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Research Article

Total Factor Productivity and Most Favored Nations Tariffs: Evidence from Croatia

Kladiola Gjini

*PhD student Department of Economics,
Faculty of Economics, University of Tirana[1], Albania*

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Abstract

One of the most important topics in empirical trade research is the link between productivity and trade liberalization. In this paper we will focus on the effect of MFN tariffs in the total factor productivity of Croatian firms over the period 2003-2012. This period is characterized by an increased openness toward European Union for Croatian firms. The aim of this paper is to present evidence on the negative link between productivity and tariffs by using the Levinsohn and Petrin (2003) method to estimate productivity of firms. Then we will use TFP as a dependent variable for firm characteristics and trade policy indicator (MFN tariffs). The results are in line with most other studies, confirming the negative relationship between TFP and tariffs. The results show that exporting firms have a higher productivity than non-exporting. We also conclude that up to a certain age productivity increases and then decreases.

Keywords: *Total factor productivity, trade, MFN tariffs.*

1. Introduction

In this paper we will focus on the effect of MFN tariffs in the total factor productivity of Croatian firms over the period 2003-2012. Data was obtained from the Bureau Van Dijk Electronic Publishing (BvDEP) Amadeus database for firms in Croatia for the period 2003-2012. This pre-accession period for Croatia was characterized by many agreements, especially for trade by removing or decreasing many trade agreements. We have collected financial information about firms, in regard to the balance sheet and the profit and loss account. In overall we have 306043 observations for about 64712 firms, and an unbalanced panel data at the 4-digit NACE[2] Rev2.

In the first section we will present some macro-economic data for Croatia. We will show in some graphs the main trade partners. Data regarding the export/import from/to Croatia are retrieved from the WITS[3].

In the second section we present the methodology used, the data and the analysis. The methodology is a semi-parametric estimation from (Levinsohn and Petrin, 2003). It addresses the potential simultaneity bias in the production function by using proxy (intermediate inputs) to estimate unobserved productivity shocks. MFN tariffs[4] are retrieved by the WITS database at the 4-digit ISIC Rev3 from the World Bank. By using correspondence tables[5] we have converted MFN tariffs at the 4-digit level ISIC Rev3 to NACE Rev 2, and then merged the two data-sets together.

In the third section we present the empirical results, by confirming what we have found in the literature review. TFP and MFN tariffs are negatively related, lowering MFN tariffs increases productivity. We use the weighted and the average values for MFN tariffs. And section four concludes.

2. Economic Indicators for Croatia

According to World Bank Croatia is part of the high income[6] classification on OECD[7] countries. Croatia in 2014 records a population of 4.236.400[8]million inhabitants. In the tables below we are presenting economic data for Croatia, GDP annual

1 Erasmus Mundus exchange student at Ghent University Belgium (2015)
2 Is the statistical classification for the economic activity in the EU
3 World Integrated Trade Solution by the World Bank
4 Are the tariffs that a country imposes to imports from other countries which are part of the WTO. They are considered as the highest rates that WTO member charge to one-other.
5 Source: www.unstats.un.org
6 Charts Bin statistics collector team 2011, Country Income Groups (World Bank Classification), ChartsBin.com, viewed 14th September, 2015
7 The primary goal is promoting policies to improve people's economic and social well-being around the world
8 Total population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship–except for refugees not permanently settled in the country of asylum, who are generally considered part of the population of their country of origin.

growth (in %) and GDP in US $. As we can see from figure 1 GDP had an increasing trend from 2003 to 2008, followed by a decreasing GDP may be stimulated by the financial world crisis. In 2011 we notice a recovery and an increase in GDP followed by a decrease in 2012. In figure 2 we present the rate of price change in the Croatian economy[9]. According to the first two figures 1 and 2 we see that in 2008 GDP has the highest value, and inflation has the lowest value. In figure 3 we see positive growth rates until the 2008, and from 2009 to 2012 we notice negative growth rates with the lowest value in 2009.

