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Abstract

This paper provides new insight into the firm-level employment impacts of trade cost changes at the industry level in the Austrian services sector. We apply a two-part model of firm survival (exit) and firm growth. Separate regressions for firm entry rates at the industry-region level complete the picture of total trade-induced net job creation. We implement the trade cost measure introduced by Chen and Novy (2011) and base it on own estimates of industry specific substitution elasticities. Falling trade costs in the Austrian services sector over the period 2000 to 2014 resulted in net job creation of about 19,000 jobs accounting for 9.5 percent of overall job flows in the sector. The smallest and least productive firms contract while large and productive firms expand as predicted by theory. Most adjustments occur at the extensive margin due to changes in the probability of firm survival.

JEL-Codes: C150, C210, C250, C230, C260, F140, F160, F660, J210, D210, L200, L800.

Keywords: services trade, trade costs, elasticity of substitution, firm-level evidence, heterogenous firms, gravity model, job flows, trade and employment.

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1 Introduction

Poor employment performance in the EU and other industrialized economies has generated an ongoing debate on the impact of trade on domestic labor demand. Public concern as well as the empirical literature on the issue have so far mainly concentrated on goods trade and its impact on employment performance in manufacturing. However, as services are increasingly exposed to international competition along with a higher tradability of services and import penetration in many service sectors, there is growing public concern about trade-induced service firm closures and a potential loss of services jobs. While empirical analysis is sparse with respect to the services sector, heterogeneous firm trade theory as well as previous empirical work on the manufacturing sector suggest a clear link between trade costs and employment that is driven by heterogeneous effects on performance across firms within an industry.

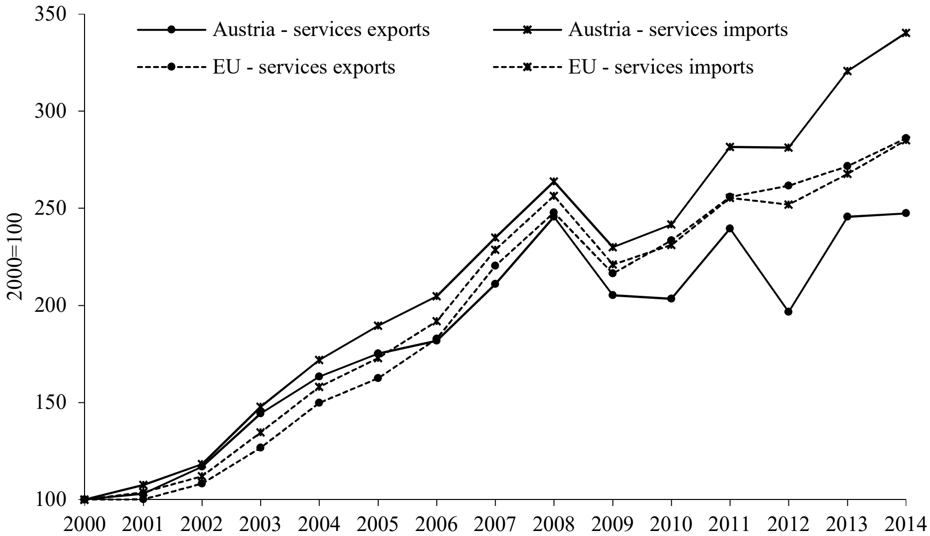
This paper examines the impact of international trade in services on firm-level job creation and destruction among Austrian service firms within the framework of a Melitz (2003) type heterogeneous firm trade model.[1] Specifically, it aims at analyzing the impact of changes in trade costs at the industry level on firm growth (intensive margin) as well as firm entry, the likelihood of firm survival (extensive margin), and the resulting net job creation. It applies the trade cost measure of Chen and Novy (2011) and Novy (2013) and takes account of both, import competition and export activity at the services industry level as well as variations of substitution elasticities across industries. The Austrian experience may serve as an interesting case study, as services trade indeed experienced remarkable growth during the period 2000 to 2014, spurred on by the European integration process in general, and EU Eastern enlargement in particular. Thereby, we observe a distinctive pattern of Austrian services trade growth. Based on trade data from the World Input Output Database (WIOD)[2], Figure 1 reveals exceptionally strong growth in services imports that accelerated towards the end of the period and surpassed services import growth in the average EU. Austrian service exports expanded strongly as well, but less dynamically than imports and have not exhibited a clear upward growth trend since the crisis year of 2009.

The related literature covers several approaches to identifying the impact of trade shocks on employment. Industry level studies use cross-industry variation in import exposure and labor market performance as the source of identification (see Molnar et al., 2007 or Görg, 2011 for a survey). Acemolglu et al. (2016) as well

[1] Trade in services refers to cross-border trade ("mode 1 of international services supply") as opposed to other modes such as consumption abroad (touristic services), commercial presence by affiliates, or the (temporary) presence of natural persons in the export market.

[2] The data is available via the homepage of the World Input-Output Database (WIOD) project (http://www.wiod.org). Timmer et al. (2015) give an illustration of the database.

Figure 1: Austrian and EU trade in services, 2000-2014



Source: WIOD, own calculations.

as Pierce and Schott (2016) provide more recent examples. Feenstra and Sasahara (2018) quantify employment impacts of export and import growth at the industry level based on world input-output analysis for the US. Autor et al. (2013, 2016) identify employment effects stemming from exposure to Chinese imports at the regional (local US labor market) level inducing a series of papers applying a similar empirical strategy (e.g Acemoglu et al., 2016; Dauth et al., 2014 for Germany; Feenstra et al., 2017 on employment effects of US exports or Balsvik et al., 2015 for Norway). Other contributions are based on firm-level data which test the key predictions of heterogeneous firm trade theory models. The early firm-level literature documented firm-level employment impacts with mainly descriptive evidence contrasting exporters, importers and non-traders (e. g. Bernard et al., 2009; Biscourp and Kramarz, 2007; Ibsen et al., 2009; Pisu, 2008). Newer contributions relate employment changes more directly to measures of import penetration or policy measures such as tariff cuts while also taking into account firm heterogeneity. Our paper most closely relates to this latter strand of the literature and contributes to it in several ways.

First, our contribution is based on the measure of job creation and destruction proposed by Davis and Haltiwanger (1992) and Davis et al. (1996) which allows for an integrated treatment of employment effects of firm entry, firm survival (exit) and firm growth. This permits to examine job re-allocation processes as predicted by the heterogeneous firm models accounting for both, the extensive and intensive margins and their relative contributions. Adjustments on the labor market at the extensive margins through exits (and entries) also matter for policy because they typically involve the displacement/placement of workers and further motivate our empirical analysis. Thus, while our paper relates to the work of Bernard et al. (2006a), Groizard et al. (2015), Uysal et al. (2015) or Mion and Zhu (2013) who examine the impact of import penetration or tariff changes on firm-level employment growth and the likelihood of firm survival or firm exit, but none directly link the analysis of firm survival/exits to implications for net job creation.[3] The same is true for the literature solely focusing on the determinants of firm survival (exits) and the choice of exit modes such as Gu et al. (2003), Head and Ries (1999), Baggs (2005) and Breinlich (2008), who examine the impact of tariff cuts resulting from the US-Canada Free Trade Agreement, or Bernard et al. (2006a), Bernard et al. (2003) for the US, Pavcnik (2002) for Chile, Greenaway et al. (2008) for Sweden or Kim et al. (2011) for Korea. Biscourp and Kramarz (2007) as well as Pisu (2008) do take into account employment losses due to firm exits in decomposing employment growth by firm trading status; their analysis however is mainly descriptive. Only most recently have Branstetter et al. (2019) provided a firm-level analysis of the effects of Chinese import competition and export competition in third markets on Portuguese firms, while considering different adjustment margins. Their work is most closely related to ours in this respect, but focuses on Chinese trade competition as well as competition in the manufacturing sector and does not include the entry margin of adjustment. Klein et al. (2003) or Moser et al. (2010) provide examples of empirical analysis on the nexus of international competitiveness, in particular real exchange rate changes, as well as on net employment, job creation and job destruction for the US at the sector level and for Germany, at the plant level, respectively. While taking into account the role of job creation and job destruction, neither relates directly to the heterogeneous firm-level models and the adjustment margins of firm entry/exit and firm survival.

Second, we add to very sparse evidence on the interaction between firm productivity and trade cost changes in the determination of firm-level employment effects for the services sector. Up to now, the related empirical firm-level literature has almost exclusively dealt with manufacturing firms and trade of manufactures. Exception are the contributions of Hijzen et al. (2011) and Bombarda et al. (2010). In contrast to our study, Hijzen et al. (2011) examine the relationship between *firm-level* imports of producer services and firm-level employment for the UK. They apply both a descriptive decomposition of employment growth by firm trade status as in Biscourp and Kramarz (2007) and a regression and propensity score matching techniques for surviving firms. Their findings imply that imports of in-

[3]Cosar et al. (2016) or Helpman et al. (2016) are examples of work on trade and firm-level employment outcomes relying on structural estimations of the heterogeneous firm model framework augmented to include labor market frictions to simulate labor market outcomes that are based on calibration rather than empirical estimation.

termediate services at the firm-level are not associated with job losses. Bombarda et al. (2010) provide evidence on the impact of import penetration at the sector level and on the exit of business services firms based on French firm-level data in 1999 to 2004 period. Again, their analysis of service firm exit, does not, however, link to implications for net job creation. To our knowledge, this is the first empirical paper to examine the impact of industry level services trade cost changes on net nob creation of services firms in the context of the heterogeneous firm model.[4]

Third, while most related papers linking international trade to employment focus on the impact of import competition and apply different measures of import penetration (with a particular recent focus on import penetration from China), our paper accounts for both imports and export-related barriers to trade, and thus also encompasses possible positive effects of new export opportunities that may offset losses associated with import competition.[5] Specifically, we derive a trade cost measure based on Chen and Novy (2011) and Novy (2013). This enables us to apply a gravity-related trade cost variable in a sector that is characterized by the intangible nature of its services and the prevalence of non-tariff trade barriers. In addition, it allows for a much better link to the theoretical framework as would (simpler) measures of trade openness or import penetration. Furthermore, the trade cost measure takes into account that substitution elasticities vary substantially across service types. We estimate substitution elasticities using firm-level profitability measures for 22 service types.[6]

Our results confirm the theoretical predictions of the Melitz model and imply that a reduction in trade costs decreases the probability of firm exit. The likelihood of firm exit clearly decreases with firm productivity and firm size. The least productive and the smallest (surviving) firms also experience declines in employment growth due to lower trade costs while the most productive and largest firms experience accelerated employment growth. The results imply that net job creation due to changes in the firm survival (exit) probabilities contribute an important part to the overall trade-induced change in employment and emphasize the importance of integrating the extensive margin into an analysis of the employment impacts of trade.

The remainder of the paper is structured as follows. Section 2 summarizes the

[4]There is more evidence on services imports and employment changes at the sector level. Papers focusing on the employment impacts of service offshoring include Crinò (2010), Amiti and Wei (2005a, 2005b), Hijzen and Swaim (2007), OECD (2007) or Falk and Wolfmayr (2008). Feenstra and Sasahara (2018) quantifying employment impacts of trade at the industry level based on world input-output analysis also include services in their analysis.

[5]This is in line with more recent work that has also widened the scope to include effects in export markets (e.g. Dauth et al. 2014, Feenstra et al., 2017, Branstetter et al., 2019)

[6]See Blank et al. (2018), Breinlich (2010) for an application of this approach to derive substitution elasticities for service industries, or Breinlich and Cunat (2010), Egger et al. (2013) in different contexts.

main set up and predictions of the Melitz (2003) model, focusing on its implications for firm-level labor demand, to motivate the empirical specification of the model. Section 3 describes the empirical specification, while Section 4 reviews the data and variables used and presents descriptive statistics. Section 5 reviews the main estimation results and Section 6 presents results from a counterfactual analysis of unchanged trade costs. Finally, Section 8 concludes.

