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A Land Far Away

Guenther Grohall, Yuri Yegorov

Abstract

What goods to export and where to sell them? Our research was pursuing these two major goals. The first one is related to detecting countries where Austria has good perspectives for boosting its export. The basic idea was to use macroeconomic data set detecting the significant variables. We found that besides the GDP of importer and distance, there are more important variables like being landlocked, language, inflation, and so forth. We found recent GDP growth rate to be non-significant in more than just the very basic models. Taking all explanatory variables into account we could calculate the country-effects, telling us how Austrian exporters are under or over-represented within each country. It is argued that exporters could put additional efforts into quickly growing countries where Austria is still under-represented.
The second goal was a more detailed view on the role of transport costs. Gravity model was shown to be correct and robust (even for a class of functions of distance). The detailed accounting for transport costs requires consideration of different transport modes and ratios of value to weight. Distance suppresses trade of cheap goods most, suggesting that Austria has no disadvantage in export of high-tech goods (like pharmaceutics and complex machines) over long distances. In particular, pharmaceutical sector has growing potential and trade with Russia is one of its perspectives.

JEL-Codes: F14, L90, R40
Keywords: International Trade, Gravity Model, Transport Cost, Growth, Advantage

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November 10, 2010

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What goods to export and where to sell them? Our research was pursuing these two major goals. The first one is related to detecting countries where Austria has good perspectives for boosting its export. The basic idea was to use macroeconomic data set detecting the significant variables. We found that besides the GDP of importer and distance, there are more important variables like being landlocked, language, inflation, and so forth. We found recent GDP growth rate to be non-significant in more than just the very basic models. Taking all explanatory variables into account we could calculate the country-effects, telling us how Austrian exporters are under- or over-represented within each country. It is argued that exporters could put additional efforts into quickly growing countries where Austria is still under-represented.

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A Land Far Away

Part I: Austrian Trade Potential with Distant Booming Countries

1 Introduction to the 1^{st} Part and Motivation

1.1 Introduction

This study tries to find interesting export locations for Austrian companies from the GDP-growth point of view: exports go to high-GDP countries, but quickly growing countries are very rewarding too as the market increases on its own. Thus growth can be imported as Felbermayr and Kohler [2006] write. Thus first it is tried to find the main factors behind Austrian exports by a standard gravity model, calculated by a Tobit estimation. Latter can deal with cut-off values, which is useful as there are several zero-entries in export data.

Taking the identified factors into account it is possible to calculate how well Austrian exporters do in each country. Especially those countries where exports are substantially below their expected values are interesting as there might be undetected export potential. In a last step these potentials are connected with the countries' average growth rates over the last years. The result is a list of states where on the one hand Austrian exports are particularly low – after controlling for a wide range of influences – and on the other hand GDP growth is high. This list understands itself as a set of promising candidates for closer inspection as only the most important quantitative data can be used in such a study.

The gravity equation was boosted by a number of interesting ideas and results in the last years. A sound theoretical foundation on a general equilibrium model using CES-utility was introduced by Anderson and van Wincoop [2003]. With this model they could also solve the "border puzzle" stating that borders are far too important in standard gravity models when intra- and international trade data is used.

Intensive and extensive margins of trade are the main topic in Felbermayr and Kohler [2006]. They differentiated between already established trade connections between two countries where trading volume can be increased and establishing trade connections between countries which did not trade yet. Thus they could solve the "distance puzzle": standard gravity equations suggest that distance's influence on trade over time increases instead of decreases. This would mean that there is nothing like globalisation in trade. Discriminating intensive and extensive trade margins leads to the by far more credible opposite result of a diminishing effect of distance. As Austria has established trade with almost all countries in the world, this differentiation is neglected in the study presented here. But Felbermayr and Kohler [2006] also use Tobit estimations to handle zero-entries. This method is adopted here too.

As exports are not performed by states and countries but by firms, Helpman et al. [2008] develop a model on company level taking into account that firms select themselves to be exporters. They develop a method how to do this without actual firm data and also distinguish between the intensive and the extensive margin. Latter is necessary as the share of zero-entries on industry level is even higher than on country level.

The paper of Chen and Novy [2010] takes gravity in the spirit of Anderson and van Wincoop [2003] to sectors and analyses trade integration across industries. They found that the most important trade barriers are high transportation costs of heavy-weight goods, Technical Barriers to Trade such as norms, regulations, and standards, as well as intransparent public procurement.

1.2 Motivation

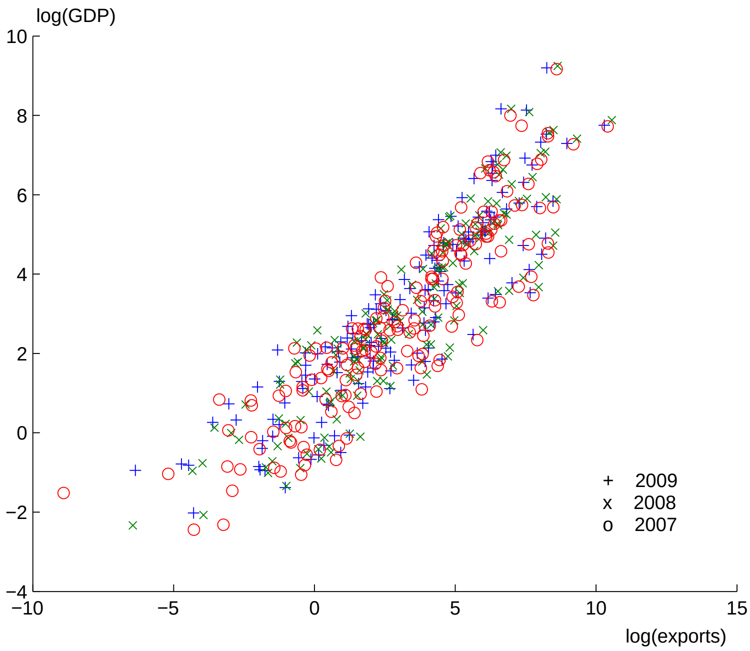
Austrian exports provided strong background for the country's economy during most of the last decade. Exports to the used sample of 174 countries rose from 77 bn € in 2000 to 125 bn € in 2008 (but fell to 92 bn in 2009 during the crisis). This is a growth of more than 6.2% every year for eight years – an impressive achievement.

Austria's main export partners are Germany and Italy. They alone bought goods and services worth nearly 50 bn € in 2008. The United States, Switzerland, the Czech Republic, France, Hungary, and the United Kingdom follow with volumes from around 6 bn € to 4 bn €. As one can see, these states are either economically powerful, or geographically close, or both.

Figure 1 shows the relation between exports and GDP, both in logs, during the last three years. There is a strong, near-linear relationship resulting in a correlation coefficient of nearly exactly 0.90 in those three years. Only at the ends this relation seems to wear off a little, since the point cloud there is bent in a convex fashion. Stated differently, when GDP is already high, additional GDP does not affect exports as much as for poorer countries. However, this figure is a powerful hint towards the gravity-model, asking for

GDP as one of the main variables.

Figure 1: Austrian exports aim at high-GDP countries.



Source: CEPII, IMF

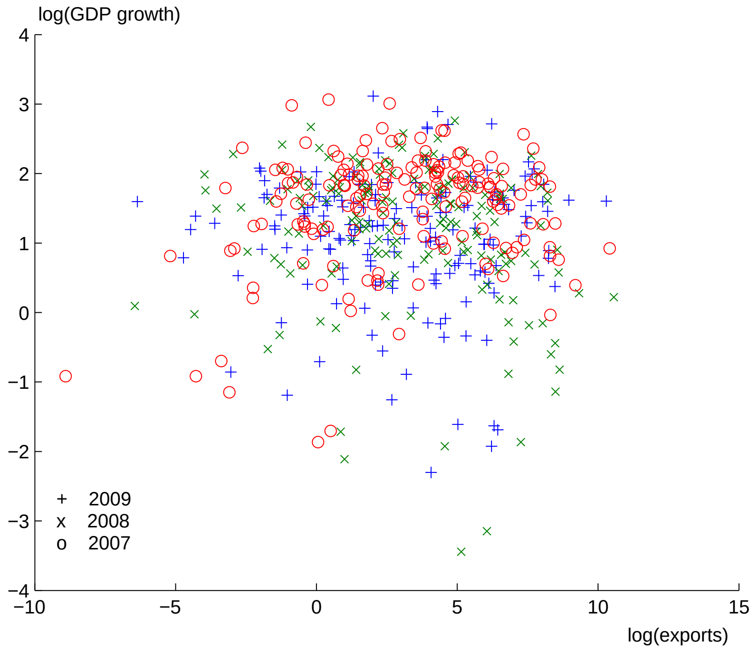
One can also see that the point cloud itself has a stable shape as the markers for all three years are evenly distributed with no bulks being visible for any one year. In the sparse areas of the graph, one can also distinguish the three entries for one country. Thus, not only the cloud's shape, but also a country's position within this cloud is constant.

This constant position relative to the cloud hints towards a high auto-correlation within the export time-series. In fact, more than half of the first-order autocorrelation values are larger than 0.47 with the average value being around 0.39 due to the skewed distribution. This high autocorrelation has the important consequence that exports to a certain country will, once they are established, remain approximately constant.

This in turn allows the exporting country to participate on the foreign country's economic growth. Plotting Austria's exports against the partner countries' growth rates leads to Figure 2. The point cloud in this case, however, reveals no relation between the two variables. Moving along the x-axis does not imply a change on the y-axis – which is confirmed by clearly insignificant correlation coefficients.

Now one could argue that this is a sign of well diversified exports. If one would like to participate on world's economic growth, exports must be distributed evenly, resulting in the pattern of Figure 2. To analyse that, world economic growth was calculated as the GDP-weighted average of all countries in the sample. The blue line in Figure 3 marked by "+" plots these world growth-rates over the last 10 years. If Austrian exports are used as weights, the red line marked by "o" appears. This is, with the exceptions of 2001 and 2006, always below world's real economic growth. The difference is on average 0.51 percent points or 5.1 percent points aggregated over the 10 years. Thus although export partners grow faster than Austria there is still room to improve.

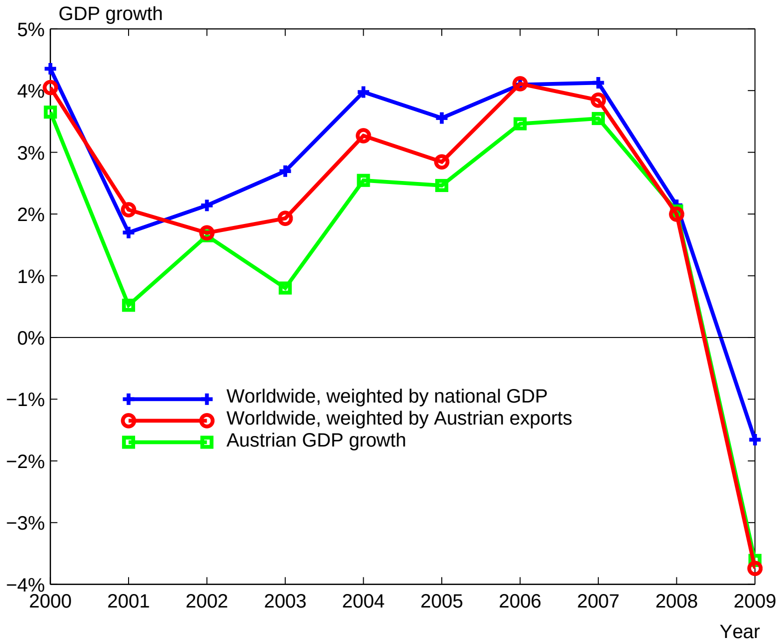
Figure 2: Austrian Exports against the partner countries' growth rates.



