Costs of exporting: evidence from Russia

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Abstract

The paper presents the stylized facts of export firms' heterogeneity in Russia and provides quantitative estimations for the ratio of fixed costs of production to fixed costs of exporting. Both stylized facts and direct costs estimations confirm the high fixed costs of exporting for Russian firms. The costs were found to be higher today in Russia than in Chile in 1990-1996 and comparable to the one estimated for Colombia over the period 1981-1986.

1. Introduction

Fixed cost of exporting introduced by Melitz (2003) into heterogeneous firm model of international trade is one of the essential assumptions that ensure a nice fit of model results to stylized facts. A selection of more productive firms into exporters is guaranteed by the excess of export fixed costs adjusted for variable trade costs over fixed costs of production.

Empirical studies across the world (Eaton et al., 2004, Bernard and Jensen, 1999,

Dennis and Shepherd, 2007) provide evidence in the support of the theoretical framework.

In this paper we provide the stylized facts of Russian firms' heterogeneity with respect to export status and heterogeneity within Russian exporters with regard to size and destinations. Direct comparison of Russian firms' distributions along these dimensions with the ones for US and French firms (Eaton et al., 2004, Bernard and Jensen, 1999) indicate the higher fixed costs of exporting in Russia.

We use a structural model of firm's heterogeneity and export activity to estimate the proxy for export costs faced by firms in Russia and compare these costs with measures available for other countries.

The structural model is based on Melitz model (2003) and extends it to allow asymmetries among countries in terms of costs of entry, production and exporting. The existence and uniqueness of equilibrium is proved for Pareto distribution of firms' productivities. While the closed-form solution for the equilibrium parameters could not be obtained in non-symmetric case, the model offers a range of the explicit relations between various sectoral aggregates. Namely, the concentration of output in the industry measured by Gini index is found to be a quadratic function of industry-wide export to output ratio, and argmaximum of this function is uniquely defined by the ratio of fixed costs of exporting to overhead costs of production. This

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quadratic function is estimated empirically to evaluate the non-observable model parameters such as fixed costs of production and exporting. Estimations are performed for three firm-level datasets: Chile for 1990-1996, Colombia for 1981-1989 and Russia 2008. In Russian case the regional dimension of the dataset is used to compensate for the lack of time one.

Empirical evaluation of the model shows that the estimate of the fixed costs of exporting for Russian firms is comparable with those for Colombian firms and much higher than the costs for Chilean firms in 90's. Both direct and indirect evidence indicate that extensive margins of trade in Russia are hugely underexploited. High fixed costs of exporting prevent new Russian firms (with new goods) from entering foreign markets which suppresses the export diversification.

Based on these results we conclude that the successful economic policy aimed at export and industrial regional diversification should deal with relaxing entry constraints for new exporters.

The paper proceeds as follows. In the next section we present the stylized facts of firms' and exporters' heterogeneity in Russia. Then we report results of firm level data analysis and estimations of fixed costs of exporting. The last section concludes.

2. Firms' heterogeneity in Russia

Heterogeneity of Russian firms with respect to export

To evaluate firms' export heterogeneity we rely on two datasets. First, we use data on sales from RUSLANA database, a product of Bureau von Dijk that collects financial reports from about 1 billion of Russian and Ukrainian firms over 2000s. While some studies have already used this data little is known about the representativeness of the dataset.

For export data at the firm level we use Russian Customs database that contains information on all individual official cross-border transactions over 1998-2009. By merging these two datasets we obtain information on firms' sales, employment, assets, investment, export status, export volume, number of export destinations, and number of exported goods.

In the subsequent analysis we use the data for 2008.

Proportion of exporters

Out of 367,026 firms with non-missing sales data in 2008 there are 11,538 exporters. The share of exporting firms is around 3% compared to 14.6% of exporting firms in US and 17.4% of firms in France (Melitz, 2006). The distribution of manufacturing firms and exporters across industries is reported in Table 1.