2 The theoretical foundation

The empirical investigation builds on the main predictions of the Melitz' (2003) heterogeneous firm model and its various extensions and adaptions that have established the core of a substantial literature on firm-level responses to trade. Few papers have so far explicitly focused on the labor market implications of the model (see Groizard et al., 2015 and Uysal et al., 2015). We focus on the model's implications of trade cost changes on firm employment and review the model's core mechanisms and predictions with respect to productivity and labor demand.

Building on the classical framework of Krugman (1980) featuring monopolistic competition with a continuum of firms each producing a unique variety of a differentiated product, the Melitz model adds firm-level heterogeneity in labor productivity (φ), fixed sunk entry costs as well as a fixed cost of serving the domestic market, f, and exporting, f_x, for each of n export markets it wants to access. These fixed costs come on top of the variable per-unit (iceberg type) costs of exporting (τ>1) and are assumed to be symmetric across all trading partners. Importantly, the productivity of each firm is randomly drawn before entry and is observed by the firm only after having paid the fixed sunk entry cost. For domestic production, these assumptions imply that the zero profit condition defines a unique minimum survival productivity cut-off point φ^* and, thus, a selection into production for firms with a productivity draw of $\varphi > \varphi^*$. The decision to export is driven by fixed export costs f_x>0 and firms only export if the net profits from exporting are positive or at least equal to the fixed costs of exporting. The zero profit cut-off for exports determines the productivity cut-off level for exporting φ_x^*.

In this model, labor demand is directly related to firm profits and revenues, which in turn depend on the productivity levels of the firms in such a way that both labor demand for domestic production $l_d(\varphi)$ and labor demand for export production $l_x(\varphi)$ can be expressed in terms of the two productivity cut-off points. Formally, in the two-country model it can be shown that labor demand is given by:

$$l(\varphi) = \begin{cases} 0 & if\ \varphi < \varphi^* \\ l_d(\varphi) & if\ \varphi \,\epsilon\, [\varphi^*,\ \varphi_x^*] \\ l_d(\varphi) + l_x(\varphi) & if\ \varphi \geq \varphi_x^* \end{cases} \tag{1}$$

with

$$l_d(\varphi) = \qquad f + f(\sigma - 1)\left(\frac{\varphi}{\varphi^*}\right)^{\sigma-1}$$

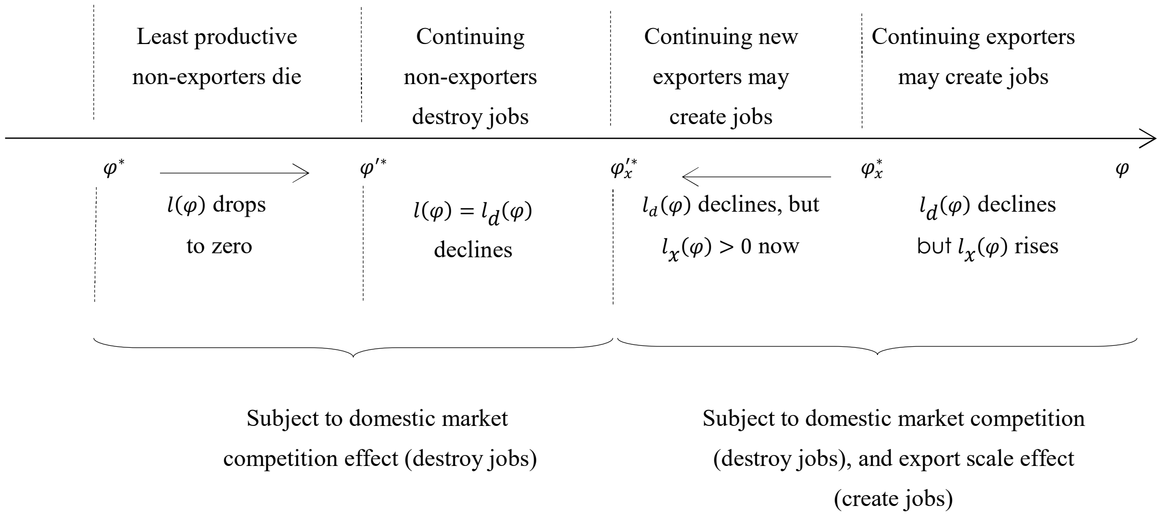
$$l_x(\varphi) = \qquad f_x + f(\sigma - 1)\,\tau^{1-\sigma}\left(\frac{\varphi}{\varphi^*}\right)^{\sigma-1}$$

where σ denotes the elasticity of substitution between any two varieties. Changes in trade costs τ affect labour demand via their impact on the productivity cut-off points φ^* and φ_x^*.

A key result of the Melitz model is that a change in trade costs (whether it be a change in τ or f_x) has opposite effects on φ^*, the cut-off point for domestic production and the exporting productivity cut-off point φ_x^*. The cut-off point for domestic production increases as lower trade barriers increase competition from foreign exporters as well as new entrants attracted by the prospect of additional profits from easier access to foreign markets. This bids up wages and leads to a re-allocation of sales and market shares from low to higher productivity firms within an industry increasing in-turn average productivity as well as the domestic productivity cut-off point. The export productivity cut-off decreases, since lower export barriers also offer new opportunities from profits in the export markets for some of the lower productivity firms, so that some of the lower productivity producers start to export.

Figure 2, taken from Groizard et al. (2015), summarizes these effects on the productivity cut-off points as well as labor demand $l(\varphi)$. First, we have a domestic market competition effect working via the entry of high productivity foreign firms and via competition for labor from increased entry and an increased scale of high productivity firms due to additional profit opportunities from trade liberalization. This forces the least productive firms to exit and destroy jobs. Some less efficient firms remain in the industry, but do not export, incurring market share and profit losses. These firms still produce for the domestic market and will decrease their labor demand and shed labor. Second, for exporters the domestic market competition effect on labor demand is counteracted by an export scale effect. Some of the more productive firms export or start to export and increase their market share but might still incur profit losses. They will generate an increase in revenues and demand for labor due to export production, while revenues and labor demand for domestic production decline. The net impact on employment is unclear and depends on the strengths of the tow-opposing effects on combined labor demand. The most efficient firms thrive and grow; they export and increase market shares and profits and will increase combined labor demand.

Figure 2: Reduction in trade costs and firm-level employment



Source: Groizard et al. (2015).

The simple Melitz model is too stylized to allow for a direct implementation, but there are numerous variations of the original Melitz model that can further guide the empirical analysis. Only a few of them explicitly address predictions on labor demand and job flows. The following are especially important for our purpose. Melitz and Ottaviano (2008) abandon the key assumption of CES preferences in the original Melitz model which implied constant mark-ups over costs. Thus, while in the original model with CES preferences factor market competitions is the main channel driving the re-allocation of market shares between firms as outlined earlier, in a model with variable mark-ups, product market competition is the key driver for the impact of trade on the distribution of firms. The mark-up of price over marginal costs is endogenous and decreases as import competition intensifies. Thus, in an open economy the interplay between market size and trade costs determines the toughness of competition. Tougher import competition is the main channel which drives re-allocation by lowering average prices (mark-ups) and forcing exits of the least productive firms.

Bernard et al. (2007) integrate the heterogeneous firm model into a model of comparative advantage and imperfect competition of the sort proposed by Helpman and Krugman (1985), which generates within-industry (as stressed by the heterogeneous firm models) and between-industry (as stressed by traditional trade theory) re-allocations of jobs. It thus offers a framework for studying the interaction of industry and firm characteristics in forming firm reactions to intensified trade as a result of lowering trade costs. Bernard et al. (2007) explicitly derive theoretical implications for gross job flows. In their modelling framework, trade liberalization results in net job creation in comparative advantage industries as well as net job destruction in comparative disadvantage sectors. It is important to note that the resulting net changes come about through gross job creation and gross job destruction in both industries, which is driven by increased specialization according to comparative advantage and inter-industry re-allocations, as well as a selective process on productivity, driving re-allocations of jobs within both industries. Trade-driven specialization according to comparative advantage results in an increasing share of resources devoted to the comparative advantage sector, which in turn leads to subsequent exits in the comparative disadvantage sector and a fall in the relative mass of firms active in the comparative disadvantage sector. Within-sector re-allocations of jobs are driven by relative productivity as in the standard Melitz model in both industries; the selection on productivity is, however, stronger in the comparative advantage sector. The reason for this is that the increase in labor demand following trade liberalization due to greater export opportunities is larger in the comparative advantage industries, bidding up the relative price of the abundant factor. This results in a higher increase in the productivity cut off for domestic production and thus more exits by low productivity firms in the comparative advantage sector relative to the comparative disadvantage sector.[7]

3 Empirical model

Our empirical investigation of the labor market implications of changes in trade barriers and their interaction with productivity builds on these predictions. In any industry, falling trade costs generate contemporaneous job creation and destruction and a re-distribution of jobs from the least productive firms to more productive firms at the intensive margin, as well as an associated increase in the death probability of low productivity firms at the extensive margin. The models do not make any predictions about the relative importance of net entry as opposed to growth and the expansion of continuing firms and this will be one of our questions in this empirical analysis.

[7]Other important extensions to the basic Melitz model include Helpman et al. (2004) and Kasahara and Lapham (2013) which take account of imports and FDI and derive common predictions for re-allocations of resources and jobs not only towards exporters, but also towards firms engaged in FDI and importing. These models are less relevant to the purpose of our paper.

To capture employment dynamics at the firm-level, the empirical specification is based on the measure of the job creation rate proposed by Davis and Haltiwanger (1992) and Davis et al. (1996). This measure permits an integrated treatment of firm entries ($y_{i,t-1} = 0$) and exits ($y_{it} = 0$) and firm growth, where y_{it} denotes firm i's number of employees in period t. In particular, they propose measuring the rate of (net) job creation from period $(t-1)$ to t of firm i by

$$g_{it} = 2\frac{y_{it}-y_{i,t-1}}{y_{it}+y_{i,t-1}} = \begin{cases} -2 \;\; if \;\; y_{it} = 0 \qquad (exit) \\ 2\frac{y_{it}/y_{i,t-1}-1}{y_{it}/y_{i,t+1}+1} \;\; if \;\; y_{i,t-1} \neq 0 \; and \; y_{it} \neq 0 \\ 2 \; if \;\; y_{i,t-1} = 0 \;\; (entry) \end{cases} \tag{2}$$

The proposed measure implies a growth rate g_{it} of exiting firms of -2, and of 2 for entering firms, while continuing firms might exhibit any growth rate in the open interval of -2 and 2. In addition to specifying the job creation rate over all observations, a main advantage of the measure is that individual job creation rates can be easily used to calculate aggregated figures within different firm groups (e. g. industry, size, age or productivity classes). However, this comes at the disadvantage of discontinuities of the distribution of g_{it} at -2 and 2. Among others, Huber et al. (2017) noted the econometric problems when applying simple (employment weighted) OLS to firm-level growth rates (Davis et al., 1996), as well as Tobit estimations. They propose an alternative maximum likelihood estimator that treats continuing firms, entrants and exiting firms separately, allowing for consistent estimates of the determinants of net job creation and aggregate average marginal effects for specific groups of firms. Following Davis et al. (2016), aggregate growth rates can be calculated by applying the following weights for each group of firms according to, for example, firm size classes or productivity classes with index k and N_k members:

$$w_{it,k} = \frac{y_{it} + y_{i,t-1}}{\sum_{j=1}^{N_k} y_{jt} + y_{j,t-1}} \tag{3}$$

to obtain:

$$\begin{aligned} \sum_{i=1}^{N_k} w_{it,k} g_{it} &= \sum_{i=1}^{N_k^N} w_{it,k} 2 + \sum_{i=1}^{N_k^+} w_{it,k} g_{it}^+ + \sum_{i=1}^{N_k^-} w_{it,k} g_{it}^- - \sum_{i=1}^{N_k^X} w_{it,k} 2 \qquad (4) \\ &= \frac{\sum_{i=1}^{N_k^N} y_{it} + \sum_{i=1}^{N_k^+} (y_{it} - y_{i,t-1})^+ + \sum_{i=1}^{N_k^-} (y_{it} - y_{i,t-1})^- - \sum_{i=1}^{N_k^X} y_{i,t-1}}{0.5 \sum_{j=1}^{N_k} (y_{jt} + y_{j,t-1})} \\ &= g_{t,+}^k + g_{t,-}^k + g_{t,N}^k + g_{t,X}^k, \end{aligned}$$

which splits firm growth into the contribution of entries N, expanding survivors

(+), contracting survivors (−) and exits X within a specified group of firms.