Source: DoT, IMF

A legitimate question is the one for alternatives. As Figure 3 shows, even GDP-weighted economic growth as a proxy for world growth is negative in 2009, although it is better than Austria and its export partners. But are there countries which still grow? The answer is given in Figure 4 and it is clear: yes, there are many countries showing positive growth rates, even during 2009 (blue line with "+"). This figure shows the unweighted histograms of the sample's growth rates over the last ten years. Years before 2007 are in different shades of grey, become lighter the older they are. The last three years are bold, coloured lines.

Figure 3: World wide GDP growth as GDP-weighted average, export-weighted average and Austrian GDP growth.



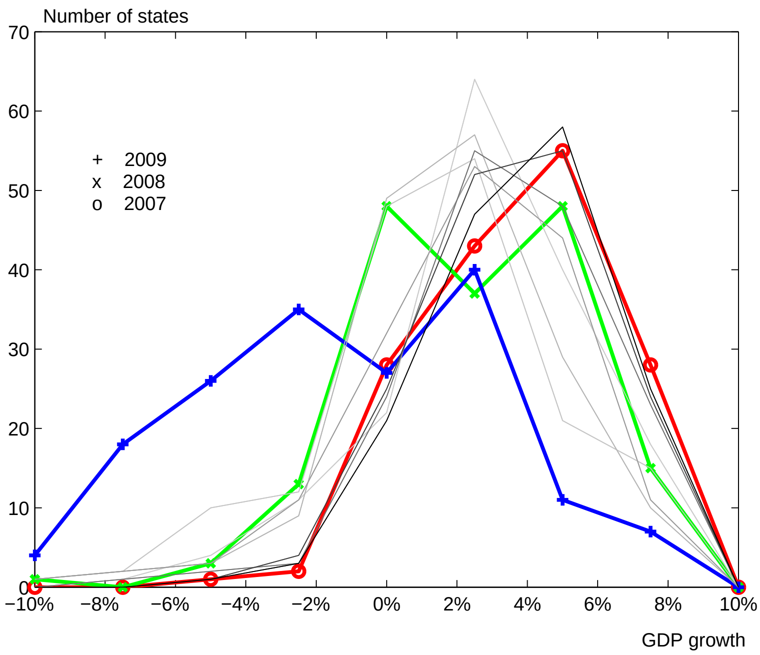
Source: DoT, IMF

Apart from the fact the there are still growing economies, Figure 4 shows different, interesting aspects. Firstly, the mode of the histogram is at 2.5%, the value where it was during many earlier years. But there is a second peak at -2.5%. This bimodal distribution is already visible in 2008, but in 2009 the two modes are 5 percent points lower.

In contrast to 2008, the low-growth group of states does not disappear quickly when growth rates are lowered: the second bulk has substantial height even at -7.5% where the curves before were more or less zero. Whether the formation of the two peaks in 2008 is already a first effect of the crisis and whether the countries forming the two peaks are the same in both years or how they moved between them would be a very interesting study, but is unfortunately out of scope here.

The main information of Figure 4 is that even in 2009 there were growing countries: these were 86 growing countries, 49 with more than 3% and 34 with more than 4% of GDP growth. The strongest performers with more than 7% were Afghanistan, Ethiopia, Azerbaijan, Qatar, Lebanon, China, Uzbekistan, Malawi, Laos, Republic of Congo, and Uganda. These countries are either poor and/or far away and the obvious question is: is exporting there worth the effort? This study first tries to find out which factors affect Austrian exports. Then it will also research how well Austrian companies do given all these factors. In other words: taking everything into account, is there potential for Austrian exporters in booming countries? If yes, what countries are most promising?

Figure 4: Histograms of GDP growth rates of the last 10 years. Years before 2007 are grey, being lighter the older they are.



Source: IMF

2 Data

2.1 Country Data

A wide collection of different country-data were used. Some of them change as time goes by (as GDP or membership in free-trade zones), some are constant or at least treated as constant (as distances or spoken languages).

Years 2000 to 2009 are covered, where the youngest data are of course often estimates.

The following list names used data and its sources. Sources of trade-zone memberships are their respective web pages. I would like to thank Tobias Renkin and Felix Schirnhofer for their most valuable help in finding and sorting data!

- Was the country an ASEAN-member in the respective year?
- Is the country landlocked?
  Source: CEPII,
  `http://www.cepii.fr/anglaisgraph/bdd/distances.htm`
- Was the country a CACM-member in the respective year?
- Was the country a CARICOM-member in the respective year?
- Distances between countries, measured as the distances between the biggest cities, or between the capitals. Country-internal distances as a measure of country size is available too.
  Source,
  CEPII, `http://www.cepii.fr/anglaisgraph/bdd/distances.htm`
- Was the country an EFTA-member in the respective year?
- Was the country an EU-member in the respective year?
- Was the country a member of the Euro-Zone in the respective year?
- Was the country an EEA-member in the respective year?
- Austrian Exports in mil. Euro. Source: Direction of Trade Statistics, accessed via the FIW-database.
- Exchange rates between Austrian currency and foreign currency. Source: IFS database, accessed via the FIW-database.
- GDP in Euro. Source: IMF World Economic Outlook, April 2010.
- GDP per capita in Euro. Source: IMF World Economic Outlook, April 2010.
- GDP growth in real terms. Source: IMF World Economic Outlook, April 2010.

- Inflation according to GDP deflator. Source: IMF World Economic Outlook, April 2010.
- Location: Africa, America, Asia, Pacific, Europe as reference.
  Source CEPII,
  `http://www.cepii.fr/anglaisgraph/bdd/distances.htm`
- German, English, French, and Italian being official languages.
  Source CEPII,
  `http://www.cepii.fr/anglaisgraph/bdd/distances.htm`
- German, English, French, and Italian are spoken by at least 20% of the population.
  Source CEPII,
  `http://www.cepii.fr/anglaisgraph/bdd/distances.htm`
- German, English, French, and Italian are spoken by at least 9% of the population.
  Source CEPII,
  `http://www.cepii.fr/anglaisgraph/bdd/distances.htm`
- Was the country a MERCOSUR-member in the respective year?
- Was the country a neighbour to Austria?
  Source: CEPII,
  `http://www.cepii.fr/anglaisgraph/bdd/distances.htm`
- Was the country a NAFTA-member in the respective year?
- Were there armed unrests or conflicts in this country within this year?
  Source: CIA-factbook,
  `https://www.cia.gov/library/publications/the-world-factbook/`
- Escalation of unrests and conflicts (1=violent demonstrations, 2=coup d'etats, 3=violent coup d'etats, 4=regional rebellion, 5=countrywide rebellion/civil war, war)).
  Source: CIA-factbook,
  `https://www.cia.gov/library/publications/the-world-factbook/`
  as well as numerous news services.
- Country's population. Source: IMF World Economic Outlook, April 2010.

2.2 On Exports

There are two significant differences between import an export data. Firstly, exports are counted as fob, imports as cif. Thus export values reflect the real volume much closer, since imports are increased by an unknown amount of freight and insurance costs. Secondly, import data are in large terms more reliable, since countries raise tariffs on imports. Therefore there is a trade-off between availability and reliability on the one hand and unbiasedness on the other.

Fortunately data on Austrian exports are very detailed and in fact only a small number of zero-entries are reported. Within the 10 years and 174 countries observed, only 32 zero-entries show up. This number is very small compared to the numbers in Felbermayr and Kohler [2006] who report significant gaps between the possible number of international trade relations and those being used. Even in 1997, only 58% of all possible bilateral combinations of countries worldwide showed non-zero trading volumes.

The first five years of Serbia are partly missing and were removed from estimations. The smallest non-zero export reported were 135 € to Tonga in 2007. As Austrian export data is very reliable, it was used for calculations without the aforementioned problems arising. Zero entries were assumed really to be zero and not placeholders for unavailable numbers.

2.3 Countries

In principle this study uses data from all countries existing from 2000 to 2009. For a small number of countries data was limited so much that they could not be included. Others were unavailable for political reasons – the most striking example is Taiwan which is not in the electronic version of the Direction of Trade database. Thus not all countries were included, but the used sample of 174 covers most of Austrian trade partners. See the Appendix for a full list of used partner countries.

3 The Model

3.1 Methods

3.1.1 Two Way Error Correction

The idea of a panel estimation is very well explained in Baltagi [1995] and should only be briefly repeated here.

A panel is a matrix-shaped data set with time along one dimension and entities along the other. In standard economics entities are countries, regions, or economic sectors. Thus one can follow the development of several of these entities over time. In the case here entities are Austrian exports to 174 countries – thus one speaks of a "fixed effects" panel – , the time frame are the years 2000 to 2009.

One big advantage of such a model set-up is that it can estimate effects which usually remain in the residuals. Take as an example exports to Belgium in a one-year estimation. Imagine now that the residual of Belgium is particularly low. Given the one-year data, we must accept that exports to Belgium are below average for some unknown reason. If we switch to panel data, we can first estimate the time effect. If, everything else considered, trade volume is high in one year, it is reasonable to assume "a good year" for world trade. These fluctuations are called the time effect.[1]

Secondly, one can estimate Belgium's "average residual" over the years already reduced by the time effect. This average deviation would be Belgium's country effect. This country effect is a pool for the country's properties which cannot be modelled, like management abilities, natural disasters, personal taste, and so on.

A standard problem of panel estimation of the gravity model are collinearities in time-invariant variables. *E.g.* distance to and language of a country are constant over time, thus there is no way to separate their influences using standard OLS methods. A method proposed by Cheng and Wall [2004] which was successfully applied by Bussière et al. [2005] and Felderer et al. [2008]. The idea is to first estimate a dynamic equation with time-varying variables only. This would be (1), where A_{it} are Austrian exports to country i at time t, γ_d being the intercept, X_{it} the time-varying regressors (GDP, inflation, *etc.*), Z_t the year-dummies, L_i the country-dummies, and u_{it} being the residuals. The coefficient vectors β, ζ, and c thus capture the effects of time-varying regressors, time itself and the country.

$$A_{it} = \gamma_d + X_{it}\beta + Z_t\zeta + L_i c + u_{it} \qquad i = 1, \dots, N \quad t = 1, \dots, T \tag{1}$$

$$c = \gamma_s + K_i\kappa + \lambda_i \tag{2}$$

The N country-effects within c are then explained in the static equation (2) by another intercept γ_s, regressors being constant over time K_i, and the remaining residuals λ_i. The vector κ is to be interpreted as the coefficients of

[1] All effects are of course calculated parallel to each other in the linear regression estimation. Talking of "first" or "then" is not precise, but should guide the reader. All effects are always calculated for everything else being held constant.

time-invariant regressors. Thus by taking the way along the second equation, one can estimate the effects of the otherwise collinear variables.

The interpretation of λ is not that of a mere residual. As the N values stored in there are country-specific (one residual for each country), but cannot be attributed to any country-related variable, λ are the remaining country effects! In contrast to c, λ is adjusted for effects like distance, language, culture, being land locked, and so on. It is therefore a much more precise estimate and will be used in this study to quantify country effects.

3.1.2 Tobit Estimation

One of the problems of estimating trade is that there is nothing like negative trade. Just by looking at the numbers, we cannot tell whether two countries are just marginally below the threshold of trading or whether they are far from establishing any trade-relations (*e.g.* two bitter, long-time enemies). As Felbermayr and Kohler [2006] report substantial numbers of zero-entries in the international trade matrix (in 1950 only 52% reported strictly positive trade, in 1997 it were 58%) it must be assumed that both such extremes exist as well as many cases in-between. Things look better for Austria where only 32 zero entries were found in the 174 possible trading partners from 2000 to 2009, but the question remains: what to do with these 32 entries?

