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Decomposing Service Exports Adjustments along the Intensive and Extensive Margin at the Firm-Level*

Elisabeth Christen†, Michael Pfaffermayr‡, Yvonne Wolfmayr§

Abstract

Using a panel-data set of Austrian service exporting firms this paper examines the determinants of service exports at the firm/destination country-level. We implement a random effects Heckman sample selection firm-level gravity model as well as a fixed effects Poisson model. Expected firm-level service exports are decomposed into the intensive and extensive margins of adjustment as a response to counterfactual changes. We find market demand to be the key determinant. Results also suggest high service export potentials due to regulatory reform in partner countries within the EU. Adjustments at the extensive margin only play a marginal role. Increasing firm size as well as changes in distance related costs are most effective in developing new export relationships in services.

Keywords: Services trade, Firm-level evidence, Firm heterogeneity, Gravity model, Sample selection, Intensive and extensive margin of trade.
JEL Codes: C15, C21, D21, F14, L20, L80
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1 Introduction

International trade in services in 2015 still only represented about a quarter of world trade in manufactured goods and accounted for only about one fifth of world trade (UNCTAD).[1] However, while the gap between services trade and goods trade is still high and to some part related to the intangible nature of most services requiring the proximity between sellers and buyers, cross-border trade in services has become the most dynamic segment of world trade, growing more quickly than trade in goods over the past 20 years especially since the mid of the noughties.[2] Technological advances, partly also deregulations and trade liberalisation, the increasingly fragmented nature of production due to offshoring as well as the increased services content of manufactured goods exports foster services trade across borders.

Against this background of the growing role of services and their increasing importance to trade flows, this paper analyzes the determinants of services trade in Austria to dissect the role of foreign demand, firm performance, the competitive environment in export markets, regulation in services and other trade barriers. We employ a large panel data set of Austrian service firms covering service exports by Austrian firms, by destination over the period 2006 to 2009. Exploiting the full panel structure of our data, we thereby focus on the determinants of both the decision of firms which export markets to serve as well as the export performance of firms in terms of export values in each destination. Thus, we take account of the extensive and intensive margins of trade as well as the correlation between the two through sample selection as implied by economic theory.

Indeed, the literature finds substantial variation in the number of markets served by a firm at the same time as the absence of bilateral trade turned out to be an important and persistent stylized fact of international trade patterns (Helpman et al., 2008). Burgeoning research on the characteristics and strategies of globalized firms at the micro-level, have documented that participation in international markets is systematically related to performance differences across firms. Most of this research focused on manufacturing industries while firm-level evidence on trade in services is still rare and has just recently begun to emerge (for an overview see: Wagner, 2007; 2012).[3] In general, these studies on trade in services suggest that many of the stylized facts on the characteristics of exporting firms, the number of markets served and the trade patterns derived for goods trade at the firm-level also hold for services trade. Exporting firms are larger, more productive, more profitable and employ a higher skilled workforce. Firms were also found to differ substantially in their engagement in international trade. Larger and more productive firms serve a greater number of export markets. Firms with high market coverage in turn are also more likely to serve less popular markets, while firms selling to only a few markets usually choose the most popular ones (e.g. Lawless, 2009). The majority of firms do not

[1] According to UNCTAD Balance of Payments (BOP) data in the version of BOP Manual 6, downloaded March, 2017.

[2] 6.2% per annum growth in trade in services versus 4.7% growth in trade in goods over the period 2005 to 2015 (Source: UNCTAD).

[3] More recent evidence for four EU-countries is given by Haller et al., 2014. firm-level evidence for Austria is given by Walter and Dell'mour (2010).

export at all, and of those that do export, most only exports to one country. Overall, exporting activities are concentrated on activities of a few firms ("superstars"). Christen et al. (2013) verify these relationships for Austrian service exporters.

The heterogeneous trade theory literature pioneered by Melitz (2003) builds the theoretical foundation for many of these empirical facts. Bernard et al. (2007), Melitz and Ottaviano (2008) are important variations of the basic model, but the extension by Chaney (2008), Helpman et al. (2008), as well as Eaton et al. (2004, 2011) taking into account asymmetric countries that are separated by asymmetric trade costs is especially relevant to this paper. The insights from both, the theory and the wide array of empirical papers, require to control for sample selection and to consider adjustments at the intensive and extensive margin of trade in firm-level gravity models. Chaney (2008) explicitly models the exporters' strategic choice on which markets to enter and provides the theoretical foundation for the extensive margin of trade. As firms exhibit heterogeneity in their productivity, only the more productive and larger firms are able to earn sufficient operating profits in a destination market to cover the associated fixed costs and self-select into exporting to specific destinations. It is key to these models that the export value decision is conditional on a positive export decision and adjustments in trade flows due to changes in exogenous determinants occur along two margins: the extensive margin as firms select into destination markets and the intensive margin as firms intensify trade in already established bilateral trade relationships.

This paper applies a random effects firm-level Heckman sample selection gravity model and defines the extensive margin as the probability to enter a specific destination market and the intensive margin as the expected volume of service exports conditional on entering that destination. Based on the predictions of the Heckman model and the formal results on the conditional expectation of log-normal random variables provided by Yen and Rosinski (2008) and Staub (2014) we elaborate on the adjustments of trade flows along the extensive and intensive margin in a number of counterfactual experiments.

Our firm-level gravity model links bilateral exports to both, firm characteristics as well as destination country characteristics. The latter include foreign demand, inward multilateral resistance as an inverse measure of competition intensity in the foreign country, market regulation as well as other trade enhancing and trade dampening bilateral and destination specific characteristics. The heterogeneous trade models imply that both, the export decision as well as the export value decision are influenced by the same firm specific and destination specific determinants except for fixed cost which are relevant only to the extensive margin but not the intensive margin. Changes in exogenous variables impact trade decisions via their impact on productivity thresholds which increase with variable and fixed trade costs as well as the competition intensity in destinations and decrease with destination country market size. We specifically examine the role of regulations on the basis of the OECD product market regulation indicator (PMR). Furthermore, we apply a measure of the multilateral resistance term that is derived from gravity regressions at the industry level. Controlling for multilateral resistance is essential to consistent parameter estimation in the gravity model framework. It is a inverse measure of competition in foreign markets and itself depends on gravity forces (trade costs, market size). The chosen measure of the multilateral resistance term allows for a decomposition into its different determinants and is essential to our counterfactual analysis as changes in any of the exogenous determinants not only impact both trade margins directly but also indirectly by changing the multilateral resistance. Thus, any increase in market size or lowering of trade costs will increase competition in all markets and dampen the direct positive effect of the changes on exports. We follow Breinlich and Tucci (2011), but apply a more structural approach which is based on Anderson and Yotov (2010) and Fally (2015).

Estimation is complicated by the fact that in a non-linear sample selection model, application of the fixed effects model to exploit the full panel dimension of the dataset is unwarranted (Semykina and Wooldridge, 2010). This is why we apply two estimation approaches. The first one is based on a panel random effects sample selection model as introduced by Raymond et al. (2010). In this non-linear sample selection model, we have to use Mundlak-terms both, for the selection and the outcome equation, in which time-specific averages of firm-level variables additionally enter the specification to account for unobserved firm specific effects. The second approach employs a Poisson model with fixed effects. The difference between the approaches is that the first model accounts for sample selection and the Poisson model does not. Estimating the Poisson model for a restricted sample of firms with positive export flows to specific destinations can be interpreted as the outcome part of a two-part model. The latter assumes selection on observables (Egger, Larch, Staub and Winkelmann, 2011), while the Heckman model accounts for selection based on unobservables. The sample selection approach however is motivated by economic theory (see Dow and Norton, 2003; Breinlich and Tucci, 2011) and more appropriate to apply in order to take account of potential (counterfactual) outcomes, i.e. the potential outcome of firms that switch into exporting to particular destination markets in response to changes in exogenous variables (the extensive margin in our paper).

The main contribution of this paper is to apply this framework in an analysis of service exports. We are also the first to implement a Mundlak approach in estimating a non-linear sample selection model. Our decomposition procedure to disentangle extensive and intensive margins is based on Dow and Norton (2003) and Yen and Rosinski (2008) and is novel within the specific context of services trade. A similar decomposition has been applied by Breinlich and Tucci (2011) for goods exports. Overall, we believe that the analysis gives important insights into the relative importance of the determinants of export performance at the firm-level. This in turn can give important guidance to economic policy within a sector that is becoming more and more relevant for economic growth and jobs. The findings not only highlight different impacts across determinants but also different impacts across trade margins. The latter are relevant as different policy instruments and strategies are appropriate to stimulate firms to intensify existing trade relationships or to establish new ones. Counterfactual analysis singles out the quantitative importance of various policy relevant experiments for both trade margins. To date, systematic analysis on the main impeding factors for Austrian service exporters to diversify into more destination markets are missing at the same time that the evidence for other countries is very sparse, especially as it comes to firm-level gravity analysis.

Based on the counterfactual results for the year 2007 we find foreign market demand was the key determinant of Austrian services export growth increasing Austrian service exports by 12% in that year. Predicted on IMF projections for 2020 we find the highest potentials for services export growth in Extra-EU markets. Improved firm performance (measured as changes in firm size in our analysis) was less important and raised service exports by 3.4%. Results further suggest that regulatory reform which lowered the restrictiveness of product market regulations to the benchmark of the least restrictive tertile of countries would have increased service exports in that year by 10% for total services trade and by over 24% to non-traditional markets outside the EU. It is interesting that the second largest impact results for traditional Austrian export markets within the EU (up to +16%). Due to the importance of EU markets, regulatory changes within the EU weight most and generate the highest potentials. Overall, the adjustments occur almost exclusively at the intensive margin, while the expansion into new markets only plays a marginal role. Increasing firm size as well as changes in the distance elasticity of trade turn out to be most effective in helping to develop new trade relationships, especially in the most distant and least traditional Extra-EU markets.