Equation (4) reveals that in applying the growth rate by Davis et al. (2016) it is possible to separately estimate models for entry, exit and continuing firms, which can then be added together using (4) as in Huber et al. (2017).

Following this procedure we specify the following probit model for the survival of firm i, in industry j and region r, at time t:

$$P(survival_{ijrt} = 1) = \Lambda \left(\boldsymbol{v}'_{it}\alpha_1 + \boldsymbol{x}'_{ijt}\alpha_2 + \boldsymbol{w}'_{jt}\alpha_3 + \delta_{jr} + \lambda_{rt} \right) \tag{5}$$

Thereby $survival_{ijrt}$ takes the value of 1 if the firm survives and is 0 otherwise. The linear regression model for the employment growth of surviving firms then takes the following form:

$$g_{ijrt} = \boldsymbol{v}'_{it}\beta_1 + \boldsymbol{x}'_{ijt}\beta_2 + \boldsymbol{w}'_{jt}\beta_3 + \delta_{jr} + \lambda_{rt} + \varepsilon_{ijrt} \tag{6}$$

where we subsume the set of explanatory firm-level variables, including firm size, firm age, their respective squares and a proxy for productivity, firm size class-year specific effects and interactions between size and age as well as size and productivity, into $\boldsymbol{v}_{it}$ with corresponding parameter vector α_1 in the probit model and β_1 in the linear regression model of continuing firms, respectively. While the theory of heterogeneous firms reviewed in Section 2 establishes a clear link between firm productivity and firm exits as well as market share re-allocations between surviving firms, the inclusion of firm size and firm age in our specifications are motivated by an array of related empirical papers (see e. g. Greenaway and Kneller, 2007, for a survey) and are also widely used in the firm growth literature (e. g. Neumark et al., 2011; Haltiwanger et al., 2013; or Sutton, 1997; Coad, 2009 for surveys). Indeed, referring back to the review of the theory of heterogeneous firms we see that these models imply a perfect correlation between firm size and productivity. This motivates us to only control for firm size in the main specification of the empirical models. However, the correlation between firm size and productivity is clearly less than perfect and the largest firms are not always the most productive. For manufacturing industries, Bartelsman et al. (2013) give evidence for a number of countries and also show that there are large differences in the within-industry covariance of size and productivity across countries, ranging from 0.51 in the US to 0.28 in Germany and to only 0.04 in Slovenia for the period 1993 to 2001. The relationship might even be less clear and the covariance lower for services firms (e. g. Riley and Bondibene, 2016 for UK). Accordingly, we will also include productivity along with firm size in alternative specifications as a robustness check, at the same time we note that sound and reliable measures of productivity in the services sector are very difficult to derive.

The vector $\boldsymbol{x}_{ijt} = (\Delta ln\tau_{j,t-1}, \Delta ln\tau_{j,t-1} lnsize_{it}, \Delta ln\tau_{j,t-1} lnprod_{it})$ collects one-year lagged changes in trade costs and related interactions with firm characteristics. Industry level variables, including productivity growth and market growth, are subsumed in $\boldsymbol{w}_{jt}$ and control for technological change as well as market dynamics at the sector level. The corresponding parameter vectors are α_2 for the trade cost variables, α_3 for the industry level variables in the probit model, and β_2 and β_3 in the linear model, respectively. The probability model of firm survival additionally adds a measure of sunk costs of exit and entry at the industry level to account for correlation with the exit rates of firms as suggested in Greenaway et al. (2008). Lastly the models include region level controls introduced as interactions of regional-industry dummies (δ_{jr}) and region-time dummies (λ_{rt}) to account for region-specific industry shocks in employment as well as macroeconomic fluctuations and other year-specific effects at the regional level. We assume that disturbances are independent, but possibly heteroskedastic, suggesting the application of robust standard errors.

Finally, we specify a model of entry at the industry-region-year level given in the following equation:[8]

$$Entry_{jrt} = \Phi\left(\Delta ln\tau_{j,t-1}\gamma_1 + \boldsymbol{w}'_{jt}\gamma_2 + \boldsymbol{w}'_{jrt}\gamma_3 + \overline{\Delta ln\tau_{j.}}\gamma_4 + \bar{\boldsymbol{w}}'_{j}\gamma_5 + \bar{\boldsymbol{w}}'_{jr}\gamma_6 + \lambda_{rt}\right) + \eta_{jrt} \tag{7}$$

where $\Delta ln\tau_{j,t-1}$ again accounts for a one-year-lagged change in trade costs, while vector $\boldsymbol{w}_{jt}$ includes industry level productivity and market growth and vector $\boldsymbol{w}_{jrt}$ subsumes industry-region level average firm size and firm age. The specification additionally introduces industry-region-specific as well industry-specific averages over time of all variables (Mundlak terms denoted as: $\overline{\Delta ln\tau_{j.}}$, $\bar{\boldsymbol{w}}'_{j}$, $\bar{\boldsymbol{w}}'_{jr}$) as a way to guard against possible correlation with industry-region specific shocks (see Papke and Wooldridge, 2008).

Based on the regression results of the models given above, we provide counterfactual analysis to elaborate on the impact of trade cost changes in more detail. Using results from the two-part model (TPM) from equations (5) and (6) we are able to decompose the expected aggregate net job creation rate into the contribution of trade-induced changes in the probability of survival (exit) and the contribution of net job creation of surviving firms. We do so by first predicting the net job creation rates with the observed data from the baseline model. We then predict a counterfactual net job creation rate for a hypothetical situation with no

[8]Specifying an econometric model at the firm-level to estimate the probability of firm entry is rendered impossible due to lack of data on firms not entering as well as pre-entry data for firms entering the market.

change in trade costs (i.e. $\Delta ln\tau_{j,t-1} = 0$ for all t). The difference between the baseline prediction and the counterfactual figures reveals the average marginal ceteris paribus impact of observed trade cost changes on net job creation from changes in the survival probability of firms as well as from surviving firms. Similarly, we proceed with results from region-industry level entry regressions based on (7). In more formal terms, skipping indices, denoting the probability of survival as p (or $1-p$, as the exit probability) and indicating counterfactual results with a superscript c, the expected net job creation rate for surviving and exiting firms, along with the respective counterfactual changes, are given by:

$$\begin{aligned} E[g] &= pE[g|survival] - (1-p)2 \text{ or} \\ \tfrac{E[g]+2}{p} &= E[g|survival] + 2 \end{aligned} \tag{8}$$

$$\begin{aligned} E[g] - E[g^c] &= p(E[g|survival] + 2) - p^c(E[g^c|survival^c] + 2) \\ &= (p - p^c)\tfrac{E[g]+2}{p} + p^c\left(\tfrac{E[g]+2}{p} - \tfrac{E[g^c]+2}{p^c}\right) \end{aligned} \tag{9}$$

where the first term of (9) gives the counterfactual changes in net job creation due to changes in the probability of firm survival and the second term represents counterfactual changes stemming from the net job creation of surviving firms for a given probability of survival. To obtain the corresponding job numbers we multiply the resulting change of the job creation rate g_{ijrt} as a result of (9) by current average employment (i.e. average employment in years t and $t-1$: $0.5(y_{ijrt} + y_{ijr,t-1})$ and aggregate over firms as well as the grouping of firms (by size, productivity classes as well as service industries).

For entries the counterfactual change in the number of jobs, again skipping indices, is estimated at industry-region-year level as:

$$E[g_{entry}] - E[g^c_{entry}] = (r - r^c)\overline{y}_{entry}N \tag{10}$$

where r and r^c are predicted entry rates from the baseline and the counterfactual regression, respectively. $\overline{y}_{entry}$ corresponds to the average employment of entering firms ($\overline{y}_{jrt}$) and N denotes the number of firms.

4 Measurement of key variables, data and descriptive statistics

4.1 Firm-level data and variables

The empirical analysis is based on the Austrian Social Security Database (ASSD), a widely used administrative data set (see Zweimüller et al., 2009, for a detailed description and Fink et al., 2010 illustrating how firm information can be extracted) in empirical research (see, e. g., Card et al., 2007; Del Bono et al., 2012; Huber and Pfaffermayr, 2010; Huber et al., 2017). The dataset covers all firm-worker links in the form of labor market histories based on social security contributions in Austria between 1972 and 2018. It contains a daily calendar of the employment relationships between individuals and, thus, allows for each point in time to calculate the (overall) number of employees in a respective firm). In this paper, we calculate annual employment figures for Austrian services industries (NACE rev.2: 411 to 829) taking September 7th as our reference day for the 2000 to 2014 time period. To capture employment dynamics at the firm-level, the empirical specification is based on the measure of the job creation rate proposed by Davis and Haltiwanger (1992) and Davis et al. (1996), as introduced in the previous Section 3, equation (2) and equation (4).

The ASSD additionally provides us with the following firm-level information that will be used in the econometric specification: industry affiliation, firm size, firm age and the wage distribution within the firm by percentile, which we use as an additional proxy for firm productivity. In specific, we calculate the deviation of median wages at the firm-level from the industry mean as a signal of the firm's productivity. One reason for the choice of this proxy for productivity is that the ASSD lacks information on service firm output or value added, as well as input factors other than labor needed to calculate labor or total factor productivity. On the other hand, there is extensive literature on the weakness of productivity measurement in services industries due to the nature of the activities, which makes it hard to derive reliable measures of output (Johnston and Jones, 2004; Grönroos and Ojasalo, 2004). The most traditional arguments are the intangibility of the output, the much lower homogeneity of units of services with much greater differences in the quality of each unit of service than in units of goods, as well as the inseparability of production and consumption, such that co-creation by customers should be taken into account. In addition each service sector has its own very specific measurement problems. We take this as an additional motivation for an alternative measure and believe that the deviation of firm-level wages from the within-industry mean serves as a good proxy for the quality of the service output and relative productivity differences between firms within an industry. Following

Greenaway et al. (2008) sunk costs of entry and exit are measured as min(entry rate, exit rate) of all firms aggregated at the NACE-rev2 3-digit industry level.

Special care will be taken to avoid possible statistical problems in relating firm size (number of employees) to firm growth due to regression to the mean effects (Van der Stadt and Wansbeek, 1990; but also Friedman, 1992; Davis et al., 1996; Haltiwanger et al., 2013).[9] To mitigate such effects, we follow the empirical literature and measure firm size as current average size (average firm size in years t and t-1). In addition, the growth rate (Davis et al., 1996) is calculated as a proportion of current average size (see Section 3, equation (2)). Furthermore, we will implement one period lagged (current) average firm size in the robustness section of our analysis.