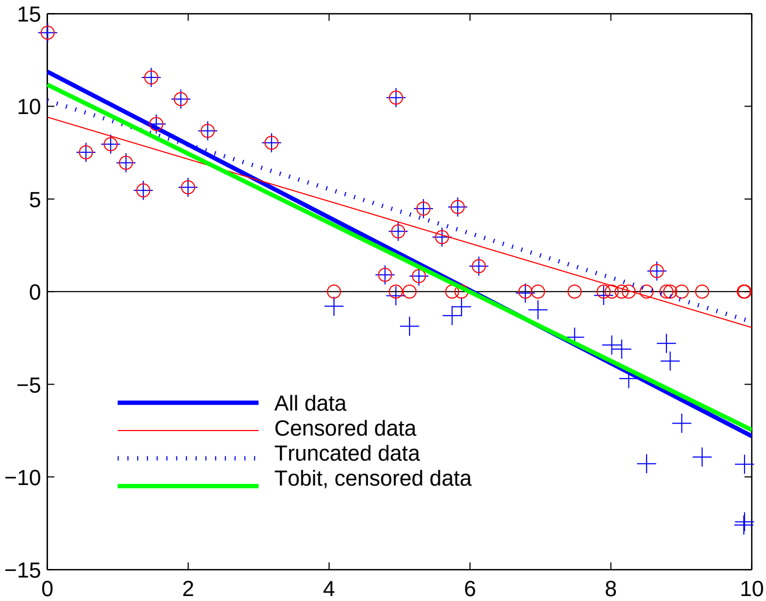
The problem is visualised by Figure 5 where blue "+" depict real, but unobservable data. As we are only able to measure y-values larger or equal to zero, red circles represent these censored values. The thick blue is the regression line using all real data. But as several data points are fixed to zero, how to proceed?

There are two naive answers: firstly, one could keep zero-entries as they are, which assumes that the data generating process really produces zeroes there. Using these censored data results in the thin red regression line, which clearly differs from the original line. Secondly, one can also remove all zero-entries from the data set. Thus one would avoid using these censored data points, but as before one would have a systematic bias (see among others Bierens [2004] for properties of linear regression with censored and truncated data). The thin, dotted, blue line represents the result of this truncation of data.

Tobit estimations, named after their inventor James Tobin, are a maximum likelihood estimation for the coefficients α and β in

$$y_i^* = \alpha + X_i\beta + \epsilon_i \tag{3}$$

Figure 5: Effects of censoring and truncation on regressions.



Source: own numbers and calculations

subject to standard linear regression restrictions and

$$y_i = \begin{cases} y_i^* & \text{if } y_i^* > 0 \\ 0 & \text{otherwise} \end{cases} \tag{4}$$

where only the values of y_i can be observed. Solutions to this model take into account that each $y_i = 0$ has a certain probability of hitting the lower limit which depends on the value of x_i. Tobit estimations try to find these coefficients, which on the one hand explain the "standard OLS-part" best, while on the other hand also give values to y_i^* such that they hit the limit with probabilities according to those in the observed data.

Tobit estimations have been expanded in such a way that the limit can be chosen freely (as in Carson and Sun [2007]). Extensions to upper (instead of or in addition to lower) limits were done (see Rosett and Nelson [1975]) as well as estimations where the limits are unknown (see Zuehlke [2003]).

Figure 5 shows the Tobit-estimation of the censored red circles as thick green line which is very close to the original thick blue line resulting from the blue crosses.

3.1.3 Gravity Models

Gravity models are well established working horses of empirical economics. They have been in used since 1960 (see Savage and Deutsch [1960]) to estimate the impact of distance and other variables on trade according to Newton's formula of gravity:

$$F_{jk} = q \cdot \frac{M_j \cdot M_k}{D_{jk}^{\rho}} \tag{5}$$

The economic interpretation is that of F_{jk} being trade-volume between countries j and k, M_j being the GDP of country j, D_{jk} being the distance between the countries and ρ describing the weakening-power distance has on trade. To be able to estimate this equation, one has to take logs, arriving at

$$\log F_{jk} = \log q + \log M_j + \log M_k - \rho \cdot \log D_{jk}, \tag{6}$$

which can be expanded by many additional geo-political, economic, cultural, or other variables as regressors as is done below.

The remaining problem is that although Tobit estimations can deal with zero-entries, the logarithm on the left hand side of (6) cannot. Thus a very small amount δ was added to each export-value to allow estimation of (6) with all data points. The Tobit estimation was then performed with a lower limit of $\ln(0 + \delta)$. Thus those export streams which are originally zero still enter the Tobit estimation as censored although they were increased and logarthmised.

3.2 The Regression

3.2.1 Chosen Variables

A series of regressions was calculated to find the smallest set of independent variables explaining most of the data's variation. Thus one tries to find an optimal balance between model complexity and explanation power. The often used approach of using only significant regressors was not used here, since the result is not the set of regressors but the best possible country effects which are analysed further afterwards. However, regressors with very high p-values were rejected.

As the dependent variable is logged, the coefficients of all logged regressors are interpreted as elasticities.

The first variable are the logged values of Austria's and the respective partner country's **GDP** in the respective year. Since it is an elasticity, a 1% increase in GDP of Austria and the partner country lead to an expected increase of exports of 0.87%. This value reflects the close relation between

Table 1: Regressors, their status as logged variable, their coefficients, and p-values. $R^2 = 0.976$.

	Log	Coeff.	p-Value
GDP Austria + Partner	*	0.87	0.00
Distance	*	-1.24	0.00
Inflation	*	-0.0251	0.05
High GDP		0.66	0.00
EU		0.10	0.33
Population		0.0046	0.15
Landlocked		-0.34	0.04
20% speak English		0.21	0.16
High Distance		0.51	0.01
Unrest / War		-0.10	0.05

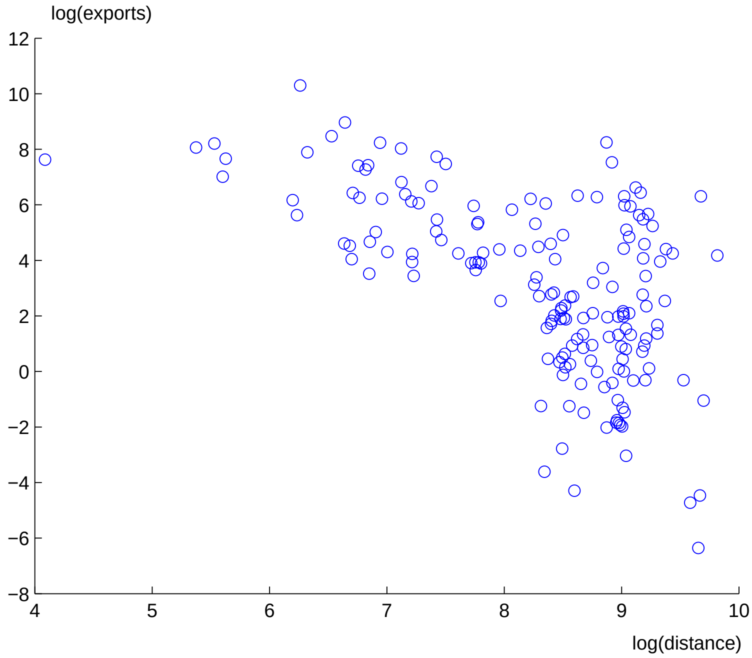
GDP and exports as can be seen in Figure 1. To avoid endogeneity problems (exports are part of the GDP), GDP of year $t+1$ was used to explain exports of year t.

The second standard variable in gravity models is **distance**. Here it is measured as the great-circle distance between the capital cities. Other measures like distances between the most important cities were tried as well, but differences in the results were minimal. The coefficient has to be interpreted in such a way that doubling the distance leads to a decline of expected exports to $(100\% \cdot 2^{-1.24}) = 42.3\%$.

Figure 6 shows a scatter plot of logged distances against logged exports, where exports were increased slightly to be able to display zero-entries too. One can see the clear relation between the two variables, but at x-values higher than about 8, additional factors seem to play increasingly important roles. This translates to distances above around 3,000 kilometres which equals the distance to Iceland, the Sahara, or Iran. It seems to be intuitive that beyond this circle many factors come into play which do not exist in Europe.

If **inflation** increases by one percent, exports are reduced by 0.025%. Pay attention not to mix up inflation's unit with the regressor's unit – as both are measured in percent! If *e.g.* one country's inflation equals 2% and another country's 3%, they differ by one percent point only, but by 50% of the lower value leading to export being lower by on average $-0.025 \cdot 50\% = 1.25\%$. Inflation thus is not particularly important within developed countries, but can become a prohibitive obstacle if it increases too much.

Figure 6: Log of distance against log exports in 2009.



Source: DoT, CEPII

High GDP is a correction variable for countries which are economically strong. It is calculated for every year and depends on unweighted worldwide GDP. In the years 2007 to 2009 it can be found in Figure 1 around 3.6, reflecting a GDP of around 35 bn €, which approximately 39% of the countries exceed.

EU-membership is the only trade-zone regressor which turned out to be at least suggestive, although it is far from significant. It remained in the regression as it can be assumed that EU-membership does play a role even though it is not identified as significant by the regression. Thus it is included for theoretical reasons, not due to data-driven arguments. The coefficient suggests an average additional $e^{0.10} - 1 = 10.5\%$ of exports when trading with an EU-partner.

Countries with high population tend to have high levels of GDP. In addition to that they also get a positive coefficient for **population** in this regression in such a way that for every million inhabitants, exports rise by $e^{0.0046} - 1 = 0.46\%$. Given that Germany has some 80 million inhabitants, this would lead to an extra 37% – a substantial amount. A possible explanation may be that not just a country's economic power attracts exports, but also the number of possible customers.

As this study does not discriminate between goods and services transportation costs for goods should play an average role. Although trucks, trains, and even planes can be used to transport certain amounts of goods over short to medium distances, ships are the only means of mass-product long-distance transportation. Being a **landlocked** partner country therefore hampers trade, even though Austria itself is landlocked too. The coefficient of -0.39 is translated into a substantial decrease to 67.5%.

The last chosen variable is the indication that 20% of a country's population speak **English**. Italian, French, and German are always insignificant (not that German speaking countries are also neighbours to Austria and are thus covered by this variable), official languages are so too. If more than 20% speak English, exports are boosted to $e^{0.23} = 1.26$ times the normal value. Again, companies engaging in international trade might place themselves in these countries.

It turned out that **high distances** are of importance too in such a way that above 9,000 kilometres the standard gravity-approach is no longer valid. It seems to be irrelevant whether a country is 9,000 or 13,000 kilometres away. Thus these countries get a "bonus" cancelling the negative effect of additional distance.

Armed **conflicts** and wars are astonishingly little significant, but one must not forget that wars usually go hand in hand with low GDP and high inflation. Coding of the variable is also not easy, as it is hard to find a linear scheme (are wars only five times worse than violent demonstrations?) and using distinctive dummy variables for each type of conflict (dummies for demonstrations and wars) yields insignificant results. Even more, the pace of forgetting about conflicts when profits are likely is a delicate question – thus it is not clear for how long past conflicts are obstacles for exports. In this study it turned out that the five-step scale which does not wear off over time seems most appropriate. The first step does not cause a lot of damage, reducing exports to around 92%, but a war, even with all other things equal, decreases exports to 66%.

3.2.2 Unimportant Variables

GDP growth is rejected in all variations of regressors. This can be expected after analysing Figure 2 where no relation between growth and exports is visible. This also supports the findings of the other major part of this study. An exception are some models with only the most basic regressors (no inflation, no EU-membership, no languages) where the moving average of growth over the last three years becomes significant. However, GDP's importance is reduced, the models explain only little of the variances and growth's coefficient is tiny: an average increase of growth of 1 percent point over three years increases exports by 1.88%. As several important regressors have to be omitted to get to this result and GDP's role seems to be negatively affected, it is possible that this moving average of growth is just a proxy for these variables and not a real cause of additional exports. The relation between exports and growth, this study's main focus, is thus at best very small and well hidden.

Neighbour states receive a positive coefficient, but it is strikingly insignificant. This may have to do with the small number of neighbour states to Austria as well as with most of them being EU-members and having their capitals close to Vienna.

One of the most striking results is that **membership** of any trade zone apart from the EU is insignificant. This could partly be expected as most of them aim at improving trade internally. Opening the whole trading zone to foreign trade seems to be a minor aspect.

