fishing	0.03%	0.00%	1.61%	0.92%	0.20%	0.51%
Coal	0.02%	0.02%	0.01%	0.00%	0.02%	0.02%
Oil	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Gas	0.02%	0.02%	0.00%	0.00%	0.00%	0.00%
Other mining	0.02%	0.02%	0.06%	0.03%	0.00%	0.00%
Bovine meat products	0.00%	0.00%	0.00%	0.09%	69.82%	69.81%
Other meat products	0.00%	0.00%	70.17%	72.20%	0.73%	0.86%
Vegetable oils, etc.	0.00%	0.22%	0.01%	0.00%	0.26%	0.29%
Dairy	0.00%	0.00%	0.00%	0.16%	0.66%	0.66%
Rice	0.04%	0.02%	0.03%	0.05%	1.09%	2.13%
Sugar	0.00%	1.79%	0.01%	0.00%	0.26%	0.27%
Other food products	0.01%	0.01%	0.03%	0.00%	1.68%	1.53%
Beverages, etc.	0.00%	0.00%	0.79%	0.79%	0.21%	0.21%
Textiles	0.00%	0.00%	0.06%	0.04%	0.30%	0.31%
Wearing apparel	0.12%	0.13%	0.21%	0.13%	0.94%	0.94%
Leather products	0.05%	0.05%	0.06%	0.04%	0.20%	0.20%
Lumber	0.04%	0.05%	0.28%	0.17%	0.44%	0.44%
Paper products, etc.	0.01%	0.00%	0.85%	0.52%	0.66%	0.66%
Petroleum and coke	0.82%	0.89%	0.03%	0.02%	0.12%	0.12%
Chemical products, etc.	1.90%	2.04%	0.32%	0.19%	0.36%	0.36%
Other mineral products	0.04%	0.04%	0.07%	0.04%	0.08%	0.08%
Ferrous metals	0.01%	0.01%	0.03%	0.02%	0.07%	0.07%
Other metals	0.00%	0.00%	0.06%	0.03%	0.17%	0.17%
Metal products	0.52%	0.60%	0.26%	0.16%	1.35%	1.34%
Motor vehicles, etc.	0.85%	0.91%	0.03%	0.02%	0.10%	0.10%
Other transport equipment	0.01%	0.00%	0.10%	0.06%	0.15%	0.15%
Electronic equipment	0.00%	0.00%	0.03%	0.02%	0.09%	0.09%
Other machinery, etc.	1.69%	1.82%	0.13%	0.08%	0.15%	0.15%
Other manufacturing	0.05%	0.06%	0.57%	0.35%	0.79%	0.80%
Electricity	0.52%	0.57%	0.40%	0.25%	1.04%	1.04%

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Table 2.F1 – continued from previous page

Sector	<i>Vegetables and fruits</i>		<i>Other meat products</i>		<i>Bovine meat products</i>	
	domestic	foreign	domestic	foreign	domestic	foreign
Gas distribution	0.03%	0.03%	0.04%	0.06%	0.07%	0.26%
Water	0.40%	0.51%	0.15%	0.10%	0.23%	0.16%
Construction	0.36%	0.11%	0.49%	0.19%	0.38%	0.16%
Trade	1.38%	1.48%	0.37%	0.22%	1.94%	1.94%
Other transport	0.61%	0.41%	0.33%	0.06%	0.28%	0.09%
Water transport	0.56%	1.82%	0.12%	0.15%	0.26%	0.09%
Air transport	0.11%	0.46%	0.35%	0.23%	0.11%	0.32%
Communications	0.18%	0.19%	0.08%	0.05%	0.11%	0.11%
Other financial intermediation	0.16%	0.17%	0.25%	0.16%	0.73%	0.73%
Insurance	0.69%	0.75%	0.00%	0.01%	0.00%	0.02%
Other business services	0.25%	0.27%	0.13%	0.08%	0.36%	0.37%
Recreation and other services	0.91%	0.75%	0.22%	0.08%	0.27%	0.20%
Other services (government):	0.07%	0.02%	0.11%	0.10%	0.20%	0.24%
Dwellings	0.14%	0.00%	0.07%	0.00%	0.35%	0.00%

Note: This table reports use of inputs from embargoed sectors in the production of Russian sectors. The data is sourced from GTAP input-output tables.

Table 2.F2
Upstreamness of sectors in European Union

Sector	Upstreamness	Sector	Upstreamness
Private households with employed persons	1.02	Computer & related activities	2.54
Public admin. & defence; social security	1.10	Finance & insurance	2.54
Health & social work	1.11	Land transport; transport via pipelines	2.59
Education	1.22	Electricity	2.59
Hotels & restaurants	1.38	Research & development	2.67
Real estate activities	1.59	Water transport	2.74
Construction	1.60	Coke, refined petroleum and nuclear fuel	2.75
Food products, beverages and tobacco	1.73	Chemicals excluding pharmaceuticals	2.79
Textiles, textile products, leather and footwear	1.77	Other non-metallic mineral products	2.81
Manufacturing and recycling (include Furniture)	1.85	Pulp, paper products and publishing	2.83
Other community, social & personal services	1.86	Metal products, except machinery	2.85
Office, accounting & computing machinery	1.87	Renting of machinery & equipment	2.96
Motor vehicles, trailers & semi-trailers	1.89	Rubber & plastics products	2.96
Wholesale & retail trade; repairs	1.91	Wood and products of wood and cork	2.97
Machinery & equipment,	2.06	Auxiliary transport and travel activities	3.0
Building & repairing of ships & boats	2.09	Other Business Activities	3.12
Air transport	2.29	Mining and quarrying (energy)	3.63
Agriculture, hunting, forestry and fishing	2.34	Mining and quarrying (non-energy)	3.63
Electrical machinery & apparatus	2.40	Iron & steel	3.68
Post & telecommunications	2.53		

Notes: This table reports simulated composition of exports before and after the onset of Russian embargo.

Appendix 2G. Additional results of simulations

Table 2.G1
Sectoral composition of exports before and after the introduction of Russian embargo

	China		Germany		France		Russia		Ukraine		USA	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Wheat	0.00%	0.00%	0.49%	0.46%	1.30%	1.31%	0.21%	0.18%	1.37%	3.19%	2.16%	2.16%
Vegetables and fruits	0.38%	0.38%	0.47%	0.49%	1.39%	1.43%	0.08%	0.08%	0.46%	0.94%	1.84%	1.90%
Plant-based fibres	0.01%	0.01%	0.00%	0.00%	0.01%	0.01%	0.00%	0.00%	0.00%	0.00%	0.66%	0.68%
Other crops	0.15%	0.16%	0.48%	0.48%	0.44%	0.44%	0.03%	0.03%	0.19%	0.21%	0.53%	0.53%
Bovine cattle, etc	0.00%	0.00%	0.08%	0.08%	0.59%	0.59%	0.01%	0.01%	0.01%	0.01%	0.13%	0.13%
Other animal products	0.15%	0.15%	0.48%	0.49%	0.57%	0.57%	0.11%	0.11%	0.43%	0.42%	0.63%	0.64%
Wool, etc.	0.03%	0.03%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.00%	0.00%	0.00%	0.00%
Forestry	0.01%	0.01%	0.10%	0.10%	0.24%	0.24%	0.83%	0.81%	1.55%	1.67%	0.53%	0.53%
Fishing	0.00%	0.00%	0.07%	0.07%	0.55%	0.56%	0.02%	0.02%	0.08%	0.15%	1.60%	1.44%
Oil	0.00%	0.00%	0.19%	0.18%	0.09%	0.09%	53.81%	53.11%	0.03%	0.12%	3.45%	3.34%
Gas	0.00%	0.00%	2.74%	2.65%	2.13%	2.17%	8.49%	8.62%	1.07%	1.82%	1.77%	1.77%
Bovine meat products	0.00%	0.00%	0.50%	0.54%	0.64%	0.69%	0.01%	0.01%	0.08%	0.65%	0.70%	0.70%
Other meat products	0.11%	0.11%	1.43%	1.53%	1.08%	1.17%	0.10%	0.11%	0.42%	1.15%	1.08%	1.18%
Vegetable oils, etc.	0.03%	0.04%	0.83%	0.83%	0.63%	0.63%	0.73%	0.71%	18.73%	19.19%	0.65%	0.64%
Dairy	0.00%	0.00%	1.97%	1.95%	3.16%	3.16%	0.27%	0.29%	4.44%	4.44%	0.60%	0.60%
Rice	0.00%	0.00%	0.02%	0.01%	0.04%	0.04%	0.04%	0.03%	0.04%	0.04%	0.18%	0.17%
Sugar	0.00%	0.00%	0.15%	0.14%	0.49%	0.49%	0.02%	0.02%	0.32%	0.42%	0.02%	0.02%
Beverages, etc.	0.03%	0.03%	1.56%	1.56%	6.71%	6.67%	0.36%	0.38%	2.43%	2.31%	1.69%	1.69%
Textiles	7.18%	7.23%	2.98%	2.98%	2.08%	2.08%	0.21%	0.23%	1.92%	1.78%	1.40%	1.39%
Wearing apparel	5.66%	5.89%	2.07%	2.03%	2.72%	2.71%	0.13%	0.13%	2.69%	2.68%	0.38%	0.37%
Leather products	5.53%	5.57%	1.15%	1.13%	2.71%	2.66%	0.16%	0.16%	1.72%	1.67%	0.34%	0.33%
Wood products	4.42%	4.42%	3.31%	3.31%	1.69%	1.68%	2.15%	2.13%	7.27%	6.39%	1.69%	1.69%
Paper products, etc.	1.22%	1.23%	4.77%	4.77%	3.55%	3.55%	1.27%	1.29%	8.12%	7.24%	4.34%	4.36%
Petroleum and coke	0.32%	0.32%	4.21%	4.17%	5.19%	5.26%	10.88%	11.27%	4.23%	5.98%	11.70%	11.60%
Chemical products, etc.	11.94%	12.01%	41.29%	41.36%	39.70%	39.59%	9.87%	10.06%	20.56%	17.93%	31.83%	31.98%
Other mineral products	2.12%	2.14%	2.66%	2.66%	2.16%	2.15%	0.63%	0.67%	4.17%	3.77%	1.66%	1.66%
Other metals	0.95%	0.98%	6.69%	6.72%	5.98%	5.98%	7.62%	7.51%	7.47%	6.53%	7.17%	7.22%
Metal products	5.41%	5.43%	7.65%	7.65%	3.86%	3.86%	0.75%	0.78%	6.41%	5.76%	3.69%	3.68%
Electronic equipment	49.73%	49.11%	9.71%	9.70%	5.60%	5.57%	0.70%	0.73%	3.17%	2.97%	14.38%	14.45%
Other manufactures	4.62%	4.76%	1.92%	1.90%	4.71%	4.65%	0.51%	0.50%	1.50%	1.33%	3.15%	3.13%

Notes: This table reports simulated composition of exports before and after the onset of Russian embargo.

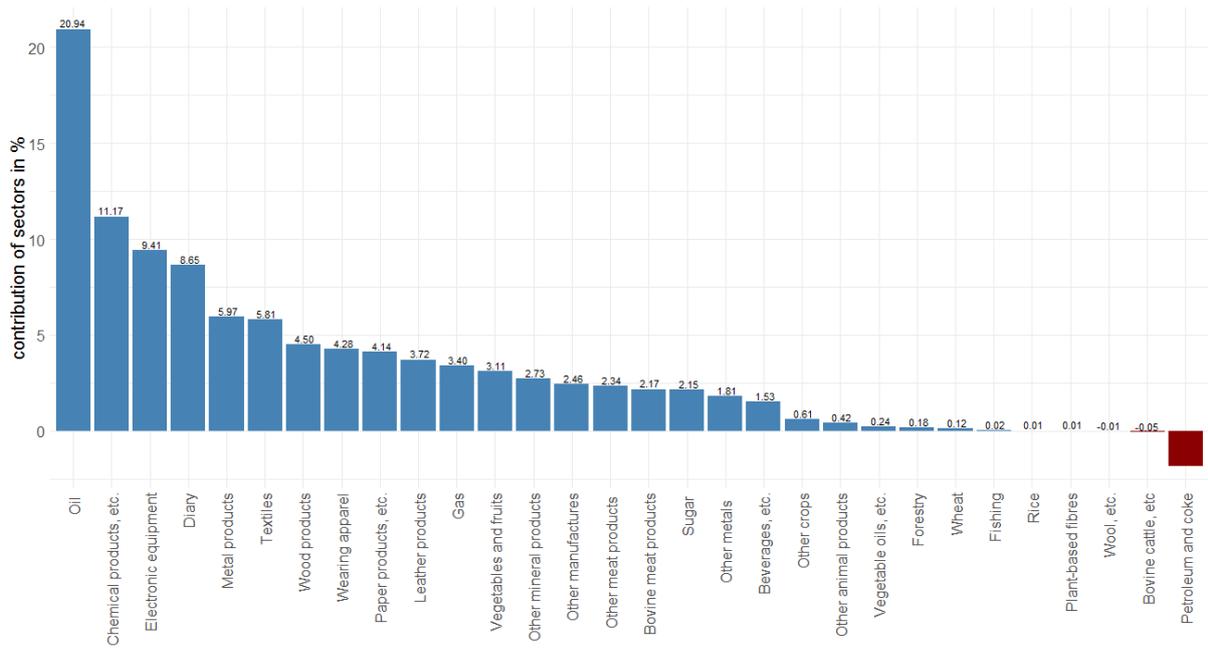


Figure 2.G1. Sectoral contribution to welfare outcomes for Russia

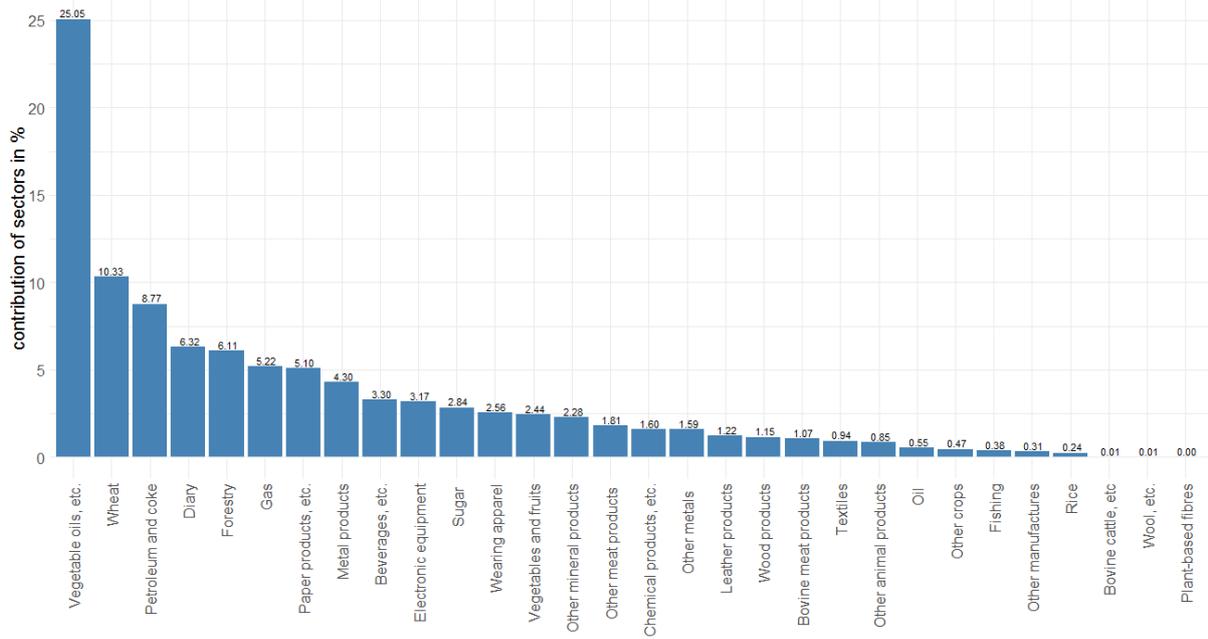


Figure 2.G2. Sectoral contribution to welfare outcomes for Ukraine

Appendix 2H. Alternative versions of the model

Table 2.H1

Outcomes of Russian embargo for Russia and embargoed countries (model with observed tariffs)

Countries	Δ Welfare	Δ Prices
Russian Federation	-1.45%	0.24%
Bulgaria	0.87%	3.84%
Czech Republic	0.35%	2.41%
Romania	0.13%	1.67%
Sweden	0.02%	1.25%
Ukraine	0%	7.05%
Portugal	-0.06%	0.17%
France	-0.13%	0.32%
Ireland	-0.13%	0.09%
Slovenia	-0.16%	1.04%
Italy	-0.17%	0.27%
United States of America	-0.17%	-0.37%
Hungary	-0.19%	1.21%
United Kingdom	-0.21%	-0.26%
Spain	-0.22%	-0.8%
Canada	-0.24%	-0.18%
Austria	-0.25%	-0.1%
Croatia	-0.26%	0.07%
Germany	-0.31%	-0.18%
Greece	-0.32%	-0.96%
Denmark	-0.34%	-0.23%
Estonia	-0.39%	2.8%
Finland	-0.4%	0.96%
Slovakia	-0.41%	1.62%
Australia	-0.42%	-0.3%
Norway	-0.43%	-0.17%
Poland	-0.55%	0.99%
Netherlands	-0.57%	0.35%
Malta	-1.57%	0.24%

Note: This table reports simulated post-embargo outcomes in terms of changes in welfare and prices.

Table 2.H2
Outcomes for third-party countries (model with observed tariffs)

Countries	Δ Welfare	Δ Prices
Belarus	2.83%	10.94%
Japan	-0.23%	-0.28%
India	-0.3%	0.16%
China	-0.4%	2.11%
Brazil	-0.43%	0.01%
Argentina	-0.54%	-0.39%
Turkey	-0.6%	0.4%
Switzerland	-0.63%	-0.14%
Indonesia	-1.17%	0.18%
Egypt	-1.87%	0%
Kazakhstan	-1.99%	0.93%

Note: This table reports simulated post-embargo outcomes in terms of changes in welfare and prices.