4.2 Measurement of trade costs and services industry level data and variables

Following Chen and Novy (2001) and Novy (2013) we measure trade costs as:

$$\tau_{jt} = \sum_{c=1}^{C} w_{cjt} \left(\frac{X_{AAjt} X_{ccjt}}{X_{Acjt} X_{cAjt}} \right)^{\frac{1}{2(\sigma_j - 1)}} = \sum_{c=1}^{C} w_{cjt} \left(\frac{t_{Acjt} t_{cAjt}}{t_{AAjt} t_{ccjt}} \right)^{\frac{1}{2}} \qquad (11)$$

With weights based on the trading partners' domestic sales:

$$w_{cjt} = \frac{X_{ccjt}^{1/2}}{\sum_{k=1}^{C} X_{kkjt}^{1/2}}$$

where X_{Acjt} and X_{cAjt} denote nominal bilateral exports from Austria (A) to partner country c in industry j at time t (and vice versa) while X_{AAjt} and X_{ccjt} denote the respective domestic trade flows (domestic sales) in Austria and the partner countries, respectively. σ_j is the industry-specific elasticity of substitution and is assumed to exceed unity ($\sigma_j > 1$). τ_{jt} thus measures bilateral trade costs (t_{Acjt} and t_{cAjt}) relative to domestic trade costs (t_{AAjt} and t_{ccjt}) and captures all factors that make international trade more costly than domestic trade. Taking the square root it measures the (geometric) average bilateral relative trade barriers. This approach to measuring trade costs was shown to be consistent with a broad range of the recent theoretical literature and improves on measures such as the *"phi-ness"* of trade by taking account of industry-specific substitution elasticities and cross-

[9] Firms experiencing a negative (transitory) shock are more likely to grow, firms with a positive shock are more likely to contract. Similarly, small businesses are likely to exhibit higher growth rates as a proportion of initial size than larger businesses.

industry variation in the degree of competition.[10] It not only captures variations in trade costs over time, country-pairs and service industries, but also takes into account trade barriers for both, imports and exports. We see this as a main advantage over simpler measures such as import penetration, as it also allows to capture possible positive effects of new export opportunities.

As a first step, we estimate the substitution elasticities across 22 services industries using firm-level balance sheet data from the Bureau van Dyke (BvD) Amadeus database in the years 2010 to 2014 across all EU countries, including Austria.[11] Referring to the theoretical framework reviewed in Section 2, which assumes constant-elasticity of substitution (CES) preferences in a monopolistic competition framework, it can be shown that firms operating profits are proportional to firms sales.[12] σ_j can therefore be directly derived from the mean or median ratio of all firms' sales belonging to service industry j to the respective firms' operating profits.[13] In practice, we follow Breinlich (2010) and use value added instead of revenues and calculate operating profits as value added minus total wage costs. Measures based on value added seem to most closely reflect the underlying assumptions and relations of the theoretical model, especially when abstracting from the presence of intermediate inputs. Substitution elasticities at the services industry level represent the median across all firm-year level estimates within a given service industry.[14]

In a next step, trade costs scaled by the estimated substitution elasticities σ_j are calculated on the basis of trade flows sourced from the WIOD database. The WIOD provides both, domestic trade (domestic sales) and bilateral exports and imports. Specifically, we use the international supply and use tables from the WIOD and thus observe trade flows at the level of service types ("products") used by all industries including the manufacturing and services industries as well

[10]The *"phi-ness"* ϕ_{jt} of trade is a measure of trade openness that relates international trade to domestic trade (trade ratio of international trade to domestic trade) and was first introduced by Head and Ries (2001): $\phi_{jt} = \sum_{c=1}^{C} w_{cjt} \left(\frac{X_{Acjt} X_{cAjt}}{X_{AAjt} X_{ccjt}} \right)^{\frac{1}{2}}$. As such, it is the inverse of our trade cost measure and additionally ignores industry-specific substitution elasticities.

[11]In Appendix A we provide a detailed list of data sources as well as the country and sector coverage in Table A1.

[12]Denoting operating profits of firm i and industry j by π_{ij}^{op} and firms' revenues by r_{ij}: $\pi_{ij}^{op} = \frac{r_{ij}}{\sigma_j}$.

[13]Operating profits are defined as profits before incurring investment costs, interests, taxes and depreciation.

[14]To test for the robustness of results to such measurement issues with respect to elasticity estimates, we contrast value added based measures to measures based on revenues and operating profits (EBITDA) also published directly in the Amadeus database as well as to measures on the *"phi-ness"* of trade. Furthermore, to deal with outliers we exclude observations below and above the 5th and 95th percentile of the respective indicators.

as the service industry that mainly produces the respective service type and all final use categories (mostly consumption).[15] The sample includes 22 NACE 2-digit sectors/service types across 43 countries between 2000 to 2014.[16] Imports and exports at the service type level are then matched to the firm-level records in the ASSD and the service industries (at the WIOD aggregated NACE 2-digit level) of firms that mainly produce this service type.[17]

A first summary of results for substitution elasticities based on our preferred value added measure (σ_j^{va}) as well as trade costs τ_{jt}^{va} for aggregated services sectors is given in Table 1. More detailed results at the NACE 2-digit level of aggregation which will be implemented in the econometrics are presented in Appendix A (Table A2). The first column reports the elasticities estimated for each industry j. On average σ_j^{va} is equal to 3.44 with values ranging from 1.33 (real estate) to 4.36 (Computer and IT services). The results confirm the fact that substitution elasticities are heterogeneous across services industries and underscore the importance of taking this variation into account. At the aggregated sector level in Table 1, substitution elasticities are highest in construction, IT and professional, scientific and technical services industries. They are lowest in real estate as well as in the finance and insurance industries, indicating low competition within these sectors.

In a comparison of our estimates with other estimates of substitution elasticities in the service sector we find important similarities to the literature using the same methodology which is based on variations of profitability across sectors (Blank et al., 2018; Breinlich, 2010). This even holds when bearing in mind differences in sector aggregations and data sets, as well as the focus on different countries. [18] A major advantage of our estimates are the more disaggregated industry levels

[15] Note that measuring trade costs on the basis of trade of services types is an advantage over measuring trade costs on the basis of service export and imports of a given service industry since the latter could include many types of services.

[16] In Appendix A we provide a detailed list of data sources as well as the country and sector coverage in Table A1.

[17] Note that in deriving industry-specific substitution elasticities σ_j we are not able to obtain information for each service type produced by a firm that could be directly matched to trade flows at the service type level used to calculate trade costs. Instead we have to assume that the services sectors to which each of the firms are attributed within the Amadeus database can be equated with services types. This assumption holds if a given service type is mainly produced by a single sector and if most of the firms within a service industry mainly produce this type of service. These conditions seem to hold for the majority of service types considered in this paper (for more details see Breinlich, 2010).

[18] Overall, our estimate of 3.44 averaged over all firms and industries compares to a value of 4.57 in Blank et al. (2018) for the German services sector and to a value of 2.45 in Breinlich (2010) for the UK. Furthermore, Blank et al. (2018) estimates for Germany reveal an elasticity of 3.92 for ICT services which compares well to ours of 3.95. For construction services they estimate an elasticity of 5.99 against our elasticity of 4. Furthermore, their estimate of 4.51 for other business services compares well to our estimate of 3.77 for professional services in our work.

Table 1: Trade cost estimates for Austrian service industries

NACE	Services industry	σ_j^{va}	(Rank)	$ln(\tau_{jt}^{va})$	(Rank)	$\Delta ln\tau_{j,t-1}^{va}$	(Rank)
69-75	Prof., scien., tech. act.	3.77	(3)	2.13	(1)	-0.65	(5)
49-53	Transport, storage[1])	3.59	(5)	2.24	(2)	-1.10	(4)
58-63	Info., comm. (ICT)	3.95	(2)	2.35	(3)	-2.57	(2)
55,56,77-82	Other	3.71	(4)	2.49	(4)	0.68	(6)
41-43	Construction	4.00	(1)	2.96	(5)	1.04	(8)
45-47	Wholesale trade[2])	3.00	(6)	4.62	(6)	-1.14	(3)
64-66	Finance, insurance	2.24	(7)	8.02	(7)	0.79	(7)
68	Real estate act.	1.33	(8)	31.74	(8)	-10.22	(1)
	Total	3.44		4.95		-0.80	

Notes: [1]) Water transport excluded. [2]) Retail trade excluded.
Source: WIOD, Amadeus, own calculations.

representing the same level of disaggregation as the trade data used to construct bilateral trade costs. Additionally, we estimate these elasticities using the firm-level profitability data of Austrian firms as well as all firms located in other EU countries, thereby taking into account the competitive environment among all major trading partners.[19]

The resulting trade costs (in logs) are presented in column 2 of Table 1. The results are intuitive and consistent with other findings for services industries in the literature based on different methodologies (see Anderson et al., 2018), with professional services and transportation services exhibiting the lowest trade barriers, and with real estate activities, finance services, insurance services and whole-sale trade at the high end of international trade barriers. At the more detailed industry level, the trade cost estimates range between 1.75 for scientific and technical activities and 31.74 for real estate activities (see Table A2 in Appendix A). Real estate and whole-sale trade exhibit the highest decrease in trade costs over the period considered together with ITC services as indicated by the log differences (Δ) of trade costs in column 3 of Table 1. Construction, finance and insurance as well as the group of "other services" reveal increasing trade costs. Total service sector trade costs decreased by -0.8 percent on average over the period considered. While the average change might seem small, the variation of changes in trade costs across industries and over time is high.

Our trade cost measure as well as the ranking of trade costs across industries crucially depend on the σ_j^{va} estimates. We therefore perform a number of robustness checks using different profitability indicators to derive trade costs and implementing the *"phi-ness"* measure in the econometric section of the paper (ϕ_{jt}).

[19]EU trading partners account for about 80 percent of Austrian exports and imports of services.

A detailed comparison of the results for the different indicators is presented in Appendix A (Table A3). Three important results emerge: First, elasticities based on revenues and operating profits (σ_j^{ebitda}) are significantly higher (2 to 7 times). Second, these estimates not only divert extensively from those found in the literature so far, but also crucially change the ranking of trade costs across services industries.[20] The rank correlation between τ_{jt}^{va} and τ_{jt}^{ebitda} only reaches a value of 0.07. The *"phi-ness"* indicator ϕ_{jt}, as a measure of trade openness has a much higher (inverse) rank correlation with our preferred measure τ_{jt}^{va} of -0.88. Third, and most importantly, however, the differences in these rankings do not carry over to changes of trade cost revealed by the different indicators. Both changes in τ_{jt}^{ebitda} and changes in ϕ_{jt} are highly correlated with changes in τ_{jt}^{va}, as can be seen in Figure A1 in Appendix A. The correlation between $\Delta ln\tau_{jt}^{va}$ and $\Delta ln\tau_{jt}^{ebitda}$ reaches a value of 0.92 and the rank correlation is equal to 0.97. The correlation and rank correlation between $\Delta ln\tau_{jt}^{va}$ and $\Delta ln\phi_{jt}$ are -0.83 and -0.95, respectively.

Additional industry characteristics for each NACE 2-digit service industry for the years 2000 to 2014 include the growth of total market demand (gross output by service sector taken from the WIOD), as well as productivity growth at the services industry level (growth of value added per person employed from EUKLEMS) to signal comparative advantages at the sector level. We match this data at the sector level to the firm-level records in the ASSD. The final data comprises approximately 2,232,403 firm-year observations including 2,048,927 observations which enter the TPM model and 183,476 entering firms, which form the basis for an aggregated estimation of entry at the industry-region-year level.

Table 2 provides summary statistics for the key variables. A key feature of the data is the predominance of very small services firms and few large firms with employees above 100. Roughly 50 percent of the firms have fewer than 3 employees, and about 1 percent have more than 100 employees. The maximum firm size is 5,522 employees. Both the probability of entry and the probability of exit reaches a value of 8 percent.

Figure 3 summarizes the data along key dimensions of our analysis. The first picture shows net changes in employment (change in the number of jobs) and the second picture reveals the decomposition of net changes into the positive contributions of entering firms and those expanding (job creation) as well as the negative contributions due to firm exits, or reductions in employment by contracting survivors (job destruction). In comparing the first two pictures in the upper panel, the first striking result is the extent to which gross employment flows of entry and exit outweigh net changes, with a lot of contemporaneous job creation and destruction. This is an empirical fact established by the work of Davis and Haltiwanger (1992).

[20]The data based on the Amadeus data base concerning these profitability indicators is very noisy.