GDP per capita may replace GDP, but explanatory power is much lower. Having GDP per capita and population in a logarithmised equation is as good as using GDP.

All **languages apart from English** are irrelevant on a worldwide scale. This might be different when the whole foreign-trade matrix is evaluated, and *e.g.* trade relation within the Spanish-speaking world are important. But in this case here, Austria is the only exporter and German has no substantial international importance.

Volatility of the exchange rate remains insignificant in almost all models. This is reasonable as most of Austria's important export partners use the Euro as currency in the observed period. There is also a highly significant correlation (r=0.21, p=0.008) between the logs of GDP and volatility of the exchange rate such that part of the information is captured by GDP.

3.3 Trade Potential

The researched question is whether there are quickly growing countries in which Austrian exporters are under-represented. The regression told us what variables explain Austrian exports. Its residuals, the country effects, are those values which cannot be explained by the variables in use. Positive country effects thus indicate exports above the expectation taking all information within the regression into account. *E.g.* South Africa has a country effect of $\lambda_{RSA} + 1.65$, which is substantially above what was expected (the country effects' standard deviation equals 0.94) considering all variables used in the regression.

The highest and lowest country effects are given in Table 2. It shows that, given all information in the variables, Austrian exporters are best established in Hong Kong, Bhutan, Mongolia, and South Africa, while in Equatorial Guinea, China, and India they could perform much better. However, the example of Bhutan shows that due to the multiplicative nature of the gravity model, small countries may be outliers if just a single exporter is interested and successfully establishes a trading connection. On the other hand, India and China are outliers due to their enormous size and other country-specific reasons.

Table 2: Highest and lowest country effects and mean GDP growth 2006 to 2008. High country effects indicate exports above expectations.

Country	Country Effect	Mean growth 06-08
Hong Kong SAR	1.99	5.18 %
Bhutan	1.80	10.34 %
Mongolia	1.73	9.23 %
South Africa	1.65	4.92 %
Maldives	1.64	10.49 %
Singapore	1.38	6.10 %
Guinea	1.37	3.06 %
Liberia	1.37	8.12 %
Belize	1.37	3.21 %
Djibouti	1.34	5.24 %
...	...	...
Lao People's Democratic Republic	-1.13	8.09 %
Brunei Darussalam	-1.28	0.87 %
Democratic Republic of Congo	-1.31	5.97 %
Slovak Republic	-1.32	8.42 %
Cameroon	-1.61	3.12 %
Burkina Faso	-1.72	4.75 %
Papua New Guinea	-1.78	5.37 %
Equatorial Guinea	-2.74	11.13 %
China	-5.11	11.39 %
India	-5.25	8.85 %

Thus we now know in which countries Austria's exporters are under-represented. But does it really pay off to export there? Table 2 also shows the mean yearly growth from 2006 to 2008 already giving some strong hints by visually inspecting the results.

Figure 7: Country effects and mean growth rates 06-08. Countries above the red curve grow quickly and show highest trade potential.

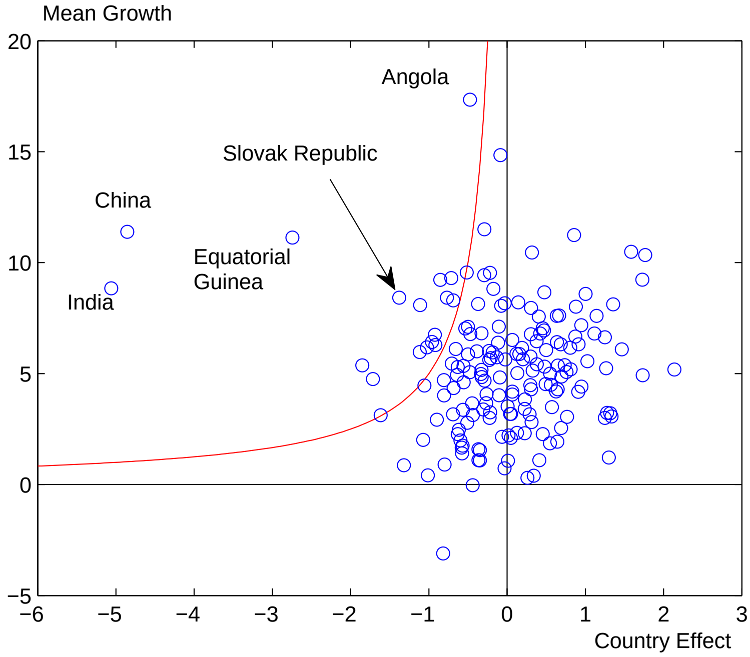


Figure 7 shows a scatter plot of the country effect on the x-axis against mean growth from 2006 to 2008 on the y-axis. Countries in the upper left corner grow quickly and are identified as having high trade potential by having large negative country effects. A mathematical way of identifying those countries which are closest to the upper left corner is to multiply the country effect λ_i by mean growth $\bar{g}_i$ to get the export-attractiveness E_i of each country, $E_i = \lambda_i \cdot \bar{g}_i$. The red curve connects all points where $E = 5$, countries above (or left) of it are thus interesting potential trading partners. As Austria has a mean growth of around 3%, one could shift the curve upwards by this amount; an exponential function intersecting with the y-axis and thus selecting countries with positive country effects too is another interesting possibility. However, all such methods are just rules of thumb only pointing at a set of countries which are to be analysed closer. Neither does an inclusion indicate any kind of a success-guarantee, nor are excluded countries automatically irrelevant.

Table 3 lists the the 45 countries having highest export attractiveness. The most outstanding country apart from India and China is Equatorial

Table 3: The first 45 countries sorted by export attractiveness E_i.

Country	Country Effect	Mean growth 06-08	E_i
China	-5.11	11.39 %	-58.19
India	-5.25	8.85 %	-46.42
Equatorial Guinea	-2.74	11.13 %	-30.52
Angola	-0.67	17.34 %	-11.66
Slovak Republic	-1.32	8.42 %	-11.10
Papua New Guinea	-1.78	5.37 %	-9.57
Lao People's Democratic Republic	-1.13	8.09 %	-9.17
Burkina Faso	-1.72	4.75 %	-8.15
Democratic Republic of Congo	-1.31	5.97 %	-7.84
Cambodia	-0.81	9.23 %	-7.52
Uganda	-0.73	9.30 %	-6.79
Rwanda	-0.79	8.42 %	-6.69
Niger	-1.04	6.18 %	-6.44
Bangladesh	-0.96	6.29 %	-6.04
Vanuatu	-0.83	6.75 %	-5.61
Albania	-0.86	6.43 %	-5.50
Belarus	-0.53	9.56 %	-5.05
Cameroon	-1.61	3.12 %	-5.02
Solomon Islands	-0.58	8.30 %	-4.81
Lesotho	-1.05	4.47 %	-4.67
Egypt	-0.57	7.03 %	-3.99
Madagascar	-0.60	6.11 %	-3.66
Ethiopia	-0.32	11.50 %	-3.66
Tunisia	-0.67	5.45 %	-3.65
Guyana	-0.76	4.71 %	-3.58
Tanzania	-0.47	7.11 %	-3.32
Nepal	-0.80	4.02 %	-3.23
Morocco	-0.59	5.35 %	-3.16
Kenya	-0.63	4.94 %	-3.14
Dominican Republic	-0.38	8.13 %	-3.12
Botswana	-0.72	4.35 %	-3.12
Namibia	-0.58	5.30 %	-3.09
Brazil	-0.60	5.06 %	-3.06
Mozambique	-0.42	6.78 %	-2.85
Pakistan	-0.62	4.61 %	-2.85
Libya	-0.48	5.87 %	-2.84
Swaziland	-0.90	2.93 %	-2.64
Sudan	-0.27	9.43 %	-2.59
Poland	-0.42	6.01 %	-2.52
Central African Republic	-0.70	3.17 %	-2.22
Myanmar	-0.21	9.54 %	-2.02
Guinea-Bissau	-1.00	2.01 %	-2.02
Lithuania	-0.29	6.82 %	-1.96
Peru	-0.22	8.82 %	-1.94
Indonesia	-0.29	5.95 %	-1.71

Guinea which already shows the method's strengths and weaknesses. Exports to this country reached their all-time-high in 2009 with a mere 2.7 mio €. Mean GDP growth from 2006 to 2008 was more than 11% – which is comparatively low in relation to the mean growth from 2000 to 2009 of more than 21%. Thus the country's economy grew quickly for at least a decade and reached a GDP of 8.5 bn € (12.2 bn $) in 2009. The method was developed for finding exactly such booming countries which are under-represented as Austrian export partners.

However, calculating Equatorial Guinea's GDP per capita is more problematic and reaches values from 6,600 € to around 18,000 € according to the population estimates. This shows that the method can never be better than the data used. As there was no good proxy for political stability apart from the unrest-variable, several shady political regimes appear in the list. Data from such countries can be unreliable and exporting there is probably more risky than to stable democracies.

Table 3 thus understands itself as a set of promising and motivating suggestions which have to be inspected closer. Already the fifth in line, Slovak Republic, is a surprise. Given that this state is an EU-member and very close to Austria one would think it would be perfectly served by Austrian exporters – which is obviously not the case. According to the method, Slovak Republic is thus a candidate for additional export-efforts. One reason for this is the very short distance between Bratislava and Vienna, telling the gravity model that trade should be much higher than it is: the rightmost circle in Figure 6 represents the Slovak Republic. Albania, Belarus, Egypt, and Brazil, Poland, and Lithuania are other countries which somehow stand out. Of course, other countries are worth a closer look too.

4 Summary and Conclusion

This study is a two-staged approach to finding interesting export locations for Austrian companies. The main idea is that although exports are strongly attracted by GDP, GDP growth is at best of minor importance. This in the first part researched the main factors explaining Austrian exports. This is done by a standard gravity model, calculated by a Tobit estimation. Latter can deal with cut-off values, which is useful as there are several zero-entries in export data. The main results were that GDP (continuous as well as with an additional bonus for high GDP), distance (continuous as well as with an additional bonus for high distances), inflation, EU membership, population, being landlocked, the share of persons speaking English, unrests/wars, and time can explain more than 97% of the data's variances.

Taking all these factors into account it is possible to calculate Austrian companies' expected exports to each country. The unexplained residuals, called "country effects" indicate how well Austrian exporters do in each country. Thus one can identify those countries where exports are substantially below their expected values and a potential for increases exists. This information is already quite useful and reported in Table 2, where India, China, Equatorial Guinea, Papua New Guinea, Burkina Faso, Cameroon, and the Slovak Republic show up as the most under-represented states.

The last step is to multiply these country effects with the countries' average growth rates over the last years. This final score is highest when high growth rates are found in countries where Austrian companies export only little. The most interesting countries are listed in Table 3 where China, India, Equatorial Guinea, Angola, and the Slovak Republic show up first. As with the exception of unrests / wars only quantitative variables were used, certain probably important descriptions could not enter the estimation. *E.g.* Equatorial Guinea certainly is a booming country with hardly any Austrian exports, but the political situation was and partly still is not very secure. Therefore the list is only indicative and should be used as a motivation and rough guideline for checking possibilities. Reading through the list, a number of other interesting countries appear surprisingly close to the top: Albania, Belarus, Egypt, and Brazil, Poland, and Lithuania. Together with China, India, and the Slovak Republic they form a set of countries where close inspection for unidentified export possibilities could be rewarding.