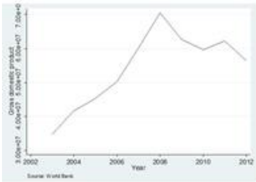

Figure 1: GDP

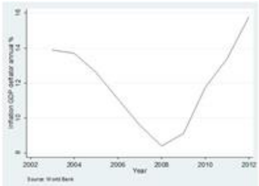

Figure 2: Inflation

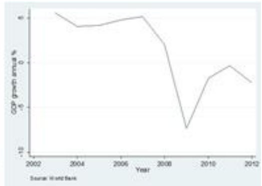

Figure 3: GDP growth

In figure 4 we present some data regarding employment and unemployment records for Croatia from 2003 to 2012. As we can notice employment rate is increasing during the first five years with the highest percent rate in 2008. And during the last four years the percent rate of employment has declined by 6%. Graphs of employment and unemployment are complementary to each other, where the employment rate has a peak the graph of unemployment has the trough. Since the rate of employment is increasing during the first years, the rate of unemployment is decreasing. After 2008 the rate of unemployment is increasing because the employment rate is decreasing.

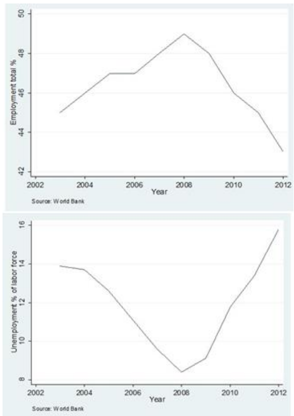

Figure 4: Employment and Unemployment

In figure 5 we present the total trade flow for Croatia, as we can see the amount of importing exceeds the amount of exporting, so from 2003 to 2012 Croatia had a negative trade balance.

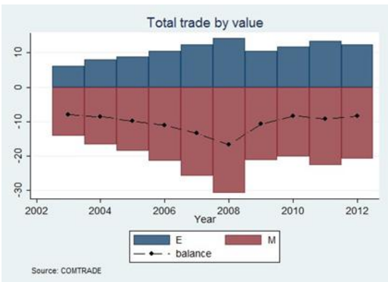

Figure 5: Trade flows

9 Inflation here is measured as the annual growth rate of the GDP implicit deflator. GDP implicit deflator is measured as the ratio of GDP in current local currency to GDP in constant local currency. Source: World Bank

The most important trade partners of Croatia are Italy, Germany, Bosnia and Herzegovina, Slovenia, Austria, China, Russia and Serbia & Montenegro. In Appendixes B and C, figures from 9 to 15 present export flows in Croatia and figures from 16 to 23 present import flows in Croatia for each partner country separately.

3. Literature Review

The importance of international trade in economic growth was supported by (Grossman and Helpman, 1990), (Rivera-Batiz and Romer, 1990) and (Ben-David and Loewy, 2003). Effects of trade in productivity have been analyzed by many economists, which often conclude on the same results that trade increases productivity. (Melitz, 2003) and (Melitz and Ottaviano, 2008) argue that trade increases productivity because resources will be reallocated from less productivity firms to more productive firms and the within firm productivity will be increased as well. According to (Helpman and Krugman, 1985) increased competition make firms to move down their cost curves and improve efficiency.

Trade liberalization gained increased attention by researchers because of its impact in productivity levels and in the country growth (Ackah, Aryeetey, and Morrissey, 2012). Productivity actually would increase by the trade liberalization. Domestic producers will face import pressure from import competition and they will cut costs and use the inputs more efficiently[10]. In the literature this is called elimination of "X-inefficiency". If firms will be not productive they cannot survive so will exit, by increasing the average productivity of the remaining firms.

(Dovis and Milgram-Baleix, 2009) and many other researchers (i.e. (Pavcnik, 2002); (Schor, 2004); (Topalova and Khandelwal, 2011); (Fernandes, 2007) and (Amiti and Konings, 2007)) have focused on the relationship between productivity and tariffs. They all conclude that decreasing tariffs increases productivity. Later on (Tybout and Westbrook, 1995) were focused on trade liberalization effects; (Blalock and Gertler, 2004) were focused on exporting effects; while (Syverson, 2010) was focused on market structure and market location.