The remainder of the paper is organized as follows: The next Section 2 reviews the related literature. Section 3 discusses the theoretical model and motivates the application of the Heckman sample selection model. Based on the model with heterogeneous firms we present the empirical specification and derive the functional composition of the comparative static analysis. In Section 4 we present the data, descriptive statistics and the regression and robustness analysis. Section 5 reports on the counterfactual analysis and Section 6 concludes.

2 Related Literature

Despite the prominent role gravity models have had in explaining aggregate bilateral trade flows, their adoption to firm-level trade data has not yet gained widespread attention in the empirical literature, even less so for services trade. Rather than estimating margin elasticities directly using firm-level trade data, the usual practice is to regress gravity variables on the decomposed margins, measured at the country-level as the number of active exporters in the markets served or/and number of service types delivered (extensive margin), and the average trade volume per exporter across destination country and/or service type (intensive margin).[4] Recent contributions on services trade include Breinlich and Criscuolo (2011) who are among the first to study firm-level services trade with a focus one trade participation and trade patterns of UK firms. In line with evidence for manufacturing firms they find important differences between service traders and non-traders with respect to firm size and productivity. A major conclusion of their study is that firm-heterogeneity is also a key feature of services trade, thereby pointing to the relevance of heterogeneous firm models for modeling service activities. In related

[4] For an overview on the different ways to decompose aggregate exports as well as the different interpretations of extensive and intensive margins see Head and Mayer, (2014)

papers Ariu (2016), Federico and Tosti (2012, 2016) as well as Biewen and Blank (2014) report similar stylized facts and provide firm-level evidence on services trade for Belgium, Italy and Germany, respectively. All these contributions analyze the adjustment at the intensive and extensive margin *at the country-level*. Similar to the findings for goods trade[5], aggregate trade is mainly explained by the extensive margin, while the intensive margin only accounts for 20% to 30%.

This is in contrast to results based on decompositions into extensive and intensive margins *at the firm-level* measured as the number of markets served and/or service types traded by the firm (extensive margin) and the average shipment of the firm per trading partner and/or service type. Cross-firm variation is mainly explained by the intensive margin. This dominance of the intensive margin can be partly explained by the large fraction of firms which trade with only one foreign destination market and in one service type, making only possible variations in the intensive margin at the firm-level. Available evidence suggests that the dominance of the intensive margin is lower for exports of goods than for exports of services suggesting higher fixed costs of exporting services (e.g. related to higher marketing costs due to higher uncertainty about the "product" quality for services; higher bureaucratic restrictions and special authorizations). Measuring the extensive margin as the number of markets served it is estimated to account for about 20% to 25% in the services trade literature and for about 35% in goods trade (Ariu, 2016; Bernard et al., 2009).

Head and Mayer (2014) refer to this practice as "margins accounting" which in principle can be done independently from underlying foundation of the gravity equation. It has the disadvantage, that measures at the country-level (number of exporting firms and average shipment per firm across destinations) leave out variations across firms and thus cannot be used to test for the contribution of firm characteristics to either the extensive or the intensive margins. On the other hand the measures at the firm-level (number of markets served and average shipment per destination across firms) leave out variations across destinations. Both trade margins however are affected by firm as well as destination country characteristics and can be included in firm-level gravity models based on destination specific micro-data simultaneously. Estimation of a Heckman sample selection gravity model at the firm-level additionally takes account for selection of firms into destination markets based on the heterogeneity of firms in terms of productivity. As in our analysis, the extensive margin is then defined as the probability to enter a specific destination market and the intensive margin as the expected volume of service exports conditional on entering that destination.

firm-level gravity analysis has so far almost exclusively focused on trade in goods. Fitzgerald and Haller (2014), Berman et al. (2012) do not control for selection, but estimate a two part firm-level gravity model to analyze firm-level reactions to exchange rate movements on the volume of trade (intensive margin) and entry/exit decisions on export markets (extensive margin) for manufacturing firms in Ireland and France, respectively. While not applying a Heckman estimation model, Fitzgerald and Haller (2014) restrict

[5]For analysis of trade in goods see e.g. Bernard et al. (2007) or Hillberry and Hummels (2008) for the US, Mayer and Ottaviano (2007) for selected EU countries and or Lawless (2010) for Ireland.

their sample of firms to long-term exporters to control for the selection bias, mentioning that selection is less likely for firms farther away from the exit and entry thresholds. Both papers confirm the low elasticity of exports to exchange rate changes found in the macro-literature. In disentangling the contribution of the intensive and extensive margins to exchange rate induced changes in the aggregate exports (counterfactual analysis in Fitzgerald and Haller, 2014; calibration in Berman et al., 2012) both document a dominance of the intensive over the extensive margin.

Crozet and Koenig (2010) examine the impact of trade costs on the probability of exporting and the export levels using French manufacturing firm-level data but obtain a decomposition of the aggregate elasticity of exports into the extensive and intensive elasticities from structural estimation of the key parameters of the Chaney (2008) model. Hence, their method of disentangling the extensive and intensive margin is more closely related to margins accounting approach at the country-level. One of the differences is, that their extensive margin is defined as in Chaney (2008) as the value shipped by the marginal exporter and that it takes account of compositional changes as new, entering exporters on destination markets will be less efficient and export less. They analyze French exports to border countries and use firm specific measures of distance to highlight the impact of variable trade costs. They proceed in 3 steps and estimate an export-selection equation, a firm-level gravity equation for export volumes and the rank-size distribution of productivity (Pareto distribution) to derive the elasticity of substitution, the distance elasticity and the degree of firm heterogeneity. The estimated parameters are then used to disentangle the role of the intensive and extensive margins of trade of changes in exports due to a reduction of trade barriers and they find a share of the extensive margin in the overall effect of distance on exports of about 60%. While the extensive margin dominates it is much smaller than what the literature has found using the "margins accounting" approach at the aggregate level of destinations.[6] They also find considerable variation in the share of the extensive margin in the overall distance-trade elasticity across manufacturing industries.

More related to our work is Greenaway et al. (2009) who apply a Heckman sample selection gravity model to control for the possible self-selection into exporting using firm-level destination specific export data on the Swedish food and beverage sector and compare their results to firm-level estimates not controlling for selection, to estimates based on data without information on destinations or firm characteristics as well as results generated from regressions at the country-level. Their comparative analysis proofs the importance to control for selection and to take account of destination and firm characteristics as well as their interactions. Their findings from estimation of the Heckman sample selection model are consistent with the predictions from the theory and confirm that more productive and larger firms are more likely to serve large and relatively close foreign markets. In addition, the export volumes are positively influenced by the size of the destination market and negatively by the distance between the trading partners.

[6] In Mayer and Ottaviano (2007) for French manufacturing firms and Hillberry and Hummels (2008) for Belgian manufacturing, the extensive margin accounts for 96% and 75% of the total distance effect on exports, respectively.

The results from the interaction effects between firm and destination country characteristics reveal that for firms that are far above the exporting productivity threshold for export market entry (i.e. high productivity firms) changes in market conditions are more important than for firms closer to the threshold.

A further example of a firm-level gravity model accounting for selection is Smeets et al. (2010). For a panel data set of large Dutch firms from the manufacturing and the wholesale and retail industries they again find results that are consistent with theory. While all gravity variables have a consistently larger impact on the intensive margin, splitting the sample between large and small destination countries reveals a more prominent role for adjustments of the extensive margin in small destination countries with respect to changes in transport costs and trade barriers. In as much as smaller countries are less competitive (smaller elasticity of substitution) (Krugman, 1979; Melitz and Ottaviano, 2008) this finding is in line with the predictions of the Melitz/Chaney model in which a lower elasticity of substitution magnifies the sensitivity of the extensive margin and dampens the sensitiveness of the intensive margin to changes in trade barriers (Chaney, 2008).

Breinlich and Tucci (2011) estimate a firm-level Heckman sample selection gravity model for a panel of Italian manufacturing firms focusing on the impact of the competitive environment in foreign markets (market crowdedness) which is usually controlled for in gravity equations by multilateral resistance (Anderson and van Wincoop, 2003). They provide a counterfactual analysis to assess the relative quantitative importance of the determinants at the firm and the country-level. Their results indicate a relatively smaller role of the competitive environment in foreign markets than for other determinant of firm-level exports, such as unit labor costs or exchange rates, with foreign demand growth turning out to be the most important determinant of export performance (with the biggest effect from demand in EU15 trading partners). The results for the relative contributions of the extensive and intensive margin coincide with findings of the rest of the literature based on firm-level data with the intensive margin accounting for the largest part of the variation.[7]

All these contributions from the literature are confined to trade in goods. Crozet et al. (2013) are the only exception. They estimate a firm-level gravity equation on both the export decision and export values based on French data on trade in professional services and apply a generalized Tobit model to control for the selection bias in the export value regression, as first suggested by Eaton and Kortum (2001).[8] The paper focuses on the role of services regulations on exports of professional services, or more specific, the role of non-discriminatory domestic regulations in the importing countries. The results show that even regulations that do not explicitly discriminate against foreign suppliers

[7]Depending on the counterfactual experiment the intensive margin accounts for 70% to 90% of the overall change in aggregate exports. This is comparable to results from Berman et al., 2012 documenting a 90% share of the intensive margin in the total change in exports following a change in the exchange rate.