Table 2: Summary statistics

		Obs.[1])	Mean	Median	Std. dev.	Min	Max
Firm-level var.							
Employment (size)	y	2,232,403	8.44	3.00	44.23	0.00	5,522.00
Job creation rate	g	2,232,403	-0.01	0.00	0.88	-2.00	2.00
Entries	din	2,232,403	0.08	0.00	0.27	0.00	1.00
Exits	dout	2,232,403	0.08	0.00	0.27	0.00	1.00
Age	age	2,232,403	10.89	7.00	11.11	0.00	43.00
Relative productivity	rprod	2,231,282	1.00	0.95	0.47	0.00	5.39
log(Size)	lnsize	2,232,403	1.29	1.10	1.00	0.00	8.62
log(Age)	lnage	2,048,927	1.98	2.08	1.07	0.00	3.76
log(Prod.)	lnprod	2,231,282	-0.12	-0.05	0.50	-6.48	1.69
Industry level var.							
Change in trade costs	$\Delta ln\tau^{va}_{j,t-1}$	2,232,403	-0.80	-1.27	8.77	-35.45	39.62
Market growth	gm	2,232,403	7.73	7.98	9.65	-21.10	69.86
Sunk costs	sunk	2,232,403	0.06	0.06	0.02	0.00	0.10
Labor prod. growth	giprod	2,232,403	-0.10	-0.03	3.14	-15.61	22.23

Notes: [1]) The sample for firm-level estimates covers 2,048,927 observations.The sample of 183,476 entering firms forms the basis for aggregated estimation of entry at the industry-region-year level.
Source: ASSD, WIOD, EUKLEMS, Amadeus, own calculations.

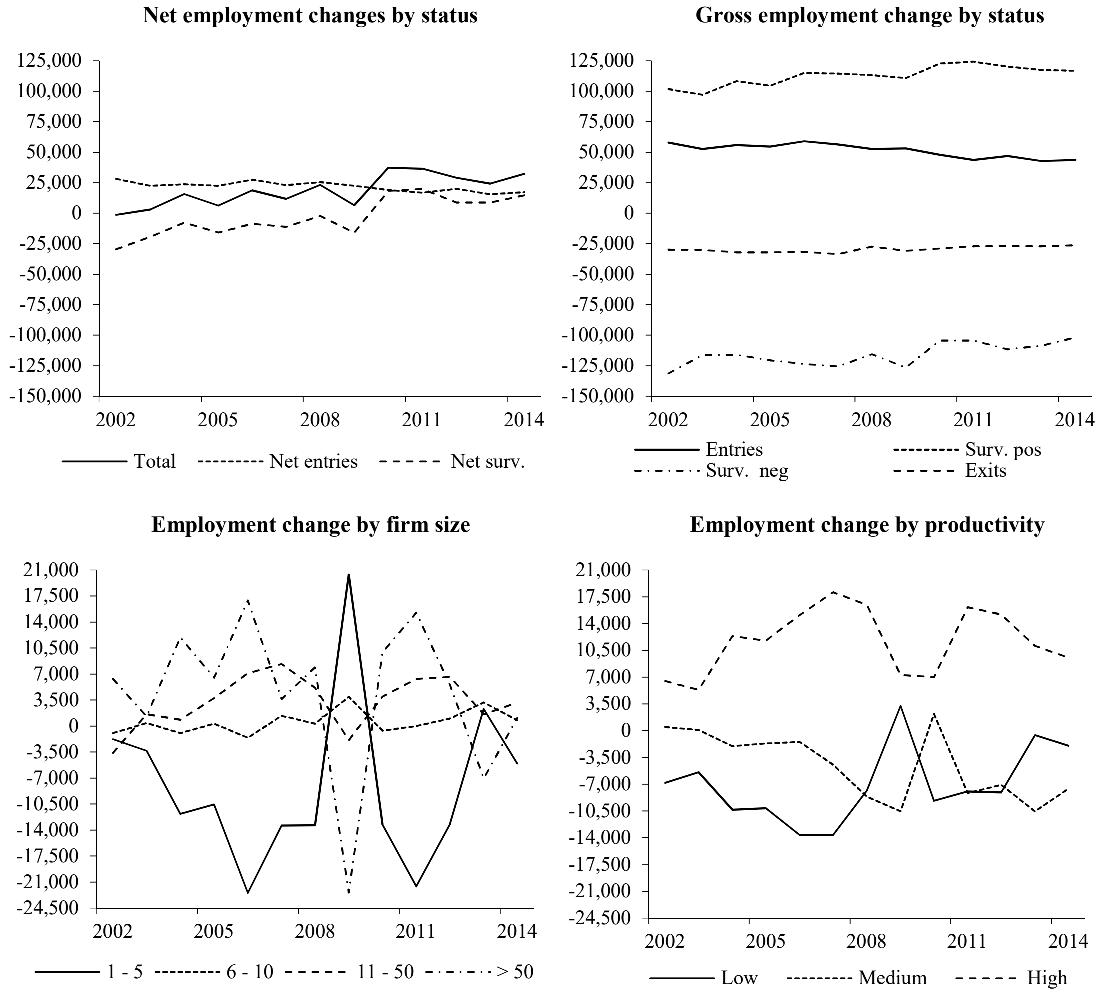
More than 150,000 jobs are created and destroyed each year, while net job creation is around 23.000 on average per year. Most interestingly however, net entry and exit of firms (the extensive margin of employment changes) in all years, except for the crisis year, contribute most to overall net job creation in Austrian services and outweigh the net contributions of surviving firms (the intensive margin of employment changes). Thus, while most employment gains and losses are due to changes in continuing firms, the net contribution is clearly higher from net entry.

The third picture in the lower left part of Figure 3 decomposes changes in employment by different firm sizes and reveals a very diverse pattern, especially in contrasting the smallest with the largest firms. The same is true for a decomposition of job changes by firm productivity classes in the fourth picture of Figure 3.

5 Estimation results

Table 3 presents parameter estimates applying the two-part empirical model (TPM) as specified in equations (5) and (6) in Section 3 and based on our preferred trade cost measure $\Delta ln\tau^{va}_{j,t-1}$ as outlined in Section 4. Since the specified empirical models include many interaction effects which cannot be directly interpreted in the

Figure 3: Changes in employment by key firm characteristics



Source: ASSD, own calculations.

non-linear probit model, and even complicate inference from the coefficients in the linear model, we will refer to Table 4 that presents the implied marginal effects for an interpretation of results.[21]

Since trade costs vary over industry and time only, they could be related to industry-time-specific shocks making trade costs endogenous. In contrast, the

[21] As outlined in Ai and Norton (2003) looking at coefficients in the table of results alone can be misleading in non-linear models as the magnitude and statistical significance of the interaction effects vary by observation. Thus even if coefficients on interaction terms are insignificant the full interaction effect based on marginal effects can be statistically significant if the full interaction effect is large and statistically significant for many observation.

individual firm job creation rates within a service industry are unlikely to influence trade costs at the industry level. We test for this kind of endogeneity problem by performing a robust Wald test on the equality of two alternative parameter estimates of the interaction term $\Delta ln\tau^{va}_{j,t-1} lnsize_{it}$ derived (i) from the baseline TPM-model, as specified in column (1) and (ii) from an alternative model that includes industry-time-specific effects. This second model drops all variables with industry-time variation only, including the (base) trade cost measure, as well as the industry-time-specific shocks and thus does not suffer from the endogeneity problem. The robust Wald test stacks the scores of these two estimators and uses a robust covariance estimator to form the test statistic following Rogers (1993). As can be seen in Table 3 the robust Wald test is insignificant for the Probit model referring to exiting firms, but significant for the OLS-model for surviving firms.

Specification (2) in Table 3 instruments for $\Delta ln\tau^{va}_{j,t-1}$ and its interactions with firm size (lnsize) to take into account this endogeneity bias using a Frankel-Romer type instrument (Frankel and Romer, 1999). Specifically, $\Delta ln\tau^{va}_{j,t-1}$ is instrumented by the change of predicted trade costs that come from a time-specific industry level gravity PPML regression of bilateral $\tau^{va}_{jc,t}$ on gravity indicators, where c denotes partner countries (see Appendix B for a detailed outline of the estimation procedure and the data sources used).[22] For the Probit model as well as the TPM model we apply the control function approach following Rivers and Vuong (1988). In doing so, we use bootstrapped standard errors where each bootstrap-step comprises both the first stage that provides the estimated residuals and the control functions and the second stage TPM-estimate. In the following we use IV-estimation results for further analysis.

Table 4 presents marginal effects of changes in trade costs based on IV regression results of specification (2) presented in Table 3. It reveals the total marginal employment effects combined for the extensive and intensive margin as well as the separate outcomes from each part, the probability of survival and the linear model on the net job creation of surviving firms. We first find a statistically highly significant inverse relationship between firm survival and trade cost changes. The probability of firm survival clearly decreases with increasing trade barriers. The results also confirm the theoretical prediction of a differential impact of trade cost changes across different firm size and productivity classes. Highter trade costs impact most strongly and negatively on the survival likelihood of the largest firms, with the effect decreasing as we move to size groups of smaller firms. The marginal impact of the smallest size group is positive and statistically significant. Thus, as trade costs increase, the smallest firms have an increasing chance to survive. A similar picture arises with respect to different productivity classes of firms, with

[22] $\Delta ln\tau^{va}_{j,t-1}$ is instrumented by $\widehat{\Delta ln\tau}^{va}_{j,t-1}$, while the instrument for the interaction term $\Delta ln\tau_{j,t-1} lnsize_{it}$ is $\widehat{\Delta ln\tau}^{va}_{j,t-1} lnsize_{it}$.

Table 3: Parameter estimates I: firm survival and firm-level employment growth of surviving firms

	(1) TPM-Base		(2) TPM-FE		(3) TPM-IV	
	b	sd	b	sd	b	sd
Probit						
$\Delta ln\tau^{va}_{j,t-1}$	0.2787***	0.028			0.3244***	0.031
$\Delta ln\tau^{va}_{j,t-1}$ lnsize$_{ijt}$	-0.2870***	0.025	-0.2852***	0.026	-0.3463***	0.033
OLS						
$\Delta ln\tau^{va}_{j,t-1}$	0.0355***	0.006			0.0406***	0.006
$\Delta ln\tau^{va}_{j,t-1}$ lnsize$_{ijt}$	-0.0144***	0.003	-0.0095**	0.004	-0.0184***	0.003
N	2,048,927		2,048,927		2,048,927	
Wald Test: Spec.(1) vs. (2)						
Probit chi(1)	0.06					
p-value	0.7989					
OLS chi(1)	11.81***					
p-value	0.0006					

Notes: IV estimation by control function approach. The control function is based on predictions of time-specific gravity equations of observed trade costs. Bootstrapped standard errors. +, *, ** and *** indicate statistical significance at the 15%-, 10%-, 5%- and 1%-level, respectively. All regressions include regional-industry, regional-time as well as firm-size class - year dummies, industry- level controls (industry level growth of total demand and productivity and sunk costs (in the probit model only), firm level controls (age, age squared, size, size squared) as well as interactions of size and age.
Source: Own calculations.

the most productive firms experiencing the largest decrease in the probability of survival as trade costs increase.

Turning to net job creation, conditional on survival, the marginal effect of changing trade costs is smaller, but again reveals a highly significant negative impact of increasing trade barriers on the employment growth of larger firms. The impact is again positive for smaller firms. A similar picture arises for different productivity classes of firms. The strongest negative effect of increasing trade costs is visible for the most productive services firms in the sample. The marginal effect on the least productive firms is insignificant.