There is a study of the World Bank which uses the Enterprise Surveys by (Saliola and Seker, 2011) to measure total factor productivity across 80 countries in different regions of the world[11] involving 21412 firms. Regions differ from each other in term of aggregate and average productivity. In another study (Sosic and Vujcic, 2005) have analyzed the trade criteria that Croatia should fulfill before accession to EU, by constructing a gravity model[12] of Croatian trade. *A functioning market economy*[13] and *coping with competitive market forces within the Union*[14] are the two pillars of the economic criteria mentioned in the Enlargement paper (for Economic, 2002). (Djankov and Hoekman, 1998) estimate total factor productivity in Bulgaria by taking into account the impact of trade liberalization and accessing global markets.

Holzner (2013) in his paper proposes a simulation exercise by using the Global Simulation Model (GSIM) to analyze trade flow changes from Croatian accession to EU. He concludes that there will be not such large benefits from tariff cuts between Croatia and other CEFTA countries; but in respect to Serbia and Kosovo he argues tariffs might increase slightly.

According to (Holzner, 2013) assessment[15] on macroeconomic and trade effects for Croatia accession to the EU, the expectation is that exports will increase by almost 2.2% with EU member countries. There is a prediction that exports with other CEFTA countries will decrease by 0.7% and export with the other countries of the world to decrease by 1.5%.

The prediction goes on even for import[16] trade flows where imports from Bosnia & Herzegovina are expected to decrease, and imports from Serbia, EU members and the rest of the World are expected to increase. So in conclusion (Wilhelmsson, 2006) and (Papazoglou, Pentecost, and Marques, 2006) EU accession generated significant net additional trade and somehow re-directed the trade flows between countries. Productivity should increase from trade liberalization because of market expansion and reduction of costs. Some of the studies in trade reforms are: (Bernard, Eaton, Jenson,

10 Domestic firms can access to the foreign technology.

11 Sub-Saharan Africa(AFR); South Asia and East Asia and Pacific(Asia); Eastern Europe and Central Asia (ECA); Latin America and the Caribbean (LAC); Middle East and North Africa (MENA)

12 The gravity model used here is a single country equation. But the basic idea of the gravity model is to estimate trade relations between pairs of countries by analyzing the potential of the economy and the trade costs approximated with geographical distances

13 Trade and prices liberalized; equilibrium demand supply defined by market forces; legal system in place; macroeconomic stability; general consensus for economic policy; no barriers to entry and exit the market

14 Macroeconomic stability; the existence of a market economy; sufficient amount of capital; stimulating competitiveness

15 The estimation is an increase in exports by $ US 104 million with EU member countries.

A decrease of $ US 180 million with the rest of the world. Exports with Serbia and Bosnia & Herzegovina will drop by $ US 71 million and $ US 18.2 million.

16 The estimation is a decrease of $ US 10 million with Bosnia & Herzegovina; an increase of $US 22 million from Serbia, an increase of $ US 110 million and $ US 190 million from EU members and the rest of the world and Kortum, 2000), (Bernard and Jensen, 2004) both on USA studies. For Canada (Trefler, Trefler). For Argentina and Brazil are respectively (Bustos, 2009) and (Schor, 2004). For Chile there is (Tybout, De Melo, and Corbo, 1991) and (Pavcnik, 2002). For Columbia and Cote d'Iviore there are the studies of (Fernandes, 2007) and (Harrison, 1994).

4. Methodology and Data for Firm Level Measures Analysis

The methodology used in this paper follows the (Levinsohn and Petrin, 2003) semi-parametric estimation which uses in the production function the intermediate inputs to account for endogeneity. In the Cobb Douglas production function framework we use the value added case. The value added of our output is retrieved form the difference sales revenues[17] variable with the material costs variable.