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Appendix – Alphabetical list of countries

Country	Country Effect	Mean growth 06-08	E_i
Albania	-0.86	6.43 %	-5.50
Algeria	-0.64	2.47 %	-1.59
Angola	-0.67	17.34 %	-11.66
Antigua and Barbuda	0.50	7.05 %	3.55
Argentina	0.22	7.96 %	1.73
Armenia	0.86	11.24 %	9.72
Australia	1.14	3.23 %	3.69
Bahrain	0.51	6.95 %	3.56
Bangladesh	-0.96	6.29 %	-6.04
Barbados	0.45	2.27 %	1.03
Belarus	-0.53	9.56 %	-5.05
Belgium	-0.11	2.15 %	-0.24
Belize	1.37	3.21 %	4.40
Benin	0.34	4.48 %	1.52
Bhutan	1.80	10.34 %	18.61
Bolivia	-0.33	5.17 %	-1.71
Bosnia and Herzegovina	0.60	6.06 %	3.64
Botswana	-0.72	4.35 %	-3.12
Brazil	-0.60	5.06 %	-3.06
Brunei Darussalam	-1.28	0.87 %	-1.11
Bulgaria	0.87	6.17 %	5.37
Burkina Faso	-1.72	4.75 %	-8.15
Burundi	0.97	4.41 %	4.28
Cambodia	-0.81	9.23 %	-7.52
Cameroon	-1.61	3.12 %	-5.02
Canada	0.48	1.93 %	0.94
Cape Verde	0.02	8.17 %	0.15
Central African Republic	-0.70	3.17 %	-2.22
Chad	-0.45	-0.03 %	0.02
Chile	0.59	4.29 %	2.55
China	-5.11	11.39 %	-58.19
Colombia	-0.09	5.64 %	-0.48
Comoros	-0.70	0.90 %	-0.63
Costa Rica	0.10	6.51 %	0.63
Côte d'Ivoire	-0.34	1.55 %	-0.53
Burkina Faso	-1.72	4.75 %	-8.15
Burundi	0.97	4.41 %	4.28
Cambodia	-0.81	9.23 %	-7.52
Cameroon	-1.61	3.12 %	-5.02
Canada	0.48	1.93 %	0.94
Cape Verde	0.02	8.17 %	0.15
Central African Republic	-0.70	3.17 %	-2.22
Chad	-0.45	-0.03 %	0.02
Chile	0.59	4.29 %	2.55

Country	Country Effect	Mean growth 06-08	E_i
China	-5.11	11.39 %	-58.19
Colombia	-0.09	5.64 %	-0.48
Comoros	-0.70	0.90 %	-0.63
Costa Rica	0.10	6.51 %	0.63
Côte d'Ivoire	-0.34	1.55 %	-0.53
Croatia	0.13	4.19 %	0.56
Cyprus	0.36	4.29 %	1.56
Czech Republic	0.30	5.13 %	1.52
Democratic Republic of Congo	-1.31	5.97 %	-7.84
Denmark	-0.60	1.41 %	-0.85
Djibouti	1.34	5.24 %	7.02
Dominica	0.67	3.49 %	2.33
Dominican Republic	-0.38	8.13 %	-3.12
Egypt	-0.57	7.03 %	-3.99
El Salvador	-0.42	3.66 %	-1.53
Equatorial Guinea	-2.74	11.13 %	-30.52
Eritrea	-0.76	-3.11 %	2.36
Estonia	0.58	4.53 %	2.61
Ethiopia	-0.32	11.50 %	-3.66
Fiji	-1.00	0.41 %	-0.41
Finland	-0.04	3.52 %	-0.15
Former Yugoslav Republic of Macedonia	0.76	4.87 %	3.70
France	-0.70	1.67 %	-1.17
Gabon	0.80	3.05 %	2.45
Georgia	0.95	8.01 %	7.62
Germany	0.09	2.31 %	0.21
Ghana	0.42	6.46 %	2.71
Greece	-0.30	3.67 %	-1.09
Grenada	-0.28	1.59 %	-0.45
Guatemala	-0.32	4.98 %	-1.58
Guinea	1.37	3.06 %	4.20
Guinea-Bissau	-1.00	2.01 %	-2.02
Guyana	-0.76	4.71 %	-3.58
Haiti	0.10	2.10 %	0.21
Honduras	-0.18	5.62 %	-0.99
Hong Kong SAR	1.99	5.18 %	10.32
Hungary	0.55	1.86 %	1.02
Iceland	0.28	3.84 %	1.07
India	-5.25	8.85 %	-46.42
Indonesia	-0.29	5.95 %	-1.71
Iraq	0.09	5.74 %	0.50
Ireland	-0.55	2.78 %	-1.54
Islamic Republic of Afghanistan	0.99	8.59 %	8.50
Islamic Republic of Iran	0.41	5.31 %	2.19
Israel	-0.18	4.83 %	-0.85
Italy	-0.14	0.73 %	-0.10

Country	Country Effect	Mean growth 06-08	E_i
Jamaica	-0.32	1.09 %	-0.35
Japan	-0.28	1.07 %	-0.30
Jordan	0.18	8.21 %	1.45
Kazakhstan	1.09	7.60 %	8.25
Kenya	-0.63	4.94 %	-3.14
Kiribati	0.47	0.40 %	0.19
Korea	0.46	4.19 %	1.94
Kuwait	-0.32	4.68 %	-1.50
Kyrgyz Republic	0.87	6.67 %	5.78
Lao People's Democratic Republic	-1.13	8.09 %	-9.17
Latvia	0.20	5.89 %	1.16
Lebanon	-0.22	5.69 %	-1.25
Lesotho	-1.05	4.47 %	-4.67
Liberia	1.37	8.12 %	11.12
Libya	-0.48	5.87 %	-2.84
Lithuania	-0.29	6.82 %	-1.96
Luxembourg	-0.10	4.03 %	-0.40
Madagascar	-0.60	6.11 %	-3.66
Malawi	-0.10	8.06 %	-0.84
Malaysia	0.97	5.55 %	5.38
Maldives	1.64	10.49 %	17.18
Mali	0.77	5.07 %	3.89
Malta	0.13	3.18 %	0.40
Mauritania	0.79	5.38 %	4.22
Mauritius	0.62	4.49 %	2.77
Mexico	-0.34	3.25 %	-1.12
Moldova	0.90	5.19 %	4.67
Mongolia	1.73	9.23 %	15.93
Morocco	-0.59	5.35 %	-3.16
Mozambique	-0.42	6.78 %	-2.85
Myanmar	-0.21	9.54 %	-2.02
Namibia	-0.58	5.30 %	-3.09
Nepal	-0.80	4.02 %	-3.23
Netherlands	-0.29	3.00 %	-0.87
New Zealand	1.24	1.22 %	1.50
Nicaragua	-0.48	3.37 %	-1.61
Niger	-1.04	6.18 %	-6.44
Nigeria	-0.19	6.39 %	-1.19
Norway	-0.69	2.28 %	-1.57
Oman	0.47	8.67 %	4.10
Pakistan	-0.62	4.61 %	-2.85
Panama	0.33	10.46 %	3.48
Papua New Guinea	-1.78	5.37 %	-9.57
Paraguay	0.21	5.64 %	1.21
Peru	-0.22	8.82 %	-1.94
Philippines	0.33	5.42 %	1.81

Country	Country Effect	Mean growth 06-08	E_i
Poland	-0.42	6.01 %	-2.52
Portugal	0.37	1.09 %	0.41
Qatar	-0.10	14.85 %	-1.41
Republic of Congo	0.23	3.41 %	0.79
Republic of Yemen	-0.27	3.39 %	-0.91
Romania	0.95	7.18 %	6.81
Russia	-0.21	7.12 %	-1.50
Rwanda	-0.79	8.42 %	-6.69
Samoa	-0.33	3.14 %	-1.05
São Tomé and Príncipe	0.36	6.16 %	2.20
Saudi Arabia	0.20	3.17 %	0.65
Senegal	0.08	3.18 %	0.27
Serbia	0.22	5.88 %	1.28
Seychelles	0.97	6.32 %	6.14
Sierra Leone	0.70	6.42 %	4.48
Singapore	1.38	6.10 %	8.43
Slovak Republic	-1.32	8.42 %	-11.10
Slovenia	0.73	5.37 %	3.91
Solomon Islands	-0.58	8.30 %	-4.81
South Africa	1.65	4.92 %	8.11
Spain	0.21	2.81 %	0.60
Sri Lanka	1.11	6.81 %	7.53
St. Kitts and Nevis	0.16	4.06 %	0.65
St. Lucia	0.19	2.33 %	0.44
St. Vincent and the Grenadines	0.21	5.02 %	1.07
Sudan	-0.27	9.43 %	-2.59
Suriname	0.58	5.00 %	2.90
Swaziland	-0.90	2.93 %	-2.64
Sweden	-0.04	2.22 %	-0.09
Switzerland	1.13	3.01 %	3.40
Syrian Arab Republic	-0.31	4.84 %	-1.48
Tajikistan	0.41	7.57 %	3.07
Tanzania	-0.47	7.11 %	-3.32
Thailand	0.81	4.18 %	3.40
The Bahamas	-0.33	1.10 %	-0.36
The Gambia	0.79	6.32 %	4.98
Togo	0.72	2.55 %	1.84
Tonga	0.38	0.30 %	0.12
Trinidad and Tobago	0.43	6.81 %	2.92
Tunisia	-0.67	5.45 %	-3.65
Turkey	-0.35	4.07 %	-1.43
Uganda	-0.73	9.30 %	-6.79
Ukraine	0.30	5.77 %	1.71
United Arab Emirates	1.20	6.64 %	7.94
United Kingdom	-0.73	1.99 %	-1.45
United States	-0.84	1.75 %	-1.47

Country	Country Effect	Mean growth 06-08	E_i
Uruguay	0.33	6.77 %	2.22
Vanuatu	-0.83	6.75 %	-5.61
Venezuela	0.54	7.60 %	4.07
Vietnam	0.63	7.62 %	4.82
Zambia	-0.23	6.02 %	-1.40
Zimbabwe	0.01	-7.30 %	-0.09

A Land Far Away

Part II: The Role of Transportation Costs and Types of Commodities for Austrian Export

1. Introduction to the 2nd Part

Investigating potentials for increasing exports could support Austrian economy in the time of and after the global crisis. Since the crisis hits many countries in the world it is important to find advantageous trade partners for Austrian export. Naturally these are countries with high GDP growth.

The list of the countries that are expected to grow more than 4% in 2010 includes 58 countries. Two of them, China and India, represent with 9% and 6.4% not only the countries with above-average growth rates even within this group, but are also the two largest economies in the list. Two other countries, Qatar and Turkmenistan, are quickest growing countries in 2010, 18.5% and 15.3%, and thus also represent interesting destinations for Austrian export.

What is the connection between economic growth and export potential? Firstly, the market volume is growing on its own and once established trading relations are quite stable (see the autocorrelation numbers in the first part of the study). Secondly, a new entry is easier into a country with higher growth rate as those countries have a higher fraction of “vacant money” to be spent. At the same time, country size is a proxy for the magnitude of possible exports measured.

Another aspect is that Austria’s export to these countries has a share of much less than 5% of all exports. Thus, although these countries will grow quickly, Austria’s exporting industries hardly take advantage of that dynamic as shown in Figure 3 in the first part.

The last facet is the long distance between Austria and almost all of these countries, so transportation costs and trade barriers play important roles. Hence the potential of such trade perspectives can be studied by using the gravity equation that accounts *inter alia* for the role of distance in trade. The result will show whether there is a way of increasing exports to these countries substantially or whether Austria’s exporting industries already utilize all possibilities and trade is really hampered by all kinds of barriers.

2. Literature Survey

The gravity model in international trade in its pure form postulates the decline of export volume with the distance between exporter and importer. It is derived from Newton's law of gravity: F = c M m / d. Here M and m can be interpreted as GDP of the trading economies. This relation has been confirmed empirically: regressing trade flows on GDPs and distance in logs results in positive coefficients for GDP and negative for distance. However, we do not necessarily get the power -1 for distance, but some other value which is often close to -1. More generally, the gravity model can be formulated as the product of some positive function of scales of trading countries and the negative function of some measure of trade barriers between them. These trade barriers include distance, but also tariffs and other costs (including language and cultural difference). Distance can serve as a proxy for the barriers making the gravity model very universal in use.