[8]See Head and Mayer (2014) for a comparative overview of estimation techniques accounting for zero trade flows and selection, and Crozet et al. (2011) for an application of the Tobit method and Monte Carlo simulations to compare different estimation methods.

affect both the export decision and the export sales of French firms, even within the EU. Foreign suppliers are thus more sensitive than domestic firms to the same regulation. Furthermore, their results indicate that these regulations act as an additional variable cost rather than as a fixed cost of market entry to French exporters of professional services.

3 A Simple Firm-Level Gravity Model

To motivate the empirical specification of the firm-level gravity model estimated below, we envisage a standard monopolistic competition model with CES-preferences and heterogeneous firms in a specific service sector similar to that introduced by Melitz (2003) and its extension by Chaney (2008). As our sample of firms refers to a single country, we consider one exporter country and skip the corresponding index. Each firm i produces a variety of some type of service and may export it to $j = 1, ..., J$ destination countries in $t = 1, ..., T$ periods. The index referring to the service sector is also skipped. Firms are assumed to differ in their (labor) productivity so that the more productive firms exhibit lower marginal costs.

In the monopolistic competition framework profit maximization implies that in each market firms price a constant mark-up over its firm and destination market specific marginal costs

$$p_{ijt} = \frac{\sigma c_{it} \tau_{jt}}{\sigma - 1}. \tag{1}$$

Thereby, p_{ijt} denotes the price of variety i in destination market j in period t and $\sigma > 1$ is the elasticity of substitution. c_{it} refers to firm specific marginal costs that are inversely related to its productivity. $\tau_{jt} \geq 1$ stands for destination specific trade costs for service trade flows to country j. The profits of firms are assumed to be separable across markets and for market j they are given by

$$\Pi_{ijt} = \frac{1}{\sigma} \left(\frac{\sigma}{\sigma - 1} \frac{c_{it} \tau_{jt}}{P_{jt}} \right)^{1-\sigma} E_{jt} - f_{jt}. \tag{2}$$

f_{jt} captures destination specific fixed costs of serving market j. $P_{jt} = \left(\sum_{l}^{N_{jt}} p_{ljt}^{1-\sigma} \right)^{\frac{1}{1-\sigma}}$ denotes the CES-price index in importer country j in period t and it is based on the presence of N_{jt} firms in destination market j with index l. E_{jt} denotes expenditures in country j spent on specific type of services, which is interpreted as destination market size. Exports of firm i to country j will be observed in period t if market specific profits are positive. This is the case if the latent variable π^*_{ijt} describing the log value of potential export profits of firm i to destination market j defined as

$$\begin{aligned} \ln \pi^*_{ijt} &= -ln(\sigma) + (1 - \sigma) \ln(\frac{\sigma}{\sigma - 1}) + (1 - \sigma) \ln c_{it} + \\ &+ (1 - \sigma) \ln \tau_{jt} + \ln(E_{jt}) + (\sigma - 1) \ln(P_{jt}) - \ln f_{jt} \end{aligned} \tag{3}$$

is positive. We assume that $\pi^*_{iit}(c_i) > 0$, i.e., that the home market is always served by firm i. The log of the value of firm i's exports to country j at time t, if positive, amounts to

$$x_{ijt} = (1-\sigma)\ln\frac{\sigma}{\sigma-1} + (1-\sigma)\ln c_{it} + (1-\sigma)\ln\tau_{jt} + \ln E_{jt} + (\sigma-1)\ln P_{jt}\pi^{*}_{ijt} \geq 0. \quad (4)$$

Firm i only exports its services to destination market j at time t if it is profitable. Hence, firms select themselves systematically into the group of service traders to a specific destination if they are able to achieve high enough operating profits relative to the involved fixed costs of serving that market (see Helpman et al., 2008). Specifically, the model implies that the decision of a firm to serve a specific foreign market depends on its marginal costs and thus on its productivity, the associated variable and fixed trade costs of exporting services as well as on the size of the destination markets. Lastly, inward trade resistance measured by $P_{jt}^{\sigma-1}$ positively impacts on the exports of a firm to that market as a higher average price implies less competition.[9]

Given the distribution of the firms' productivity, only a fraction of firms - the most productive ones - will be able to achieve high enough operating profits and decide to export to a specific destination market (extensive margin). Firms with a productivity level below this threshold only serve the domestic and nearby markets, where trade barriers are assumed to be absent or lower. Service exports of a firm to a specific destination market are more likely to be observed the lower the fixed costs of exporting to that market and the higher potential exports sales to that market. With the exception of fixed trading costs the model suggests that essentially the same set of variables determine the value of a firm's service export to a specific destination market (intensive margin) and the propensity to serve that market (extensive margin).

3.1 Empirical Specification and Comparative Static Analysis

The model of firm specific exports lends itself to a sample selection approach. If potential (latent) trade flows are too small as compared to the involved fixed destination specific fixed costs, exports are not observed and the corresponding observations are set to zero and treated as missing values. However actual and potential outcomes are the same if profitable exports to a destination are feasible for a specific firm. So missing potential trade flows are not true zeros as a two-part model would assume (see Dow and Norton, 2003). In addition, it is likely that unobserved shocks (e.g. on trade costs) impact on both the selection and the outcome equation leading to correlated disturbances of the selection and the outcome equation.

Under normality of the unobserved stochastic disturbances one can use a standard Heckman sample selection model based on the latent propensity to export, π^{*}_{ijt}, for the selection equation and the nominal export volume, x_{ijt}, for the outcome equation. While the Heckman sample selection model seems restrictive, it has also important advantages. Under the assumption of a bivariate normal distribution, it is possible to derive theory consistent comparative statics and to disentangle the reactions of firms at the intensive

[9]Note that Breinlich and Tucci (2011) define their measure of market crowdedness as the inverse of the inward trade resistance term ($CR_{jt} = P_{jt}^{1-\sigma}$).

and extensive margins as a response to changes in exogenous determinants. A non-parametric estimation framework would not allow such a decomposition.[10]

To set up the econometric specification, we introduce the service industry-group index k a firm belongs to and we subsume the set of explanatory variables of the outcome equation into the vector z_{ijkt} with corresponding parameter vector ϕ. The right hand side variables of the selection equation are collected in z_{ijkt} and w_{ijkt} with parameter vectors β and γ which include those of the outcome equation plus additional proxies of destination-specific and firm-specific fixed costs that form the exclusion restriction, w_{ijkt}. Hence, identification does not rely on the non-linearity of the score of the likelihood only, but also on exclusion restrictions. Cameron and Trivedi (2005) show that the sample selection model, since it is non-linear, is formally identified without any exclusion restriction and precise estimation will be possible if the variation of z_{ijkt} is large enough. However, adding an exclusion restriction is recommended, if the Mills' ratio turns out highly collinear to the explanatory variables in the outcome equation, especially when two-step estimators are used.

The panel sample selection model that is estimated below allows for firm specific random effects in both the outcome and the selection and includes Mundlak terms (i.e., i-specific averages of the explanatory variables) to guard against possible correlation of explanatory variables and the random firm effects. Raymond et al. (2010) propose to estimate this model in a maximum likelihood framework using numerical quadrature formulas. The firm-level gravity model is estimated in the following specification:

$$\begin{aligned}
\ln \pi^*_{ijkt} &= z'_{ijkt}\beta + w'_{ijkt}\gamma + \overline{z}'_{i.}\theta + \overline{w}'_{i.}\delta + \delta_k + \lambda_t + \mu_i + \epsilon_{ijkt} \\
&:= A_{ijkt} + \mu_i + \epsilon_{ijkt} \\
\ln x_{ijkt} &= z'_{ijkt}\phi + \overline{z}'_{i.}\varphi + \chi_k + \psi_t + \nu_i + \eta_{ijkt} \text{ if } \ln \pi^*_{ijkt} \geq 0 \\
&:= B_{ijkt} + \nu_i + \eta_{ijkt} \\
\ln x_{ijkt} &= \text{unobserved if } \ln \pi^*_{ijkt} < 0.
\end{aligned}$$

Thereby, (ϵ_{ijkt},η_{ijkt}) denote the idiosyncratic disturbances and (μ_i, ν_i) the firm specific random components imposing independent bivariate normal distributions with $\mu_i, \nu_i | z_{ijkt}$ $, w_{ijkt}, \overline{z}_{i.}, \overline{w}_{i.} \sim N(0; \sigma_\mu, \sigma_\nu, \rho_{\mu\nu})$ and $\epsilon_{ijkt}, \eta_{ijkt} | z_{ijkt}, w_{ijkt}, \overline{z}_{i.}, \overline{w}_{i.} \sim N(0; 1, \sigma_\epsilon \rho_{\epsilon\eta})$. The corresponding likelihood and the numerical maximization procedure is described in detail by Raymond et al. (2010).

This panel sample selection model is more general than available ones as it includes selection effects in both the within and between dimensions. As a main advantage, this approach allows comparative static analysis of both the extensive margin (selection into exporting to a specific destination market) and the intensive margin (change in service exports to a specific destination given they are positive) at the firm-level.

[10] So far and as outlined in the literature review in Section 2, the common practice in estimating gravity models distinguishing between the intensive and extensive margins are mainly based on aggregate figures at the destination country-level and the number of firms in a destination is considered to reflect reactions at the extensive margin.

For firms, which decided to export to destination j at time t, the conditional expectation of their service exports can be derived as:

$$E[x_{ijkt}|\pi^*_{ijkt} \geq 0] = B_{ijkt} + \rho\lambda(A_{ijkt}),\ \lambda(A_{ijkt}) = \frac{\phi(A_{ijkt})}{\Phi(A_{ijkt})}. \tag{5}$$

with $\rho = \rho_\mu\sigma_\mu\sigma_\nu + \rho_\epsilon\sigma_\epsilon$. To quantify the impact of a change in exogenous determinants on the extensive and intensive margin of services trade, we compare the expected service export flows in the counterfactual and the baseline scenario accounting for changes in the probability of exports and thus in potential and actual exports to a specific destination. Hence, it is possible to predict firm-level exports to a destination for those firms who do not export under the baseline, but will do in the counterfactual (and vice versa).