For the *capital* variable we use the tangible fixed assets variable; and for the labor variable we use the number of employees' variable.

We define *age* as the difference between the year of the reporting firm and the minimum year of reporting. Minimum year of reporting is considered the year of entry of the firm. We define *export* as a dummy variable which is retrieved from the exportrevenue variable in the dataset. It takes values of 1 if a firm reports export revenues in that year, and 0 if the firm reports no export revenues for that year.

Ownership is another dummy variable, which takes values of 1 of a firm has foreign origin, and 0 if the firm has domestic origin. *Size* is categorical variable retrieved from the number of employees' variable in the dataset. It takes values of 1 for micro firms, 2 for small firms, 3 for medium firms and 4 for large firms.

4.1 Total factor productivity

Total factor productivity the residual from the functional relationship output-inputs-productivity can be used in different policies or measures.

$$Yit = AitKit\beta kL\beta itlMit\beta m \quad (1)$$

Y_i the output of firm i in period t; A_{it} is the Hicksian efficiency of firm i in period t; K_{it} L_{it} and M_{it} are the inputs of capital, labor and materials.

$$vit = \beta 0 + \beta llit + \beta kkit + \omega it + \eta it \quad (2)$$

Equation of (3) can be transformed from the monotonicity condition into equation (4).

$$mit = mt(\omega it;kit) \quad (3)$$

$$\omega it = \omega t(mit;kit) \quad (4)$$

And if

$$\varphi it(mitkit) = \beta 0 + \beta kkit + \omega it(mit;kit)$$

then we can re-write equation (2) into equation (5)

$$vit = \beta llit + \varphi it(mitkit) + \eta it \quad (5)$$

$$E\,[vit|mit;kit] = E\,[lit|mit;kit]\beta l + \varphi it(mit;kit) \quad (6)$$

If we now subtract equation (5) to the equation (6) we get the result as in the following equation (7) which gives the possibility to regress $v_{it} - E\,[v_{it}|m_{it};k_{it}]$ on $l_{it} - E\,[l_{it}|m_{it}k_{it}]$ with a no-intercept OLS.

$$vit - E\,[vit|mit;kit] = (lit - E\,[lit|mitkit])\beta l + \eta it \quad (7)$$

In the second stage we will subtract the from the output v_{it} the value of the $\beta_l l_{it}$. (Levinsohn and Petrin, 2003) assume that productivity follows a firstorder Markov process which means that the expected value of productivity ω_{it} in time t conditional on the productivity $\omega_{i;t-1}$ of a previous period $t-1$ will be the same as the expected value of productivity if we know $\omega_{i;t-1}$ $\omega_{i;t-2}$ and so on. We notice that productivity now has two components, the expected value of productivity in time t conditional on productivity of a previous period and the 'surprise component' (the mean zero innovation).

$$\omega it = E\,[\omega it|\omega i;t-1] + \xi it \quad (8)$$

If we group together the intercept and the expected value of productivity conditional on a previous period productivity, we get equation (9) as below:

$$g(\omega i;t-1) = \beta 0 + E\,[\omega it|\omega i;t-1] \quad (9)$$

Furthermore we will estimate the coefficient of the state variable (capital) by using a variation in v^*_{it} unrelated to $g(\omega_{i;t-1})$.

$$v^*_{it} = v_{it} - \beta_l l_{it} - \beta_k k_{it} + g(\omega_{i;t-1}) + \eta^*_{it} \quad (10)$$

17 This variable is deflated across years by using the GDP deflator of 2010.

5. Empirical Results

In this section we are presenting the empirical results of finding TFP for Croatian firms by two models, the fixed effect model and the Levinsohn and Petrin method. There are some advantages in using (Levinsohn and Petrin, 2003) method, because they use intermediate inputs as a proxy for productivity which respond to the entire productivity term. And it is simpler to link theory and estimation strategy.