Table 2.H3
Simulations of the model without input-output linkages

Embargoed countries	Δ Welfare	Non-embargoed countries	Δ Welfare
Australia	0.001%	Argentina	0.007%
Belgium	-0.01%	Belarus	0.133%
Canada	-0.002%	Brazil	0.01%
Germany	-0.002%	Switzerland	0.002%
Spain	-0.008%	China	0%
France	-0.001%	Egypt	0.017%
United Kingdom	0.004%	Indonesia	0.005%
Ireland	-0.005%	India	0%
Italy	-0.002%	Japan	-0.001%
Lithuania	-0.482%	Kazakhstan	-0.004%
Latvia	0.014%	Republic of Korea	-0.001%
Malta	-0.01%	Turkey	0.01%
Netherlands	-0.012%		
Norway	0.007%		
Poland	-0.042%		
Romania	0.004%		
Russian Federation	0.057%		
Slovakia	-0.014%		
Slovenia	0%		
Sweden	0%		
Ukraine	-0.054%		
United States of America	-0.001%		

Note: This table reports simulated post-embargo outcomes in terms of changes in welfare and prices. In this version of the model, it is assumed that the input-output linkages don't exist.

RISK- AND COST-SHARING IN FIRM-TO-FIRM TRADE

3.1 Introduction

Sellers and buyers trading across borders are subject to important risks and costs throughout the entire shipping process. They undergo lengthy customs procedures, are exposed to poor infrastructure, communication and transportation services, and face uncertain business environments in the destination market. For instance, Carballo et al. (2016) show that border-processing costs range between 17% and 35%, while the applied tariffs are about 9%. As for transportation, Hummels and Schaur (2013) estimate that each day in transit results in an ad-valorem tariff of 0.6 to 2.1%. Moreover, it has also been shown that the cost of single-lane road transport is 70% higher than the cost of high-capacity expressway transport for an average shipment (Coşar and Demir 2016).

These transaction-related risks and costs might be borne either by the seller, the buyer or both. As they are not negligible, in order to reduce contract uncertainty, trading partners usually decide *ex ante* how to split responsibilities throughout the shipping process. They do so based on existing schemes of risks and costs, known as Incoterms and introduced by the International Chamber of Commerce (ICC) to facilitate the conduct of international trade. More precisely, Incoterms are contractual instruments defining a *de facto* uniform legal framework. They are widely used in international transactions, being accepted by governments and firms worldwide. Instead of drafting entire pages of explanations which might be subject to interpretations, through a three-letter abbreviation incorporated in the sales contract, trading firms clearly delimit their responsibilities for each transaction (International Chamber of Commerce 2010).

To illustrate how Incoterms diminish contract uncertainty, consider the following example. A buyer located in Buzău (Romania) orders five pallets of radio-electronic components from a seller located in Ekaterinburg (Russia). The buyer wants the seller to transport the goods up to the Romanian border. The trading partners agree to use terms which place risks and costs up to the Romanian border on seller and decide that the ownership of goods is transferred once the shipment reaches the buyer's premises. The trucker employed by the seller collects the goods. After leaving the Russian territory and entering Ukraine, due to poor infrastructure,

the truck is involved in an accident. Following the accident, the goods end up in the Dniester River. The radio-electronic components are drenched and become useless. As both parties had agreed that the seller bears all risks and costs up to the delivery point at the Romanian border, the buyer is entitled to ask for a compensation or a replacement shipment. Now, assume that the contracting parties decide to use terms implying that risks and costs are shared between the seller and the buyer. The ownership of goods is still transferred once the goods arrive at the buyer's premises. The same accident as before occurs. By using these terms, the parties implicitly agree that the seller organizes and pays for the main carriage, while the buyer bears all risks thereof. In this case, the buyer is not entitled to ask for a compensation or a replacement shipment. Hence, by clearly stating who between the seller and the buyer bears the transaction-related risks and costs, these terms reduce contract uncertainty.

This chapter analyzes empirically the factors determining how sellers and buyers split risks and costs in international trade transactions. To do so, we rely on a highly detailed dataset including the universe of daily shipments between Russian exporters and their international customers, over the 2012-2015 period. For each transaction, we observe the exporting firm, the importing firm in a given destination, the traded product and the Incoterms rule that governs the sales contract. Our analysis is performed at the transaction level, exploiting all these dimensions.

More precisely, relying on the Incoterms rules, we construct three classes of risks and costs for the trading partners: increased responsibilities on the buyer, shared responsibilities, and increased responsibilities on the seller. We start by providing stylized facts regarding the split of costs and risks across sellers, buyers, destinations, and products. Then, based on the broad patterns revealed by the data analysis, we investigate how various seller, buyer, destination and product characteristics affect the division of responsibilities in international trade transactions. Seller and buyer characteristics appear to explain a large part of the variation in the use of the different classes of responsibilities. We show that big firms and firms connected to numerous partners are more likely to bear risks and costs throughout the shipping process. More interestingly, big buyers appear to take on more responsibilities regardless of the size of the seller, whereas big sellers take on responsibilities only when the international buyer is small. While the characteristics of products and destination countries explain a smaller part of the variation in the use of the different classes of risks and costs, they also significantly affect the split of risks and costs between sellers and buyers. For instance, buyers are more likely to bear risks and costs when importing intermediate products and raw materials compared to situations where they import final goods. Finally, buyers are less willing to take on responsibilities if their country is characterized by a good business environment.

This study contributes to several strands of literature. First and foremost, it adds to work on incomplete contracts. Sales contracts are incomplete by their very nature, because firms cannot foresee all possible future states and, in any case, conditioning contracts on all future

states would bring costs to a prohibitive level. In general, incomplete contracts have been mainly used as a tool to explain *the boundaries of the firms* (i.e. number and size of existing firms). In doing so, different angles have been adopted. For instance, the property rights approach, developed by Grossman and Hart (1986) and Hart and Moore (1990), analyzes whether buyers outsource the production of an intermediate good to a supplier or integrate the latter. Under the transaction costs approach, which was first introduced by Coase (1937), firms decide how much to subcontract to upstream partners and how much to produce in-house.¹

More recently, several studies analyze how sellers and buyers - whose goal is to reduce contract incompleteness - decide upon the conditions governing their contracts. Generally, trading partners write *ex ante* contracts establishing rules about how problems should be solved, who has bargaining power, etc. Thus, before setting up a contract, firms involved in international trade transactions conduct negotiations with respect to four aspects: transfer of costs, transfer of risks, title transfer and payment terms (O'Meara 2017). The vast majority of papers investigating the contract conditions focus on the payment terms. For instance, relying on the characteristics of financial markets and contract enforcement in both the origin and the destination countries, Schmidt-Eisenlohr (2013) studies how firms optimally select the payment terms. Antràs and Foley (2015) document broad patterns in the use of financing terms based on data from a US exporter of poultry products and build a model to explain firms' choices. Niepmann and Schmidt-Eisenlohr (2017) explore under which conditions and to what extent firms use terms requiring bank intermediation to alleviate the risks in trade transactions. Finally, Demir and Javorcik (2018) analyze how firms adjust to increased competitive pressures through the choice of financing terms. Overall, these papers show that the characteristics of the destination market, especially the legal conditions, tend to play an important role in the choice of payment terms.

However, according to O'Meara (2017), the negotiations between sellers and buyers are centered around the terms dealing with the transfer of risks and costs (i.e. Incoterms), as they reduce contract uncertainty to a large extent. Once they have been selected, the other conditions (i.e. title transfer and payment terms) follow. Despite their wide use and acknowledged importance, the terms focusing on the split of risks and costs in international trade transactions have been understudied. While a few case studies exist in the logistics management literature,² to the best of our knowledge, this is the first work in the international trade literature to assess

¹The current state of the general literature on incomplete contracts is summarized by Hart (2017). Antràs (2015) and Chor (2018) provide comprehensive insights into the theory of incomplete contracts in international trade. Recent applications of the property rights approach to international trade include Antràs and Chor (2013) and Alfaro et al. (2018). As for the transactions costs approach, it has been recently applied to international trade by Fally and Hillberry (2015) and Kikuchi et al. (2018).

²Del Rosal (2016) makes use of detail data to assess the factors influencing the choice of delivery terms use in Spanish seaborne containerized trade. Schaefer (2017) analyzes how logistics management decisions are made by seller-buyer dyads and reviews more contributions related to these terms. Also, Shangina (2007) investigates the determinants of Incoterms in the seafood exports from Norway to Russia. Ying Szu (2014) explores the determinants of Incoterms selection and in addition their impact on export performance based on a survey.

how exporting and importing firms split risks and costs throughout the shipping process.

Our study also contributes to the recent and growing literature on firm-to-firm connections in international trade.³ Most of the papers exploring the role of heterogeneous firms, either relied on the exporter side, building on Melitz (2003), or the importer side, as in Antras et al. (2017). A nascent and increasing body of research analyzes the heterogeneity of both exporters and importers and the various implications for the exporter-importer relationships. Bernard et al. (2009), Castellani et al. (2010) and Muûls and Pisu (2009), to name a few, explore both seller and buyer heterogeneity among US, Italian and Belgian firms, respectively. A detailed picture of the current literature is provided by Bernard and Moxnes (2018). We contribute to this strand of research by analyzing how both seller and buyer characteristics shape the decisions on how to split responsibilities throughout the shipping process.

The remainder of this chapter is organized as follows. Section 3.2 describes the data and provides stylized facts regarding the split of costs and risks in international trade transactions across several dimensions: sellers, buyers, products and destinations. In Section 3.3, we explore how seller and buyer characteristics shape the choice of a class of responsibilities. The empirical strategy, the results and some robustness tests are presented. Sections 3.4 and 3.5 analyze how risks and costs are divided between sellers and buyers, based on the product and the destination characteristics, respectively. In Section 3.6 we sketch a simple model within the transaction costs approach and demonstrate its empirical implications. Section 3.7 concludes.

³Different aspects have been addressed by this strand of research: the role of complex information transmission in firm-to-firm trade (Cristea 2011), the firm-to-firm matching along the global supply chain (Dragusanu 2016), the heterogeneity and the granularity in individual buyer-seller relationships (Eaton et al. 2016), etc.

3.2 Data

This study is based on a highly detailed dataset, including the universe of export transactions from the Russian Federation over the 2012-2015 period. More precisely, the database encompasses all export declarations submitted to the Russian Customs Authorities on a daily basis during this time span. A declaration corresponds to a shipment and includes the following information among many other things: the identification number (ID) of a Russian exporting firm (seller) and its location, the name of the importing firm (buyer) and its exact address, the product(s) exchanged detailed at the HS10 level, the ID of the customs point through which the transaction is processed and the exact date the shipment is registered and released by customs authorities. Moreover, for each shipment, we have information on the value (in dollars) and the volume (in kilograms) exchanged, the terms of the contract sales (i.e. Incoterms), the transport mode(s) within and beyond borders, and whether the goods are transported in containers.

While sellers, HS10 products and customs points are uniquely identified in the dataset, when it comes to buyers, we rely on their names and addresses to construct a unique identifier. However, since the export declarations are filled in manually, potential errors may occur. Thus, creating an ID using firm names and addresses as reported in raw data may lead to an overestimation of the number of buyers. In order to overcome this issue, we proceed to an extensive cleaning of the buyer names before associating them together as a unique firm. Furthermore, we use the locations of customs points⁴, sellers and buyers to compute the distance from a given seller to the customs point and from the customs point to the buyer. The methods used to create unique buyer IDs and to compute distances are explained in Appendix A.

During the period under observation, more than 45,013 different Russian sellers have delivered 3,919,429 shipments including 9,425 different HS10 products to more than 131,659 buyers across 218 destinations. The detailed statistics corresponding to each year are presented in Table 3.1. The number of sellers increases over time, from 20,000 in 2012 to almost 25,000 in 2015. As far as the buyers are concerned, the same trend can be noticed. Moreover, the annual number of buyers appears to be around 2.5 times more important than the number of sellers. The number of seller-buyer pairs rises from 76,834 in 2012 to 90,810 in 2015. Over 2012-2015, the overall number of shipments goes up. The last line describes the annual value of Russian exports towards the world.⁵ We notice that the export value (in million dollars) is more or

⁴The customs control points are scattered within the territory of Russia and the other members of Eurasian Customs Union – Armenia, Belarus, Kazakhstan and Kyrgyzstan. The map illustrating their locations is reported on Fig. 3.A1 (see Appendix 3A)

⁵A comparison with the BACI database shows very similar figures. In 2012, the value of exports is about 5% lower in our dataset than in BACI. However, for the following years, the gap between the two datasets decreases systematically. The differences that we observe are mainly due to the fact that BACI includes information on Belarus and Kazakhstan, countries that are part of the Eurasian Customs Union together with Russia. Trade with these countries is not recorded in our customs data. Moreover, BACI is constructed relying on a specific procedure that reconciles the declarations of the exporter and the importer: http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=1. Thus, it does not provide real trade as declared by customs, but the most likely one, based on the declarations of both partners.

Table 3.1
Overall annual summary statistics

Statistics	Year			
	2012	2013	2014	2015
Nb of sellers	20,279	20,885	21,591	24,579
Nb of buyers	50,842	52,201	53,771	62,525
Nb of seller-buyer pairs	76,834	80,172	83,562	90,810
Nb of shipments	885,483	950,046	996,162	1,087,738
Nb of HS10 products	7,365	7,562	7,523	7,900
Nb of destinations	198	204	202	200
Nb of customs points	509	489	519	517
Export value (million \$)	459740.7	461767.3	447208.6	307836.6

Note: The figures reported in this table include oil for comparison purposes with the official statistics.

less stable during 2012-2014 and decreases drastically in 2015. This decline can be explained through the international sanctions following the Russian embargo.

In what follows, the sector corresponding to mineral fuels and oils is excluded from the analysis for two main reasons. First, this sector dominates Russian trade to a large extent, being likely to induce biases in our analysis. Second, Incoterms are designed for the sale of goods that can be unitized (O'Meara 2017). Thus, Incoterms are not used for oil delivered via pipelines.

3.2.1 Incoterms

Our goal is to understand how sellers and buyers choose to divide their obligations, risks and costs in international trade transactions. To do so, we rely on Incoterms, which "define the responsibilities of sellers and buyers for the delivery of goods under sale contracts. They are authoritative rules for determining how risks and costs are allocated to the parties" (International Chamber of Commerce 2010). The Incoterms rules have been first introduced by the ICC in 1936 and widely used in international trade ever since. Their abbreviation through a set of three letters is extensively recognized and reflects the business-to-business practices. Over the years, Incoterms have been regularly amended to keep up with the latest developments in terms of international transactions (i.e. evolution of transport practices, use of electronic communications, etc.). The last revision of Incoterms rules by the ICC dates back to 2010.

In all international transactions, sellers and buyers have to deal with ten main issues (O'Meara 2017): (i) provision of goods; (ii) customs procedures for both export and import; (iii) organization of the international transportation and insurance; (iv) delivering and accepting the goods; (v) transfer of risks from seller to buyer; (vi) allocation of costs between seller and buyer; (vii) notifications from seller to buyer and vice-versa; (viii) provision of documentation (i.e. proof

of delivery, etc); (ix) operations such as checking, packaging, marking, etc.; (x) assistance with information.

The Incoterms rules show how these different responsibilities are split between the seller and the buyer. As of 2010, there are 11 rules, as shown in Figure 3.1.⁶ The individual terms are presented in ascending order of the obligations of the seller and descending order of the obligations of the buyer. To illustrate this progression, the main stages of the shipping process are also presented, highlighting where the delivery occurs. When it comes to Incoterms, the concept of delivery indicates where the risk of loss of or damage to the goods passes from the seller to the buyer (International Chamber of Commerce 2010).⁷

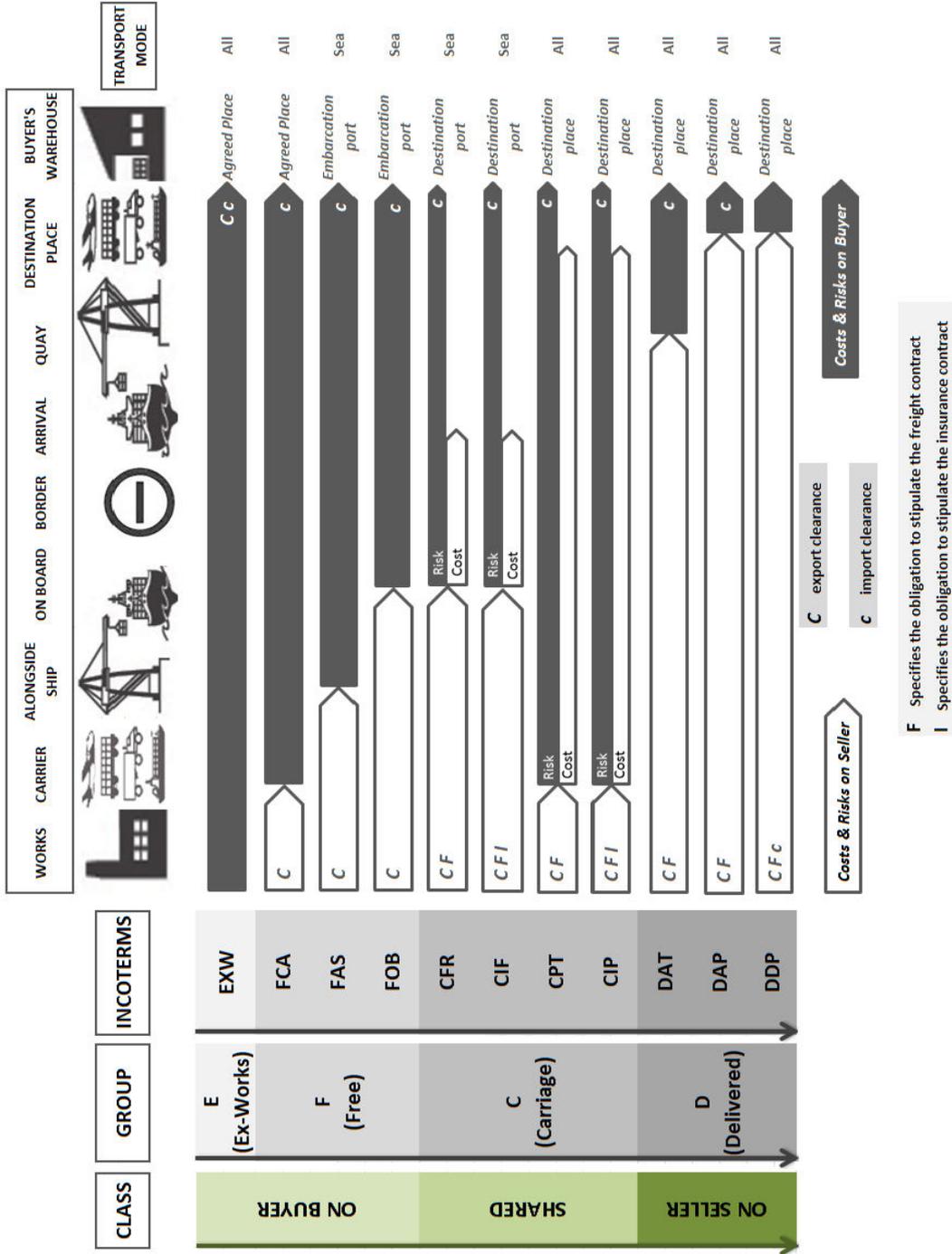
Incoterms can be grouped relying on the share of obligations between the seller and the buyer (Malfliet 2011). Thus, four categories can be distinguished: E, F, C, and D. In the case of E-terms (EXW), the goods are made available to the buyer at the seller's premises. Put it differently, goods are *ready to be collected*. The F-terms (FCA, FAS, FOB) imply that the buyer is accountable for all risks and costs associated with the main international transportation. Goods are *sent from*. As far as the C-terms (CFR, CIF, CPT, CIP) are concerned, the seller pays for the main international transportation, but does not bear the risks associated with it. Goods are *sent to, freight prepaid*. Finally, the D-terms (DAT, DAP, DDP) state that the seller is held responsible for all risks and costs related to the main international carriage up to the delivery point in the country of destination. Goods are *delivered at*. To sum up, for the E- and F- terms the buyer takes more responsibilities compared to the seller, for the C-terms the responsibilities are shared between the seller and the buyer, and for the D-terms the seller has more responsibilities compared to the buyer. Our analysis relies on these last groupings of risks and costs: *On buyer* responsibilities (i.e. E+F), *Shared* responsibilities (i.e. C), and *On seller* responsibilities (i.e. D).