We aggregate the implied firm-level percentage changes and report aggregate group specific figures. In the aggregate, changes at the extensive margin can be analyzed in terms of the probabilities of the firms' export status in a particular destination. It is not necessary to derive predicted individual changes in the firm's actual export status. Actually, this latter approach involves the prediction of a dummy variable based on estimated probabilities and risks erroneously classifying exporters as non-exporters and vice versa. We follow Yen and Rosinski (2008, p. 5) and Staub (2014) and first calculate the estimated expectation of the positive trade flows in levels as

$$E[e^{x_{ijkt}}|\pi^*_{ijkt} \geq 0] = e^{B_{ijkt}+\left(\sigma^2_\nu+\sigma^2_\epsilon\right)/2}\frac{\Phi(A_{ijkt}+\rho)}{\Phi(A_{ijkt})}. \tag{6}$$

The corresponding unconditional expectation is therefore given by:

$$E[e^{x_{ijkt}}] = E[e^{x_{ijkt}}|\pi^*_{ijkt} \geq 0]P(\pi^*_{ijkt} \geq 0) = e^{B_{ijkt}\beta+\left(\sigma^2_\nu+\sigma^2_\epsilon\right)/2}\Phi(A_{ijkt}+\rho). \tag{7}$$

Aggregating over a set of N exporting firms with given weights ω_{ijkt} yields $\sum_{i=1}^{N}\omega_{ijkt}E[e^{x_{ijkt}}]$ as a measure of the expected aggregate nominal services trade flow of this group of firms to country j. Note, this measure considers both exporting firms and firms not exporting to specific destinations, but sets exports for the latter to zero, which occurs with probability $1 - P(\pi^*_{ijkt} \geq 0)$.

Moreover, following Breinlich and Tucci (2011) one can decompose the expected aggregate export volume into two components in order to analyze the reaction of the intensive and the extensive margin of adjustment as response to changes in exogenous variables. The first component refers to continuing exporters holding the probability of exporting constant (intensive margin). The second component refers to the extensive margin. Following Chaney (2008) and as outlined in Head and Mayer (2014), at the extensive margin a reduction in trade costs induces an increase in the number of exporters as well as a decrease in the expected export value conditional on exports (compositional changes). The compositional change is determined by the entry of new firms which are less efficient and export less. In our model this translates to an increase in the probability of exporting to a specific market and a decrease in the Mills ratio and thus the expected export value conditional on exporting, given that $\rho>0$.

In particular, the expected percent change (G_{ijkt}) can be decomposed as:

$$\begin{aligned} G_{ijkt} &= \frac{E[e^{x^C_{ijkt}}] - E[e^{x_{ijkt}}]}{E[e^{x_{ijkt}}]} \\ &= \frac{E[e^{x^C_{ijkt}}|\pi^{*C}_{ijkt} \geq 0]P(\pi^{*C}_{ijkt} \geq 0) - E[e^{x_{ijkt}}|\pi^{*C}_{ijkt} \geq 0]P(\pi^{*C}_{ijkt} \geq 0)}{E[e^{x_{ijkt}}|\pi^{*}_{ijkt} \geq 0]P(\pi^{*}_{ijkt} \geq 0)} \\ & \quad \text{(intensive margin at constant probability to export)} \\ &+ \frac{E[e^{x_{ijkt}}|\pi^{*C}_{ijkt} \geq 0]P(\pi^{*C}_{ijkt} \geq 0) - E[e^{x_{ijkt}}|\pi^{*}_{ijkt} \geq 0]P(\pi^{*}_{ijkt} \geq 0)}{E[e^{x_{ijkt}}|\pi^{*}_{ijkt} \geq 0]P(\pi^{*}_{ijkt} \geq 0)} \\ & \quad \text{(extensive margin at constant positive export flows).} \end{aligned} \tag{8}$$

Thereby, superscript C refers to the counterfactually changed situation. Inserting the conditional expectations and the probabilities to export from above yields the decomposition into the extensive margin and the intensive margin.

The contribution to the intensive margin of firm i is therefore given as:

$$int_{ijkt} = \frac{\Phi(A^C_{ijkt} + \rho)}{\Phi(A_{ijkt} + \rho)} \left[e^{B^C_{ijkt} - B_{ijkt}} - 1 \right], \tag{9}$$

while contribution of the extensive margin reads

$$ext_{ijkt} = \left(\frac{\Phi(A^C_{ijkt} + \rho)}{\Phi(A_{ijkt} + \rho)} - 1 \right). \tag{10}$$

Adding these two components yields the corresponding overall change:

$$tot_{ijkt} = int_{ijkt} + ext_{ijkt}. \tag{11}$$

In order to obtain the aggregate percentage change for a group of firms of size N, we use the weights $\omega_{ijkt} = E[e^{x_{ijkt}}]/\sum_{l=1}^{N} E[e^{x_{ljkt}}]$

$$\frac{\sum_{i=1}^{N} E[x^C_{ijkt}] - E[x_{ijkt}]}{\sum_{i=1}^{N} E[x_{ijkt}]} = \sum_{i=1}^{N} \omega_{ijkt} tot_{ijkt} \tag{12}$$

and similarly for the extensive an intensive margin. In our empirical exercise, these weights will be based on the predictions of the baseline model. The counterfactual experiments first focus on the overall response in trade flows comparing the predictions from the baseline and counterfactual scenario using (11) and (12). In a second step, we decompose the overall percentage change in exports into its contribution at the extensive (10) and intensive margin (9) applying the same aggregation as in (12). Thereby, we first consider continuing exporters (intensive margin) holding the probability of exporting constant, and second, we calculate changes in the probability of exporting at given conditional expectations of positive exports (extensive margin).

4 Data and Estimation Results

4.1 Data Description

The empirical analysis makes use of the Austrian Trade in Services Survey of non-financial corporations, which is conducted by Statistics Austria on behalf of the Austrian Nationalbank (OeNB) since 2006 on a quarterly basis. It forms the basis for the balance of services as part of the Austrian balance of payments and is mandatory for all firms whose service exports surpass industry specific threshold levels (either 50,000 € or 200,000 € during a calender year). These thresholds were determined on the basis of a pre-survey on service exports and imports within the Structural Business Statistic[11], apply to total firm exports, but not destination specific export values, and are chosen to cover at least 90 percent of all service exports in every 2-digit NACE industry (OeNB 2011; Walter and Dell'Mour, 2010).[12] We restrict the sample to firms that have their main activity in services and that report a service trade flow to at least one destination country during the period 2006 to 2009. Due to data limitations - especially with respect to services regulations - the country dimension of service exports in the main specifications is restricted to 31 destination countries, covering almost 90 percent of Austrian exports of services. The sample thus includes the most important trading partners. In total, the survey sample covers 5,554 service traders excluding financial and insurance companies as well as the tourism sector.[13]

Additional information on the industry affiliation of the company, employment and sales revenues is drawn from matched Structural Business Survey data from Statistics Austria. Furthermore, the matched OeNB's company database provides us with information on foreign ownership of the firms (yes or no). Additionally, we merged diverse country information from different sources, including CEPII's variables on geographical and cultural ties.[14] This set of explanatory variables includes measures on bilateral distance between the trading partners, contiguity and common official language. Following Eaton et al. (2004) the size of the destination market is captured by absorption, defined as gross production (according to Input-Output tables from WIOD) plus imports minus exports and measured at the industry-destination level. To capture the regulatory environment in services trade we examine the role of barriers in services on the basis of the economy-wide OECD product market regulation indicator (PMR).[15] This indicator

[11] Leistungs- und Strukturerhebung (LSE), Statistics Austria.

[12] The survey data used in this paper do not include imputed values for missing data or estimates for trade values below the reporting thresholds. Due to the survey design, larger firms are overrepresented. However, larger firms are more likely to export to multiple export markets, while small firms are most likely to serve only one market. Hence, the survey design is suited to examine the choice between destinations of service exporting firms, while it does not allow us to analyze the entry decision of becoming an service exporter (the entry into exporting decision).

[13] The database explicitly excludes travel data, which is captured separately in services trade statistics by another mode of supply. Financial and insurance companies are covered in a distinct OeNB survey and are thus not included in the Austrian Trade in Services Survey.

[14] http://www.cepii.fr/CEPII/en/welcome.asp

[15] http://www.oecd.org/eco/growth/indicatorsofproductmarketregulationhomepage.htm

is only available every 5 years (starting 1998) and since our panel covers the period 2006 to 2009 we use regulatory data for 2008 with few imputations for six Eastern European Countries from the PMR wave 2013 (Bulgaria, Cyprus, Latvia, Lithuania, Malta and Romania). Thus, the overall service regulation level is captured as a time-invariant trade barrier and enters as a categorical variable, distinguishing between three regulatory environments (low, medium and high) based on the tertiles of the PMR distribution for the year 2008. In addition, we make use of the starting a business indicators provided by the World Bank's World Development Indicators (WDI) database. These indicators collect information on the number of days and procedures to start a business in the respective host country. We use the information on the number of days as well as the above mentioned foreign control variable as a proxy for the fixed costs exporting firms face when they decide to start exporting to a particular host country.