Finally, the table shows the combined marginal effect of changes in trade costs on the expected job creation rate due to the growth of surviving firms and due to changes in the probability of firm survival (exits): The contribution of surviving firms is derived by multiplying the expected net job creation rate in surviving firms $E(g \mid survival = 1)$ with the probability of survival from the probit estimation p. The contribution of firm exits is derived by multiplying the expected growth rate of exiting firms -2 (as implied by the Davis et al. (1996) job creation rate formula) with the probability of exit (1-p). In Table 4 we see that the combined effect

Table 4: Marginal effects of a change in trade costs on firm survival and firm-level employment growth

	Combined		Probability of Survival		Surviving	
	est	sd	est	sd	est	sd
Total	-0.149^{***}	0.015	-0.065^{***}	0.008	-0.026^{***}	0.008
Firm size						
1-5	0.037^{***}	0.006	0.009^{***}	0.002	0.022^{***}	0.004
6-10	-0.021^{***}	0.005	-0.013^{***}	0.002	0.004	0.004
11-50	-0.050^{***}	0.008	-0.017^{***}	0.002	-0.017^{+}	0.007
>50	-0.340^{***}	0.031	-0.148^{***}	0.017	-0.062^{***}	0.014
Productivity						
Low	-0.034^{***}	0.007	-0.016^{***}	0.003	-0.003	0.005
Medium	-0.142^{***}	0.014	-0.063^{***}	0.008	-0.024^{***}	0.008
High	-0.185^{***}	0.018	-0.081^{***}	0.009	-0.033^{***}	0.009

Notes: Marginal effects are based on parameter estimates of the IV-specification (2) of Table 3. Bootstrapped standard errors. +, *, ** and *** indicate statistical significance at the 15%-, 10%-, 5%- and 1%-level, respectively.
Source: Own calculations.

of an increase in trade barriers on employment growth is statistically significant and negative for larger services firms and more productive firms. Put differently, the econometric results suggest that decreasing trade costs imply positive overall employment impacts, whla heterogeneous ones across different firm sizes and productivity classes of firms imply impacts in a way suggested by the theory reviewed in Section 2.

Since we measure changes in trade costs in log differences, the revealed marginal effects in Table 4 can be interpreted as semi-elasticities: an increase of trade costs of 1 percent in the one-year-lagged period, decreases the job creation rate by 15 percentage points. Job creation decreases by 34 percentage points for the largest firms, and vice versa for decreasing trade barriers.

Table 5 summarizes parameter estimates based on the specification of entry rates outlined in equation (7) of Section 3. The results reveal the impact of trade barriers on the entry rates of firms and complete the picture of employment impacts at different adjustment margins. The model needs to be specified at the industry-region-time level since at the firm-level we lack observations for firms that never entered the market. The model is estimated by applying a fractional response GLM (probit) model with heteroskedastic robust standard errors following Papke and Wooldridge (2008). Table 5 presents results of the specified model with and without instrumenting for $\Delta ln\tau^{va}_{j,t-1}$. Since industry-time-specific trade shocks were shown to pose endogeneity problems, we prefer estimates from specification (2) for further analysis, although differences between the two models are small. Again, we apply the control function approach, basing the control function on predictions of time-specific gravity equations of observed trade costs as laid out above. Overall, the signs of all coefficients are as expected and highly significant. Most importantly, increasing trade costs divert firm entry. The marginal effects of an increase in trade barriers of 1 percent amounts to a 3.2 percent decrease in the entry rates at the industry level in the preferred IV-control function specification (industry-specific shocks in trade costs are accounted for with the Mundlak term $\overline{\Delta ln\tau_{j.}^{va}}$).

Table 5: Parameter estimates II: Entry rates at the industry-region-year level

	GLM-Base		GLM-IV	
	b	sd	b	sd
$\Delta ln\tau_{j,t-1}^{va}$	-0.2510***	0.054	-0.2363***	0.056
Marg. effect $\Delta ln\tau_{j,t-1}^{va}$	-0.0341***	0.007	-0.0321***	0.008
Market growth (gm_{jt})	0.0038***	0.001	0.0038***	0.001
Productivity growth ($giprod_{jt}$)	0.0046***	0.001	0.0046***	0.001
Log $Size_{jrt}$	-0.4036***	0.074	-0.4037***	0.073
Log Age_{jrt}	0.1809***	0.066	0.1797***	0.066
$\overline{\Delta ln\tau_{j.}^{va}}$	-0.3355**	0.137		
$\overline{\Delta ln\tau_{j.}^{va,pr}}$			-0.4451***	0.150
N	2,498		2,498	

Notes: Industry-region-specific as well industry-specific averages over time of all variables (Mundlak terms) included. IV estimation by control function approach. The control function is based on predictions of time-specific gravity equations of observed trade costs. Marginal effects are based on the respective parameter estimates. Robust standard errors. +, *, ** and *** indicate statistical significance at the 15%-, 10%-, 5%- and 1%-level, respectively.
Source: Own calculations.

6 Counterfactual analysis

Based on the regression results of the two-part, firm-level model as well as the industry-region level entry model we provide a counterfactual analysis contrasting the employment impact of the observed changes in trade costs with a scenario of unchanged trade costs over the period considered (i.e. $\Delta ln\tau_{j,t-1}^{va} = 0$ for all t). We proceed as described in Section 3 along the lines of equation (9). Again, a special focus is put on the decomposition of the expected aggregate net job creation rate into the contribution of trade-induced employment changes resulting from a change in the probability of survival (exit) and the entry rates of firms (extensive adjustment margin) as well as the contribution of the employment changes of surviving firms (intensive margin).

From Section 3 and Table 1 we know that trade costs across all sectors decreased by 0.8 percent between 2000 and 2014 in Austria. Thus, based on the counterfactual scenario of unchanged trade costs, the difference between the baseline prediction and the counterfactual figures reveals the average marginal ceteris paribus impact of the observed dismantling of trade barriers.[23]

Table 6 presents the results and reveals the contribution of changes in firm entry rates, the probability of firm exits as well as net job creation in surviving firms to overall job flows due to the implied decrease in trade costs. The decomposition of changes in the exit probability and employment changes of surviving firms is also displayed for each firm size and productivity group.[24]

Overall, our experiment results in an increase in employment of about 19,000 jobs, which accounts for a share of 9.5 percent of the total 205,110 services jobs created in Austria over the period 2002 to 2014. The results on the decomposition indicate the importance of exit dynamics for overall employment patterns. Falling trade costs decreased the exit probability of Austrian services firms and this margin of adjustment is responsible for the largest bulk of employment gains. The patterns for firm size groups and productivity groups confirm the main re-allocation patterns predicted by the theory of heterogeneous firms. The smallest firms as well as firms with the lowest productivity contract and destroy jobs. The change in the exit probability of Austrian services firms accounts for the largest share across size and productivity groups. It is only within the smallest firm group that the employment reduction of surviving firms contributes to an almost equal amount.

Table 7 presents counterfactual results by aggregated services industries. At this level of disaggregation it turns out that observed changes in trade costs contributed positively to job creation in all services sectors, with the exception of the construction services industry and the insurance sector. Referring back to our analysis of trade cost changes, we see that over the period protection levels increased, on average, in the construction sector as well as the insurance sector and, thus, fed into the job losses in both sectors, respectively. Across industries, adjustments in the exit probability account for the largest part of net job creation. The whole-sale trade industry presents an exception to this rule, with employment changes in surviving firms accounting for the largest contribution and the change in firm entry rates accounting for the second largest contribution to overall trade-induced net job creation. The entry margin is of relatively higher relevance, also

[23]Counterfactual results by sector will reveal respective changes of trade costs by each sector as summarized in Table 1 in Section (4) or A2 in Appendix A.

[24]Decomposition by firm size and firm productivity classes are not possible for the contribution of changes in firm entry rates since these had to be estimated at the sector-region level.

Table 6: Counterfactual scenario of unchanged trade costs ($\Delta ln\tau^{va}_{j,t-1}$=0) – impact on employment by firm size, productivity and margin of adjustment

	Total as observed	Total impact	Subtotal (1)+(2)	(1) Contrib. of changes in exit probability	(2) Contrib. of empl. changes of surv. firms	(3) Contrib. of changes in the entry rate
	Changes in the number of employees (2002 - 2014)					
Total	205,110	18,920	17,516	15,892	1,624	1,404
Firm size						
1-5	13,718	.	-1,347	-661	-686	.
6-10	35,314	.	90	111	-21	.
11-50	74,871	.	983	616	367	.
>50	81,207	.	17,791	15,826	1,964	.
Productivity						
Low	-35,486	.	-1,164	-1,046	-118	.
Medium	16,531	.	5,179	4,522	658	.
High	223,704	.	13,501	12,417	1,085	.
	Contribution to total (observed) net job creation in percent					
Total	100.00	9.22	8.54	7.75	0.79	0.68
Firm size						
1-5	.	.	-0.66	-0.32	-0.33	.
6-10	.	.	0.04	0.05	-0.01	.
11-50	.	.	0.48	0.30	0.18	.
>50	.	.	8.67	7.72	0.96	.
Productivity						
Low	.	.	-0.57	-0.51	-0.06	.
Medium	.	.	2.52	2.20	0.32	.
High	.	.	6.58	6.05	0.53	.

Notes: Decomposition by firm size and firm productivity classes are not possible for the contribution of changes in firm entry rates since these had to be estimated at the sector-region level.
Source: Own calculations.

in the finance and insurance industries.

7 Robustness of results

We perform several sensitivity checks taking up issues of different measurement of trade costs as outlined in Section 4. We additionally test the robustness of our results to the inclusion of firm productivity as an additional control to the base specification as well as the inclusion of one-year-lagged firm size variables to take into account possible regression to the mean effects and possible endogeneity problems (compare Section 3). To make the different estimation results compara-

Table 7: Counterfactual scenario of unchanged trade costs ($\Delta ln\tau^{va}_{j,t-1}$=0) – impact on employment by service industry

	Total as obs.	Total impact	Subtotal (1)+(2)	(1) Contrib. of changes in exit probab.	(2) Contrib. of empl. changes of surviving firms	(3) Contrib. of changes in the entry rate
	Contribution to total (observed) net job creation in percent [1])					
Total	100.00	9.22	8.54	7.75	0.79	0.68
Service industry						
Construction	.	-2.11	-1.95	-1.51	-0.44	-0.15
Wholesale trade[2])		0.49	0.22	-0.25	0.47	0.27
Transport, storage[3])	.	1.21	1.19	1.09	0.10	0.03
Info., comm. (ICT)	.	0.99	0.75	0.59	0.17	0.23
Finance, aux. services	.	4.71	5.15	4.88	0.27	-0.44
Insurance	.	-3.43	-3.63	-3.32	-0.31	0.20
Prof., scient., tech. act.	.	0.99	0.85	0.73	0.12	0.14
Other	.	6.37	5.96	5.53	0.43	0.40

Notes: [1]) Total observed net job creation over the period 2002 to 2014 amounted to 205,110 services jobs. [2]) Retail trade excluded. [3]) Water transport excluded.
Source: Own calculations.

ble, we contrast the respective counterfactual results of the considered alternative specifications to the counterfactual results from the preferred base specification presented in the preceding Section 6 ($\Delta ln\tau^{va}$ - *Base*) in Table 8. The respective parameter estimates resulting from the TPM-model on firm survival and employment growth of surviving firms are presented in Table A4 in Appendix A, and the parameter estimates of the entry model are revealed in Table A5 in Appendix A.

Table 8 summarizes results across specifications and along the decomposition of the contribution of changes in the exit probability, employment changes of continuing (surviving) firms as well as changes in the firm entry rate. It turns out that our main results are very robust to the measurement of trade costs using profitability data based on revenues and the firm EBITDA to calculate substitution elasticities ($\Delta ln\tau^{ebitda}_{j,t-1}$), the inclusion of productivity as an additional control variable ($\Delta ln\tau^{va}_{j,t-1}$ - *Prod.*) and the introduction of the lagged size variable, as well as its interaction with the trade cost measure $\Delta ln\tau^{va}_{j,t-1} - lnsize_{t-1}$. This holds for the total amount of jobs created as well as the decomposition of employment changes along the different margins of adjustments.