Table 1: Estimation of productivity

	FE model	Lev-Pet
	β/se	*β/se*
lnlabor	0.706***	0.621***
	(0.00)	(0.00)
lncapital	0.086***	0.091***
	(0.00)	(0.00)
cons	11.002***	
	(0.02)	
N	306043	306043
(se) statistics	in parenthesis	
$*p < 0.05 ** p < 0.01$	$***p < 0.001$	

In a second step we will use TFP as a dependent variable to control for other firm's characteristics (i.e. age, export status, origin of the firm, and size).

Theory explains that if tariffs decrease, firm decisions to enter export[18]market will be positively affected, which by itself will affect firm's productivity.

In the table 2 we present the OLS regression coefficients for TFP in regard to firm characteristics i.e. age, age squared, export status, origin of the firm, number of employees and to MFN tariffs. In the first column we use

MFN weighted tariffs for these countries: Bosnia & Herzegovina, China, EU, Serbia[18], Russia and USA. The two most important tariffs MFN with Serbia and European Union.

Table 2: OLS regression for MFN tariffs

	MFN weighted	MFN average
	β/p	*β/p*
age	0.223***	0.215***
	(0.00)	(0.00)
age^2	-0.039**	-0.036*
	(0.01)	(0.01)
Employees	0.198***	0.200***
	(0.00)	(0.00)
Export	0.561***	0.536***
	(0.00)	(0.00)
Ownership	0.470***	0.455***
	(0.00)	(0.00)
Bosnia	0.008	
	(0.34)	
China	0.014*	
	(0.02)	
EU	-0.031***	
	(0.00)	
Russia	0.002	
	(0.73)	

18 Exporters are more productive than non-exporters. [18]Here Serbia include even Montenegro

Serbia	-0.018***	
	(0.00)	
USA	-0.004*	
	(0.02)	
Bosnia		0.032***
		(0.00)
China		0.002
		(0.70)
EU		-0.006
		(0.60)
Russia		-0.018**
		(0.00)
Serbia		-0.014***
		(0.00)
USA		-0.004
		(0.12)
Constant	10.362***	10.368***
	(0.00)	(0.00)
*R*2	0.294	0.297
N	2557	2557
(p-value)	statistics	in parenthesis
$*p < 0.05$	$**p < 0.01$	$***p < 0.001$

From the literature review we expect to have negative coefficients for tariffs. If there is a decrease in tariffs it mean that it would have a positive impact in productivity of firms. From the literature review we expect a negative coefficient for age squared, and a positive coefficient for age. Our model now is a non-linear OLS model with a quadratic term (age squared). Productivity of firms increases across time as the firm becomes older and becomes more experienced. But at a higher age the productivity of firms start to increase at a decreasing rate, so firms are not so productivity as in the beginning. At some point productivity reaches the optimal levels, doesn't grow anymore and starts to fall. We can conclude that productivity and age have an inverted U-shaped relationship. So if European tariffs decrease by 10% we expect an increasing effect in productivity of firms by 0.3%, and if Serbian tariffs decrease by 10% we expect an increase in productivity of firms by 0.13%. And if we analyze the second column of the table 2 and we use in our estimate the MFN tariffs but in average terms, we see that European tariffs are not significant any more ($p - value > .05$). Now important tariffs are those of Russia and Serbia. They have both negative coefficients, which mean that a decrease in tariffs with those countries increases productivity of firms in Croatia. If tariffs with Russia decrease by 10% the increase in productivity is 0.2%; if tariffs with Serbia decrease by 10% we notice an increase 0.1% in productivity.

In figure 6 we check for correlation among the tariffs for all our countries. We notice that tariffs of Bosnia and Herzegovina have a positive correlation with tariffs of all the countries except for USA.

China's tariffs have positive correlation with BiH, EU and Serbia; they have a negative correlation with Russia and USA.

EU's tariffs have a positive correlation with BiH, China and Russia; they have a negative correlation with tariffs from Serbia and USA. Russia's tariffs have a positive correlation with BiH, EU and Serbia; they have a negative correlation with China and Russia.