In economics we have different groups of trade models. In the middle of the 20^{th} century models based on trade costs which are linear in distance, were popular. For example, Samuelson (1954) considered the effect of transport costs, linear in distance, on trade. Kantorovich (1941) put the focus on transport costs since back then they formed a substantial part of total costs, especially when distances are substantial and goods were heavy. The article analyzed the environment of physically identical goods and did not explain why trade takes place for other than the closest possible trading partners.

In traditional trade models we typically have two asymmetric countries with different factor endowments which is called the Heckscher-Ohlin model. This asymmetry determines why one of them has an advantage in producing certain goods and specializes in doing so.

Hotelling (1929) was one of the first to suggest this idea of spatial competition. He considered a unit interval [0, 1] with uniformly distributed consumers and firms in two locations within this interval. For any fixed locations of sellers a and b and prices p_1, p_2, there exists an indifferent consumer, for whom the sum of prices and transportation costs to buy from are equal for both sellers. Then all consumers to the left will buy from left seller and to the right consumers from the right seller. However, in a two-stage game where sellers can choose the location first and then decide about prices there can be no Nash equilibrium due to the demand discontinuity. This was discovered by d'Aspremont et al (1979) and later the classical Hotelling model became less popular among economists. However, as it was shown by Yegorov (2000), the problem of discontinuity disappears in a two-dimensional set up with linear transportation costs when the locations of firms are fixed and exogenously given. In this case the set of indifferent consumers is located on a hyperbola. Note that this set contains consumers at different distances from the producers and thus explains the coexistence of trade flows for identical goods at different distances. *E.g.* rice may be exported for 1000 km, 3000 km and 10,000 km given that the most distant importer has no closer other exporting country.

It is difficult to consider many countries in a theoretical set up. But we can expect that for each particular good each country may have more chances to buy from an exporting country the closer it is. This conceptually contributes to gravity law. Finally we can also consider heterogeneity between production costs. In spirit of Hotelling's model this will allow a country with cost advantage to serve also long distance market, while a high cost competitor has to find its niche among neighbours.

The new economic geography (see, for example, Fujita, Krugman, Thisse, 1999) has a different modelling approach to trade. Initially the model starts from two points with a continuum of industrial goods and one agricultural good produced there. The preferences are assumed to be of Dixit-Stiglitz type, and transportation costs are "melting". To make the transition to gravity-type models, it is necessary to generalize the set up in order to allow many locations. Distant trade is then explained by preferences of consumers for varieties, thus pushing them to consume a certain share of a good even from a distant producer. However, consumption and trade intensity decline with distance since a larger fraction of good "melts" during transportation.

3. Goals of Research

Within this part of the study there will be two directions of research which will join at the stage of conclusions and policy implications. The first approach will use macro data on Austrian trade to find empirical regularities concerning trade, distance, and transport costs. The second will analyze the role of transport costs at the company level. For this purpose it was necessary to obtain a set of transportation micro data to estimate the relationship between transport cost and distance for different categories of export goods.

A relatively simple theoretical model will be developed based on a distribution of production costs of identical goods across firms. The number of firms that can be competitive exporters will be estimated as the function of distance, explicitly accounting for the sum of production and transport costs. On the one hand it follows the spirit of Zamboni, Shah, and Bezzo, 2009, with heterogeneous firms and accounting for export profitability given production and trade costs. At the same time it uses a simpler framework similar to one proposed by Samuleson, 1952, with transport costs as frictions proportional to distance which allows for multiple prices in equilibrium and zero trade flows.

The main hypothesis is that Austria has an advantage in exporting goods with large cost per unit of weight. The idea is that since the major component of trade cost is related to distance and weight while depending little on content. Thus the fraction of trade cost within total delivery cost is smaller for more expensive goods (per unit of weight). That is why a non-monopolistic firm which wants to have an advantage in exporting over long distances should have lower production costs and/or higher quality with this advantage margin (measured as a share of total cost) should be larger for cheap goods (*i.e.* those that have a low rice to weight ratio).

We will do this cost estimations based on sectors. As an example, the ratio of cost per weight is likely to be smaller for construction goods (below 1 $/kg), a bit more for food (close to 1 $/kg), more for machines (close to 10 $/kg), even more for clothing (about 30 $/kg) and highest for high-tech products (above 100 $/kg for computers).

3.1. Interesting Ideas and Hypotheses

1. Our first hypothesis is that fast growing countries in 2009-10 are located at a substantial distance from Austria and thus trade costs (substantially) suppress trade with them.

2. Another friction is the absence of a sea port in Austria increasing trade costs as sea trade costs per unit of good and distance are lower than rail- and street-traffic.

3. Still there are high tech goods for which trade costs for any distance are substantially below their prices. For such goods it is easiest to create additional trade potential. A lack of marketing and other historic reasons could have suppressed that in the past.

4. Trade and Transport Costs

4.1. Transport costs

Transport costs represent the main component of trade costs and can be measured directly. However, a common problem is lack of microeconomic data on transport cost. Sometimes aggregate data on CIF and FOB values of export can be used to estimate γ, the relative fraction of trade costs to the value of export:

$$\gamma = \text{CIF/FOB} - 1.$$

Anderson and Wincoop (2004) found that transport costs constitute a significant (21% of the product value in industrialized countries), but relatively small fraction of the overall barriers to international trade (totaling to 170% of the product *ad valorem* base). Nevertheless, since other barriers to export tend to differ less across different exporters, transport cost might play a decisive role for the volume of trade to a particular destination country.

Transport costs can be estimated in two ways:

a) from a sample of trade contracts with known weight, value, and distance;
b) from data on typical transport costs per unit of weight and distance.

We start with the second method. Here it is possible to rely on the Table 2 of Zamboni, Shah, and Bezzo, 2009. The estimations of transport cost are for Northern Italy for products with low price-weight ratio (ethanol and corn) and can be also used as minimal estimates for Austrian transport costs for two reasons: a) Austria and Italy are both in EU, and thus have prices within the same orders of magnitude; b) for goods with higher price-weight ratio unit transport cost can only increase (insurance, protection, etc).

From Table 2 we see that a typical truck has the capacity of 20-23 tons, and transport cost is about 0.5 € / t * km. The difference between products (0.5 for ethanol and 0.54 for corn) can be neglected. Cost for rail transport is lower, at about 0.2 € / t * km, for ships it is 0.06, and for trans-ships only 0.005. Some reasons for these economies of scale: a train can carry 55-60 tons, a barge 3000 tons, and ships up to 8000 tons. For sea transport there are also economies of scale in distance: while the capacities of ships (8000 tons) and trans-ships (10000 tons) do not differ much, distance plays a role, making unit transport costs for trans-ships only 0.005 (12 times less than ships, 40 times less than trains and 100 times less than trucks).

What analytical conclusions can be drawn? If the trans-ship distance is 10000 km and the truck distance only 100 km, the contributions of both transport costs are the same. But we have to note, that truck transport cost also depends on distance. For small distances (below 100 km) uploading and downloading are significant cost components, while at larger distances (several thousand km), average transport costs per unit of weight and distance can converge towards the cost by train[1].

4.2. Cost of combined transport for Austrian trade

In order to test hypothesis 2 from subsection 3.1 we used private information about transport costs for imports from overseas which were provided by an Austrian transport firm. Although costs of imports are not our object of study, they were an interesting piece of information because they can be used for exports in a symmetric way and thus allow estimating the role of transport costs in different modes. The sample is too little to be analyzed with econometric methods. However, it was possible to approximate the effect of combined transport (sea plus truck) on the share of transport costs. The following table gives basic information and calculated ratios. The first ratio, Truck/TTr, is the fraction of truck costs within total transport costs. TrC/Val is the ratio of transport costs to the value of the good, which is similar to the CIF/FOB ratio, but does not include other trade costs.

Table 1: The ratios of truck cost in total transport costs and transport costs in value.

Nr.	Depart A	Via B	Arrival C	Type	Weight, kg	Truck/TTr	TrC/Val	Val/Wgt, Euro/kg
1	Ecuador	Hamburg	Vienna	Food	25000	0,286	0,050	2,00
2	Ecuador	Hamburg	Berlin	Food	25000	0,135	0,042	2,00
3	Ecuador	Hamburg	Vienna	Textile	8000	0,286	0,050	6,25
4	Ecuador	Hamburg	Berlin	Textile	8000	0,135	0,042	6,25
5	China	Hamburg	Vienna	Textile	8000	0,211	0,171	2,50
6	China	Hamburg	Berlin	Textile	8000	0,094	0,149	2,50

We see that food and textile have moderate ratios of value to weight. For overseas delivery the share of transport cost to FOB ranges from 4% to 17%, *i.e.* it is rather substantial. It is important to see that the relatively small distances of the trucks add a substantial fraction to transport costs. Land-locked countries like Austria thus have a clear disadvantage, having about 1% to 3% of additional transportation costs.

[1] However, this question requires additional study, and sample of truck delivery of Austrian goods to CIS countries can be useful)

5. Modeling Transportation

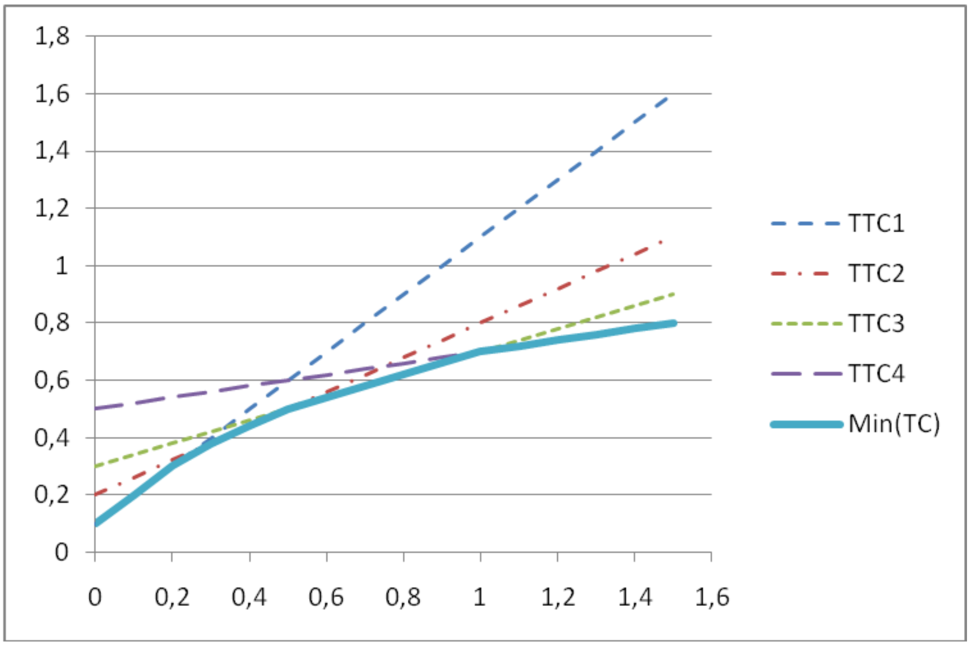
5.1. Transport cost theory and different modes of transport

Transport occurs in different modes: by trucks, rail, and ships. Additionally, expensive goods needing fast delivery are often transported by air. For each mode j there exist fixed costs F_j (uploading, downloading) and variable costs t_j which are usually proportional to distance. Thus for each particular mode j the relation between transport cost for a given unit of weight and distance is as follows:

$$TC_j(1,d) = F_j + t_j\, d \qquad (1)$$

Fig.1 shows the dependence of total transport cost (TTC) on distance for different transport modes. We see that there exists optimal mode of transportation given by lower envelope (solid line).

Figure 1: Total transport costs as function of distance for multimodal transportation.



When calculating transport costs for a given unit of weight and a unit of distance τ_j one assumes declining average transport cost as distance increases:

$$\tau_j = TC_j(1,1) = t_j + F_j / d \qquad (2)$$

As shown in Zamboni, Shah, and Bezzo, 2009, unit weight unit distance transport costs are cheapest for ships and most expensive for trucks which have a lower capacity. As we can also see, small trucks (5 t) can give lower transport costs than large trucks (20 t) due to fixed costs of the loading procedure. Hence fixed costs are comparable with variable costs at distances below 100 km which are typical in this study. While we do not have access to the costs of uploading of other transport modes, we can assume them to be comparable ore even growing as uploading a ship includes more logistic costs than uploading truck.