Certain Incoterms rules are adapted to any transport mode (EXW, FCA, CPT, CIP, DAT, DAP, DDP), including multimodal, whereas certain rules are recommended for maritime and inland waterway transport (FAS, FOB, CFR, CIF) (International Chamber of Commerce 2010). Since within each of the three groupings of terms previously defined (*On buyer*, *Shared*, *On seller*) there are rules used for both maritime and non-maritime transportation, the transportation mode is taken into account in our empirical analysis.

⁶The detailed description of Incoterms rules is presented in Appendix B.

⁷In the case of the C-terms, even though the risk passes from the seller to the buyer at an early stage of the shipping process, the costs for the next stages might still be borne by the seller.

Figure 3.1. Balance of obligations, risks and costs between the seller and the buyer



Source: The figure is created by the authors, based on a chart designed by the ICC and available at: https://www.export.org.uk/page/Incoterms_Online. The delivery takes place where the white wide arrow ends and the black wide arrow begins. For the C-group, where the white wide arrow ends, two other narrower arrows begin, one white and one black. The white one indicates that costs are still borne by the seller, whereas the black one indicates that risks are on the buyer. The presence of a letter on the white/black arrow implies that the seller/buyer is in charge of the corresponding activity. C/c refers to the obligation for export/import clearance. F mentions the responsibility to stipulate the freight contract. I specifies the responsibility to stipulate the insurance contract.

Table 3.2
Share of transactions and export value (%) by classes of risks and costs

Responsibilities	2012		2013		2014		2015	
	Trans.	Exp. Val.						
<i>On buyer</i>	53.4	56.6	53.6	52.8	51.9	51.6	54.8	53.8
<i>Shared</i>	22.0	24.4	22.9	28.2	24.2	27.6	22.7	26.5
<i>On seller</i>	24.6	19.0	23.5	19.0	23.9	20.8	22.5	19.7

Note: For each year, the first and the second columns present the share of transactions and the share of export value, respectively, occurring on a given class of responsibilities: *On buyer* (E- and F-terms), *Shared* (C-terms), *On seller* (D-terms).

The use of the three classes of responsibilities over the period 2012-2015 is detailed in Table 3.2. For each year, the first column reports the share of transactions covered by a given class of terms, while the second column shows the share of total exports (in value) occurring on a specific type of terms. Overall, we notice a stable use of the different classes of risks and costs during the period under observation. Thus, in slightly more than half of all annual transactions and for slightly more than half of the export value, the risks and costs are mainly borne by the buyer. The responsibilities are shared between the seller and the buyer in around 23% of all transactions, which amount to around 26% of the total export value. Finally, the seller takes more responsibilities than the buyer in 24% of the cases, representing 19% of the export value of all Russian firms.⁸

The stable use of the different categories of terms over time is also confirmed by a more granular analysis. During the whole period, we observe 232,797 unique seller-buyer pairs in our data, out of which only 13,744 switch to another class of risks and costs. This represents a share of 5.9% of all seller-buyers pairs. Indeed, according to Bergami (2012) traders do not often change from the established routines. Thus, a seller-buyer dyad tends to use the same terms for the upcoming transactions. When it comes to individual sellers and buyers, 28.4% and 16.8%, respectively, appear to switch to another category during the time span considered. Since the use of the different types of terms does not dramatically change over time for a seller-buyer pair, the following statistics only refer to 2012.⁹

In order to explore the sources of variation in the use of the different groupings of terms, we proceed as follows. We separately regress a dummy set to one for transactions occurring on a given class of responsibilities, on several sets of fixed effects: seller, buyer, seller-buyer, product, and destination country.¹⁰ Table 3.3 presents the R-squared of the different regressions. Seller, buyer and seller-buyer pair characteristics explain a large part of the variation in

⁸To further understand the composition of each class of risks and costs, the same exercise is conducted on the individual Incoterms rules. The results are presented in Table 3.C1.

⁹The figures are very similar for the upcoming years.

¹⁰This approach follows Antràs and Foley (2015). While an ANOVA test would have provided a clear decomposition of the variance, convergence issues appear, due to the sizable sets of fixed effects.

Table 3.3
Sources of variation in the use of the different classes of risks and costs (2012)

Source	Responsibilities		
	<i>On buyer</i>	<i>Shared</i>	<i>On seller</i>
Seller	0.636	0.619	0.657
Buyer	0.780	0.780	0.774
HS10 Product	0.191	0.243	0.265
Destination	0.149	0.080	0.202
Seller-Buyer	0.941	0.929	0.943

Note: The table reports the R-squared corresponding to simple regressions of a dummy variable set to 1 for a given class (*On buyer*, *Shared*, *On seller*) on different sets of fixed effects as described in column *Source*.

the use of the different types of terms. Across all classes of risks and costs, the R-squared of the regressions on seller, buyer, and seller-buyer pair fixed effects is, respectively, around 0.6, 0.7, and 0.9. The differences across products explain around 20% of the use of the different groupings of terms. The destination country characteristics account for less than 20% of the variance.¹¹

3.2.2 Stylized facts

This section explores the patterns of use of different classes of responsibilities. Thus, we start by presenting broad features of the sellers, buyers and seller-buyer pairs across the three groupings of risks and costs. Then we explore the product and destination dimensions, respectively, in relation to the different classes of risks and costs.

The characteristics of exporting and importing firms appear to determine to a large extent the use of the different categories of terms. As balance-sheet data on Russian exporters and their international customers are not easily available, we rely on the customs data at our disposal to infer characteristics related to the size of the partners.

First, for Russian sellers, the customs data include the universe of exporters. Therefore, the size of a Russian seller s in year t is proxied through its total export sales across all HS10 products p and buyers b : $Size_{s,t} = \sum_{p,b} Export\ Value_{s,t,p,b}$. We also compute the total number of international buyers that a Russian seller is connected to within a year, regardless of the product exchanged.

Second, for international buyers, we only observe their total purchases across the Russian firms. This provides a distorted picture of their size. In order to derive a more appropriate

¹¹For any other combinations of firm and product characteristics or firm and destination characteristics, the R-squared is triggered by firms' characteristics.

Table 3.4
Summary statistics for seller and buyer sizes (2012)

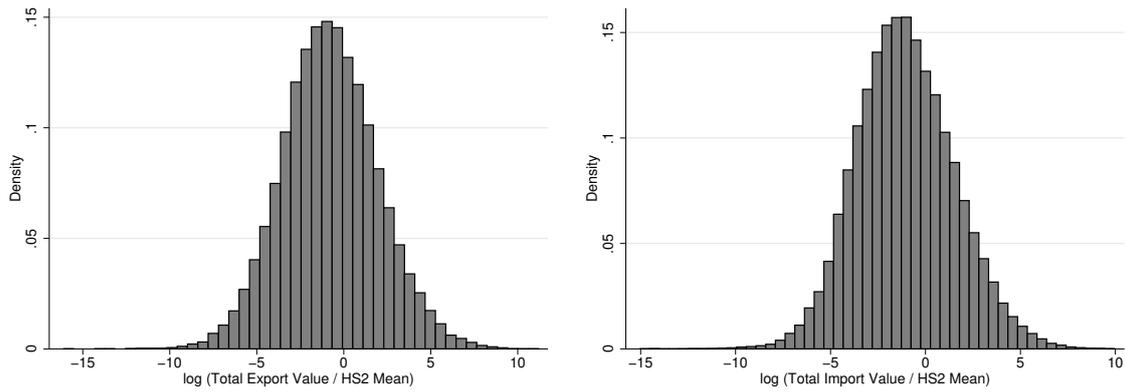
	Nb	Mean	Std Dev	p10	p25	p50	p75	p90	p95	p99
<i>Seller size (export values)</i>										
All firms	19022	11.74	278.94	0.01	0.03	0.14	0.79	3.77	10.13	100.76
Firms: <i>On buyer</i> responsibilities	11502	12.32	182.11	0.01	0.04	0.19	1.08	5.68	15.75	159.34
Firms: <i>Shared</i> responsibilities	6855	16.51	214.29	0.01	0.04	0.21	1.37	7.04	20.42	225.86
Firms: <i>On seller</i> responsibilities	6006	20.69	431.08	0.02	0.08	0.41	1.83	8.53	22.77	261.19
<i>Buyer size (Comtrade-adjusted import purchases)</i>										
All firms	49066	113.97	1,159.68	0.05	0.29	2.30	19.02	122.31	335.55	1,917.19
Firms: <i>On buyer</i> responsibilities	26121	111.17	1,046.65	0.06	0.33	2.32	17.32	108.45	323.63	1,955.28
Firms: <i>Shared</i> responsibilities	16846	159.49	1,539.56	0.10	0.58	4.36	32.78	187.14	460.09	2,564.71
Firms: <i>On seller</i> responsibilities	12154	131.63	1,610.74	0.04	0.21	1.75	15.60	108.84	310.57	1,838.26

Note: The first column reports the number of firms in total and for each class of risks and costs separately. As the same firm may use various terms with different partners, the sum of the number of firms across the various terms exceeds the overall number of firms. *Mean* and *Std Dev* report the average size of firms and the standard deviation, respectively. *p10-p99* reports values for the 10th-99th percentile of the distribution. The sizes have been computed as described in the data section and are in million dollars.

measure, we make use of the UN Comtrade database.¹² More precisely, based on these data we compute the share of the Russian Federation in the total imports of an HS6 product in a destination d in year t : $Share\ RUS_{HS6,d,t} = Import\ value\ from\ RUS_{HS6,d,t} / Import\ Value\ from\ WLD_{HS6,d,t}$. Then, for a unique buyer-year-HS10 product-seller quadruplet, we divide the total import sales by the previously computed share. Finally, to obtain the buyer size, we sum the Comtrade-adjusted import purchases of buyer b in year t across all HS10 products p and sellers s : $Size_{b,t} = \sum_{p,s} (Import\ Value_{b,t,p,s} / Share\ RUS_{HS6,d,t})$. We also compute the total number of Russian sellers that an international buyer is connected to within a year, regardless of the product exchanged.

The sizes of sellers and buyers are very heterogeneous. Table 3.4 provides summary statistics for firm sizes in 2012. The average size of a Russian exporter is around 11.74 million dollars, with a standard deviation of 278.94 million dollars. Moreover, sellers at the 95th percentile are more than 1000 bigger than sellers at the 10th percentile and account for 94% of total sales. When it comes to international buyers, the average size is around 113.97 million dollars, with a standard deviation of 1,159.68 million dollars. Buyers at the 95th percentile are more than 6000 times bigger than buyers at the 10th percentile and account for 82% of total purchases. The histogram in Figure 3.2 illustrates the full seller and buyer size distributions, after demeaning at the HS2-level. In both cases, the average firm within a sector corresponds to the zero value on the x-axis. Thus, the largest firms are about 20,000 times bigger than their sector average.

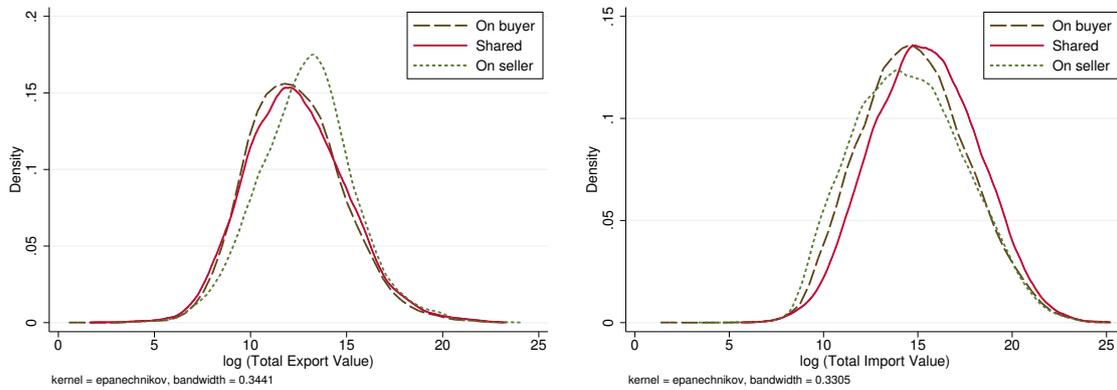
¹²UN Comtrade is the pseudonym for the United Nations International Trade Statistics Database and provides annual bilateral trade data detailed at the HS6 level.



(a) Full seller size and buyer size distributions (2012)

(b) Export Sales to the World

Figure 3.2. Full seller size and buyer size distributions (2012)



(a) Export Sales to the World

(b) Import Sales from Russia

Figure 3.3. Seller size and buyer size distributions by class of risks and costs (2012)

Table 3.4 also describes firms' heterogeneity across the different classes of responsibilities. Thus, we notice that the sellers willing to take more risks and costs have an average size 20% higher than the ones sharing responsibilities with buyers and 40% higher than the ones charging more risks and costs on buyers. The standard deviation for seller sizes is also very important in the case of *On seller* responsibilities (431.1), compared to *On buyer* (182.1) and *Shared* responsibilities (214.3). The Figure 3.3(a) confirms that the distribution of full firm size for the sellers taking more risks and costs is shifted to the right and has a higher dispersion compared to the other two distributions. As for buyers, we observe that, in the case of *Shared* responsibilities, their average size is 17% higher compared to their peers taking more obligations and 30% more important than the one of their peers charging more risks and costs on sellers. The Figure 3.3(b) shows that, with some variations, the distribution of full buyer size is similar across all groupings of terms.

Table 3.5
Summary statistics for seller and buyer connections (2012)

	Nb	Mean	Std Dev	p10	p25	p50	p75	p90	p95	p99
<i>Number of international customers</i>										
All firms	19022	4.3	11.3	1	1	1	3	9	15	47
Firms: <i>On buyer</i> responsibilities	11502	5.6	13.9	1	1	2	5	12	20	61
Firms: <i>Shared</i> responsibilities	6855	6.7	16.7	1	1	2	5	14	25	84
Firms: <i>On seller</i> responsibilities	6006	7.5	17.0	1	1	3	7	16	28	83
<i>Number of Russian sellers</i>										
All firms	49066	1.7	3.1	1	1	1	1	3	4	11
Firms: <i>On buyer</i> responsibilities	26121	2.0	4.2	1	1	1	2	4	6	14
Firms: <i>Shared</i> responsibilities	16846	2.0	4.7	1	1	1	2	3	6	16
Firms: <i>On seller</i> responsibilities	12154	2.6	5.8	1	1	1	2	5	8	22

Note: The first column reports the number of firms in total and for each class of risks and costs separately. As the same firm may use various terms with different partners, the sum of the number of firms across the various terms exceeds the overall number of firms. *Mean* and *Std Dev* report the average number of partners and the standard deviation, respectively. *p10-p99* reports the number of connections for the 10th-99th percentile of the distribution.

The number of connections for sellers and buyers are presented in Table 3.5. The average number of buyers for a Russian seller is 4.3 and the standard deviation is 11.3. The average number of Russian sellers for an international buyer is 1.7, with a standard deviation of 3.1. Half of all Russian firms have only one international partner, while the top 1% of exporters sell to more than 47 customers. Half of the customers buy from one Russian seller, while the top 1% of buyers are connected to more than 11 Russian sellers. The analysis across the different groupings of terms shows that, on average, sellers taking more risks and costs have 10% more partners than the ones sharing risks and costs with the buyers and 25% more connections than the ones charging more responsibilities on buyers. As for buyers, the picture is less clear-cut. On average, *On buyer* and *Shared* responsibilities are used when a buyer is connected to 2 Russian sellers, whereas *On seller* responsibilities appear to be used when a buyer has around 2.6 partners. Fig. 3.4 shows that the number of connections is dispersed and skewed even within HS2-sectors. Sellers and buyers with the highest number of buyers and sellers, respectively, are connected to 50 times more partners than the average firm within a sector.