Inward and outward multilateral resistance terms in gravity models have been recognized as the key variables for consistent parameter estimation in gravity models (Anderson and van Wincoop, 2003). In formal terms, inward multilateral resistance (IMRT) is a function of the CES price index ($\ln P_j^{\sigma-1}$ in the gravity equation (4) in Section 3) in the destination countries and is itself determined by gravity forces (trade costs, market size, exporter and importer capabilities). Note the inverse relationship between the CES price index and a measure of market crowdedness or the degree of competition as implemented by Breinlich and Tucci (2011): A higher CES-price index in country j) implies lower competition from other exporter countries. Hence, for our measure of inward multilateral resistance we expect a positive impact on exports to that destination.[16] Different strategies have been proposed in the literature to take account of multilateral resistance terms in the estimation of the gravity model (Head and Mayer, 2014). Most common is the use of exporter and importer fixed effects. Another way was proposed by Baier and Bergstrand (2009) using GDP-weighted averages of trade costs. We use the properties of structural gravity and build on Anderson and Yotov (2010) and Fally (2015) to derive our measure of multilateral resistance. We proceed by first estimating a gravity equation for a large and balanced set of exporting and importing counties for each year at the service industry level, controlling for exporter and importer fixed effects to obtain predictions of bilateral trade costs. Using these predictions, we solve the system of equations for multilateral resistance. For details and the formal derivation see Appendix 8.2.

For an overview of the data sources see Table A1 in Appendix 8.1. A list of the 31 destination countries and selected host country characteristics is provided in Table A2. While 7 out of the 31 destination countries share a common border with Austria, 4 countries share a common language. In terms of service regulations 11 countries face the lowest restrictions, while all other countries are characterised by higher levels of PMR. After dropping observations with missing information in either dimension of the firm-year-industry-destination panel we obtain a sample of 3,847 service traders, with 119,460

[16] Outward multilateral resistance measures the degree of competition faced by the exporting country. Since our analysis is confined to Austria as the only exporting country, the outward multilateral resistance term is not relevant in our design.

firm-destination pairs and a total 477,840 firm-destination-year observations including zero trade flows to specific destinations.

Summary statistics for the dependent variable as well as the set of explanatory variables are reported in levels in Table 1. In specific, we compare the group of service exporting firms that export to a specific destination to those that do not serve this specific market. It offers a first glimpse on the relevance of firm characteristics as well as the influence of destination market characteristics in the choice of destination markets for service exports. The percentage of positive service export flows across all 31 individual destination countries for service sector firms amount to 17 percent and on average, these firms are active in 8 export destinations.

Table 1: Descriptive statistics

	Zero Export Flows: 82.6%			Positive Exports: 17.4%		
Variable	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
Exports (bn $)	394,887	0.00	0.00	82,953	981.85	7,767.23
Sales (bn $)	394,887	38.10	235.52	82,953	110.31	525.87
Distance (km)	394,887	2,380.03	3,512.95	82,953	1,343.67	2,180.82
Absorption (bn $)	394,887	463.04	1,186.34	82,953	570.00	1,210.35
IMRT	394,887	12.32	15.22	82,953	6.93	9.00
PMR High	394,887	0.70	0.46	82,953	0.67	0.47
Contiguity	394,887	0.17	0.37	82,953	0.43	0.50
Common Language	394,887	0.10	0.30	82,953	0.24	0.43
Foreign control	394,887	0.35	0.48	82,953	0.36	0.48
Start Business (days)	394,887	22.25	26.60	82,953	18.77	15.64

Notes: Firms without any service exports are excluded. For an overview of the data sources see Table A1 in the Appendix.

In line with the findings in the literature, firms serving a specific destination market are on average characterized by larger size (higher sales). Markets not served are on average of smaller market size, more distant in terms of physical distance (in kilometers) less crowded. Additionally, all other trade barrier variables (contiguity, language, product market regulation and the number of days to start a business) indicate higher impacts of such barriers for firms serving less destination markets. In particular, less than 20 percent of zero trade flows refer to neighboring countries and only 10 percent to markets with language familiarities. This marks the clear geographical concentration of Austrian service exports to close markets in terms of geography and language, a fact that can also be read from the results for firms serving a particular market (column 2 and 5 in Table 1).

4.2 Econometric Results

Table 2 reports the estimation results of the panel random effects Heckman sample selection model based on the specification discussed in Section 3.1 and estimated by maximum likelihood. It accounts for unobserved firm specific effects by the inclusion of "Mundlak-terms", i.e. time specific averages of firm-level variables and additionally takes account of firm specific random effects both in the selection (column 1) and the outcome equation (column 2). The disturbance terms thus also include random effects with variance σ_μ^2 in the selection equation and σ_ν^2 in the outcome equation in Table 2 that are correlated across equations inducing time-invariant sample selection effects ($\rho_{\mu\nu}$, i.e. selection effects in the between dimension). Selection effects in the within dimension are captured by the respective variance and covariances of the remainder error (σ_η^2 and $\rho_{\epsilon\eta}$, respectively). We use firm size (ln (total firm sales)) as a proxy of firm performance/marginal costs, market size is proxied by an industry-destination-time specific measure of absorption and trade cost measures include geographical distance as well as indicator variables for contiguity, common language and regulation based on the OECD PMR indicator as well as a an inward multilateral resistance term (IMRT) as an inverse measure of market crowdedness. All variables are measured as outlined and described in Section 4.1. Both equations (selection and outcome) additionally include time and industry fixed effects. Richer dummy specifications are introduced in the robustness section.

In order to avoid relying on the normality assumption for identification only, we also use exclusion restrictions in the selection equation. The theoretical model displayed in Section 3.1 suggests that trade frictions affecting fixed trade cost of exporting but not variable trade costs form a valid exclusion restriction. We include the foreign control indicator variable as a firm-specific exclusion variable as firms may have better access to foreign markets if they are part of a multinational network of firms. On the other hand, these affiliates may concentrate on local markets so that the sign of the foreign control coefficient is unclear a priori. Additionally, in line with Helpman et al. (2008), we make use of country-level data on regulation costs of firm-entry provided by the World Bank ("starting a business" indicators). Although exporters may not need a business operation in the respective host country, we surmise that these costs are a good proxy for destination-specific fixed costs of exporting.

The panel selection model serves as our baseline model since it is directly motivated by the standard heterogeneous firm trade models in which selection is inherent and since it forms a useful basis for a decomposition into intensive and extensive margins taking account of potential outcomes in counterfactual analysis, i.e. the potential exports of firms that switch into exporting to particular destination markets in response to changes in exogenous variables. We compare it to results of a Poisson model with less restrictive distributional assumptions on the error structure which allows to control for firm fixed effects. This is impossible in the non-linear Heckman selection model due to the incidental parameter problem. As noted before, it has the drawback that it does not account for selection and that it does not allow for a separation of the intensive and extensive margins of export decisions. We report results for the sample of firms with positive export flows only (column 3) and for total observations, including zero export flows (column 4). For reasons related to the restrictive access policy of the Austrian National Bank to firm-level data and the very demanding and time consuming maximum likelihood procedures, the estimates of the panel Heckman selection model are based on a randomly drawn 30% sample of the original firm-level data.[17]

Looking at the results, first, consider the export decision model based on the selection equation in column 1 of Table 2. All variables have the expected sign with firm size, foreign absorption, inward multilateral resistance, contiguity and common language showing the expected positive impact on the decision to export to a specific market, while distance and higher trade barriers due to market regulation lower the probability of firms exporting to a specific destination. All of these variables are highly significant in explaining selection into destination markets. As to the exclusion restrictions meant to proxy fixed costs of exporting (foreign control, starting a business) both have the expected sign, but only one, the foreign control dummy variable is significantly different from zero. The starting a business variable is too highly correlated with the overall PMR index to be precisely estimated. As noted in Section 3.1 the sample selection model is formally identified without any exclusion restriction, in addition we have highly significant estimates of the remaining parameters. Furthermore note, that the coefficients in column 1 are not to be interpreted as elasticities. Counterfactual analysis in Section 5 will lend to an interpretation of the coefficients in quantitative terms.

Second, also the results of the the outcome equation (intensive margin) are as expected and highly significant. A (qualitative) comparison between the selection and outcome equations of the Heckman model suggests that contiguity, common language, geographical distance as well as market size (foreign absorption) are the most important determinants not only for the decision to export to a new market, but also for intensifying existing bilateral trade relationships. The results reveal a relatively larger role for market growth for the intensive margin while firm size is a somewhat more important factor for the selection into exporting to a destination market.

Apart from the (albeit low) significance of one of the exclusion variables, the variance and covariance parameters at the bottom of columns 1 and 2 of Table 2 indicate significant correlation of errors across the selection and outcome equations and thus highlight significant selection effects, both in the between and within dimension of the data. This confirms that the selection of firms into exporting is systematic and needs to be considered in the econometric specification. This is further proven by referring to the results of the Poisson fixed effects regression models which disregard selection. The Poisson model specifications are identical to the outcome equation of the Heckman selection model, except that it includes firm fixed effects but no industry fixed effects which are rendered unnecessary since firms always belong to one single industry. While the results are qualitatively similar, the size of the estimated parameters change significantly. This is specifically true for the Poisson model for the sample of firms with positive destination

[17]The Bank's policies do not allow direct access to firm-level data for confidentiality reasons and therefore all data and econometric analysis have to be done at the OeNB offices with the need to comply with the staff's office hours and time tables. Likewise, all work has to be done on a desktop provided by the Bank with limited server space and memory. Summary statistics on the main variables reveal identical mean, standard deviations and other distributional parameters for the 30% sample and the full sample.