Contrasting the baseline results with the outcomes based on the *"phi-ness"* of trade $\Delta ln\phi_{j,t-1}$, we find less concordance. As a measure of trade openness inverse to trade costs that ignores the heterogeneity of substitution elasticities across sectors, the results based on the *"phi-ness"* measure reveal the importance of capturing cross-industry variation in competitive conditions, and the need to separate those from variation in trade costs (Chen and Novy, 2011).

Table 8: Robustness of counterfactual results across specifications – total and by margin of adjustment

	Total impact	Subtotal (1)+(2)	(1) Firm exits	(2) Surviving firms	(3) Firm entries
	Changes in the number of employees				
$\Delta ln\tau^{va}_{j,t-1} - Base$	18,920	17,516	15,892	1,624	1,404
$\Delta ln\tau^{ebitda}_{j,t-1}$	18,377	17,110	15,720	1,390	1,267
$\Delta ln\phi_{j,t-1}$	16,066	14,821	9,213	5,609	1,244
$\Delta ln\tau^{va}_{j,t-1} - Prod.$	.	16,887	15,561	1,326	.
$\Delta ln\tau^{va}_{j,t-1} - lnsize_{ij,t-1}$	.	15,630	13,178	2,452	.
	Contribution to total (observed) net job creation in percent[1])				
$\Delta ln\tau^{va}_{j,t-1} - Base$	9.22	8.54	7.75	0.79	0.68
$\Delta ln\tau^{ebitda}_{j,t-1}$	8.96	8.34	7.66	0.68	0.62
$\Delta ln\phi_{j,t-1}$	7.83	7.23	4.49	2.73	0.61
$\Delta ln\tau^{va}_{j,t-1} - Prod.$	.	8.23	7.59	0.65	.
$\Delta ln\tau^{va}_{j,t-1} - lnsize_{ij,t-1}$	.	7.62	6.42	1.20	.

Notes: [1]) Total observed net job creation in the services sector in period 2002 to 2014 amounts to 205,110.
Source: Own calculations.

Table 9 compares counterfactual results across the different specifications along firm size and productivity classes as well as aggregated service industries. It reveals the respective contribution to total observed employment changes and underscores the robustness of our results to different underlying data in the measurement of trade costs as well as the inclusion of a productivity measure or the introduction of lagged firm size along the dimensions of firm size and productivity classes. At the level of individual service sectors differences in the measurement of trade costs turn out to matter more and are again most obvious in contrasting baseline results with the results based on the *"phi-ness"* measure of trade openness.

Table 9: Robustness of counterfactual results across specifications by firm size, productivity and service industry

	As obs.	Estimated CF				
		(1) $\Delta ln\tau^{va}_{j,t-1}$ -Base	(2) $\Delta ln\tau^{ebitda}_{j,t-1}$	(3) $\Delta ln\phi_{j,t-1}$	(4) $\Delta ln\tau^{va}_{j,t-1}$ -Prod.	(5) $\Delta ln\tau^{va}_{j,t-1}$ -lnsize$_{ij,t-1}$
		Contribution to total (observed) net job creation in percent[1])				
Total[2])	100	8.54	8.34	7.23	8.23	7.62
Firm size						
1-5	.	−0.66	−0.65	−0.22	−0.75	−0.58
6-10	.	0.04	0.01	0.19	0.04	0.07
11-50	.	0.48	0.34	1.43	0.44	0.63
>50	.	8.67	8.64	5.83	8.50	7.50
Productivity						
Low	.	−0.57	−0.26	0.62	−0.66	−0.23
Medium	.	2.52	2.17	4.26	2.38	2.74
High	.	6.58	6.44	2.35	6.51	5.10
Service industry						
Construction	.	−1.95	−2.40	1.14	−1.88	−1.96
Wholesale trade[3])	.	0.22	0.31	2.18	0.26	0.61
Transport, storage[4])	.	1.19	1.10	0.97	1.07	1.92
Info., comm. (ICT)	.	0.75	1.94	1.87	0.59	0.91
Finance, aux. serv.	.	5.15	4.64	−1.75	5.15	2.74
Insurance	.	−3.63	−5.94	−2.92	−3.54	−2.70
Prof., scient., tech. a.	.	0.85	1.21	1.07	0.81	0.85
Other	.	5.96	7.46	4.66	5.77	5.25

Notes: [1]) Total observed employment change in the services sector in period 2002 to 2014 amounts to 205,110. [2]) Contribution of trade cost-induced changes in entry rates not included in totals. [3]) Retail trade excluded. [4]) Water transport excluded.
Source: Own calculations.

8 Conclusions

This paper presents new insights into the firm-level employment effects of changes in trade costs at the industry level and the interactions of these effects with firm heterogeneity in productivity, focusing on services firms and services trade in Austria. It adds new evidence to a very scarce literature on the firm-level impacts of the services trade. We apply a measure of net employment growth suggested by Davis et al. (1996) that allows an integrated treatment of firm entry, firm survival (exit) and firm growth. We first formulate a two-part model that estimates separate equations for the probability of firm survival and conditional on survival, for continuing firms that can be combined to assess the overall impact of re-allocation processes, as predicted by the heterogeneous firm models on firm-level net employment growth on the extensive and intensive margin, alons with their relative contributions. We estimate the two-part model for a sample of Austrian services firms from 2000 and 2014 using firm-level data from the Austrian Social Security

Database and applying an industry level trade cost measure based on Chen and Novy (2011) and Novy (2013). To cover the firm entry margin of trade-induced employment changes we specify a model of entry rates at the industry-region level. We apply instrumental variable estimation throughout, to take account of an endogeneity bias of trade costs due to common industry-specific shocks.

Special care is taken in the construction of the trade cost indicator, and the applied measure has two major advantages over (simpler) measures of trade openness or import penetration. First, it is comprehensive in that it captures all factors that make international trade more costly than domestic trade, and in that it covers both sides of the "trade-coin", impediments to imports as well as exports. Second, it closely links to the theoretical framework of gravity models and takes account of variations in the substitution elasticities across sectors. We derive sector-specific substitution elasticities from profitability measures sourced from the BvD Amadeus database and combine these estimates with trade data from the WIOD database at the service type (i.e. product) level.

Our results widely support theoretical predictions on firm-level employment responses to falling trade barriers and its interactions with firm productivity and firm size. We find that the dismantling of trade barriers decreases the likelihood of firm exit of larger (more productive) firms while it increases the exit probability of the smallest (least productive) firms. Among the group of surviving firms, the smallest (least productive) firms also experience declines in employment growth due to falling trade barriers, while the most productive and the largest firms experience accelerated employment growth.

We find that decreasing trade costs in the Austrian services sector over the period 2000 to 2014 resulted in net job creation of about 18,000 to 19,000 jobs, which accounts for a share of 9.5 percent of total job creation in the service sectors considered in the analysis (total amount of services jobs created: 205,110). The decomposition into different adjustment margins reveals the importance of the extensive margin to overall trade-induced net job creation which is derived from changes in the probability of survival as well as changes in the rate of firm entry. The patterns for firm size groups and productivity groups again confirm the main re-allocation patterns predicted by the theory of heterogeneous firms. The least productive (smallest) firms contract as a result of falling trade barriers. At the service industry level the counterfactual analysis reveals decreasing trade costs and induced net job creation in all sectors but the construction and insurance sectors. Both sectors experienced an increase in trade barriers and related net job losses to the amount of around 4,300 and 7,000 jobs, respectively.

Appendix

Appendix A: Data sources and complementary results

Table A1: Data sources and data coverage

Source	Acronym	Time coverage	Level of observations	Service sector coverage	County coverage	Indicators	Variables calculated
Austrian Social Security Database	ASSD	2004-2014	Firm level	NACE rev2; 4-digits (4110-8299)	AT	Number of employees NACE 4-digit Firm age Wage distribution by percentile	y, g, entry, lnsize, exits industry affiliation lnage lnprod (productivity=deviation of median wages at the firm level from the industry mean)
World Input Output Database	WIOD	2004-2014	Aggregated NACE rev2 service types Aggregated NACE rev2 sectors	NACE rev2; 2-digits (41-82) NACE rev2; 2-digits (41-82)	43 countries: EU28 + AUS, BRA, CAN, CHE, CHN, IDN, IND, JPN, KOR, MEX, NOR, RUS, TUR, TWN, USA	Bilateral exports and imports from international supply and use tables (IntSUTs) Domestic production of service types Sector output	$\Delta\tau_{jt}$, $\Delta\tau_{jt-1}$ Industry level market growth
Bureau van Dijk European Company Database	AMADEUS	2010-2014	Firm level	NACE rev2; 2-digits (41-82)	EU28	Revenues (Sales) EBITDA (earnings before interest, taxes and amortization) Value added Cost of employees	σ_j^{ebitda} σ_j^{va}
EU KLEMS Productivity and Growth Accounts (2017)	EUKLEMS	2004-2014	ISIC rev4	Aggregated NACE rev2; 2-digits (41-82)	EU28 + USA	Growth of value added per person employed (LP_2 serie)	Industry level productivity growth
Centre d'Etudes Prospectives et d'Informations Internationales Geography Database	CEPII				43 countries: EU28 + AUS, BRA, CAN, CHE, CHN, IDN,IND, JPN, KOR, MEX, NOR, RUS, TUR, TWN, USA	Distance, contiguity, common language, landlocked	$\Delta\tau_{j,t-1}^{predicted}$

Table A2: Trade cost estimates at the detailed service industry- level (NACE 2-digits according to WIOD)

NACE	Services industry	σ_j^{va}	(Rank)	$ln(\tau_{jt}^{va})$	(Rank)	$\Delta ln\tau_{j,t-1}^{va}$	(Rank)
72	Scientific research, developm.	3.49	(12)	1.75	(1)	-2.59	(6)
71	Architect., engineering activ.	4.12	(3)	1.90	(2)	-1.33	(10)
62-63	Computer, IT	4.36	(1)	1.95	(3)	-3.70	(3)
58	Publishing activities	3.68	(8)	2.01	(4)	0.48	(15)
53	Postal, courier activities	4.33	(2)	2.02	(5)	0.63	(16)
73	Advertising, market research	3.60	(11)	2.13	(6)	-3.07	(5)
69-70	Legal, account., head off. act.	3.71	(7)	2.14	(7)	0.70	(17)
49	Land transport	3.63	(9)	2.21	(8)	-1.28	(11)
77-82	Other services	4.02	(4)	2.31	(9)	-1.45	(7)
52	Support act. for transp.	3.29	(14)	2.45	(10)	-0.22	(14)
55-56	Travel services	3.61	(10)	2.55	(11)	1.38	(19)
41-43	Construct., civil engineering	4.00	(5)	2.96	(12)	1.04	(18)
51	Air transport	2.75	(16)	2.99	(13)	-1.40	(8)
74-75	Other prof., scient., tech. act.	3.37	(13)	3.13	(14)	-0.72	(12)
45	Trade of motor veh., motorc.	3.76	(6)	3.40	(15)	-3.89	(2)
65	Insurance services	2.59	(17)	4.36	(16)	3.23	(22)
59-60	Motion picture, video, telev.	2.33	(20)	4.53	(17)	-1.37	(9)
61	Telecommunications	2.45	(19)	4.53	(17)	1.53	(20)
46	Wholesale trade	2.78	(15)	4.97	(19)	-0.36	(13)
66	Auxiliary financial, insurance	2.59	(17)	5.33	(20)	2.55	(21)
64	Financial services	1.51	(21)	13.90	(21)	-3.08	(4)
68	Real estate activities	1.33	(22)	31.74	(22)	-10.22	(1)
	Total	3.44		4.95		-0.80	

Source: WIOD, Amadeus, own calculations.