Table 3.6 presents statistics for seller-buyer pairs. The transaction value of the average seller-buyer pair is around 1.39 million dollars, with a standard deviation of 21.84 million dollars. Moreover, we notice that the transaction value of the average seller-buyer pair relying on *On buyer* responsibilities is 24% and 38% higher than for *Shared* and *On seller* responsibilities, respectively. Also, the transaction value of seller-buyer pairs at the 95th percentile is 270 times more important than for seller-buyer pairs at the 10th percentile. As far as the split of risks and costs is concerned, for dyads at the 95th percentile, the transaction value for *On buyer* and *Shared* responsibilities is, respectively, 23% and 28% higher than for *On seller* risks and costs.

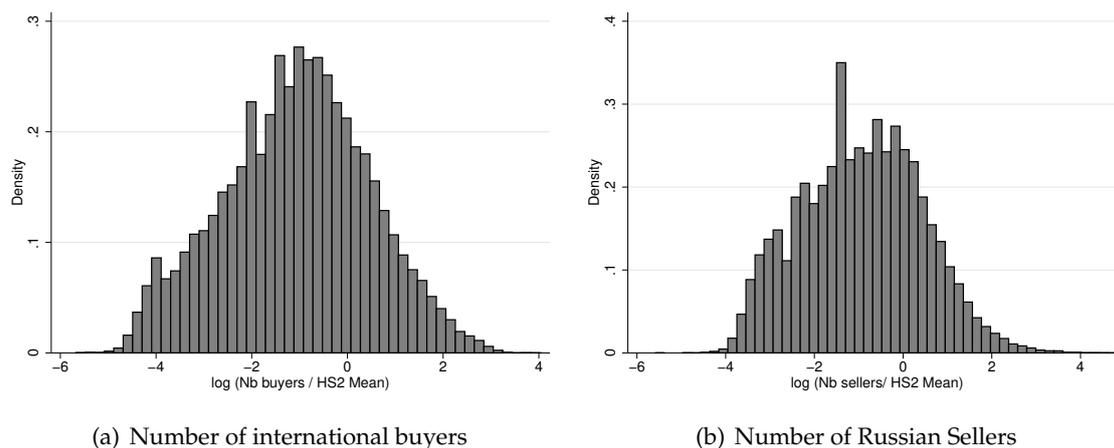


Figure 3.4. Distribution of seller and buyer connections (2012)

Table 3.6
Summary statistics for seller-buyer relations (2012)

	Nb	Mean	Std Dev	p10	p25	p50	p75	p90	p95	p99
<i>Seller-Buyer Pairs (Transaction values)</i>										
All pairs	80813	1.39	21.84	0.01	0.02	0.07	0.28	1.11	2.73	18.10
Pairs: <i>On buyer</i> responsibilities	40264	1.59	26.86	0.01	0.02	0.07	0.28	1.11	2.79	19.41
Pairs: <i>Shared</i> responsibilities	21873	1.21	13.34	0.00	0.02	0.06	0.28	1.20	2.99	18.35
Pairs: <i>On seller</i> responsibilities	20741	0.99	10.68	0.01	0.02	0.07	0.27	0.96	2.15	12.13
<i>Seller-Buyer Pairs (Number of transactions)</i>										
All pairs	80813	9.81	59.54	1	1	2	5	16	33	131
Pairs: <i>On buyer</i> responsibilities	40264	11.50	74.94	1	1	2	6	19	38	154
Pairs: <i>Shared</i> responsibilities	21873	8.94	74.52	1	1	2	4	13	28	121
Pairs: <i>On seller</i> responsibilities	20741	12.83	85.72	1	1	2	8	23	45	163

Note: The first column reports the number of pairs in total and for each class of risks and costs separately. As the same pair may use various terms, the sum of the number of pairs across the various terms slightly exceeds the overall number of pairs. *Mean* and *Std Dev* report the transaction value and the standard deviation, respectively, for the average pair. *p10-p99* reports values for the 10th-99th percentile of the distribution. The values are in million dollars.

Moreover, the average seller-buyer pair operates 9.81 transactions, with a standard deviation of 59.54 transactions. It appears that the average seller-buyer dyad using *On seller* risks and costs trades 10% and 30% more frequently compared to the average seller-buyer dyad using *On buyer* and *Shared* responsibilities, respectively. As for dyads at the 95th percentile, they trade on *On seller* risks and costs 15.5% more often than on *On buyer* risks and costs and 37.7% more often compared to *Shared* responsibilities. All in all, seller-buyer pairs seem to use *On seller* risks and costs for more frequent transactions with a lower value, while *On buyer* and *Shared* risks and costs are used for less frequent transactions with a higher value.

The product dimension could also explain how sellers and buyers split responsibilities throughout the shipping process. Table 3.7 reports statistics for the top 20 HS2 sectors, which account for 88% of Russian trade (after exclusion of oil). The sectors with an important share in total exports (> 5%) are: *Iron and steel, Precious metals, Fertilisers, Aluminium and articles thereof,*

Table 3.7

Share of export value (%) for the top 20 HS2 sectors and composition by classes of risks and costs (2012)

Sector	Description	Total	Responsibilities		
			<i>On Buyer</i>	<i>Shared</i>	<i>On seller</i>
72	Iron and steel	17.2	84.4	9.4	6.2
71	Precious metals	11.2	29.7	42.5	27.7
31	Fertilisers	9.5	56.2	15.7	28.1
76	Aluminium and articles thereof	5.9	91.6	5.9	2.5
44	Wood and articles of wood	5.7	51.8	10.0	38.2
10	Cereals	5.3	89.3	4.1	6.6
84	Nuclear reactors, boilers, machinery	4.3	29.0	27.6	43.4
28	Inorganic chemicals	3.8	46.9	37.1	16.0
29	Organic chemicals	3.7	30.8	49.8	19.5
74	Copper and articles thereof	3.6	46.2	41.0	12.9
40	Rubber and articles thereof	3.0	42.5	32.8	24.7
26	Ores, slag and ash	2.9	73.6	12.6	13.8
85	Electrical machinery and equipment	2.3	26.1	48.4	25.5
03	Fish and crustaceans	2.2	26.1	68.1	5.8
15	Animal or vegetable fats and oils	1.6	78.9	6.6	14.5
73	Articles of iron or steel	1.5	45.0	29.3	25.7
25	Salt, sulphur, earths and stone	1.2	47.3	33.6	19.1
39	Plastics and articles thereof	1.1	48.6	33.1	18.3
48	Paper and paperboard	1.1	47.3	38.4	14.2
75	Nickel and articles thereof	0.8	85.1	12.0	2.8

Note: The first column reports the share of a sector in the total exports of Russia. The top 20 HS2 sectors account for 88% of total exports (excluding oil). The next three columns show the share of exports covered by the different classes of responsibilities within a sector. For instance, *Iron and steel* represents 17.2% of Russian exports and 84.4% of trade in this sector occurs on *On buyer* responsibilities.

Wood and articles of wood, and *Cereals*. An analysis of how the risks and costs are split across these sectors shows that *On buyer* responsibilities account for more than 84% of total trade in *Iron and steel*, *Aluminium and articles thereof* and *Cereals*. Although almost half of trade in *Fertilisers* and *Wood and articles of wood* also takes place on *On buyer* responsibilities, we notice an increase in the use of *On seller* risks and costs, which account for 28% and 38% of total trade in these sectors, respectively. On the contrary, in the case of *Precious metals*, the vast majority of trade occurs on *Shared* responsibilities. These figures suggest that the split of risks and costs varies across sectors. Overall, it seems that buyers are more likely to bear risks and costs for raw materials and intermediate goods, compared to other types of products.

To further explore this aspect, we classify goods in four categories according to different stages of processing, as defined by UNCTAD. The upper panel of Table 3.8 shows that Russian firms mainly export intermediate goods (64.4%) and raw materials (17.8%). Capital and consumer goods together add up to 17.8% of all Russian exports. If we analyze how risks and

Table 3.8
Share of export value (%) for different types of goods and composition by classes of risks and costs (2012)

Type of goods	Total	Responsibilities		
		<i>On buyer</i>	<i>Shared</i>	<i>On seller</i>
<i>Stages of Processing (UNCTAD)</i>				
Capital goods	9.3	32.1	33.5	34.5
Consumer goods	8.5	45.5	36.1	18.4
Raw materials	17.8	74.4	15.2	10.4
Intermediate goods	64.4	56.7	24.1	19.3
<i>Differentiated vs. Homogeneous</i>				
Differentiated goods	19.3	43.5	33.0	23.5
Homogeneous goods	80.7	62.3	21.3	16.4

Note: The first column reports the share of a type of goods in the total exports of Russia. The next three columns show the share of exports covered by the different classes of responsibilities for a type of goods. For instance, for the upper panel, the *Intermediate goods* represent 64.4% of Russian exports and 56.7% of trade for this category occurs on *On buyer* responsibilities. In the same way, for the lower panel, *Differentiated goods* represent 19.3% of Russian exports and 43.5% of trade for this category occurs on *On buyer* responsibilities.

costs are split across these different types of goods, we notice that in the case of raw materials *On buyer* responsibilities are extremely important, covering 74.4% of total exports. *Shared* and *On seller* responsibilities cover less than 15% of Russian exports of raw materials each. While *On buyer* risks and costs are also prevalent for intermediate goods (56.7%), the use of *Shared* and *On seller* responsibilities increases to 24% and 19.3% of total exports, respectively. In the case of consumer goods, *On buyer* risks and costs become less important in favor of *Shared* risks and costs. All groupings of responsibilities cover similar shares of total trade in capital goods. Furthermore, in the lower panel of Table 3.8, we analyze trade in differentiated and homogeneous goods. Only 19.3% of the total Russian exports refer to differentiated goods. As for the split of responsibilities across these two types of products, *On buyer* responsibilities are less used in the case of differentiated goods, compared to homogeneous goods. At the same time, we observe a higher use of *Shared* and *On seller* responsibilities for differentiated products, compared to homogeneous goods.

Furthermore, the destination type may also affect the division of responsibilities between sellers and buyers. In this section, we analyze whether there is variation in the use of the different classes of responsibilities, depending on the business regulations in the destination country. We rely on the *Doing Business* indicators, which take into account a wide array of factors likely to influence the overall business environment of a country, including both practical and legal aspects.¹³

¹³Contract enforcement, which is analyzed in the papers on the payment terms - Schmidt-Eisenlohr (2013),

Table 3.9
Share of export value (%) for different categories of destinations and composition by classes of risks and costs (2012)

<i>Doing Business</i>	Total	Responsibilities		
		<i>On buyer</i>	<i>Shared</i>	<i>On seller</i>
Low level	49.5	64.0	21.3	14.7
High level	50.5	50.8	26.5	22.7

Note: The first column reports the share of a category of destinations in the total exports of Russia according to the *Doing Business* status. The next three columns show the share of exports covered by the different classes of responsibilities for a given category of destinations. For instance, 50.5% of Russian exports go to high *Doing Business* destinations and 50.8% of trade for this category occurs on *On buyer* responsibilities.

In Table 3.9, we observe that half of all Russian exports go to destinations with a good business environment and the other half to destinations with low scores of *Doing Business*.¹⁴ Overall, the statistics suggest that there is not much variation in the use of the different classes of risks and costs according to the *Doing Business* status in the destination country. In all types of destinations, *On buyer* responsibilities prevail, followed by *Shared* and *On seller* responsibilities. However, we notice that *Shared* and *On seller* responsibilities tend to cover a higher share of exports in the destinations with a high level of *Doing Business*.¹⁵

3.3 Seller and Buyer Characteristics

This section explores how seller and buyer characteristics influence the split of risks and costs in international trade transactions. Section 3.3.1 describes the empirical strategy. In Section 3.3.2 we analyze the results, whereas in Section 3.3.3 we present several robustness tests.

3.3.1 Strategy

Firms' characteristics appear to influence the choice of the various classes of risks and costs to a large extent. In order to understand how features of both sellers and buyers shape the use of the different responsibilities, our empirical approach draws mainly on the two-sided heterogeneity literature. Bernard et al. (2018) show that only high-productivity sellers export to many buyers and their marginal customer is small. At the same time, high-productivity buyers purchase from many sellers and their marginal supplier is small. These results are triggered by the fact that only high-productivity firms are better able to cover fixed (i.e. relationship-

Antràs and Foley (2015), Demir and Javorcik (2018) - is already included in the *Doing Business* score.

¹⁴The *Doing Business* indicators come from the World Bank. Countries with a score above the median are assumed to have a good business environment. On the opposite, countries with a score below the median are considered as having a poor business environment.

¹⁵Similar figures emerge if we consider the contract enforcement or the development status of the destination countries instead of the *Doing Business* indicators.

specific) and variable (i.e. trade) costs.

The different categories of risks and costs may impact the repartition of fixed and variable transaction costs between sellers and buyers.¹⁶ Thus, *On buyer* responsibilities disproportionately increase costs for buyers, whereas *On seller* responsibilities disproportionately raise costs for sellers. As the more productive firms are generally better able to cope with additional costs, the overall efficiency of sellers and buyers is likely to influence the split of risks and costs throughout the shipping process. Moreover, the seller-buyer network structure is also expected to play an important role. Who sells to whom or who buys from whom might affect firms' marginal costs and productivities (Bernard and Moxnes 2018). Therefore it has further implications for the repartition of responsibilities along the supply chain. In what follows, we aim to explore how firm efficiency and the seller-buyer network structure influence the choice of the different classes of risks and costs, by estimating the following equation:

$$Choice_{sbpT} = \text{Seller charact.}_{st} + \text{Buyer charact.}_{bt} + \text{Relationship charact.}_{sb(T)t} \quad (3.1) \\ + \text{Controls}_{sbpT} + \text{FE} + \varepsilon_{sbpT}$$

The dependent variable $Choice_{sbpT}$ describes the choice of a class of responsibilities for transaction T occurring between seller s and buyer b exchanging the HS10-product p . We rely on two estimators. First, we employ an ordered logistic regression, as the different classes of risks and costs imply a logical order of responsibilities for both the seller and the buyer. Therefore, $Choice_{sbpT}$ is defined so as to follow increasing obligations of the buyer and decreasing obligations of the seller: 1. *On seller* responsibilities \rightarrow 2. *Shared* responsibilities \rightarrow 3. *On buyer* responsibilities. Second, we arrange the three groups of responsibilities in a "ladder" with two steps and run estimations based on a Linear Probability Model (LPM) for each step. Thus, in the first step, $Choice_{sbpT}$ represents a dummy set to 1 for *On buyer* or *Shared* responsibilities and 0 otherwise. In the second step, $Choice_{sbpT}$ is a dummy which takes the value of 1 for *On buyer* responsibilities and 0 otherwise. Taken together, the two steps follow closely the order implied by the ordered logistic regression, as the ladder goes towards maximum of responsibilities on the buyer (in the second step). Separately, they show a clearer decomposition of responsibilities between the seller and the buyer. The main reason for also conducting this analysis is the fact that, compared to the ordered logit estimator, the LPM estimator allows for sizable fixed effects, in order to control for more unobserved characteristics.

The covariates are as follows. The vector $\text{Seller charact.}_{st}$ refers to the characteristics of the seller s in year t and includes the size, used as a proxy for efficiency, and the number of partners. Given the wide dispersion of sellers in terms of sizes, our analysis relies on a binary measure instead of a continuous one. Thus, based on sizes, we classify sellers s as big if

¹⁶Fixed costs may be related to insurance procurement. If sellers/buyers accept to bear all risks in international transactions, they may want to shield themselves from extreme events (i.e. loss of or damage to the goods), by paying an insurance subscription. Variable costs are generated by the shipping process *per se*.

they belong to the 95th percentile in year t , which is the year of transaction T (*Big S: top 5%*). This choice is motivated by the fact that the top 5% of sellers cover 94% of all Russian exports. Moreover, it appears that sellers at the 95th percentile are similar in size to average sellers. As the network structure is also likely to matter in the split of risks and costs, we introduce in our analysis the overall number of buyers for seller s in year t (*Nb of B per S*).

The vector Buyer charact. $_{bt}$ refers to the characteristics of the buyer b in year t and follows the same logic as the vector Seller charact. $_{st}$. In order to be consistent with the previous definition, buyers b are considered as big in year t if they belong to the 95th percentile (*Big B: top 5%*). We also include the overall number of Russian suppliers for buyer b in year t (*Nb of Russian S per B*) to control for the network effects.

Besides the partners' individual features, the characteristics of their relationship are likely to play an important role in the choice of responsibilities. In established relationships, sellers and buyers may split their obligations differently, since they have developed a relation of trust.¹⁷ Thus, we introduce a dummy variable for a new relationship between seller s and buyer b for transaction T , regardless of the HS10 product p exchanged (*New relationship*). We equally take into account the importance of the partners for each other. The share of a buyer b in the total exports of seller s in year t is introduced in the analysis (*Share of B in exports of S*). Analogously, we include the share of a seller s in the total (Comtrade-adjusted) imports of buyer b in year t (*Share of S in imports of B*).

Finally, we account for several factors specific to each transaction (Controls_{sbpT}). In order to capture the importance of proximity between partners, we introduce the distance from a seller to the customs points (*Dist. seller - customs point*) and the distance between the customs point and a buyer (*Dist. customs point - buyer*). The use of these distances (instead of the direct distance between the seller and the buyer) is motivated by the fact that they correspond to different stages of the shipping process and the responsibilities for each stage might be split between the seller and the buyer. Also, since within a group of terms, certain individual rules are not recommended for waterway transportation (International Chamber of Commerce 2010), we include two dummy variables for waterway transport inside (*Transp. inside: waterway*) and outside (*Transp. outside: waterway*) Russia. Furthermore, shipping containers might facilitate the switch between different transport modes. We introduce a dummy variable set to 1 for the use of containers (*Container trade*).