Serbia's tariffs have a positive correlation with all countries tariffs, except

for EU tariffs. USA's tariffs have a positive correlation only with Serbia's tariffs, and with all other countries tariffs there is a negative correlation.

	Bosnia~N	China_~N	EU_MFN	Russia~N	Serbia~N	USA_MFN
Bosnia_MFN	1.0000					
China_MFN	0.1932	1.0000				
EU_MFN	0.1848	0.5634	1.0000			
Russia_MFN	0.4394	-0.0644	0.2215	1.0000		
Serbia_MFN	0.0581	0.0833	-0.0121	0.4544	1.0000	
USA_MFN	-0.0777	-0.0123	-0.0389	-0.0266	0.2012	1.0000

Figure 6: Correlation for tariffs

Now we will estimate equation (11). We have included the age squared variable and the *lagtfp* variable[19]. In this equation *controls* includes firm characteristics like age, age squared, employees, ownership; *export* is a dummy variable which takes values of 1 is firm es exporting and 0 if firm is not exporting. The β_3 reveals at what extent exporters differ from non-exporters. $lntfp_{it} = \beta_0 + \beta_1 lagTFP_{it} + \beta_2 CONTROLS_{it} + \beta_3 EXPORT_{it} + e_{it}$ (11) Also we know that the coefficients of age and age squared will not be interpreted separately. They are both significant, indicating that the relationship of TFP and age is nonlinear. Their signs will reveal to us their rough form. We notice a positive coefficient for age and a negative coefficient for age squared which may indicate a monotonic increasing function of TFP by age, until a turning point is reached and after it the function begins to decrease.

Table 3: TFP estimate

Variables	*beta/se*
Lagtfp	0.512***
	(0.00)
Age	0.023***
	(0.01)
	-0.011***
	(0.00)
Age^2	
Employees	0.116***
	(0.00)
Export	0.334***
	(0.00)
Ownership	0.405***
	(0.01)
Cons	5.154***
	(0.02)
R-squared	0.412
N	291113

6. Conclusions

During the period of pre-accession Croatia experienced growth in the external trade. We found TFP by using the Levinsohn and Petrin estimator. Croatia has a negative trade balance during the period 2003-2012, which means a propensity toward imports. Referring to table 2 in the first model age increases productivity up to 2.8 years, and after this period it decreases. We conclude that Bosnian and Russian tariffs are not significant in our specification. We notice a positive relationship productivity and China MFN weighted tariffs (maybe this is explained by the low trading between the two countries). And for European Union, Serbia and USA we confirm the negative relationship between productivity and MFN weighted tariffs. We state that exporting firms have a 56% higher productivity than non-exporting firms; and firms with foreign ownership have 47% higher productivity than firms owned by domestic actors. In the second model of the table 2 we see that results are almost the same with the one of the first model. By using MFN average tariffs we see that tariffs with China and EU are not relevant. Russia, Serbia and USA confirm the negative relationship productivity and MFN average tariffs. Referring to table 2 we see that the R^2 is low in both specifications, about 30% and very few observations 2557. If we don't include tariffs in our specification (referring to table 3) and we check only for lagged TFP (by one period), age, *age*^{2}, employees (lag by one period), export and ownership we see an increased R^2 of about 41%. And also we get a bigger sample of about 291113 observations. Productivity of the previous year increases the productivity of the actual year by almost 51% (all other variables to be held constant). Age and *age*^{2} export, employees and ownership have the same signs, but different coefficients in the model (compared to table 2.