Table 2: Baseline Results

	Random Effects Heckman ML		Poisson Fixed Effects	
	Selection	Outcome	exp>0	exp>=0
Estimated slope parameters				
Ln Sales	0.131***	0.170***	0.080**	0.207*
	(0.008)	(0.039)	(0.040)	(0.109)
Ln Distance	-0.400***	-0.554***	-0.157**	-0.483***
	(0.008)	(0.028)	(0.073)	(0.078)
Ln Absorption	0.349***	0.851***	0.552***	0.776***
	(0.012)	(0.039)	(0.066)	(0.067)
Ln IMRT	0.155***	0.419***	0.370***	0.461***
	(0.025)	(0.083)	(0.124)	(0.128)
PMR High	-0.094***	-0.313***	-0.332***	-0.369***
	(0.012)	(0.037)	(0.082)	(0.084)
Contiguity	0.488***	1.225***	0.806***	0.870***
	(0.016)	(0.048)	(0.121)	(0.134)
Com. Language	0.489***	1.032***	0.532***	0.826***
	(0.015)	(0.043)	(0.098)	(0.093)
Mean Ln Sales	0.087***	0.285***		
	(0.010)	(0.034)		
Foreign Control	0.033+			
	(0.023)			
Ln Start Business	-0.007			
	(0.007)			
Fixed effects	Industry Year		Firm Year	Firm Year
Observations	156,718		82,649	477,840
Est. variance & covariance par.				
	Transformed	Original		
σ^2_μ	-0.080***	0.922		
	(0.022)			
σ^2_ν	0.604***	1.829		
	(0.026)			
$\rho_{\mu\nu}$	0.868***	0.701		
	(0.031)			
σ^2_η	0.848***	2.336		
	(0.007)			
$\rho_{\epsilon\eta}$	0.604***	0.540		
	(0.019)			

Notes: Dependent variables are (i) service export participation (selection equation, column 1), (ii) non-zero export flows (outcome equation, column 2 and 3) (iii) export flows incl. zero flows. Industry dummies comprise the following service sector groups: construction, transportation, hotels and restaurants (excl. travel services), business services, telecommunication, finance and insurance, other services. 31 destination countries are as specified in Table A2 in the Appendix 8.1. Transformed variance and covariance parameters are measured in logs for σ^2_μ (random effect selection equ.), σ^2_ν (random effect outcome equ.), σ^2_η (variance of remainder error), and by atanh from $\rho_{\mu\nu}$ (covariance between μ and ν) and $\rho_{\epsilon\eta}$ (covariance of remainder error between selection and outcome equ.). Standard errors are reported in parentheses. + p<0.15, * p<0.10, ** p<0.05, *** p<0.01 indicate statistical significance at the 15-, 10-, 5-, and 1-percent level.

specific export flows in column 3. In addition the significance level of firm size falls in both Poisson models specified.

4.3 Robustness Analysis

We assess the robustness of the baseline estimation results along several dimensions and summarize results in Table 3. First, we re-estimate the Heckman selection model by adding destination country fixed effects to rule out that results are driven by ommitted variable bias in that dimension. This implies that country specific time-invariant variables cannot be included (specification 2). Second, we test the sensitivity of our results to an even richer set of fixed effects in the Poisson Model (including non-zero firm-level trade flows to specific destinations) by adding industry-year (specification 4), destination (specification 5), destination-year (specification 6) and firm-year, destination fixed effects (specification 7). We perform these robustness checks for the Poisson model only, again mainly for reasons related to the access policy of the Austrian National Bank to firm-level data and the very demanding and time consuming maximum likelihood procedure to estimate the panel Heckman sample selection model.[18]

In a similar vein, we test for the sensitivity of results to different clustering of standard errors to control for within group error correlations for correct statistical inference (Moulton, 1986, 1990; Cameron and Miller, 2015). Clustering is not feasible in maximum likelihood estimation for any parametric model with selection. It is inconsistent as soon as any distributional assumptions are relaxed (Cameron and Trivedi, 2009, p.327).[19] In the Poisson model consistency is remained and we compare two cluster options. We first cluster at the firm-level such that observations are independent between firms but interdependent across destination markets, service industries and years within each firm. In a second step, we cluster at the industry-destination-year level and thus control for correlations of firm-level observations within destination-industry and year as in Breinlich and Tucci (2011).[20]

A look at Table 3 first reveals that the results are very robust to the inclusion of industry-year fixed effects. All regressors keep their sign and significance. The magnitude of absorption and the destination market crowdedness term increases. Second, inclusion of destination fixed effects or destination-year fixed effects again leads to robust results for the firm-level variables and the destination varying parameters in the selection equation of the Heckman selection ML model, while only market crowdedness is robust in the outcome equation. In the Poisson model estimates controlling for destination fixed effects leads to a clear reduction in the magnitude and a loss in statistical significance of foreign absorption as well as foreign market crowdedness.

[18] See footnote 17.

[19] Note however, that in a specification with random effects, the model accounts for correlation within firms, in this case equicorrelation, which is similar to controlling for clustered standard errors within firms.

[20] Following others (e.g. Berman et al., 2012; Fitzgerald and Haller, 2014) we cluster at the destination-year level. We also experimented with clustering of standard errors at the destination-year level (not reported), leading to same inference as clustering at the industry-destination-year level.

Table 3: Robustness Analysis

	Random Effects Heckman ML				Poisson Fixed Effects Model				
	(1) Baseline		(2) Destination FE		(3) Baseline	(4)	(5) Alternative Fixed Effects	(6)	(7)
	Selection	Outcome	Selection	Outcome					
Estimated slope parameters									
Ln Sales	0.131	0.170	0.135	0.244	0.207	0.206	0.205	0.205	
- *cl(firm, equicorrelation)*	(0.008)***	(0.039)***	(0.008)***	(0.029)***	(0.109)*	(0.106)*	(0.106)*	(0.106)*	
- *cl(inddestyear)*					(0.035)***	(0.035)***	(0.034)***	(0.034)***	
Ln Distance	-0.400	-0.554			-0.483	-0.526			
- *cl(firm, equicorrelation)*	(0.008)***	(0.028)***			(0.078)***	(0.082)***			
- *cl(inddestyear)*					(0.052)***	(0.053)***			
Ln Absorption	0.349	0.851	0.175	-0.008	0.776	1.013	0.288	0.239	0.324
- *cl(firm, equicorrelation)*	(0.012)***	(0.039)***	(0.031)***	(0.091)	(0.067)***	(0.107)***	(0.194)+	(0.217)	(0.155)**
- *cl(inddestyear)*					(0.063)***	(0.082)***	(0.134)**	(0.133)*	(0.169)*
Ln IMRT	0.155	0.419	0.115	0.300	0.461	1.009	0.104	0.096	0.17
- *cl(firm, equicorrelation)*	(0.025)***	(0.083)***	(0.031)***	(0.093)***	(0.128)***	(0.238)***	(0.127)	(0.130)	(0.215)
- *cl(inddestyear)*					(0.139)***	(0.190)***	(0.144)	(0.141)	(0.234)
PMR High	-0.094	-0.313			-0.369	-0.394			
- *cl(firm, equicorrelation)*	(0.012)***	(0.037)***			(0.084)***	(0.087)***			
- *cl(inddestyear)*					(0.078)***	(0.079)***			
Contiguity	0.488	1.225			0.870	0.858			
- *cl(firm, equicorrelation)*	(0.016)***	(0.048)***			(0.134)***	(0.135)***			
- *cl(inddestyear)*					(0.098)***	(0.099)***			
Com. Language	0.489	1.032			0.826	0.857			
- *cl(firm, equicorrelation)*	(0.015)***	(0.043)***			(0.093)***	(0.099)***			
- *cl(inddestyear)*					(0.086)***	(0.089)***			
Mean Ln Sales	0.087	0.285	0.089	0.163					
- *cl(firm, equicorrelation)*	(0.010)***	(0.034)***	(0.010)***	(0.031)***					
- *cl(inddestyear)*									
Foreign Control	0.033		-0.055						
- *cl(firm, equicorrelation)*	(0.023)+		(0.020)***						
- *cl(inddestyear)*									
Ln Start Business	-0.007								
- *cl(firm, equicorrelation)*	(0.007)								
- *cl(inddestyear)*									
Fixed effects	Industry Year		Industry Year Destination		Firm Year	Firm Ind x Year	Firm Year Destination	Firm Dest x Year	Firm x Year Destination
Observations	156,718		156,718		477,840	477,840	477,840	477,840	407,451
Est. variance & covariance par.									
$\ln(\sigma^2_\mu)$	-0.080		-0.064						
	(0.022)***		(0.020)***						
$\ln(\sigma^2_\nu)$	0.604		0.633						
	(0.026)***		(0.023)***						
$\text{atanh}(\rho_{\mu\nu})$	0.868		0.917						
	(0.031)***		(0.026)***						
$\ln(\sigma^2_\eta)$	0.848		0.830						
	(0.007)***		(0.007)***						
$\text{atanh}(\rho_{\epsilon\eta})$	0.604		0.603						
	(0.019)***		(0.018)***						

Notes: Poisson model including zero export flows to specific destinations. Clustered (cl) standard errors are reported in parentheses. + p<0.15, * p<0.10, ** p<0.05, *** p<0.01 indicate statistical significance at the 15-, 10-, 5-, and 1-percent level. Random effects in the Heckman sample selection model imply equicorrelation within firms and is similar to controlling for clustered standard errors within firms in the Poisson model.

Controlling for destination fixed effects obviously leaves not enough variation in the destination varying variables for identification. Overall the results suggest that cross-destination variation in the data is more important than cross-industry variation or within variation for identification. Referring back to the model specified in Section 3.1 the set of industry-year fixed effects seems to be closer to our intention of modeling firm decisions within industries to export to different destinations. Lastly, Table 3 also reveals that the results are robust to different clustering of standard errors except with respect to foreign absorption in the specifications controlling for destination-year effects (specifications 6 in Table 3).