The ordered logistic estimations include HS2-sector and destination-year fixed effects, whereas the LPM estimations rely on HS10-product and destination-year fixed effects. Thus, by fixing the sector/product and destination dimensions, we aim at exploiting the variation stemming from seller, buyer and relationship-specific characteristics.

¹⁷For instance, Antràs and Foley (2015) show that established relationships matter for the choice of financing terms.

Furthermore, in order to understand the interplay between heterogeneous sellers and buyers, we estimate the following equation using both ordered logistic and LPM regressions:

$$\begin{aligned}
Choice_{sbpT} = & \alpha_1 \text{Seller size (dummy)}_{st} \times \text{Buyer size (dummy)}_{bt} & (3.2) \\
& + \alpha_2 \text{Nb of B per S}_{st} + \alpha_3 \text{Nb of Russian S per B}_{bt} \\
& + \text{Relationship charact.}_{sb(T)t} + \text{Controls}_{sbpT} + \text{FE} + \varepsilon_{sbpT}
\end{aligned}$$

Compared to the previous analysis, instead of the actual sizes of firms, we introduce interaction terms between different categories of partners in terms of sizes. The term *Seller size (dummy)*_{st} × *Buyer size (dummy)*_{bt} implies three possible combinations: *Big S (top 5%) Big B (top 5%)*, *Big S (top 5%) Small B (bottom 95%)*, *Small S (bottom 95%) Big B (top 5%)*. The comparison group is *Small S (bottom 95%) Small B (bottom 95%)*. The other variables are identical to the ones presented in Equation 3.1.

3.3.2 Results

Table 3.10 reports the results for the estimation of Equation 3.1. The first column refers to the ordered logistic estimation, whereas the next two columns describe the LPM results. In both cases the order implies increasing responsibilities for the buyer and decreasing responsibilities for the seller.

The coefficients in column 1 are log odds ratios. Our results suggest that for big sellers, there is a decrease in the log odds of being in a higher level of *Choice*,¹⁸ given all of the other variables in the model are held constant. More precisely, being a big seller (compared to being a small one), reduces the odds of using *On buyer* responsibilities (compared to *Shared* and *On seller* responsibilities) by 18%. These results are also confirmed by the LPM estimations. Column 2 compares *On buyer* and *Shared* responsibilities with *On seller* responsibilities. Column 3 compares *On buyer* responsibilities with *Shared* and *On seller* responsibilities. The results delivered by both columns suggest that big sellers are less likely to choose *On buyer* and *Shared* responsibilities compared to *On seller* responsibilities. As far as the seller's network is concerned, an increasing number of customers decreases the log odds of using *On buyer* responsibilities, all else equal. An extra customer decreases the odds to charge risks and costs on buyers (compared to all other cases) by 10%. The LPM estimations reinforce this result. The more connections sellers have, the lower the probability to charge responsibilities on their customers.

Overall, these results are in line with the findings highlighted by the literature. Big firms are

¹⁸A higher level of *Choice* means increasing responsibilities for the buyer.

Table 3.10
Choice of Responsibilities: Firm sizes

	OLogit	LPM Ladder ($S \rightarrow Sh \rightarrow B$)	
	(1)	(2a)	(2b)
	$S \rightarrow Sh \rightarrow B$	$(B + Sh)/S$	$B/(Sh + S)$
Big S (top 5%)	-0.203 ^a (0.006)	-0.078 ^a (0.001)	-0.018 ^a (0.002)
Nb of B per S	-0.115 ^a (0.001)	-0.006 ^a (0.000)	-0.027 ^a (0.000)
Big B (top 5%)	0.559 ^a (0.005)	0.068 ^a (0.001)	0.079 ^a (0.001)
Nb of Russian S per B	0.007 ^a (0.001)	-0.002 ^a (0.000)	0.002 ^a (0.000)
New relationship for S and B	-0.191 ^a (0.002)	-0.029 ^a (0.000)	-0.029 ^a (0.001)
Share of B in the exports of S	-0.346 ^a (0.004)	-0.032 ^a (0.001)	-0.027 ^a (0.001)
Share of S in the imports of B	-0.400 ^a (0.061)	-0.050 ^a (0.007)	-0.012 ^b (0.006)
Dist. seller - customs point	0.055 ^a (0.001)	0.009 ^a (0.000)	0.026 ^a (0.000)
Dist. customs point - buyer	0.056 ^a (0.001)	0.023 ^a (0.000)	0.006 ^a (0.000)
Transp. inside: waterway	0.345 ^a (0.011)	-0.020 ^a (0.001)	0.059 ^a (0.002)
Transp. outside: waterway	1.403 ^a (0.005)	0.261 ^a (0.001)	0.249 ^a (0.001)
Container trade	-0.380 ^a (0.004)	-0.021 ^a (0.001)	-0.105 ^a (0.001)
Observations	5244094	5306992	5306992
Fixed effects:			
HS2 Sector & Dest. – Year	Yes		
HS10 Product & Dest. – Year		Yes	Yes

Note: Column 1 reports the results for the ordered logistic regression. $S \rightarrow Sh \rightarrow B$ indicates that the terms are arranged in increasing order of the responsibilities of the buyer. Columns 2a and 2b present the results of the LPM estimations for the ladder $S \rightarrow Sh \rightarrow B$. In column 2a, the dependent variable is a dummy set to 1 for the use *On buyer* and *Shared* responsibilities (0 otherwise). In column 2b, the dependent variable is a dummy set to 1 for the use of *On buyer* responsibilities (0 otherwise). Robust standard errors in parentheses, with ^a, ^b and ^c denoting significance at the 1%, 5% and 10% level respectively.

more efficient and better able to cover additional costs.¹⁹ Therefore, big sellers are less likely to charge the risks and costs associated with international transactions on their customers and more willing to take on responsibilities. Furthermore, Oberfield (2018) refers to the sellers connected to many buyers, which are at the right tail of the distribution, as "star suppliers". These

¹⁹The literature on one-sided heterogeneity (Melitz 2003; Antras et al. 2017) and two-sided heterogeneity (Bernard and Moxnes 2018) deliver the same message.

suppliers are also more productive, being able to cover additional costs. Consequently, they are willing to bear more risks and costs throughout the shipping process.

As far as big buyers are concerned, there is an increase in the log odds of being in a higher level of *Choice*, all else equal. In contrast with a small buyer, for a big buyer, the odds of taking on more responsibilities is 40% higher. The LPM estimations also show that big buyers are more likely to choose *On buyer* responsibilities compared to *Shared* and *On seller* responsibilities. Moreover, a higher number of Russian suppliers raises the log odds of adopting terms with increasing obligations on the buyer, all else equal. An extra Russian seller for a given buyer leads to an increase of 0.7% in the odds of using *On buyer* responsibilities. This result is also confirmed by the LPM analysis.

All in all, big buyers are more likely to bear the risks and costs associated with international transactions, as they are more efficient and better able to cover additional costs. Also, according to Bernard and Moxnes (2018), big buyers tend to have several small suppliers. The transaction-costs approach developed in the literature on incomplete contracts, equally stipulates that buyers would ideally divide the production process into numerous tasks (i.e. across several suppliers). Thus, as the share of each supplier in the input bundle decreases, buyers tend to have a higher bargaining power over their suppliers. As a consequence, buyers may save on input costs and, since the suppliers are located in the same destination, they may also save on transportation costs. Therefore, buyers are more likely to take on transaction costs.

When it comes to the relationship-specific characteristics, in column 1, we document a negative and significant coefficient on the dummy variable for a new relationship. Thus, compared to old relationships, a new connection between sellers and buyers decreases the odds of using *On buyer* responsibilities by 17%, all else equal. Buyers might be less motivated to take on risks and costs if a substantial level of trust with their suppliers is not achieved. Moreover, establishing a new seller-buyer match requires relation-specific fixed costs. On top of this, there are transaction-specific costs. The models on incomplete contracts assume that buyers have to bear initial relation-specific sunk costs. If this is the case, in freshly established relations, higher contract-specific transaction costs would largely affect the short-run profits and the decisions of buyers to bear risks and costs. These results are confirmed by the LPM estimations. As for the mutual importance, we find the following results. The probability to use *On buyer* responsibilities decreases if the buyer has a high share in the total exports of the seller. The same holds true when the seller has a big share in the imports of the buyer. Put it differently, *On buyer* responsibilities are used when the seller is not important to the buyer and the buyer is not important to the seller. This result reinforces the previous findings and is also in line with Bernard and Moxnes (2018).

As far as the control variables are concerned, we notice that higher distances both within and beyond borders are associated with a higher probability that buyers bear more respon-

sibilities. Buyers import mainly intermediate goods and raw materials, which are needed in the production process. Thus, they might be more likely to take on responsibilities over long distances, also implying higher delays, in order to better control their production processes. The waterway transportation both within and beyond borders increases the probability that buyers take obligations on their own. In fact, sea and river transportation lead to lower costs compared to other transportation modes. Thus, as they may save on transportation costs, buyers accept to bear more risks and costs. Finally, shipping in containers decreases the probability that risks and costs are borne by buyers, as they might experience additional costs related to the use of containers. Moreover, trade in containers allows sellers to benefit from economies of scale, by sharing transport costs with other sellers or by serving several buyers in the same market.

In what follows, we dig into the interactions between buyers and sellers of different sizes. We categorize all transactions into four groups: i) big seller and big buyer; ii) big seller and small buyer; iii) small seller and big buyer and iv) small seller and small buyer. Trade between small sellers and small buyers is used as the comparison group. Table 3.11 reports the results.

The results show that, compared to the case where both partners are small, trade between big partners increases the probability to use *On buyer* responsibilities. Furthermore, trade between big sellers and small buyers decreases the likelihood that buyers take on risks and costs. Finally, when small sellers trade with big buyers, the probability that the transaction occurs on *On buyer* responsibilities increases. To sum up, big buyers tend to bear important responsibilities, regardless of the size of the sellers. This result might be explained by the fact that big Russian sellers are generally smaller than their big customers. When it comes to big sellers, they only bear more risks and costs for a transaction if the buyer is small.

The results for the number of connections and the relationship-specific variables (new relationship and mutual importance) are identical to the ones presented in Table 3.10. The coefficients for distances, trade in containers and international transportation by water transport are also perfectly in line with the principal set of results.

Table 3.11
Choice of Responsibilities: Interactions between Firm sizes

	OLogit	LPM Ladder ($S \rightarrow Sh \rightarrow B$)	
	(1)	(2a)	(2b)
	$S \rightarrow Sh \rightarrow B$	$(B + Sh)/S$	$B/(Sh + S)$
Big S (top 5%) Big B (top 5%)	0.985 ^a (0.016)	-0.055 ^a (0.002)	0.092 ^a (0.002)
Big S (top 5%) Small B (bottom 95%)	-0.277 ^a (0.006)	-0.069 ^a (0.001)	-0.024 ^a (0.002)
Small S (bottom 95%) Big B (top 5%)	0.488 ^a (0.006)	0.078 ^a (0.001)	0.071 ^a (0.001)
Nb of B per S	-0.113 ^a (0.001)	-0.006 ^a (0.000)	-0.027 ^a (0.000)
Nb of Russian S per B	0.010 ^a (0.001)	-0.003 ^a (0.000)	0.002 ^a (0.000)
New relationship for S and B	-0.189 ^a (0.002)	-0.029 ^a (0.000)	-0.029 ^a (0.001)
Share of B in the exports of S	-0.338 ^a (0.004)	-0.032 ^a (0.001)	-0.028 ^a (0.001)
Share of S in the imports of B	-0.399 ^a (0.061)	-0.050 ^a (0.007)	-0.012 ^b (0.006)
Dist. seller - customs point	0.054 ^a (0.001)	0.010 ^a (0.000)	0.026 ^a (0.000)
Dist. customs point - buyer	0.055 ^a (0.001)	0.023 ^a (0.000)	0.006 ^a (0.000)
Transp. inside: waterway	0.341 ^a (0.011)	-0.018 ^a (0.001)	0.058 ^a (0.002)
Transp. outside: waterway	1.383 ^a (0.005)	0.262 ^a (0.001)	0.247 ^a (0.001)
Container trade	-0.376 ^a (0.004)	-0.022 ^a (0.001)	-0.105 ^a (0.001)
Observations	5244059	5306992	5306992
Fixed effects:			
HS2 Sector & Dest. – Year	Yes		
HS10 Product & Dest. – Year		Yes	Yes

Note: Column 1 reports the results for the ordered logistic regression. $S \rightarrow Sh \rightarrow B$ indicates that the terms are arranged in increasing order of the responsibilities of the buyer. Columns 2a and 2b present the results of the LPM estimations for the ladder $S \rightarrow Sh \rightarrow B$. In column 2a, the dependent variable is a dummy set to 1 for the use *On buyer* and *Shared* responsibilities (0 otherwise). In column 2b, the dependent variable is a dummy set to 1 for the use of *On buyer* responsibilities (0 otherwise). Robust standard errors in parentheses, with ^a, ^b and ^c denoting significance at the 1%, 5% and 10% level respectively.

3.3.3 Sensitivity Analysis

We proceed to several sensitivity tests, to confirm the robustness of our analysis. First, we define big firms as the top 1% of sellers and buyers and replicate Tables 3.10 and 3.11. The results are presented in Tables 3.C2 and 3.C3, respectively, and reinforce the previous findings

corresponding to the top 5% of sellers and buyers.

Then, we conduct several robustness tests based on Equation 3.1, using an LPM estimator for the second step of the ladder, which implies maximum responsibilities on the buyer.²⁰ The findings are presented in Table 3.C4. The results reported in column 1 rely on HS10-product-destination-year fixed effects, to explore the split of risks and costs across sellers and buyers within product-destination pairs in a given year. In column 2, we add additional controls for the characteristics of a shipment, likely to also influence the choice. Thus, we include the value and the volume of a shipment. Column 3 presents the estimation results for the original distances between the customs point and the buyer. In the baseline estimations, the missing distances due to missing coordinates for the buyer locations have been completed with the distances from the customs point to the capital city of the country of the buyer. In column 4, we add customs point-year fixed effects in addition to HS10-product and destination-year fixed effects. Customs procedures and transportation are major stages of the shipping process, likely to impose important risks and costs on firms.

While our baseline regressions take into account the distance and the transportation mode, they do not consider the customs point characteristics. Therefore, adding customs point fixed effects allows us to control for more factors likely to influence the choice of a class of responsibilities. Finally, in column 5, we replicate the baseline results, replacing firms' characteristics and relationship-specific variables, which have been computed in t , with the ones corresponding to $t-1$. We also replace the dummy variable associated with a new relationship with the actual number of shipments between a seller and a buyer in $t-1$. Our previous findings hold across all these estimations. Big sellers and big buyers are more likely to take on risks and costs.

3.4 Product Characteristics

This section explores the product characteristics. The descriptive evidence shows that responsibilities may be divided differently across various types of products. Thus, we further analyze how the product characteristics shape the choice of the different classes of responsibilities, by estimating the following equation:

$$Choice_{sbpT} = \text{Product charact.}_{pT} + \text{Controls}_{sbpT} + \text{FE} + \varepsilon_{sbpT} \quad (3.3)$$

We use an LPM estimator, where the dependent variable corresponds to the two steps of the ladder of responsibilities. The covariates are as follows. We consider three categories of products according to the different stages of processing as defined by UNCTAD: intermediate,

²⁰For comparison purposes, we also conduct the same analysis for the first step of the ladder, opposing *On buyer* and *Shared* responsibilities to *On seller* responsibilities. Table 3.C5 reports the results.

Table 3.12
Choice of Responsibilities: Product Characteristics

	LPM Ladder ($S \rightarrow Sh \rightarrow B$)			
	(B+Sh)/(S)	(B)/(Sh+S)	(B+Sh)/(S)	(B)/(Sh+S)
	(1a)	(1b)	(2a)	(2b)
Intermediate goods	0.001 ^c (0.000)	0.004 ^a (0.000)		
Capital goods	-0.002 ^a (0.001)	0.003 ^a (0.001)		
Differentiated goods			-0.038 ^a (0.000)	-0.050 ^a (0.000)
Observations	5446241	5446241	5446241	5446241
R ²	0.907	0.900	0.907	0.900
Fixed effects: ST&BT&DT&HS2	Yes	Yes	Yes	Yes

Note: A group of two columns presents the results of the LPM estimations for the ladder $S \rightarrow Sh \rightarrow B$. In columns (a), the dependent variable is a dummy set to 1 for the use *On buyer* and *Shared* responsibilities (0 otherwise). In the columns (b), the dependent variable is a dummy set to 1 for the use of *On buyer* responsibilities (0 otherwise). All estimations include shipment-specific controls. Robust standard errors in parentheses, with ^a, ^b and ^c denoting significance at the 1%, 5% and 10% level respectively.

capital and consumer goods.²¹ The vector Product charact._{*pT*} includes two dummy variables, for the HS10-product *p* exchanged in transaction *T*, referring to intermediate and capital goods. Consumer goods are used as the baseline category. The estimations take into account all the transaction-specific controls previously detailed. We include the following fixed effects: seller-year, buyer-year, destination-year and HS2-sector fixed effects. Seller-year, buyer-year and destination-year fixed effects aim at capturing all seller, buyer and destination characteristics likely to influence the split of risks and costs. We also introduce HS2-sector fixed effects to control for any sector differences that may affect the outcome. Thus, the variation that we exploit is due to the detailed product dimension.

The results are presented in Table 3.12. We show that, after controlling for other confounding factors, buyers have a higher probability to bear more responsibilities in transactions of intermediate goods and capital goods compared to transactions of consumption goods. Several studies have shown that in the case of intermediate products, which are further used in the production chain, timely delivery and predictability of delivery are crucial (Gamberoni et al. 2010; Li and Wilson 2009; Baniya 2017). Hence, buyers importing intermediate goods might want to have a better control over the shipping process, in order to make sure that their production chain is not affected. As a consequence, they are likely to bear more risks and costs. When it comes to differentiated goods, buyers appear to be less likely to bear transaction-related risks and costs. With increasing product differentiation, risks and costs might raise substantially (Baniya 2017), as special conditions might be needed to ship the goods. Thus, buyers are less likely to take on responsibilities.