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19 lag TFP of one period

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Appendix A: Density plots

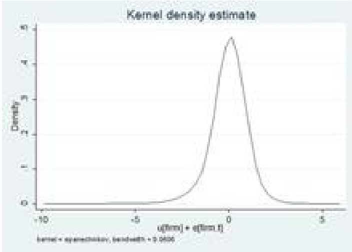

Figure 7: Kernel density TFP by FE method

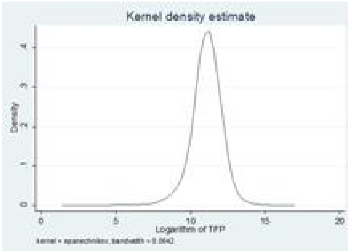

Figure 8: Kernel density TFP by LP method

Appendix B: Exporting

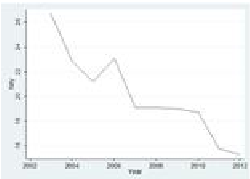

Figure 9: Italy

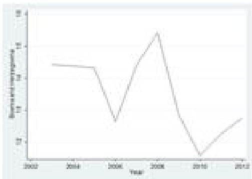

Figure 10: Bosnia

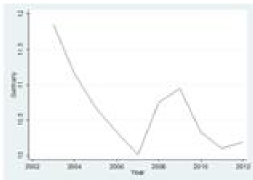

Figure 11: Germany

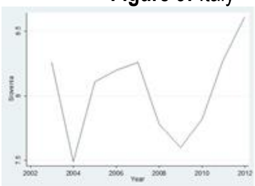

Figure 12: Slovenia

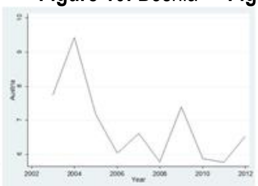

Figure 13: Austria

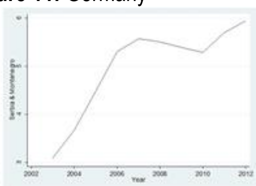

Figure 14: RS & ME

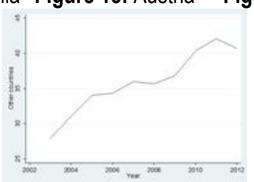

Figure 15: Other countries

Appendix C: Importing

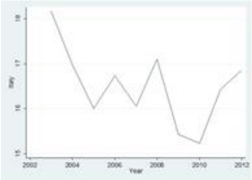
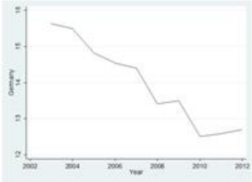
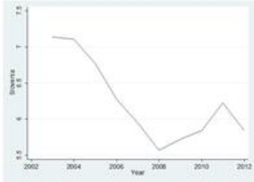

Figure 16: Italy **Figure 17:** Germany **Figure 18:** Slovenia

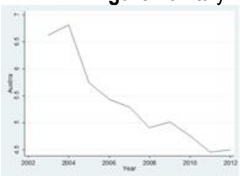
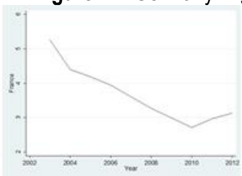
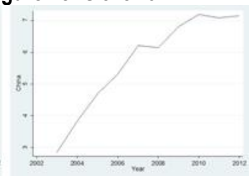

Figure 19: Austria **Figure 20:** France **Figure 21:** China

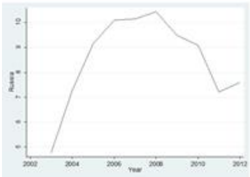
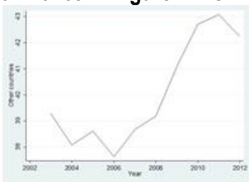

Figure 23: Other countries **Figure 22:** Russia

Appendix D: SME EU definition

In the table below 4 there is the EU definition for enterprises that we have used. According to the European definition[20] for enterprises there are three criterias for the enterprise definition: (i) number of employees (ii) annual turnover and/or (iii) balance sheet.

Table 4: Categories for enterprises

Firm category	Employees	Turnover	Balance sheet
Micro	< 10	≤2m e	≤2 m e
Small	< 50	≤10m e	≤10m e
Medium-sized	< 250	≤ 50m e	≤43m e

20 EU recommendation 2003/361