5 Counterfactual Analysis

5.1 Design of Experiments

To evaluate the quantitative importance of regression results we perform a comparative static partial equilibrium analysis based on the procedure outlined in detail in 3.1. We consider a number of counterfactual scenarios and compare expected values of baseline to counterfactual firm-level export flows. Importantly, the Heckman selection ML model allows counterfactual analysis of both the extensive margin (change in the probability of selection into a specific export market at given conditional expectation of positive exports) and the intensive margin (change of exports to specific destination market holding the probability of exporting constant). In order to highlight impacts varying along specific country dimensions, we report the results according to the popularity and distance (cultural as well as geographical) of the respective export destination in Austrian service exports. Specifically, we group destination markets into the following 5 groups: (1) *neighboring countries* including the Czech Republic, Germany, Hungary, Italy, Slovakia, Slovenia and Switzerland, (2) *traditional EU export markets* with a share in total Austrian service exports of more than 1%, comprising Belgium, France, Great Britain, the Netherlands, Romania, Sweden and Spain, (3) *traditional Extra-EU export markets* with a share in total Austrian service exports of more than 0.5% including Japan, Russia, Turkey and the USA, (4) *less-traditional EU destinations* which are defined by Bulgaria, Denmark, Estonia, Finland, Greece, Ireland, Latvia, Lithuania, Luxembourg and Portugal as well as (5) *non-traditional Extra-EU export markets* which include Australia, Brazil and New Zealand.

In the following we perform six counterfactual experiments for the year 2007: (1) holding firm size constant, (2) holding market demand (foreign absorption) constant, (3) changing market demand based on IMF 2020 projections published in the World Economic Outlook, (4) reducing in the distance elasticity in bilateral Austrian trade by one percentage point, (5) setting PMR to the level of the least restrictive benchmark countries (all of the more restrictive countries in terms of PMR are re-grouped to the most liberal tertile of countries) and (6) changing PMR only within EU27 (only the more restrictive EU countries are re-grouped to the least restrictive tertile of countries).

The comparative static analysis takes into account indirect channels of counterfactual changes by their impact on the multilateral resistance terms (MRT). Thus, any increase in destination market size or lowering of trade costs that increase competition in all destinations will dampen the direct positive effect of such changes on exports. We take account of the indirect MRT channels in the various experiments by re-estimating multilateral resistance terms for the counterfactual situation of changed market sizes (experiment 2 and 3) and the reduction in regulatory burden in all or only within EU27 trading partners (experiment 5 and 6). In the distance experiment which affects only bilateral relationships of Austrian service exports, the small country assumption holds and we ignore this indirect channel. The same holds true for changes in firm size.

5.2 Counterfactual Results

Table 4 summarizes results across experiments for aggregate exports and decomposed along the extensive and intensive margins based on the random effects Heckman ML model and compares it to results based on Poisson coefficient estimates. Table 5 displays results in more detail along the country-group dimension. Before going into the details of each experiment two observations are important. First, confirming the findings in the robustness analysis, comparing the results between the two estimation models, we see that the results based on the Poisson model coefficient estimates draw the same qualitative picture. We find somewhat stronger impacts of trade cost changes and somewhat smaller impacts of market demand and firm size changes. Qualitatively the results are the same, even with respect to inferences at the country-group level (Table 5).

Table 4: Counterfactual Results

	Heckman ML			Poisson
	Total	Intensive	Extensive	Total
	Changes in agg. export growth 2007 (%)			
Firm size unchanged	-3.36	-3.31	-0.05	-2.73
Market size unchanged	-11.96	-11.87	-0.09	-9.68
Expected market size change 2020	16.53	16.43	0.10	13.22
Reduction of trade costs				
Reduction in distance elasticity	7.00	6.92	0.08	9.10
PMR set to least restrictive benchmark	9.84	9.80	0.04	12.49
PMR set to least restrictive within EU27	8.59	8.56	0.03	10.94

Second, adjustments in exports occur almost exclusively at the intensive margin (Table 5). This result confirms the findings on the relative contribution of the extensive and intensive margin in the empirical literature reviewed in Section 2. In comparable firm-level analysis for manufacturing firms, the intensive margin accounts for 70% to 90% of the overall change in exports. Furthermore, there are indications in the empirical literature that the dominance of the intensive margin is even larger for service exports. Indeed, given uncertainty and incomplete information which even weight more heavily in services trade, exporters are likely to be faced with higher fixed costs of entry into new markets and thus are likely to start with lower probability and if they enter with smaller transactions in new markets (e.g. Segura-Cayuela and Vilarrubia, 2008; Rauch and Watson, 2003). It is also for this reason, that the extensive margin involves small quantities. While the intensive margin contributes most in neighboring countries, the adjustment of the extensive margin gains increased importance the more distant and the less relevant export market are. Furthermore, results suggest that increasing firm size as well as changes in the distance elasticity of trade turn out to be most effective in helping to develop new trade relationships as the larger share of the extensive margin changes in total export change reveal.

We now turn to the individual experiments. The first two (unchanged firm size, unchanged market demand) calculate growth rates of exports in the absence of changes in market demand and in the absence of firm growth and allows to analyze their relative contributions to observed export growth in 2007. We find an important role of export demand for Austrian service exports. Keeping absorption constant in 2007 would have reduced Austrian service exports by 12%. The role of firm growth was less important. In the absence of any firm growth, Austrian service exports would have been lowered by 3.4%. As stated before, and consistent with theory, firm heterogeneity plays a crucial role in the probability to select into new export markets. We read this in our results by the higher relative response of the extensive margin to firm size changes as compared to changes of other variables in other experiments.

The third experiment estimates export potentials of an increase in destination market absorption within the service industry of the firm based on IMF GDP projections for the year 2020. Overall, if market demand in 2007 were as high as projected for the year 2020 total exports would have increased by 16.5%. Projections are most favourable for Extra-EU markets leading to potential increases in Austrian service exports of 44% in traditional Extra-EU markets and 59% in non-traditional Extra-EU markets. Counterfactual results also reveal high potentials for increased service exports as a result of changes in trade costs. Reducing the elasticity of exports to geographical distance by one percentage point, which mirrors a proportional reduction in distance related costs for all bilateral relations of Austria, would increase Austrian service exports by 7%. The response to a change in distance related costs is higher the more distant markets are, varying between +6.6% for neighboring countries and +10.4% for the most distant Extra-EU countries.

Turning to the impact of regulatory reforms in destination countries, we find that lowering regulatory burdens to the benchmark of the least restrictive tertile of all destinations would lead to an increase of service exports of 10%. Analysis by market-groups reveals the highest potentials for export growth in non-traditional Extra-EU markets (+24%) and interestingly traditional Austrian service export markets within the EU (+16%). Due to the importance of EU markets, regulatory changes within the EU weight most and generate the highest potentials. Changing the regulatory environment of more restrictive EU countries only (experiment 6), would lead to an aggregate change in exports of 8.6% (this accounts for almost 90% of the change in exports when regulations are lowered in all destinations). Regulatory reform in most restrictive countries within the EU27 only,

Table 5: Counterfactual Results by Destination Country Group

	Heckman			Poisson
	Changes in agg. export growth 2007 (%)			
	Firm size unchanged			
	Total	Intensive	Extensive	Total
Neighbors	-3.35	-3.32	-0.03	-2.59
Trad. EU	-3.39	-3.30	-0.09	-2.98
Trad. Extra-EU	-3.26	-3.15	-0.11	-2.96
Non-Trad. EU	-3.55	-3.40	-0.16	-3.31
Non-Trad. Extra-EU	-3.63	-3.39	-0.24	-3.56
All destinations	-3.36	-3.31	-0.05	-2.73
	Market size unchanged			
	Total	Intensive	Extensive	Total
Neighbors	-12.14	-12.08	-0.05	-9.57
Trad. EU	-11.95	-11.80	-0.16	-10.06
Trad. Extra-EU	-8.10	-7.97	-0.13	-7.16
Non-Trad. EU	-15.37	-15.04	-0.33	-13.65
Non-Trad. Extra-EU	-15.54	-15.01	-0.54	-14.14
All destinations	-11.96	-11.87	-0.09	-9.68
	Expected market size change 2020			
	Total	Intensive	Extensive	Total
Neighbors	14.11	14.07	0.04	10.78
Trad. EU	11.24	11.12	0.12	9.64
Trad. Extra-EU	43.82	43.37	0.45	36.85
Non-Trad. EU	14.66	14.43	0.23	12.86
Non-Trad. Extra-EU	58.97	57.64	1.33	53.60
All destinations	16.53	16.43	0.10	13.22
	Change in distance elasticity by 1pp			
	Total	Intensive	Extensive	Total
Neighbors	6.61	6.57	0.04	8.26
Trad. EU	7.35	7.22	0.14	10.12
Trad. Extra-EU	9.04	8.83	0.21	12.70
Non-Trad. EU	7.54	7.30	0.24	10.82
Non-Trad. Extra-EU	10.44	9.94	0.51	15.68
All destinations	7.00	6.92	0.08	9.10
	PMR set to least restrictive benchmark			
	Total	Intensive	Extensive	Total
Neighbors	8.84	8.82	0.02	10.99
Trad. EU	15.66	15.57	0.09	20.53
Trad. Extra-EU	7.94	7.88	0.05	10.29
Non-Trad. EU	6.94	6.87	0.07	9.39
Non-Trad. Extra-EU	24.44	24.04	0.40	33.44
All destinations	9.84	9.80	0.04	12.49
	PMR set to least restrictive within EU27			
	Total	Intensive	Extensive	Total
Neighbors	8.32	8.29	0.02	10.44
Trad. EU	15.03	14.94	0.09	19.80
Trad. Extra-EU	0.75	0.76	-0.02	0.75
Non-Trad. EU	7.31	7.24	0.07	9.77
Non-Trad. Extra-EU	-0.38	-0.32	-0.05	-0.46
All destinations	8.59	8.56	0.03	10.94

Notes: For definitions of country groups see Table A2.

would lead to a re-direction of Austrian exports towards the EU and away from Extra-EU countries, both at the extensive and intensive margins of export.