²¹Intermediate goods regroup both intermediate products and raw materials.

3.5 Destination Characteristics

In this section, we explore the role of the business regulations (including the legal conditions) of the destination countries in shaping the choice of the different classes of responsibilities. We estimate the following equation, relying on an LPM estimator:

$$Choice_{sbpT} = \text{Destination charact.}_{dt} + \text{Controls}_{sbpT} + \text{FE} + \varepsilon_{sbpT} \quad (3.4)$$

The dependent variable $Choice_{sbpT}$ corresponds to the two-step ladder previously described. The vector $\text{Destination charact.}_{dt}$ includes several variables specific to destination country d in year t . The variable of interest refers to the *Doing Business* score (in log), which is used to proxy the overall quality of the business environment in the destination country. We include the GDP per capita (in log), in order to control for the development level of the destination. The overall importance of the Russian Federation for a destination is accounted for through its share in the total imports of that country. We control for the usual gravity variables: whether the two partners share a border, have a common language or are involved in a trade agreement. All the shipment-specific controls previously detailed are taken into account. The fixed effects are as follows: seller-year, buyer-year and HS10-product fixed effects. Seller-year and buyer-year fixed effects aim at capturing all seller and buyer characteristics likely to influence the split of risks and costs. We also introduce HS10-sector fixed effects to control for any product differences that may affect the choice. Thus, the variation that we exploit is due solely to the destination characteristics.

Table 3.13 reports the results. The probability that buyers take on full responsibilities appears to decrease if the destination country is characterized by a high level of *Doing Business*. Indeed, a seller might be more willing to bear risks and costs associated with the shipping process if the business environment in the destination country is certain. This result is supported by the overall findings of the literature exploring the role of business regulations in trade (Hoekman and Nicita 2011; Djankov et al. 2010; Dutt and Traca 2010; Álvarez et al. 2018, etc.). Moreover, it is also in line with the papers on the payment terms. For instance, Antràs and Foley (2015) find that financing terms implying more risks for the seller are more likely to be chosen if the buyer is located in countries with a good contract enforcement.

At the same time, buyers located in a country with a good business environment might also want to bear less responsibilities, for several reasons. First, this allows them to eliminate the risks and costs associated with the shipping process. Second, since they are located in a country with good legal conditions (i.e. high *Doing Business*), if the physical delivery does not take place as stipulated in the sales contract, buyers can constrain sellers to abide by their contractual obligations and to provide a replacement shipment or a compensation.²² All in

²²The parties can specify in the contract the governing law and jurisdiction. Nevertheless, unlike otherwise specified, the legal conditions in the country where the physical delivery should occur appear to prevail in practice. In the case of *On seller* terms, the physical delivery is supposed to take place in the country of destination, meaning

Table 3.13
Choice of Responsibilities: Destination Characteristics

	LPM Ladder ($S \rightarrow Sh \rightarrow B$)			
	(B+Sh)/(S)	(B)/(Sh+S)	(B+Sh)/(S)	(B)/(Sh+S)
	(1a)	(1b)	(2a)	(2b)
Score DB_{DEST}	-0.010 ^a (0.003)	-0.033 ^a (0.004)		
Dummy if $DB_{DEST} > DB_{RUS}$			-0.004 ^a (0.001)	-0.003 ^a (0.001)
GDP per capita	-0.003 ^a (0.000)	-0.001 ^a (0.000)	-0.004 ^a (0.000)	-0.003 ^a (0.000)
Share of <i>RUS</i> in Imports of <i>DEST</i>	0.093 ^a (0.007)	0.191 ^a (0.010)	0.086 ^a (0.006)	0.204 ^a (0.009)
Observations	5076678	5076678	5183130	5183130
R ²	0.905	0.902	0.905	0.902
Fixed effects: <i>ST&BT&HS10</i>	Yes	Yes	Yes	Yes

Note: A group of two columns presents the results of the LPM estimations for the ladder $S \rightarrow Sh \rightarrow B$. In columns (a), the dependent variable is a dummy set to 1 for the use *On buyer* and *Shared* responsibilities (0 otherwise). In the columns (b), the dependent variable is a dummy set to 1 for the use of *On buyer* responsibilities (0 otherwise). Score DB_{DEST} is the *Doing Business* score (in log) of the destination country. Dummy if $DB_{DEST} > DB_{RUS}$ is a dummy variable set to 1 if the *Doing Business* score of the destination country is higher than the one of the Russian Federation. All estimations include the usual gravity variables (contiguity, common language, trade agreements) and other shipment-specific controls. Robust standard errors in parentheses, with ^a, ^b and ^c denoting significance at the 1%, 5% and 10% level respectively.

all, buyers appear to be less likely to bear risks and costs in international transactions if their country has a good level of *Doing Business*.

In order to confirm the robustness of our results, we also conduct estimations, where we replace the *Doing Business* score of the destination country with a dummy variable set to 1 if the destination country has a higher *Doing Business* score compared to the Russian Federation. The results are perfectly in line with those previously obtained. Moreover, we show that the higher the GDP per capita in the destination country, the lower the probability that buyers bear risks and costs throughout the shipping process. These results mirror the ones obtained for the *Doing Business* Indicators. Finally, our findings suggest that the higher the importance of Russia in the destination country, the higher the probability that responsibilities are borne by the buyer.

3.6 Sketchy model

This section provides a simplified theoretical basis behind the decision of international buyers and sellers to split the costs and risks in a certain manner. By establishing the responsibilities, Incoterms largely contribute to overcoming of contract incompleteness. The incomplete contracts, on the contrary to the complete ones, do not incorporate all possible states of the that the legal conditions in the destination country matter for the contract enforcement.

world. The contract incompleteness is a realistic assumption since conditioning contract on all possible outcomes would bring the costs to the prohibitive level.

Antràs (2003) has brought the incomplete contracts to the international trade and global value chains literature.²³ The prevailing branch of this literature is the property rights approach. The common assumption is that the headquarter (buyer) makes an initial investment to establish the relationship with seller. The party that contributes the most is endowed with stronger bargaining power.²⁴ Therefore, the buyer has residual rights of control over assets of the seller. Meanwhile, the seller can fully manage the contracts over the arms-length shipments. Buyer has the choice: either outsource the production of an intermediate good to a supplier, or integrate the latter (Antràs 2013). The outsourcing occurs when a seller contributes to bilateral relationships relatively more, and the integration is when buyer does so. The most recent applications of the property rights approach to the international trade include Antràs and Chor (2013) and Alfaro et al. (2018).²⁵

The ownership assumption of the property rights approach is not directly testable with our data. Therefore, despite staying within the incomplete contracts theory, we prefer the workhorse of the transaction costs approach. Coase (1937) introduced transactions costs approach to the incomplete contracts literature. The transaction costs are an important source of the contract incompleteness. Saussier (2000) advocates that the contract incompleteness is endogenous to the intentions of contracting parties to reduce the transaction costs. The transaction costs refer to transactions that occur between rather than within firms. Under the transaction costs approach, it is assumed that the contracting parties bargain over the prices of the inputs.

We propose a sketchy model within the transaction costs approach of the incomplete contracts literature. This simplified theoretical demonstration is based on the theoretical approach of Kikuchi et al. (2018). They developed a production chain model explaining the stylized facts on the vertical integration, structure of value chain and firm boundaries. The equilibrium defines input prices, allocation of tasks across firms, number and sizes of firms. Another relevant theoretical approach is the study of Fally and Hillberry (2015). They developed a model of supply chains in which the transaction costs and within firms coordination costs determine the share of tasks completed within firm. They demonstrate that the transaction costs impact absolute advantages.

In this paper, we consider production chain of a consumer good. The manufacturing pro-

²³Using U.S. customs data he demonstrated that the share of intrafirm imports are higher in the sectors that are more capital-intensive.

²⁴According to Grossman and Hart (1986) and Hart and Moore (1990), such allocation is optimal since it ex-ante minimises under-investment

²⁵Antràs (2015) provides comprehensive guidance to the incomplete contracts in international trade. The most up-to-date literature survey is provided by Davin Chor in his draft of a handbook chapter (see Chor (2018)).

cess involves numerous stages (tasks) that have to be completed in the technology driven sequence. Each task consists in the production of an intermediate input. The final producer faces a trade-off à la Coase (1937), between vertical integration and outsourcing. If the firm prefers vertical integration, more tasks are allocated to home. This solves so-called "hold-up" problem.²⁶ At the same time, such integration also implies coordination costs within firms. The more tasks are allocated to home, the larger firm is. With bigger firm size, it gets more costly to manage an average task at home ($c'(0) > 0$). These coordination costs are related to the bureaucracy and use of managerial efforts. The outsourcing of tasks allows to limit the coordination costs. On the other hand, the more tasks are outsourced to the upstream producers, the higher transaction costs are.

Firms within production chains aims to minimise the transaction costs. The optimal firm size (number of tasks completed in-house) minimises transaction costs.²⁷ The final producer optimally assigns production-related tasks to i upstream firms. The range of tasks for each supplier is written as l_i . The stages of production are indexed by $t \in [0, 1]$. The allocation of tasks across suppliers is feasible if $\sum_{i \geq 1} l_i = 1$. In period $t = 0$ none of the tasks are accomplished, and at $t = 1$ the final good is completely assembled from intermediate inputs.

The intermediate suppliers and the final producers enter into one-to-one trade relations. A firm i produces their good at stage t_i . She is an upstream consumer of the intermediate good that was produced by another firm in the chain at stage t_{i+1} . This firm completes in-house tasks l_i bearing costs $c(l)$. Our data suggests that in 25% of cases, the buyer is connected to more than one seller. Thus, we assume that any firm can have $k \geq 1$ upstream partners.²⁸ A firm completes a certain portion of her tasks in-house and divides the remainder equally between k partners. Once firm i receives outputs of all subcontractors, she completes in-house operations and assembles an intermediate good. The latter is then sold to the subsequent firm that operates at stage t_{i-1} of a global value chain. It is worth to note that the producer a final good acquires an intermediate input that was produced at stage t_1 . The final stage of production is indexed by $s = t_0$. Any intermediary stage of production can be written as $t_i = t_{i-1} - l_i$.

Transaction costs are determined by the markets of the intermediate inputs. The transaction costs are modelled as the difference between prices of downstream and upstream firms. Assuming that a buyer bears δ share of transaction costs with $\delta > 1$. Thus, the buyer's expenditures are δv . The seller receives a fraction v and the rest is taken by the trade intermediaries and other agents. Transferring of tasks to subcontractors engenders additive transaction costs

²⁶See discussion of "hold-up" problem under the incomplete contracts in Klein et al. (1978) and Williamson (1989). We assume here that a buyer bears initial relating-specific sunk costs. A supplier has the incentive to free ride, since she might have an outside option to establish the contract relations with another buyer. The problem is further fuelled by the fact that the contracting parties envisage all future outcomes and thus don't conclude long-lasting contracts. The non-verifiability of the initial investment in also often the case.

²⁷This was demonstrated by Grossman and Helpman (2002, 2003) and Chen and Feenstra (2008) in application to international trade.

²⁸It is worth to note that our model does not account for the case when a seller is connected to multiple buyers.

$g(k)$, which are monotonically growing with k . We assume that each firm can freely choose k at each stage. If there are no subcontractors ($k = 1$), the additive costs are null: $g(1) = 0$. Thus, the total costs of a firm within the value chain are composed of processing costs $c(l_i)$, input costs $\delta kp(t_i/k)$ and subcontracting costs $g(k)$. Therefore, the profit function of a downstream firm i can be written as follows:

$$\pi_i = p(t_{i-1}) - \delta kp(t_i/k) - c(l_i) - g_i(k) \quad (3.5)$$

The equilibrium for the chain is solved for the pair (p, l) . In equilibrium the profits of all active firms are zero ($\pi_i = 0$ for any i). In the equilibrium, the optimal price p^* corresponds to the solution of the minimisation program: $p^*(t_s) = \min_{t \leq s} \{c(s-t) + \delta p^*(t)\}$, where $s \in [0, 1]$.

In the reminder of this section, we consider the final stage (indexed by f) of the global value chain. The final producer (buyer) acquires an intermediate input that is produced by a Russian supplier (seller) and does $l \leq f$ part of the final production in-house. Similarly to any firm in the chain, the buyer can outsource her task to k upstream partners in equal proportions. The seller bears a fraction of costs $\gamma \in (0, 1]$, so that $\delta/\gamma > 1$. Depending on the value of γ , the following 3 cases are possible:

1. $\gamma = 1$: The totality of transaction costs are borne by seller. This case corresponds to Incoterms group D.
2. $\gamma \in (0; 1)$: The transaction costs are shared between seller and buyer. This happens when the Incoterms of C group are applied.
3. $0 < \gamma \ll 1$: If γ is infinitely close to 0, the totality of transaction costs are on buyer. This case corresponds to E and F groups of Incoterms rules.

The buyer's profit can be written as follows:

$$\pi(f, l) = \gamma p(f) - \delta kp((f-l)/k) - c(l) - g(k) \quad (3.6)$$

In the equilibrium, the optimal price of the final good $p^*(f)$ corresponds to the solution of the minimisation program:

$$p^*(f) = \min_{k \in \mathbb{N}, t \leq f} \left\{ \frac{c(f)}{\gamma} + \frac{\delta}{\gamma} kp^*(t/k) + g(k) \right\} \quad (3.7)$$

Considering that the equilibrium is achieved, we derive the following expression for the share of costs and risks on seller:

$$\gamma = \frac{c(f) + \delta k p^*(t/k)}{p^*(f) - g(k)} \quad (3.8)$$

The functional form of γ suggests the following relations. The share of total transaction costs borne by seller is an increasing function of buyer's expenditures on intermediate input (δ), price of the intermediate input ($p(t/k)$), number of buyer's upstream partners (k) and buyer's additive transaction costs ($g(k)$). The share of transaction costs on seller decreases with higher price of the final good ($p(f)$). Mentioned relations allows us to formulate and test the following hypotheses.

Hypothesis 1 (H1): *The probability of transaction costs to be on the buyer decreases when buyer is connected to more numerous partners.*

To test this hypothesis, we proceed to estimate the following equation with a linear probability estimator.

$$Choice_{sbpT} = \text{Nb of Russian S per B}_{sbpT} + \text{Controls}_{sbpT} + \text{FE} + \varepsilon_{sbpT} \quad (3.9)$$

Tested specification includes fixed effects for products (HS2 or HS10) and year. The results are reported in table 3.D1 (see Section 3.7). The risks and costs are more probably on the buyer with lower number of Russian sellers per buyer. We conclude that this empirical evidence supports our simplified theoretical demonstration.

Hypothesis 2 (H2): *The probability of transaction costs to be on the buyer increases when the production costs of a final good are lower.*

We test this hypothesis by referring to the development level of the countries of destination. Numerous studies documented relocation of production activities from developed to developing countries (see, e.g. Buckley and Mucchielli (1997), Brainard and Riker (1997), Barba Navaretti and Falzoni (2004), and Egger and Egger (2006)). Pennings and Sleuwaegen (2000) found that bigger and more innovative firms, as well as the ones having better access to a global network, are more probable to relocate their activities. On the contrary, uncertainty – which is associated with less developed country – decreases such probability. Thus, we expect the production costs in more developed countries to be higher due to higher costs of local inputs and higher wages. We source the GDP per capita from World bank. We further create a dummy for a developed destination, which takes the unity value for countries classified by World Bank as "Upper middle income" and "High income". The estimated equation is the following:

$$Choice_{sbpT} = \text{Development level}_{sbpT} + \text{Controls}_{sbpT} + \text{FE} + \varepsilon_{sbpT} \quad (3.10)$$

The results are reported in table 3.D2. We observe that the probability that buyers take on risks and costs is lower when they are located in more developed countries. We attribute this result to higher production costs.

Hypothesis 3 (H3): *The probability of transaction costs to be on the buyer increases when the price of an intermediate input is lower.*

We test this hypothesis empirically on a sub-sample of exported intermediate goods and raw materials. The prices are proxied by unit values, which is a commonly made assumption. Thus, we estimate the following equation with a LPM estimator:

$$Choice_{sbpT} = \log(\text{Unit values})_{sbpT} + \text{Controls}_{sbpT} + \text{FE} + \varepsilon_{sbpT} \quad (3.11)$$

Table 3.D3 contains the results. The probability that risks and costs are on the buyer is growing with lower prices of the intermediate inputs. We conclude that hypothesis H3 is confirmed.

Hypothesis 4 (H4): *The probability of transaction costs to be on the buyer increases when the price of a final good is higher.*

We test this hypothesis similarly to H3. This time, we subsample the transactions involving consumer goods. The results are reported in table 3.D4. These results are somewhat ambiguous and are not sufficient to confirm or reject H4.

3.7 Conclusion

The use of Incoterms allows trading partners to reduce contract uncertainty, by attributing clear-cut responsibilities to each of them. However, this powerful tool widely employed by firms is yet understudied. Through this chapter, we shed light on the use of different schemes of risks and costs in firm-to-firm trade. More precisely, we empirically explore the factors determining how sellers and buyers divide responsibilities throughout the shipping process. To do so, we employ a highly-detailed transaction-level dataset on Russian exports over the 2012-2015 period.

The following conclusions emerge. First, in line with the two-sided heterogeneity literature, we show that more efficient firms and firms with an important number of partners are more likely to bear risks and costs throughout the shipping process. More precisely, the probability that transactions occur on *On buyer* responsibilities increases for big buyers and for buyers connected to many suppliers, but decreases for big sellers and for sellers connected to several foreign customers. We also show that *On buyer* responsibilities are more likely to be used in transactions between big buyers and any type of seller and between big sellers and

small buyers. Second, our results point to a higher probability to rely on *On buyer* responsibilities in transactions of intermediate and capital goods, compared to transactions of final goods. We also show that *On buyer* responsibilities are more likely to be used for homogeneous compared to differentiated products. Third, after controlling for other potentially confounding factors, we show that if the destination country is characterized by a good business environment, transactions are less likely to take place on *On buyer* responsibilities.