Let us denote the distance where fixed costs are equal to variable costs as D_j. Then these distances are growing for a sequence of transport modes with decreasing variable costs. For example, for trucks we can have D_1=100 km, for rail D_2=300 km, and for ships D_3=1000 km. This happens because variable costs are declining with j, while fixed costs may be constant or even growing.

What can we infer from that? How will the best unit distance transport cost depend on distance? Delivery by trucks is optimal for short distances, for medium distances it can be rail, while for large distances sea delivery has an advantage. If we draw graphs of (2) for different j, then we can see at which intervals of distances each particular mode becomes optimal. The function, composed of the respective best modes, will be named minimal unit weight unit distance transport cost. Due to competition the optimal mode will be used for deliveries at a particular distance. This function would be an envelope of the set of functions τ_j (i=1,2,…n), if the number of modes n grows and declines with distance d. The exact law of decline is unknown.

Why do we have a decline of trade with distance? The gravity model postulates that the trade flow is inversely proportional to distance and proportional to GDP:

$$F_{ij} = M_i \, M_j / d \qquad (3)$$

Suppose that all countries produce identical goods at identical costs, but do not produce all the varieties. Then a country that does not produce this variety should import it from the closest producer. This will minimize total transport costs being a key cost in a competitive environment. But there are also three additional effects:

a) preferences for more varieties,
b) non-linearity of transport costs in distance,
c) differences in production costs of similar varieties across countries.

The cumulative influence of these effects gives a non-zero probability for long distance delivery. However, the intensity of trade should decline. Empirically we can observe a declining function of trade intensity after normalizing for volume intensity with GDPs. If we study the exports of one country, Austria in our case, then the trade flow is proportional to the GDP of the importing country and indirectly proportional to distance:

$$F_i = GDP_i * f(d), \qquad f'(d) < 0 \qquad (4)$$

5.2. The Role of different commodities

Commodities also differ in the ratio of value V to weight W, ρ=V/W. For high tech commodities (electronics, pharmaceutics) ρ is high, while for *e.g.* raw materials it is low. The lower ρ, the higher is the share of transport costs in the final costs of the delivered product. Thus we can expect that the role of distance in the trade pattern is less pronounced for high tech goods. In particular we can expect that Austria can have substantial exports of high tech goods for more distant countries. And among these are the countries with high growth.

5.3. Cost distribution model

Consider the model with production costs uniformly distributed over the interval [p/2, p], where p is the price of some good. Under these assumptions the less efficient producer can sell its output at the equilibrium world price p, having zero profit, while other firms can make non-zero profits. Now add geography with a spatial distribution of producers and consumers. Keeping the assumptions about production costs and adding transport costs which are linear in distance, we come to the conclusion that more efficient firms can transport their goods over longer distances. Now let us use the data for rail transport. Assuming linear transport cost at 0.2 € / t * km (which is the same as 0.2 € / (kg * 1000 km)), we can now consider heterogeneity of goods with respect to value to weight ρ. If that would be 1 per kg of weight for all goods, then the ratio of transport cost (TC) to the world price (of 1 kg of this good) is given by

$$h \equiv TC / p = 0.2\ D / \rho, \qquad (5)$$

where D is the distance in 1000 km. Now we can find the fraction of firms that will be able to export good ρ at distance D. Integrating the density $f(\rho)=2/\rho$ over the interval $[\rho/2, \rho\text{-}0.2D]$, we find this share of firms that can do this export profitably:

$$S(\rho, D) = 1 - 0.4\ D / \rho \qquad (6)$$

It is easy to see that for each good ρ there exists a critical distance D* such that S(D*) = 0. For $\rho = 1$ (low), this distance is 2500 km, for $\rho = 10$ (medium) it is already 25000 km (all the world can be covered), while for $\rho = 100$ (high) it is 250000 km. Thus, transport costs play only small role for goods with high ρ, but a substantial role for goods with medium values of ρ. Goods with low ρ can be sold only locally.

5.4. Aggregation

Since transport can take place between virtually any pair of points in a continuous space, but data are typically available on a country or regional level (*e.g.* Intra-EU vs. Extra-EU trade), it may be of theoretic interest to consider deriving a formula about such aggregated volumes. Consider a radially symmetric model with country radius R_0, internal radius R_1 (border of EU) and external radius R_2 (maximum distance). If we postulate the trade flow intensity to be inversely proportional to distance r (F = c / r), then spatial integration gives the following ratio of Intra-EU trade to overall trade:

$$\beta \equiv IT / (IT + ET) = (R_1 - R_0) / (R_2 - R_0).$$

Although this formula is simple, its direct application is limited. While it has been derived for a continuous 2-dimensional homogeneous world, we have substantial spatial heterogeneity of demand caused by the existence of oceans, non-uniform population density, or differences in GDP per capita across countries. Finally there are differences in tariff policies. Nevertheless this approach complements the non-spatial approach where only the membership in a certain group is taken into account while distances are ignored.

6. Data Analysis

6.1. Main importers from Austria

Table 2 gives the dynamics of Austrian exports (measured in mio USD) to the top 10 importers as from 2007, the last year before crisis. We see the stable dominant position of Germany and the second position of Italy. Emerging economies also play role, but they were hit by the crisis in a substantial amount.

Table 2: Dynamics of Austrian export to top-10 importers.

Country	DEU	ITA	USA	SWI	HUN	FRA	CZE	GBR	ESP	RUS
2000	22480,60	5958,88	3362,70	4534,29	3366,93	3017,40	1863,30	2901,47	1821,11	650,35
2001	22871,80	6150,36	3635,26	3837,73	3217,26	3496,76	1957,33	3387,41	1825,37	911,34
2002	24711,80	7306,89	3884,77	4232,73	3393,74	3654,14	2139,96	3877,78	2416,75	1001,44
2003	30622,40	9425,07	4750,30	5031,02	3864,92	4585,62	2784,73	4602,10	2596,24	1464,52
2004	37816,00	10498,40	7059,99	5672,28	4321,56	5018,61	3476,27	5012,29	2906,52	1997,48
2005	38833,70	10813,50	7279,01	6421,28	4166,90	5179,98	3672,30	4952,64	3368,43	2558,47
2006	41170,20	12316,60	7922,82	6413,88	4662,70	5143,53	4336,66	5198,45	3803,83	3132,84
2007	48816,30	14478,40	8018,41	7092,59	5972,25	5877,07	5847,84	5839,94	4622,22	3996,86
2008	53628,40	15568,00	7801,93	7578,04	6679,66	6736,42	7182,67	5746,01	4302,04	5047,89
2009	42629,50	11250,10	5494,16	6869,98	4586,03	5437,67	5279,97	4429,74	2537,80	3272,13

Table 3 reports Austrian exports to the fastest growing economies. The ratio of exports to GDP can be regressed on the growth rate and some function of distance.

Table 3: Fast growing economies and Austrian export

N	Country	Growth 2008,%	Exp, mio €	GDP 2009	Exp/GDP,%
1	Turkmenistan	15,30%	28,289	n/a	n/a
2	Uzbekistan	7,00%	61,921	30,321	0,204
3	Afghanistan	8,60%	5,570	13,318	0,042
4	Bangladesh	5,40%	75,844	92,121	0,082
5	Bhutan	5,30%	1,456	1,473	0,099
6	Cambodia	4,30%	0,733	10,901	0,007
7	China	9,00%	1.875,230	4.757,743	0,039
8	India	6,40%	608,902	1.242,641	0,049
9	Indonesia	6,40%	228,081	514,931	0,044
10	Laos	5,40%	0,286	5,721	0,005
11	Myanmar	5,00%	5,821	26,523	0,022
12	Nepal	4,10%	0,838	13,140	0,006
13	Sri Lanka	5,00%	36,245	41,323	0,088
14	Timor	7,90%	0,015	0,599	0,003
15	Vietnam	5,30%	86,517	91,764	0,094
16	Egypt	4,50%	207,202	187,956	0,110
17	Iraq	5,80%	43,423	70,104	0,062
18	Jordan	4,00%	57,684	22,556	0,256
19	Lebanon	4,00%	43,005	32,660	0,132
20	Libya	5,20%	90,113	60,609	0,149
21	Qatar	18,50%	127,784	92,541	0,138
22	Saudi Arabia	4,00%	437,762	379,500	0,115
23	Syria	4,20%	63,496	54,352	0,117
24	Yemen	7,30%	15,873	26,236	0,061

25	Chile	4,00%	109,459	150,361	0,073
26	Guyana	4,00%	0,640	1,196	0,054
27	Peru	5,80%	59,046	127,368	0,046

6.2. Regressions

This part of the data analysis is complementary to one done in the first part. The focus here will be on fastest growing countries of 2009 as reported in Table 3. Firstly, it will be shown that even for this subsample the gravity law describes trade very well. Robustness is checked in a variety of model set ups. Export were normalized (see the definition of EGDP below) and distance enters as 1/D, as D, and after taking logs.

Let us introduce new variable $EGDP_i = AEXP_i / GDP_i$ being the normalized exports from Austria to country i. Note that in this set up, GDP does not have a coefficient. We also define INVD = 1/D, where D is the distance in km. If the gravity model is applicable, INVD must be highly significant. GDP growth of the importing country in 2008 is captured by GR08.

Regression 1

Dependent Variable: EGDP
Method: Least Squares
Date: 08/07/10 Time: 16:28
Sample (adjusted): 2 27
Included observations: 26 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GR08	0.002199	0.002145	1.025084	0.3155
INVD	301.6034	55.23988	5.459885	0.0000

R-squared	0.421797	Mean dependent var	0.080622
Adjusted R-squared	0.397705	S.D. dependent var	0.061622
S.E. of regression	0.047823	Akaike info criterion	-3.168806
Sum squared resid	0.054890	Schwarz criterion	-3.072029
Log likelihood	43.19448	Durbin-Watson stat	2.328999

Regression 1 confirms the significance of the inverted distance, while GDP growth is insignificant. The regression in the first part fully supports this estimation's result. Adding a constant to the regressors does not improve the results..

Result 1. *Although the sample size is small (only countries with high growth rate have been selected), inverted distance is highly significant, while GDP growth is not significant. This confirms important role of geography and the gravity model in describing trade intensity.*

Regression 2 uses non-normalized export data and the original distance values D. Here R^2=0.97 and GDP is the most significant variable, while distance is significant at 10% level. If we use INVD (instead of D), the role of distance becomes non-significant. Regression 1 already captures this dependence and allows working more precisely with the role of distance.

Regression 2

Dependent Variable: AEXP
Method: Least Squares
Date: 08/07/10 Time: 16:36
Sample (adjusted): 2 27
Included observations: 26 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GR08	-0.551082	4.372497	-0.126034	0.9009
GDP	0.396834	0.013643	29.08644	0.0000
DIST	-0.007317	0.004002	-1.828535	0.0811
C	88.60008	38.63718	2.293130	0.0318

R-squared	0.975752	Mean dependent var	163.1903
Adjusted R-squared	0.972445	S.D. dependent var	376.8898
S.E. of regression	62.56202	Akaike info criterion	11.25083
Sum squared resid	86108.15	Schwarz criterion	11.44439
Log likelihood	-142.2608	F-statistic	295.0974
Durbin-Watson stat	1.918553	Prob(F-statistic)	0.000000

It is also possible to run regressions in logs as it was done in the first part. The results do not change much and are very similar to those found with the panel of 174 countries over 10 years using many explanatory variables.