6 Conclusions

This paper studies the determinants of firm-level service exports in Austria. It examines the role of firm size as well as destination country characteristics such as foreign demand, regulation and other trade related costs as well as the competition intensity in the foreign market. We employ a large panel data set on Austrian services firms covering service exports by Austrian firms by destination over the period 2006 to 2009. Exploiting the full panel structure of our data, we thereby focus on the determinants of both, the decision of firms which export markets to serve as well as the export performance of firms in terms of export values in each destination and thus take account of the extensive and intensive margins of trade as well as the correlation between the two through sample selection as implied by economic theory. Counterfactual analysis singles out the quantitative importance of various policy relevant experiments for both trade margins and can inform economic policy on which determinants affect export performance within a sector that is becoming more and more relevant for economic growth and jobs.

The empirical analysis is based on a firm-level gravity model derived from a standard heterogeneous firms model which features selection of firms into exporting to specific markets if it is profitable to do so. The selection itself is governed by an interplay of the heterogeneity parameter (productivity, firm size) and destination specific fixed costs of exporting. We apply a non-linear panel random effects sample Heckman sample selection model in which we account for time specific averages of firm-level variables (Mundlak-terms) to account for unobserved firm specific effects for our baseline results. We compare it to results of a Poisson model with less restrictive distributional assumptions and the possibility to directly control for firm fixed effects. Based on the predictions of the Heckman model and the formal results on the conditional expectation of log-normal random variables we elaborate on the adjustments of trade flows along the extensive and intensive margin in counterfactual experiments related to changes in firm size, foreign market demand, regulatory intensity as well as distance related costs of exporting in a particular year.

Based on the counterfactual results for the year 2007 our results indicate that improved firm performance (measured as changes in firm size in our analysis) raised service exports by 3.4% while foreign market growth in that year increased Austrian service exports by 12%. Overall the adjustment occurred almost exclusively at the intensive margin, while the expansion into new markets played only a marginal role. Increasing firm size as well as changes in the distance elasticity of trade turn out to be most effective in helping to develop new trade relationships, especially in the most distant and least traditional Extra-EU markets. IMF projections for 2020 suggesting an expected increase in GDP of 34% on average across destinations in our sample result in a pronounced increase in Austrian service exports to Extra-EU destinations, both in the more traditional and the less traditional Extra-EU markets. While the adjustments at the extensive margin are again very small, they are relatively more important for less traditional markets, both within and outside EU. Results further suggest that there is high potential for increased service exports as a result of institutional and regulatory reforms in destination countries. At the extreme, lowering the restrictiveness of product market regulations to the benchmark of the least restrictive tertile of countries has the potential to increase Austrian service exports by 10% and by over 24% to non-traditional markets outside the EU. It is interesting that the second largest impact results for traditional Austrian services export markets within the EU (up to +16%). Due to the importance of EU markets, regulatory changes within the EU weigh most and generate the highest potentials.

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8 Appendix

8.1 Appendix A: Data

Table A1: Variable Description and Data Sources

Variable	Definition	Source
Distance	km	CEPII: Mayer and Zignago (2011)
Contiguity	0=No, 1=Yes	CEPII: Mayer and Zignago (2011)
Common language	0=No, 1=Yes	CEPII: Mayer and Zignago (2011)
Historical ties	0=No, 1=Yes	CEPII: Mayer and Zignago (2011)
International border	0=No, 1=Yes	WIFO calculations
Product market regulation (PMR)	0=least rest. (1^{st} *terc.*), 1=most rest. (2^{nd}&3^{rd} *terc.*)	OECD (2015)
Start Business	Days	World Bank Doing Business
Foreign control	0=No, 1=Yes	OeNB
Absorption	bn $	WIOD, OECD
GDP 2020	bn $	IMF (2016)
Exports (firm lev.)	bn $	OeNB
Sales (firm lev.)	bn $	OeNB
Exports (ind. lev.)	bn $	OECD, TSD: Francois-Pindyuk (2013)
Gross production value	bn $	OECD, WIOD

Table A2: Country List

ISO code	Name	Common border	Common language	Lowest tertile of PMR-level (least regulated)	Neighbours	Destination country groups: Traditional EU	Non-traditional EU	Traditional Extra-EU	Non-traditional Extra-EU
AU	Australia								•
BE	Belgium		•			•			
BG	Bulgaria						•		
BR	Brazil								•
CH	Switzerland	•	•		•				
CZ	Czech Republic	•			•				
DE	Germany	•	•	•	•				
DK	Denmark			•			•		
EE	Estonia			•			•		
ES	Spain					•			
FI	Finland			•			•		
FR	France					•			
GB	Great Britain			•		•			
GR	Greece						•		
HU	Hungary	•			•				
IE	Ireland			•					
IT	Italy	•			•				
JP	Japan			•				•	
LT	Lithuania						•		
LU	Luxembourg		•	•			•		
LV	Latvia						•		
NL	Netherlands			•		•			
NZ	New Zealand			•					•
PT	Portugal						•		
RO	Romania					•			
RU	Russia							•	
SE	Sweden					•			
SI	Slovenia	•			•				
SK	Slovakia	•			•				
TR	Turkey							•	
US	USA			•				•	

8.2 Appendix B: Multilateral Resistance Terms

Skipping industry group and time index, in a structural gravity framework trade flows X_{ij} between exporter country i and destination j for a specific industry in a given year are given by:

$$X_{ij} = \frac{Y_i E_j}{Y_W} \left(\frac{\tau_{ij}}{\Pi_i P_j} \right)^{1-\sigma} \tag{A1}$$

where Y_i is total output in the exporting country, Y_W is world output and E_j refers to total expenditure in destination country j; τ_{ij} captures bilateral trade costs and as before $\sigma > 1$ is the elasticity of substitution. The terms Π_i and P_j are the outward and inward multilateral resistance terms (MRT), respectively. The MRT are given by

$$\Pi_i^{1-\sigma} = \sum_{j=1}^{J} \frac{E_j}{E_W} \left(\frac{\tau_{ij}}{P_j} \right)^{1-\sigma} \tag{A2}$$

$$P_j^{1-\sigma} = \sum_{i=1}^{J} \frac{Y_i}{Y_W} \left(\frac{\tau_{ij}}{\Pi_i} \right)^{1-\sigma} \tag{A3}$$

which are derived under the assumption of market clearing implying the following adding up-constraints on the sum of trade flows for each exporting country and each destination country:

$$Y_i = \sum_{j=1}^{J} X_{ij} \tag{A4}$$

$$E_j = \sum_{i=1}^{J} X_{ij} \tag{A5}$$

$$E_W = Y_W = \sum_{i=1}^{J} \sum_{j=1}^{J} X_{ij} \tag{A6}$$

For each industry group and year equation (A4) implies that the value of gross production equals total exports (exports to all destination countries j, including i itself). In equation (A5) the value of expenditures in destination country j equals the sum of inward trade (= sum of exports over all i exporting countries to country j including i itself). From this we have

$$\sum_{j=1}^{J} X_{ij} = Y_W \frac{Y_i}{Y_W} \Pi_i^{\sigma-1} \sum_{j=1}^{J} \frac{E_j}{E_W} \tau_{ij}^{1-\sigma} P_j^{\sigma-1}. \tag{A7}$$

Then defining

$$\begin{aligned}\mu_i &= \ln\left(\frac{Y_i}{Y_W}\Pi_i^{\sigma-1}\right) &\text{(A8)}\\ m_j &= \ln\left(\frac{E_j}{E_W}P_j^{\sigma-1}\right) &\text{(A9)}\\ z'_{ij}\beta &= (1-\sigma)\ln\tau_{ij}, &\text{(A10)}\end{aligned}$$

the following estimation equation can be specified

$$X_{ij} = e^{z'_{ij}\beta+\mu_i+m_j}\epsilon_{ij}, \tag{A11}$$

expressing trade flows a product of an exporter and importer term and a trade cost term. In a first step we estimate the gravity equation for a large and balanced sample of 35 exporting and importing counties by Poisson PML for each year and service industry group controlling for exporter and importer fixed effects. From this we obtain a prediction of trade costs, $z'_{ij}\widehat{\beta} = \widehat{(1-\sigma)\ln}\,\tau_{ij}$, as well as estimates of the trade resistance terms as captured by importer and exporter fixed effects. Thereby, the trade cost variable is assumed to be a function of geographical distance (ln Distance) and a number of dummy variables including language, contiguity, defined as in Section 4.1. We additionally include colony as a dummy variable accounting for historical ties and a border dummy to differentiate between cross-border trade and within-border trade, since estimation includes trade flows within the exporting countries. In a second step, we solve the systems of trade resistances (A4) and (A5) to derive predictions for the μ_i and m_j terms both for the observed data as well as for the counterfactuals. The baseline estimate of $\widehat{m}_j - \ln\left(\frac{E_j}{E_W}\right)$ yields an index of inward multilateral resistance (IMRT), $\widehat{\ln P_j^{\sigma-1}}$, that enters the firm-level gravity equation as industry group-destination country-time specific explanatory variable.