While this chapter provides a first analysis regarding the division of risks and costs between firms involved in export transactions, further evidence is needed. For instance, it would be particularly interesting to explore how firms that are both exporters and importers behave when it comes to bearing risks and costs throughout the shipping process. This would also allow to analyze firm dynamics and outcomes under the transaction cost approach developed in the literature on incomplete contracts.

Acknowledgements for Chapter 3

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Appendix

Appendix 3A. Data preparation

Construction of Buyer IDs

The steps followed to clean the buyer names in order to create a unique ID are detailed below:

1. We replace all non-alphanumeric characters in the name of a buyer (i.e. commas, dots, hyphens, etc.) by a single space.
2. Buyer names appear in the dataset either in Cyrillic or Latin characters. Moreover, both uppercase and lowercase letters are used. Stata treats all these characters as different even though they might be the same. First, we convert all Cyrillic characters in Latin characters. Then we transform them in capital letters.
3. The type of business entities may enter the name of a firm in an extended form or as an abbreviation. We only use abbreviations, taking into account all possible misspellings. For instance, take the example of a buyer which we will refer to as firm X. Firm X, located in Azerbaijan, may appear in our dataset under different forms. It may be introduced as "OBSHESTVO S OGRANICHENNOI OTVETSTVENNOSTYU FIRM X" or simply as "OOO FIRM X". Without proceeding to any modification of the name, these observations would be considered as two different firms, even though they have the same name and are located at the exact same address. In order to correct these errors, we replace "OBSHESTVO S OGRANICHENNOJ OTVETSTVENNOSTYU", which is the Russian equivalent for "Limited Liability Company", with "OOO". Since the type of business entity may also be partly abbreviated as in "KOMPANIYA S OGR OTVETSTV FIRM X", we replace all these possible cases by "OOO". As another example, a German buyer, named Firm Z, may appear as "FIRM Z GESELLSCHAFT MBH" or as "FIRM Z GMBH". In order to be consistent, we replace "GESELLSCHAFT MBH" with "GMBH". GMBH stands for GESELLSCHAFT MIT BESCHRÄNKTER HAFTUNG and is the German equivalent for "Limited Liability Company". We repeat this exercise for all types of legal entities specific to the different destinations in our dataset.

4. After correcting these errors, we focus on the names of the importing firms in the remaining long strings. Some interesting patterns emerge. Some firms may import on behalf of another firm. We may have cases such as "FIRM A *ON BEHALF OF* FIRM B". For all possible synonyms of "ON BEHALF OF" including the Russian ones (i.e. "IN THE NAME OF", "FOR THE ACCOUNT OF", "FOR FURTHER DELIVERY TO", "PO PORUCHENIYU", "PO KONTRAKTU", "TRANZITOM CHEREZ" etc.), we keep the first importer (i.e. FIRM A) and remove the second one (i.e. FIRM B). It is important to do so because the same Firm A may import for itself or on behalf of another firm. We keep track of these cases by creating a dummy variable for intermediary firms.
5. We eventually create a unique ID for buyers relying on their names, their country of origin, and the `matchit` command in Stata. Indeed, despite these extensive cleaning operations, some errors may still occur. The `matchit` command overcomes this problem, by performing different string-based matching techniques and allowing for a fuzzy similarity between two firm names. In order to create the buyer ID, we match together firm names with a degree of similarity higher than 85%.

Although this method might still be subject to errors, we are confident that the number of buyers is more or less correctly determined. If a firm has several plants in different cities within a country, it is considered as one firm.

Construction of Distances

The Russian Federation is geographically a big country with lengthy borders. We take into account the geographical dimension, by computing the following distances: seller-buyer, seller-customs point, customs point-buyer. We proceed as follows:

1. *Seller-Buyer distance*. The dataset includes information on the location of a sender within Russia and of a buyer abroad, which allows us to compute the distance between them. We write a script that searches through Google and returns the Global Positioning System (GPS) coordinates of the sender and the buyer. We further compute the distance between them as the shortest distance between two points on an ellipsoid.²⁹ However,

²⁹The ellipsoid is defined by World Geodetic System 1984.

certain shortcomings arise due to potential misspellings in the addresses filled in the declarations. We discuss the potential problems and how we address them in what follows. For the address of a sender, we only observe the city where the firm is located. The misspellings can be easily addressed. The script returned the GPS coordinates for almost all Russian exporters. Nevertheless, in the case of the buyers, we have the detailed address. This is more problematic, because misspellings in several words might return no result at all or it may lead to some errors. To overcome this issue, after getting all possible results via Google, we proceed to a further check, relying on the geosphere package in R. First, we develop an algorithm to identify the city in the detailed address and then directly obtain GPS coordinates existing in the package. Then, we compare the coordinates found by Google with the ones found by R, wherever possible. In the vast majority of cases, the results obtained from R are highly similar to the ones obtained from Google. In very few cases, the distance between the coordinates found through the two methods is important and we set them to missing. These two approaches together allow us to obtain coordinates for more than 95% of the senders and for almost 70% of the buyers. Since the share of missing coordinates for international buyers is still important, we aim to recover them. Relying on R, we obtain the coordinates of capital cities of each destination in our database and replace missing coordinates for buyers with these ones. This method does not appear to be problematic, as tested in different robustness tests.

2. *Seller-Customs Point & Customs Point-Buyer distances.* Customs points have a unique ID. This allows us to write another script in order to obtain their exact address and GPS coordinates. We manage to do so for more than 90% of all customs points. With these coordinates we are able to compute the distance from a seller to the customs point through which the export transaction is processed and from the customs point to the buyer, using the same method as for the distance between a seller and a buyer.

Customs control points

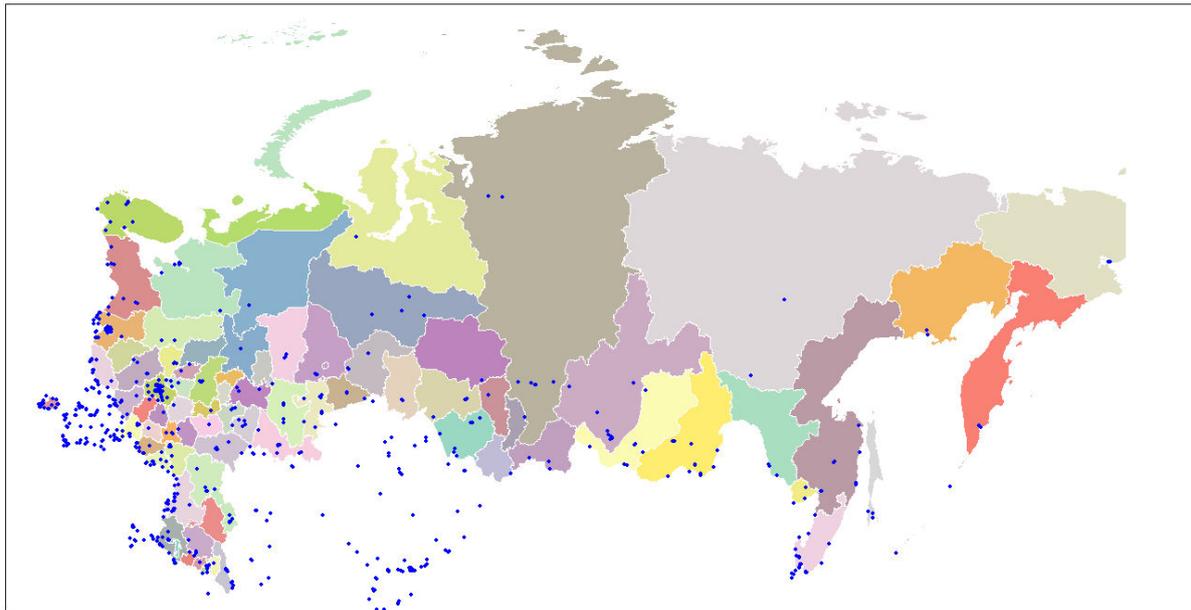


Figure 3.A1. Location of customs control points through which the export flows leave Russian territory.

Appendix 3B. Incoterms

The different categories of Incoterms are described below:

1. **EXW (Ex-Works)** may be used regardless of the mode of transport. It represents the minimum obligation for the seller. The seller delivers when it places the goods at the disposal of the buyer at the seller's premises or another named place (i.e. works, factory, warehouse, etc.). The seller does not load the goods, nor clears them for export. Once the delivery takes place, all risks and costs are borne by the buyer.
2. **FCA (Free Carrier)** may also be used irrespective of the mode of transport. Under FCA, the seller may deliver the goods at its premises or at another place agreed by the parties by loading them on the collecting vehicle provided by the buyer. In both cases, the seller is in charge of clearing the goods for exports, being held responsible and paying all costs for this activity. The buyer bears all risks and costs associated with the following stages of the shipping process.

3. **FAS (Free Alongside Ship)** is recommended for sea or inland waterway transportation. It stipulates that the seller delivers when the goods are placed alongside the ship designated by the buyer at the named port of shipment. As in the previous case, the buyer incurs all risks and costs from that moment onwards.
4. **FOB (Free On Board)** is also recommended for sea or inland waterway transportation. In the case of FOB, the seller delivers the goods at the named port of shipment, by putting them down on board the vessel, after clearing for export. The risk of loss of or damage to the goods passes when the goods are on board the vessel. The buyer bears all the costs from that moment onwards.
5. **CPT (Carriage Paid To)** is appropriate for any mode of transport. For this term, risks and costs are transferred at different places. Delivery, and implicitly passing of risk, occurs upon departure, when the seller transfers the goods to the main carrier, after clearing them for export. However, the seller pays the costs of transportation up to the arrival at the agreed place of destination. In other words, the carriage is paid by the seller, but takes place at buyer's risk.
6. **CIP (Carriage and Insurance Paid)** is very close to CPT, but adds an extra obligation for the seller who has to provide cargo insurance covering the goods to the agreed point of destination. The seller obtains insurance for the benefit of the buyer (who bears all risks for the main transportation).
7. **CFR (Cost and Freight)** is appropriate for sea and inland waterway transportation. It has two critical points. Delivery (i.e. passing of risk) occurs in the port of departure, when the seller places the goods on board the vessel. On the other hand, the seller pays the freight until the port of destination. Sea carriage is paid by the seller, but occurs at buyer's risk.
8. **CIF (Cost, Insurance and Freight)** is very similar to CFR, but puts an additional obligation on the seller to procure cargo insurance in the buyer's interest (similar to the CIP rule).
9. For **DAT (Delivered At Terminal)**, which may be used regardless of the transportation mode, the seller delivers the goods when he places them at the disposal of the buyer, un-

loaded from the arriving vehicle, in a terminal at the agreed port or place of destination. The buyer has the obligation to clear the goods for import.

10. **DAP (Delivered At Place)**, which may be used irrespective of the mode of transport, means that the seller delivers when the goods are placed at the disposal of the buyer on the arriving vehicle, ready for unloading, at the agreed place of destination. Import duties and formalities have to be conducted by the buyer.
11. **DDP (Delivered Duty Paid)** is essentially the same as DAP. The only difference consists in an extra obligation on the seller to obtain all official authorizations, carry out all customs formalities and pay all duties, taxes and other charges payable upon import. The term represents the maximum obligation for the seller (as opposed to EXW).

Appendix 3C. Additional Tables

Table 3.C1
Share of transactions and export value (%) for each Incoterms rule

Incoterms	2012		2013		2014		2015	
	Trans.	Exp. Val.						
EXW	2.0	0.5	2.0	0.9	2.0	0.7	2.4	0.5
FCA	47.1	34.1	47.3	31.7	45.8	27.9	48.2	30.4
FAS	0.4	1.5	0.4	1.4	0.4	1.7	0.4	2.1
FOB	3.6	21.6	3.6	19.8	3.4	22.5	3.3	21.3
CFR	1.7	2.9	1.9	3.1	2.0	3.3	2.4	3.9
CIF	1.0	1.3	1.0	1.5	1.1	1.5	1.3	1.9
CPT	15.1	9.9	15.6	10.4	16.7	13.6	15.6	15.4
CIP	4.5	9.7	4.7	12.6	4.7	8.6	3.8	4.6
DAT	0.8	0.3	0.5	1.4	0.7	4.5	0.7	3.9
DAP	23.4	17.9	22.7	17.0	22.8	15.6	21.3	15.8
DDP	0.5	0.3	0.5	0.2	0.5	0.2	0.5	0.2

Note: For each year, the first and the second columns present the share of transactions and the share of export value, respectively, occurring on a given Incoterms rule.

Table 3.C2
Choice of Responsibilities: Firm sizes (big firms defined as top 1%)

	OLogit	LPM Ladder ($S \rightarrow Sh \rightarrow B$)	
	(1)	(2a)	(2b)
	$S \rightarrow Sh \rightarrow B$	$(B + Sh)/S$	$B/(Sh + S)$
Big S (top 1%)	-1.008 ^a (0.035)	-0.377 ^a (0.006)	-0.247 ^a (0.005)
Nb of B per S	-0.110 ^a (0.001)	-0.005 ^a (0.000)	-0.026 ^a (0.000)
Big B (top 1%)	0.288 ^a (0.012)	0.039 ^a (0.002)	0.061 ^a (0.003)
Nb of Russian S per B	0.040 ^a (0.001)	0.001 ^a (0.000)	0.005 ^a (0.000)
New relationship for S and B	-0.196 ^a (0.002)	-0.029 ^a (0.000)	-0.030 ^a (0.001)
Share of B in the exports of S	-0.309 ^a (0.004)	-0.027 ^a (0.001)	-0.020 ^a (0.001)
Share of S in the imports of B	-0.394 ^a (0.061)	-0.049 ^a (0.007)	-0.011 ^c (0.006)
Dist. seller - customs point	0.052 ^a (0.001)	0.009 ^a (0.000)	0.026 ^a (0.000)
Dist. customs point - buyer	0.061 ^a (0.001)	0.023 ^a (0.000)	0.006 ^a (0.000)
Transp. inside: waterway	0.340 ^a (0.011)	-0.020 ^a (0.001)	0.059 ^a (0.002)
Transp. outside: waterway	1.386 ^a (0.004)	0.260 ^a (0.001)	0.249 ^a (0.001)
Container trade	-0.379 ^a (0.004)	-0.023 ^a (0.001)	-0.106 ^a (0.001)
Observations	5244094	5306992	5306992
Fixed effects:			
<i>HS2 Sector & Dest. – Year</i>	Yes		
<i>HS10 Product & Dest. – Year</i>		Yes	Yes

Note: Column 1 reports the results for the ordered logistic regression. $S \rightarrow Sh \rightarrow B$ indicates that the terms are arranged in increasing order of the responsibilities of the buyer. Columns 2a and 2b present the results of the LPM estimations for the ladder $S \rightarrow Sh \rightarrow B$. In column 2a, the dependent variable is a dummy set to 1 for the use *On buyer* and *Shared* responsibilities (0 otherwise). In column 2b, the dependent variable is a dummy set to 1 for the use of *On buyer* responsibilities (0 otherwise). Robust standard errors in parentheses, with ^a, ^b and ^c denoting significance at the 1%, 5% and 10% level respectively.

Table 3.C3*Choice of Responsibilities: Interactions between Firm sizes (big firms defined as top 1%)*

	OLogit	LPM Ladder ($S \rightarrow Sh \rightarrow B$)	
	(1)	(2a)	(2b)
	$S \rightarrow Sh \rightarrow B$	$(B + Sh)/S$	$B/(Sh + S)$
Big S (top 1%) Big B (top 1%)		-0.897 ^a (0.006)	-0.731 ^a (0.008)
Big S (top 1%) Small B (bottom 99%)	-1.008 ^a (0.035)	-0.377 ^a (0.006)	-0.247 ^a (0.005)
Small S (bottom 99%) Big B (top 1%)	0.288 ^a (0.012)	0.039 ^a (0.002)	0.061 ^a (0.003)
Nb of B per S	-0.110 ^a (0.001)	-0.005 ^a (0.000)	-0.026 ^a (0.000)
Nb of Russian S per B	0.040 ^a (0.001)	0.001 ^a (0.000)	0.005 ^a (0.000)
New relationship for S and B	-0.196 ^a (0.002)	-0.029 ^a (0.000)	-0.030 ^a (0.001)
Share of B in the exports of S	-0.309 ^a (0.004)	-0.027 ^a (0.001)	-0.020 ^a (0.001)
Share of S in the imports of B	-0.394 ^a (0.061)	-0.049 ^a (0.007)	-0.011 ^c (0.006)
Dist. seller - customs point	0.052 ^a (0.001)	0.009 ^a (0.000)	0.026 ^a (0.000)
Dist. customs point - buyer	0.061 ^a (0.001)	0.023 ^a (0.000)	0.006 ^a (0.000)
Transp. inside: waterway	0.340 ^a (0.011)	-0.020 ^a (0.001)	0.059 ^a (0.002)
Transp. outside: waterway	1.386 ^a (0.004)	0.260 ^a (0.001)	0.249 ^a (0.001)
Container trade	-0.379 ^a (0.004)	-0.023 ^a (0.001)	-0.106 ^a (0.001)
Observations	5244094	5306992	5306992
Fixed effects:			
HS2 Sector & Dest. – Year	Yes		
HS10 Product & Dest. – Year		Yes	Yes

Note: Column 1 reports the results for the ordered logistic regression. $S \rightarrow Sh \rightarrow B$ indicates that the terms are arranged in increasing order of the responsibilities of the buyer. Columns 2a and 2b present the results of the LPM estimations for the ladder $S \rightarrow Sh \rightarrow B$. In column 2a, the dependent variable is a dummy set to 1 for the use *On buyer* and *Shared* responsibilities (0 otherwise). In column 2b, the dependent variable is a dummy set to 1 for the use of *On buyer* responsibilities (0 otherwise). Robust standard errors in parentheses, with ^a, ^b and ^c denoting significance at the 1%, 5% and 10% level respectively.