Table A3: Trade cost measures in comparison (NACE 2-digits according to WIOD)

NACE	$ln(\tau_{jt}^{va})$	(Rank)	σ_j^{ebitda}	(Rank)	$ln(\tau_{jt}^{ebitda})$	(Rank)	$ln(\phi_{jt})$	(Rank)	$\Delta ln\tau_{j,t-1}^{va}$	(Rank)	$\Delta ln\tau_{j,t-1}^{ebitda}$	(Rank)	$\Delta ln\phi_{j,t-1}$	(Rank)
72	1.75	(1)	8.50	(15)	0.58	(8)	-4.37	(1)	-2.59	(6)	-0.86	(3)	6.46	(4)
71	1.90	(2)	9.87	(13)	0.67	(11)	-5.94	(8)	-1.33	(10)	-0.47	(7)	4.15	(6)
62-63	1.95	(3)	10.19	(11)	0.71	(12)	-6.56	(10)	-3.70	(3)	-1.35	(2)	12.43	(1)
58	2.01	(4)	10.30	(10)	0.58	(8)	-5.38	(3)	0.48	(15)	0.14	(15)	-1.29	(15)
53	2.02	(5)	15.20	(3)	0.48	(4)	-6.75	(13)	0.63	(16)	0.15	(16)	-2.09	(17)
73	2.13	(6)	12.91	(5)	0.46	(3)	-5.52	(4)	-3.07	(5)	-0.67	(4)	7.98	(3)
69-70	2.14	(7)	7.03	(18)	0.96	(17)	-5.81	(7)	0.70	(17)	0.31	(18)	-1.90	(16)
49	2.21	(8)	11.45	(8)	0.56	(7)	-5.80	(6)	-1.28	(11)	-0.32	(9)	3.36	(7)
77-82	2.31	(9)	12.10	(7)	0.63	(10)	-6.98	(15)	-1.45	(7)	-0.39	(8)	4.37	(5)
52	2.45	(10)	14.31	(4)	0.42	(1)	-5.60	(5)	-0.22	(14)	-0.04	(13)	0.51	(14)
55-56	2.55	(11)	9.08	(14)	0.82	(14)	-6.65	(12)	1.38	(19)	0.45	(20)	-3.61	(20)
41-43	2.96	(12)	12.78	(6)	0.75	(13)	-8.86	(20)	1.04	(18)	0.27	(17)	-3.13	(19)
51	2.99	(13)	11.08	(9)	0.52	(6)	-5.22	(2)	-1.40	(8)	-0.24	(11)	2.44	(9)
74-75	3.13	(14)	10.05	(12)	0.82	(14)	-7.41	(17)	-0.72	(12)	-0.19	(12)	1.72	(11)
45	3.40	(15)	23.39	(1)	0.42	(1)	-9.41	(21)	-3.89	(2)	-0.48	(6)	10.75	(2)
65	4.36	(16)	5.59	(19)	1.50	(19)	-6.91	(14)	3.23	(22)	1.11	(22)	-5.12	(22)
59-60	4.53	(17)	7.32	(17)	0.96	(17)	-6.05	(9)	-1.37	(9)	-0.29	(10)	1.83	(10)
61	4.53	(17)	8.27	(16)	0.90	(16)	-6.56	(10)	1.53	(20)	0.31	(18)	-2.22	(18)
46	4.97	(19)	19.58	(2)	0.48	(4)	-8.84	(19)	-0.36	(13)	-0.03	(14)	0.64	(13)
66	5.33	(20)	5.59	(19)	1.84	(20)	-8.45	(18)	2.55	(21)	0.88	(21)	-4.05	(21)
64	13.90	(21)	3.59	(21)	2.75	(21)	-7.13	(16)	-3.08	(4)	-0.61	(5)	1.58	(12)
68	31.74	(22)	2.10	(22)	9.39	(22)	-10.34	(22)	-10.22	(1)	-3.02	(1)	3.33	(8)

Notes: Refer to Table A2 for service industry names attached to each NACE 2-digit number.
Source: WIOD, Amadeus, own calculations.

Table A4: Robustness of TPM-IV estimates I: Firm survival and firm-level employment growth

Trade cost indicators	(1) $\Delta ln\tau^{va}_{j,t-1} - Base$	(2) $\Delta ln\tau^{ebitda}_{j,t-1}$	(3) $\Delta ln\phi_{j,t-1}$	(4) $\Delta ln\tau^{va}_{j,t-1} - Prod.$	(5) $\Delta ln\tau^{va}_{j,t-1} - lnsize_{ij,t-1}$
Probit					
$\Delta Trade\ cost_{j,t-1}$	0.3244***	1.3812***	-0.1059***	0.2714***	0.3242***
	(0.031)	(0.128)	(0.020)	(0.035)	(0.035)
$\Delta Trade\ cost_{j,t-1} lnsize_{ijt}$	-0.3463***	-1.5459***	0.1221***	-0.3273***	-0.3037***
	(0.033)	(0.151)	(0.019)	(0.037)	(0.032)
$\Delta Trade\ cost_{j,t-1} lnprod_{ijt}$				-0.1352***	
				(0.029)	
OLS					
$\Delta Trade\ cost_{j,t-1}$	0.0406***	0.1629***	-0.0196***	0.0375***	0.0254***
	(0.006)	(0.026)	(0.005)	(0.007)	(0.006)
$\Delta Trade\ cost_{j,t-1} lnsize_{ijt}$	-0.0184***	-0.0780***	0.0116***	-0.0162***	-0.0160***
	(0.003)	(0.014)	(0.002)	(0.003)	(0.003)
$\Delta Trade\ cost_{j,t-1} lnprod_{ijt}$				-0.0041	
				(0.005)	
N	2,048,927	2,048,927	2,047,860	2,048,092	2,048,927

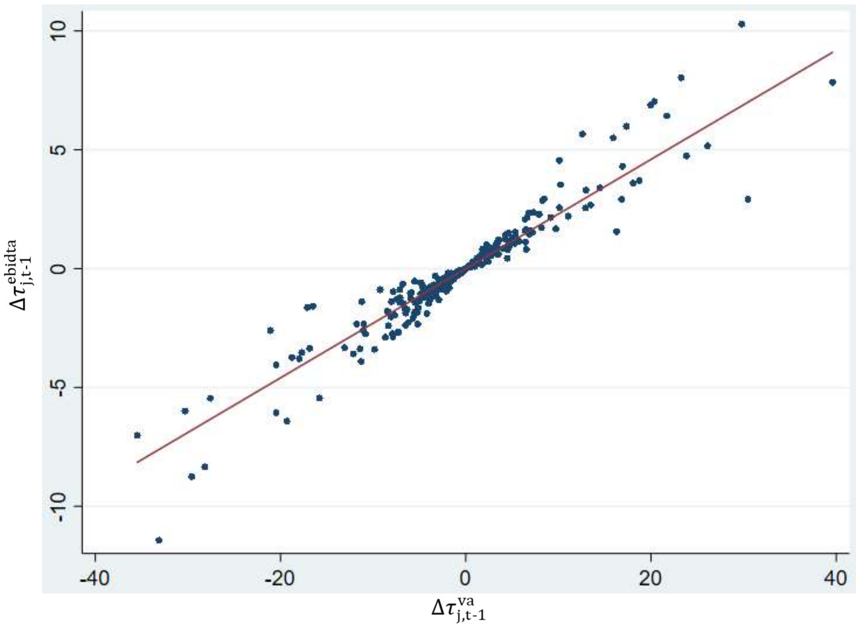
Notes: IV estimation by control function approach. Predicted trade costs from a regression of the trade cost variable on gravity variables are used as instruments. Bootstrapped standard errors in parenthesis. +, *, ** and *** indicate statistical significance at the 15%-, 10%-, 5%- and 1%-level, respectively. All regressions include regional-industry, regional-time as well as **firm-size class - year dummies**, industry level controls (industry level growth of total demand and productivity and sunk costs (in the probit model only), firm level controls (age, age squared, size, size squared) as well as interactions of size and age. The specification including firm productivity, additionally includes interactions of firm productivity and firm size.
Source: Own calculations.

Table A5: Robustness of GLM-IV estimates at the industry-region-year level: firm entry rates

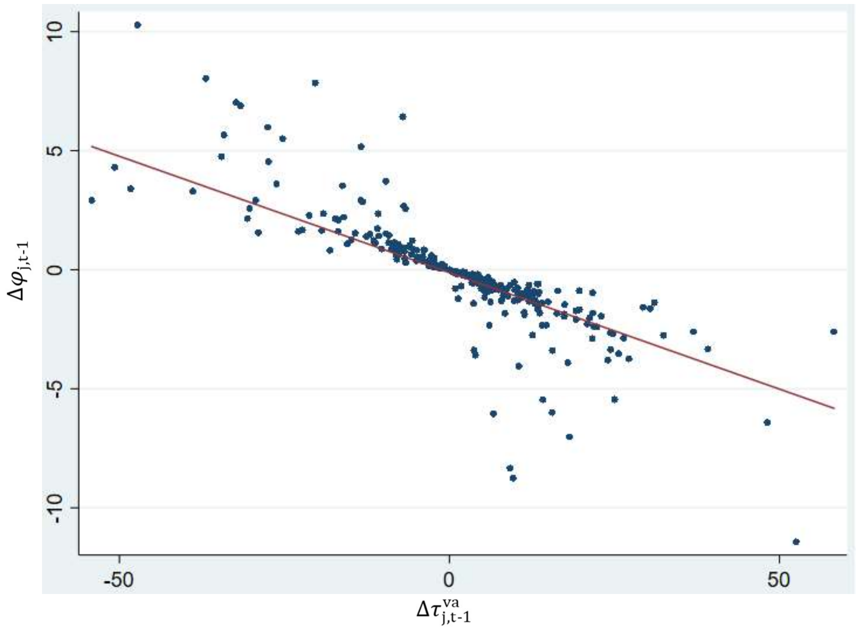
	(1) $\Delta ln\tau^{va}_{j,t-1}$	(2) $\Delta ln\tau^{ebitda}_{j,t-1}$	(3) $\Delta ln\phi_{j,t-1}$
$\Delta Trade\ cost_{j,t-1}$	-0.2363***	-0.7733***	0.1045***
	(0.056)	(0.203)	(0.032)
Market growth$_{jt}$	0.0038***	0.0038***	0.0038***
	(0.001)	(0.001)	(0.001)
Productivity growth$_{jt}$	0.0046***	0.0048***	0.0046***
	(0.001)	(0.001)	(0.001)
Log Size$_{jt}$	-0.4037***	-0.4086***	-0.4145***
	(0.073)	(0.074)	(0.074)
Log Age$_{jt}$	0.1797***	0.1788***	0.1800***
	(0.066)	(0.066)	(0.067)
$\overline{\Delta Trade\ cost}^{pr}_{j.}$	-0.4451***	-1.1725**	0.0969***
	(0.150)	(0.493)	(0.081)
N	2,498	2,498	2,498

Notes: IV estimation by control function approach throughout. Predicted trade costs from a regression of the trade cost variable on gravity variables are used as instruments. Robust standard errors in parenthesis. +, *, ** and *** indicate statistical significance at the 15%-, 10%-, 5%- and 1%-level, respectively.
Source: Own calculations.

Figure A1: Correlation among different trade cost indicators



Correlation coefficient: 0.9210; Spearman rank correlations: 0.9727



Correlation coefficient: -0.7441; Spearman rank correlations: -0.9367

Source: WIOD, Amadeus, own calculations.

Appendix B: Prediction of trade costs from an industry level gravity model

Following Frankel and Romer (1999), predicted trade costs serve as an instrument for observed trade costs and are generated by a PPML gravity regression of the bilateral trade costs $\tau^{va}_{jc,t}$ (Austria, with the 42 trading partners indexed by c) on standard gravity indicators. Specifically, gravity indicators comprise distance, contiguity, common language and landlockedness) interacted with industry dummies (based on aggregated NACE 2-digits as published in the WIOD) as well as industry and partner country fixed effects. Trade flows are collected from the WIOD, while the gravity variables are taken from the CEPII. The model is estimated for each year separately, to allow for changes in parameters over time.

Table A1 in Appendix A provides a detailed overview of the data used. The sample includes 22 service industries that match the level of disaggregation in the WIOD trade data, with 42 partner countries also listed in the WIOD database. To save space, the PPML-estimation results are not reported.

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