Regression 3

Dependent Variable: LOG(AEXP)
Method: Least Squares
Date: 11/08/10 Time: 17:18
Sample (adjusted): 2 27
Included observations: 26 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GR08	0.002063	0.064717	0.031879	0.9749
LOG(DIST)	-1.121863	0.328860	-3.411369	0.0025
LOG(GDP)	1.184057	0.093807	12.62224	0.0000
C	8.258156	2.900119	2.847524	0.0094

R-squared	0.894652	Mean dependent var	3.130616
Adjusted R-squared	0.880287	S.D. dependent var	2.716068
S.E. of regression	0.939750	Akaike info criterion	2.854232
Sum squared resid	19.42884	Schwarz criterion	3.047785
Log likelihood	-33.10501	Hannan-Quinn criter.	2.909968
F-statistic	62.27731	Durbin-Watson stat	2.056610
Prob(F-statistic)	0.000000		

This shows that gravity law is very robust for Austrian exports, giving similar results independent from the sample (size), method, and explanatory variables.

6.3. Pharmaceutics

The sector of pharmaceutics has been selected for a more detailed analysis for several reasons. Firstly, it is an important component of Austrian exports as can be seen in the first column of Table 4. Secondly, the price/weight ratio (calculated below) is small and thus the role of distance is less pronounced. Thirdly, this sector's exports are growing over time, both in value and in weight, and thus represent an important potential for growth. Tables 4 and 5 report the dynamics of Austrian exports to some countries in thousand Euros (Table 4) and in tons (Table 5). This allows finding the ratio of value per weight and to see how it differs across countries. In Table 4 we can see that in 2007 to 2009 the shares of Extra-EU and Intra-EU trade were comparable, suggesting that transport costs, which are substantially larger for Extra-EU trade, are no big obstacles in this sector.

Table 4: Dynamics of Austrian pharmaceutical export (in thousand Euro)

Year	EXTRA-EU	Intra-EU	China	India	Russia	Kazakhstan	Kuwait
2000	1038615	749576	9021	3355	103144	5299	734
2001	1350306	746651	16719	4320	168555	7913	2443
2002	1806280	987277	16649	3342	138454	12639	1886
2003	1626854	1102540	23717	3647	180000	12914	795
2004	1437694	1222085	20905	3195	206524	18774	1788
2005	1848405	1583245	25300	3367	361134	29113	2870
2006	2257687	1808310	32857	2350	484824	34453	3245
2007	2255675	2109227	25339	2251	513474	41282	4660
2008	2465049	2307150	32235	4725	664037	52432	4237
2009	2891886	2405747	84501	5052	677113	67650	3995

Table 5: Dynamics of Austrian pharmaceutical export (in tons)

Year	EXTRA-EU	Intra-EU	China	India	Russia	Kazakhstan	Kuwait
2000	14192.0	21579.0	85.8	32.2	1954.0	86.5	25.6
2001	16206.0	23844.2	232.4	48.5	2995.9	106.0	127.5
2002	17342.0	25917.7	431.3	38.7	2481.7	182.1	126.4
2003	19611.8	22191.4	493.2	39.7	3714.3	201.0	33.9
2004	16405.8	29488.5	297.9	41.9	4025.4	249.6	34.9
2005	18329.7	29584.4	436.7	39.2	5868.7	419.7	113.6
2006	22021.7	31828.6	574.1	26.6	7334.3	427.9	172.7
2007	22115.8	43938.4	384.0	27.3	6834.3	540.0	249.0
2008	25788.7	57472.4	406.9	53.9	7770.1	616.6	112.3
2009	25949.2	59812.0	893.1	49.7	7257.3	618.5	155.2

Table 6 shows the ratio of value to weight. We can make several conclusions from these data. Firstly, we see the difference for ρ=V/W (value-weight ratio) for the case of the pharmaceutical industry: ρ was 94 €/kg for extra-EU trade and 43 €/kg for Intra-EU trade, which is clearly lower. Secondly, ρ was higher for more distant countries, on average 89 Euro/kg for India with a direct distance of 5600 km and 26 Euro/kg for Kuwait with a distance 2900 km. We can also see changing preferences to the bundle of pharmaceutical goods imported from Austria. For example, China decreased V/W from 105 to 94, while Russia increased it from 52 to 93. Thirdly, we see that the overall variation of ρ (in this set, from 18.7 to 105 Euro/kg) has a substantially high lower bound that allows to classify pharmaceutics as a good with high ρ and thus with a less important role of distance on trade.

Table 6: *Dynamics of value-weight ratios (in Euro/kg) for pharmaceutical export.*

Year	EXTRA-EU	Intra-EU	China	India	Russia	Kazakhstan	Kuwait
2000	73,18	34,74	105,14	104,19	52,79	61,27	28,66
2001	83,32	31,31	71,94	89,08	56,26	74,65	19,16
2002	104,16	38,09	38,60	86,36	55,79	69,41	14,92
2003	82,95	49,68	48,09	91,87	48,46	64,25	23,46
2004	87,63	41,44	70,17	76,26	51,31	75,22	51,23
2005	100,84	53,52	57,94	85,88	61,54	69,37	25,26
2006	102,52	56,81	57,23	88,36	66,10	80,52	18,79
2007	101,99	48,00	65,99	82,47	75,13	76,45	18,72
2008	95,59	40,14	79,22	87,67	85,46	85,03	37,73
2009	111,44	40,22	94,62	101,66	93,30	109,38	25,74

We can also see the growing role of Russia as a trade partner for this commodity group. Not only did the Russian volume of pharmaceutical imports grow, but also Russia's share in Extra-EU trade (Figure 2). Hence, Russia is a promising trading partner in pharmaceutics for Austria, despite its temporal difficulties related to the crisis.

Figure 2: Dynamics of Russian share in Extra-EU pharmaceutical export of Austria.

6.4. Machines

For the export of machines we also can construct the dynamics of exports to selected countries and regions, both in thousand Euro (Table 7) and in tons (Table 8).

Table 7: Dynamics of Austrian machine export (FOB) in thousand Euros.

Year	EXTRA-EU	Intra-EU	China	India	Russia	Kazakhstan	Kuwait
2000	4495909,62	6658512,72	151380,98	14940,33	66402,13	1740,02	3697,87
2001	4645623,31	7771086,71	102209,14	17773,93	78179,23	2625,19	2162,60
2002	4637645,79	8030473,44	115873,86	19308,81	88410,73	3973,91	3979,10

2003	4183567,98	8473834,86	141456,77	17675,57	113962,54	9123,87	5967,62
2004	3638764,11	8168764,05	177571,74	30751,59	185847,43	4835,84	5887,94
2005	3169285,23	8611993,88	180424,59	41977,41	193271,41	13491,51	2710,08
2006	3479971,60	8917316,10	210962,74	54956,29	160618,97	6782,28	13097,68
2007	3372787,25	10036698,81	269472,19	73207,94	140762,82	16804,03	33168,61
2008	3899487,80	9629723,80	308926,43	107237,30	198947,73	19982,50	21803,40
2009	3196187,03	7607530,77	313878,19	76860,30	126742,05	7254,60	14303,19

Table 8: Dynamics of Austrian machine export (FOB) in tons.

Year	Extra-EU	Intra-EU	China	India	Russia	Kazakhstan	Kuwait
2000	242908,30	447086,50	2550,40	403,40	3453,10	118,20	231,30
2001	251421,50	349129,70	2329,70	697,40	3288,70	203,10	164,60
2002	251388,60	346468,00	3344,10	532,50	3382,60	411,80	775,10
2003	239604,00	326152,30	3412,10	505,80	6580,10	478,90	670,30
2004	195780,50	399482,40	8915,70	1939,70	6467,00	486,20	701,90
2005	167086,40	428100,90	8638,80	2949,50	7248,90	982,60	91,60
2006	185438,70	444793,10	5229,50	3207,40	8729,50	478,00	1312,50
2007	160035,30	483653,00	6775,60	4297,70	7403,70	1015,40	4641,30
2008	170192,90	501188,80	5881,60	7032,10	8469,50	1012,60	2471,50
2009	148556,90	446276,60	8037,40	5623,90	5761,40	366,80	1296,10

The value-weight ratio (€/kg) for Extra- and Intra-EU trade is showing in Table 9 along with fractions of Extra-EU trade for years 2000 to 2009.

Table 9: Dynamics of the value/weight ratio for Intra- and Extra-EU export of Austrian machinery and the fraction of Extra-EU export in total export (FOB).

Year	Extra-EU	Intra-EU	% Ex-EU, ton	%Ex-EU, €
2000	18,51	14,89	35,20%	40,31%
2001	18,48	22,26	41,87%	37,41%
2002	18,45	23,18	42,05%	36,61%
2003	17,46	25,98	42,35%	33,05%
2004	18,59	20,45	32,89%	30,82%
2005	18,97	20,12	28,07%	26,90%
2006	18,77	20,05	29,42%	28,07%
2007	21,08	20,75	24,86%	25,15%
2008	22,91	19,21	25,35%	28,82%
2009	21,51	17,05	24,97%	29,58%

From Table 9 we can infer that machines also have a rather high ratio of value to weight although lower than for pharmaceutics. Thus, transport costs should play a more important role here. Indeed we can see that this ratio is higher for far away countries. The average value of the value-weight ratio for extra-EU is 17.3 Euro/kg, while for China it is 35.2, for India 21.0, and for Russia 20.6. Thus the distance can influence the selection of exported commodities.

The average fraction of Extra-EU machinery export for 2000 to 2009 was 30.22% in weight and 29.16% in value. However, in the crisis year of 2009 the share of extra-EU machinery export in weight (25%) was lower than in value (29.6%). Thus distance indeed plays a role. For pharmaceutics the fraction of extra-EU export was higher (56% in value).

7. Conclusions

1. The provided research confirms the important role of geography for Austrian trade when exporting to fastest growing economies in the world. In contrast to the first part of the study, these countries were used here.
2. GDP growth of the importing countries has been shown to be insignificant when explaining the volume of Austrian exports. This may have several explanations. Firstly, we included only the last data point of growth, which is highly different from the previous pattern, due to heterogeneous effect of crisis. Countries are typically slow in adjusting their export. However, growth in different forms (pure and moving average) was also found to be insignificant in the panel estimation of the first part. Secondly, all countries with high growth are located far from Austria and thus distance can suppress trade to these countries very much.
3. Special focus has been put on detailed specifications of trade technology. Using real data from a transport company it was possible to approximately evaluate the role of the different transportation modes and the range of distances where they are most suitable. *E.g.* ships are very efficient at long distances, since higher fixed costs are compensated by lower variable costs.
4. As there are no sea ports in Austria, there is a certain disadvantage when competing with *e.g.* Germany. Direct (non-sea) delivery can be done mostly for EU countries – which are not within the set of observed countries. Thus, Austria could aim at increasing trade in those sectors where the ratio of price to weight is high and thus the role of transport cost is lower.
5. Machines have intermediate value-weight ratios, about 15 to 25 €/kg, and thus are more affected by transport costs compared to pharmaceutics. Here Austria might have an additional disadvantage when using sea transport (compared to Germany or the Netherlands, having Hamburg and Rotterdam). The additional costs of only 1% to 2% are substantial in highly competitive markets. Food has an even lower value-weight ratio suppressing long-distance preventing exports quite a lot.
6. The pharmaceutical sector shows promising potential for export growth. The value-weight ratios here range from 25 to 100 €/kg depending on the importer. We see an increasing role of Russia here with the share of Austrian Extra-EU pharmaceutical exports growing from 10% to 25% between 2000 and 2009. While Russia did not grow quickly in the year of crisis, it did so before. The positive dynamics of both value and weight of pharmaceutical export confirms an important and promising role of this sector for future trade. In fact, export growth was positive even during the crisis: the value of Extra-EU export grew from 2.46 bn euro in 2008 to 2.89 bn euro in 2009.
7. Another important observation is the growing importance of Russia as a purchaser of Austrian pharmaceutics. Its imports grew from 103 mio € in 2000 to 677 mio € in 2009, forming about 25% of Extra-EU export of Austrian pharmaceutics at present. Despite the fact that Russia was hit by the crisis of 2008 this special export did not slow down and still shows high potential for growth after Russia’s recovery from the crisis.

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