Table 3.C4
Choice of Responsibilities: Robustness for Firm sizes

	LPM Ladder: Step 2 - (B) vs. (Sh + S)				
	Altern. set of FE	Additional Controls	Original Distance	Cust.-Year FE	Charact. in <i>t-1</i>
	(1)	(2)	(3)	(4)	(5)
Big S (top 5%)	-0.025 ^a (0.002)	-0.020 ^a (0.002)	-0.018 ^a (0.002)	-0.007 ^a (0.002)	-0.012 ^a (0.002)
Nb of B per S	-0.037 ^a (0.000)	-0.027 ^a (0.000)	-0.027 ^a (0.000)	0.021 ^a (0.001)	-0.039 ^a (0.000)
Big B (top 5%)	0.088 ^a (0.001)	0.085 ^a (0.001)	0.079 ^a (0.001)	0.019 ^a (0.001)	0.109 ^a (0.002)
Nb of Russian S per B	0.002 ^a (0.000)	0.002 ^a (0.000)	0.002 ^a (0.000)	0.024 ^a (0.000)	-0.002 ^a (0.000)
New relationship for S and B	-0.014 ^a (0.001)	-0.030 ^a (0.001)	-0.032 ^a (0.001)	-0.008 ^a (0.000)	
Nb. transactions in <i>t-1</i>					0.016 ^a (0.000)
Share of B in the exports of S	-0.068 ^a (0.001)	-0.027 ^a (0.001)	-0.025 ^a (0.001)	0.023 ^a (0.001)	-0.061 ^a (0.001)
Share of S in the imports of B	-0.020 ^c (0.011)	-0.015 ^a (0.006)	-0.017 ^a (0.006)	-0.028 ^a (0.003)	-0.054 ^a (0.001)
Value (in log)		-0.019 ^a (0.000)			
Quantity (in log)		0.019 ^a (0.000)			
Dist. seller - customs point	0.018 ^a (0.000)	0.024 ^a (0.000)	0.025 ^a (0.000)	0.006 ^a (0.000)	0.029 ^a (0.000)
Dist. customs point - buyer	0.003 ^a (0.000)	0.008 ^a (0.000)		-0.001 ^a (0.000)	0.006 ^a (0.000)
Dist. customs point - buyer (\neq adj.)			0.010 ^a (0.000)		
Transp. inside: waterway	0.026 ^a (0.003)	0.057 ^a (0.002)	0.033 ^a (0.002)	0.076 ^a (0.003)	0.047 ^a (0.003)
Transp. outside: waterway	0.179 ^a (0.001)	0.241 ^a (0.001)	0.254 ^a (0.001)	-0.020 ^a (0.004)	0.240 ^a (0.001)
Container trade	-0.079 ^a (0.001)	-0.107 ^a (0.001)	-0.092 ^a (0.001)	-0.034 ^a (0.001)	-0.092 ^a (0.001)
Observations	5189626	5306870	4473820	5233337	3012386
R ²	0.569	0.326	0.334	0.584	0.344
Fixed effects: (HS10)DT	Yes				
HS10 & DT		Yes	Yes	Yes	Yes
Customs Year				Yes	

Note: The dependent variable is a dummy set to 1 for the use of *On buyer* responsibilities (0 otherwise). Robust standard errors in parentheses, with ^a, ^b and ^c denoting significance at the 1%, 5% and 10% level respectively.

Table 3.C5
Choice of Responsibilities: Robustness for Firm sizes

	LPM Ladder: Step 1 - (<i>B + Sh</i>) vs. (<i>S</i>)				
	Altern. set of FE	Additional Controls	Original Distance	Cust.-Year FE	Charact. in <i>t-1</i>
	(1)	(2)	(3)	(4)	(5)
Big S (top 5%)	-0.083 ^a (0.002)	-0.051 ^a (0.002)	-0.077 ^a (0.001)	-0.023 ^a (0.001)	-0.091 ^a (0.002)
Nb of B per S	-0.002 ^a (0.000)	-0.006 ^a (0.000)	-0.004 ^a (0.000)	-0.009 ^a (0.000)	-0.012 ^a (0.000)
Big B (top 5%)	0.105 ^a (0.001)	0.065 ^a (0.001)	0.073 ^a (0.001)	0.045 ^a (0.001)	0.061 ^a (0.001)
Nb of Russian S per B	-0.004 ^a (0.000)	-0.003 ^a (0.000)	-0.001 ^a (0.000)	0.001 ^a (0.000)	-0.001 ^a (0.000)
New relationship for S and B	-0.012 ^a (0.000)	-0.029 ^a (0.000)	-0.028 ^a (0.000)	-0.030 ^a (0.000)	
Nb. transactions in t-1					0.014 ^a (0.000)
Share of B in the exports of S	-0.035 ^a (0.001)	-0.032 ^a (0.001)	-0.034 ^a (0.001)	-0.040 ^a (0.001)	-0.053 ^a (0.001)
Share of S in the imports of B	-0.128 ^a (0.016)	-0.049 ^a (0.007)	-0.049 ^a (0.007)	-0.050 ^a (0.007)	-0.006 ^a (0.001)
Value (in log)		0.006 ^a (0.000)			
Quantity (in log)		-0.008 ^a (0.000)			
Dist. seller - customs point	0.006 ^a (0.000)	0.010 ^a (0.000)	0.007 ^a (0.000)	0.013 ^a (0.000)	0.009 ^a (0.000)
Dist. customs point - buyer	0.015 ^a (0.000)	0.022 ^a (0.000)		0.004 ^a (0.000)	0.023 ^a (0.000)
Dist. customs point - buyer (\neq adj.)			0.025 ^a (0.000)		
Transp. inside: waterway	-0.033 ^a (0.002)	-0.018 ^a (0.001)	-0.027 ^a (0.002)	0.016 ^a (0.001)	-0.030 ^a (0.002)
Transp. outside: waterway	0.197 ^a (0.001)	0.265 ^a (0.001)	0.260 ^a (0.001)	0.094 ^a (0.003)	0.262 ^a (0.001)
Container trade	0.026 ^a (0.001)	-0.021 ^a (0.001)	-0.014 ^a (0.001)	0.029 ^a (0.001)	-0.011 ^a (0.001)
Observations	5189626	5306870	4473820	5306803	3012386
R ²	0.597	0.377	0.387	0.438	0.394
Fixed effects:					
(HS10)DT	Yes				
HS10 & DT		Yes	Yes	Yes	Yes
Customs Year				Yes	

Note: The dependent variable is a dummy set to 1 for the use *On buyer* and *Shared* responsibilities (0 otherwise). Robust standard errors in parentheses, with ^a, ^b and ^c denoting significance at the 1%, 5% and 10% level respectively.

Appendix 3D. Empirical implications of the model

Table 3.D1

Impact of number of sellers per buyer on the repartition of risks and costs

	LPM Ladder ($S \rightarrow Sh \rightarrow B$)			
	(B+Sh)/(S)	(B)/(Sh+S)	(B+Sh)/(S)	(B)/(Sh+S)
	(1a)	(1b)	(2a)	(2b)
log(Nb of Russian S per B)	-0.008 ^a (0.000)	-0.009 ^a (0.000)	-0.004 ^a (0.000)	-0.002 ^a (0.000)
Dist. seller - customs point	0.005 ^a (0.000)	0.020 ^a (0.000)	0.012 ^a (0.000)	0.021 ^a (0.000)
Transp. inside: waterway	-0.011 ^a (0.001)	0.082 ^a (0.002)	-0.027 ^a (0.001)	0.048 ^a (0.002)
Dist. customs point - buyer	0.028 ^a (0.000)	0.003 ^a (0.000)	0.020 ^a (0.000)	0.003 ^a (0.000)
Transp. outside: waterway	0.214 ^a (0.001)	0.248 ^a (0.001)	0.262 ^a (0.001)	0.250 ^a (0.001)
Container trade	-0.028 ^a (0.001)	-0.147 ^a (0.001)	-0.078 ^a (0.001)	-0.190 ^a (0.001)
Observations	5513329	5513329	5512551	5512551
R ²	0.17375	0.07754	0.31524	0.22711
Fixed effects:				
HS2 + Year	Yes	Yes		
HS10 + Year			Yes	Yes

Note: A group of two columns presents the results of the LPM estimations for the ladder $S \rightarrow Sh \rightarrow B$. In columns (a), the dependent variable is a dummy set to 1 for the use *On buyer* and *Shared* responsibilities (0 otherwise). In the columns (b), the dependent variable is a dummy set to 1 for the use of *On buyer* responsibilities (0 otherwise). All estimations include shipment-specific controls. Robust standard errors in parentheses, with ^a, ^b and ^c denoting significance at the 1%, 5% and 10% level respectively.

Table 3.D2*Impact of development level of destination on the repartition of risks and costs*

	LPM Ladder ($S \rightarrow Sh \rightarrow B$)			
	(B+Sh)/(S)	(B)/(Sh+S)	(B+Sh)/(S)	(B)/(Sh+S)
	(1a)	(1b)	(2a)	(2b)
log (GDP per capita)	-0.002 ^a (0.000)	-0.004 ^a (0.000)		
Developed			-0.028 ^a (0.001)	-0.020 ^a (0.001)
Dist. seller - customs point	-0.000 ^c (0.000)	0.018 ^a (0.000)	-0.001 ^b (0.000)	0.018 ^a (0.000)
Transp. inside: waterway	-0.016 ^a (0.002)	0.012 ^a (0.003)	-0.016 ^a (0.002)	0.013 ^a (0.003)
Dist. customs point - buyer	0.002 ^a (0.000)	-0.003 ^a (0.000)	0.002 ^a (0.000)	-0.003 ^a (0.000)
Transp. outside: waterway	0.142 ^a (0.001)	0.119 ^a (0.002)	0.139 ^a (0.001)	0.117 ^a (0.002)
Container trade	-0.015 ^a (0.001)	-0.102 ^a (0.001)	-0.015 ^a (0.001)	-0.099 ^a (0.001)
Observations	5219889	5219889	5287155	5287155
R ²	0.905	0.902	0.905	0.903
Fixed effects: ST&BT&HS10	Yes	Yes	Yes	Yes

Note: A group of two columns presents the results of the LPM estimations for the ladder $S \rightarrow Sh \rightarrow B$. In columns (a), the dependent variable is a dummy set to 1 for the use *On buyer* and *Shared* responsibilities (0 otherwise). In the columns (b), the dependent variable is a dummy set to 1 for the use of *On buyer* responsibilities (0 otherwise). All estimations include shipment-specific controls. Robust standard errors in parentheses, with ^a, ^b and ^c denoting significance at the 1%, 5% and 10% level respectively.

Table 3.D3*Impact of intermediate goods' prices on the repartition of risks and costs*

	LPM Ladder ($S \rightarrow Sh \rightarrow B$)			
	$(B+Sh)/(S)$	$(B)/(Sh+S)$	$(B+Sh)/(S)$	$(B)/(Sh+S)$
	(1a)	(1b)	(2a)	(2b)
log(Unit values)	-0.005 ^a (0.000)	-0.015 ^a (0.000)	-0.005 ^a (0.000)	-0.014 ^a (0.000)
Dist. seller - customs point	0.000 (0.000)	0.020 ^a (0.001)	0.000 (0.000)	0.019 ^a (0.001)
Transp. inside: waterway	-0.022 ^a (0.003)	0.001 (0.003)	-0.020 ^a (0.003)	0.002 (0.003)
Dist. customs point - buyer	-0.001 ^c (0.000)	-0.001 ^a (0.000)	0.000 (0.000)	-0.001 ^a (0.000)
Transp. outside: waterway	0.202 ^a (0.002)	0.147 ^a (0.002)	0.193 ^a (0.002)	0.146 ^a (0.002)
Container trade	-0.026 ^a (0.001)	-0.099 ^a (0.002)	-0.019 ^a (0.001)	-0.101 ^a (0.002)
Observations	2869104	2869104	2869085	2869085
R ²	0.887	0.878	0.888	0.879
Fixed effects: <i>ST&BT&HS10</i>	Yes	Yes	Yes	Yes

Note: A group of two columns presents the results of the LPM estimations for the ladder $S \rightarrow Sh \rightarrow B$. In columns (a), the dependent variable is a dummy set to 1 for the use *On buyer* and *Shared* responsibilities (0 otherwise). In the columns (b), the dependent variable is a dummy set to 1 for the use of *On buyer* responsibilities (0 otherwise). All estimations include shipment-specific controls. Robust standard errors in parentheses, with ^a, ^b and ^c denoting significance at the 1%, 5% and 10% level respectively.

Table 3.D4*Impact of consumer goods' prices on the repartition of risks and costs*

	LPM Ladder ($S \rightarrow Sh \rightarrow B$)			
	(B+Sh)/(S)	(B)/(Sh+S)	(B+Sh)/(S)	(B)/(Sh+S)
	(1a)	(1b)	(2a)	(2b)
log(Unit values)	0.000 ^c (0.000)	-0.002 ^a (0.000)	0.000 ^b (0.000)	-0.002 ^a (0.000)
Dist. seller - customs point	-0.003 ^a (0.000)	0.016 ^a (0.000)	-0.003 ^a (0.000)	0.016 ^a (0.000)
Transp. inside: waterway	0.006 ^b (0.003)	0.014 ^a (0.005)	0.012 ^a (0.003)	0.014 ^a (0.005)
Dist. customs point - buyer	0.001 ^a (0.000)	-0.008 ^a (0.000)	0.001 ^a (0.000)	-0.008 ^a (0.000)
Transp. outside: waterway	0.026 ^a (0.002)	0.108 ^a (0.003)	0.027 ^a (0.002)	0.113 ^a (0.003)
Container trade	-0.003 ^b (0.001)	-0.074 ^a (0.002)	-0.004 ^b (0.001)	-0.076 ^a (0.002)
Observations	1820065	1820065	1819995	1819995
R ²	0.937	0.925	0.937	0.926
Fixed effects: <i>ST&BT&HS10</i>	Yes	Yes	Yes	Yes

Note: A group of two columns presents the results of the LPM estimations for the ladder $S \rightarrow Sh \rightarrow B$. In columns (a), the dependent variable is a dummy set to 1 for the use *On buyer* and *Shared* responsibilities (0 otherwise). In the columns (b), the dependent variable is a dummy set to 1 for the use of *On buyer* responsibilities (0 otherwise). All estimations include shipment-specific controls. Robust standard errors in parentheses, with ^a, ^b and ^c denoting significance at the 1%, 5% and 10% level respectively.

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ABSTRACT

In Chapter 1 I investigate firm-level efficiency outcomes of mergers between the European energy producers. I compute eco-efficiency using data envelopment analysis and the Malmquist-Luenberger productivity index. I find that carefully regulated domestic horizontal mergers do not have a statistically significant impact. Cross-border horizontal mergers hamper eco-efficiency in the short run but stimulate it two years after completion. Vertical mergers are detrimental to eco-efficiency. I put forward policy suggestions regarding the regulation of mergers. Chapter 2 is joint work with Julian Hinz. We investigate the effects of self-imposed Russian embargo on food import from Western countries. We build a Ricardian model with sectoral linkages, trade in intermediate goods and sectoral heterogeneity in production. The calibration of the model with real data allows to simulate the outcomes of embargo in terms of changes in welfare and prices. We further quantify the impact on consumer prices in Russia with the difference-in-differences estimator. Chapter 3 is based on a paper co-written with Cristina Herghelegiu. We investigate the use of International Commercial Terms. They are pre-defined schemes of repartition of costs and risks between buyers and sellers, which serve to mitigate the uncertainty. We rely on a highly detailed dataset on Russian exports over the 2012-2015 period. We find that big firms are more likely to take on responsibilities. Big buyers bear more responsibilities regardless of the seller size, whereas big sellers do so only when their partner is small. Risks and costs are more likely on buyers in transactions of intermediate and capital goods.

Keywords: Electric power industry, Mergers and acquisitions, Eco-efficiency, Data envelopment analysis, Fractional regression model, Carbon dioxide emissions, Trade policy, Embargo, Consumer prices, Sectoral linkages, Exact hat algebra, Risks and costs, Incoterms, Firm-to-Firm Exports

RÉSUMÉ

Dans le chapitre 1, j'examine les résultats des fusions entre producteurs européens d'énergie en termes d'efficacité. Je calcule l'éco-efficacité en utilisant l'analyse de l'enveloppement des données et l'indice de productivité Malmquist-Luenberger. Je trouve que les fusions horizontales nationales, qui sont soigneusement réglementées, n'ont pas d'impact. Les fusions horizontales transfrontalières nuisent à l'éco-efficacité à court terme mais la stimulent deux ans après l'achèvement. Les fusions verticales nuisent à l'éco-efficacité. Je présente des suggestions de politiques concernant la réglementation des fusions. Le chapitre 2 est un travail conjoint avec Julian Hinz. Nous enquêtons sur les effets de l'embargo russe auto-imposé sur les importations de produits alimentaires en provenance des pays occidentaux. Nous construisons un modèle ricardien avec des liens sectoriels, des échanges de biens intermédiaires et une hétérogénéité sectorielle dans la production. L'étalonnage du modèle avec des données réelles permet de simuler les résultats de l'embargo en termes de changements de bien-être et de prix. Nous quantifions en outre l'impact sur les prix à la consommation en Russie à l'aide de la méthode des doubles différences. Le chapitre 3 est basé sur un article co-écrit avec Cristina Herghelegiu. Nous enquêtons sur l'utilisation des conditions commerciales internationales (Incoterms). Ce sont les schémas prédéfinis de la répartition des coûts et des risques entre les acheteurs et les vendeurs. Nous nous appuyons sur un ensemble de données très détaillées sur les exportations russes durant la période 2012-2015. Nous constatons que les grandes entreprises sont plus susceptibles d'assumer des responsabilités. Les gros acheteurs assument plus de responsabilités, quelle que soit la taille du vendeur, alors que les gros vendeurs le font uniquement lorsque leur partenaire est petit. C'est plus probable que les risques et les coûts sont sur les acheteurs dans les transactions de biens intermédiaires et de biens d'équipement.

Mots clés: Industrie électrique, Fusions et acquisitions, Eco-efficacité, Analyse de l'enveloppement des données, Modèle de régression fractionnaire, Émissions de dioxyde de carbone, Politique commerciale, Embargo, Prix à la consommation, Liens sectoriels, Algèbre de chapeau exacte, Risques et coûts, Incoterms, Exportations