Table 1 Number of producers and exporters in industries, 2008

	# of Producers	% that Export	# of Producers	% that Export	# of Producers	% that Export
	Russia, 2008		**France, 1986***		**USA, 1994***	
Food and tobacco products	8,629	6.2	59,637	5.5	11,887	13.1
Textiles and apparel	4,074	4.2	24,952	24.1	17,456	6.2
Lumber and furniture	5,581	7.7	29,196	12.1	22,518	6.7
Paper and allied products	912	8.9	1,757	45.3	4,512	18.0
Printing and publishing	8,001	1.9	18,879	15.1	27,842	2.9
Chemicals, etc.	2,778	15.3	3,901	55.4	7,312	30.3
Rubber and plastics	3,488	6.6	4,722	44.3	8,758	22.2
Leather and leather products	433	9.0	4,491	26.3	1,052	17.0
Stone, clay, glass, and concrete	4,016	6.5	9,952	16.3	10,292	9.0
Primary metal products	891	15.5	1,425	52.8	4,626	22.1
Fabricated metal industries	5,763	5.8	25,923	16.8	21,940	15.2
Machinery and computer equipment	8,255	9.0	17,164	26.8	27,003	19.6
Electronic and electrical equipment	3,717	10.2	9,382	30.2	9,525	34.6
Transport equipment	1,690	12.0	3,786	32.9	5,439	23.5
Instruments, etc.	2,142	11.4	7,567	13.3	4,232	43.1
Miscellaneous manufacturing	1,078	7.4	11,566	21.0	7,254	13.0
Coke, oil products, nuclear	273	18.3				

* Data for France are from Eaton and Kortum (2004), data for USA are from Bernard and Jensen (1995).

According to Table 1 the Russian industry with the highest penetration by exporters is chemicals, but even there the share of exporters (15%) is substantially lower than in France (55%) and USA(30%). There is no industry where the share of exporters in Russia would exceed the one in France and only in Lumber and furniture industry the share of exporters in Russia (7.7%) is higher than in USA (6.7%).

Exporters' premia

To evaluate the extent of exporter premia in Russia we follow Bernard and Jensen (1999) and estimate the following equation

$$x_{ikr} = a + b \cdot EXP_{ikr} + g \cdot lnL_{ikr} + \sum_r d_r \cdot Region_r + \sum_k h_k \cdot Industry_k + \epsilon_{ikr} \qquad (1)$$

where

x_{ikr} – characteristic of firm *i* from industry *k* from region *r*

EXP_{ikr} - dummy variable, equal to 1, in the firm *ijk* is exporter and 0, if serves only domestic market

L_{ikr} – employment in the firm *ijk*

$Region_r$, $Industry_k$ - dummy variables for region (2-digit postal code) and industry (3-digit NACE)

The summary of the results is reported in Table 2. Estimations reported in columns (b), (d) and (f) control for firm's size.

Table 2 Exporters' premia in Russia, 2008

	(a)	(b)	(c)	(d)	(e)	(f)
	All firms		**Firms with turnover < $500,000**		**Manufacturing firms**	
	(%)	(%)	(%)	(%)	(%)	(%)
Employment	136		16		311	
Assets	400	68	-	-	1300	130
Turnover	335	21	22	8	860	49
Investments	195	95	-	-	270	93
Productivity	80	21	0	8	140	49

As compared to the US firms in 1992 (Bernard and Jensen, 1999, 2002) Russian exporters have higher size premium (100% vs. 136%), and controlling for size have higher sale premium (21% vs.17%).

Within exporters' heterogeneity

Firms that serve several foreign markets are on average more productive. While this result is in line with the ones reported for other countries (Eaton et al., 2004) the Russian largest exporters do not fit into the general pattern, as the relation is non-monotonic: we find a decrease in productivity among firms serving more than 50 destinations compared to firms, serving between 3 and 50 markets.

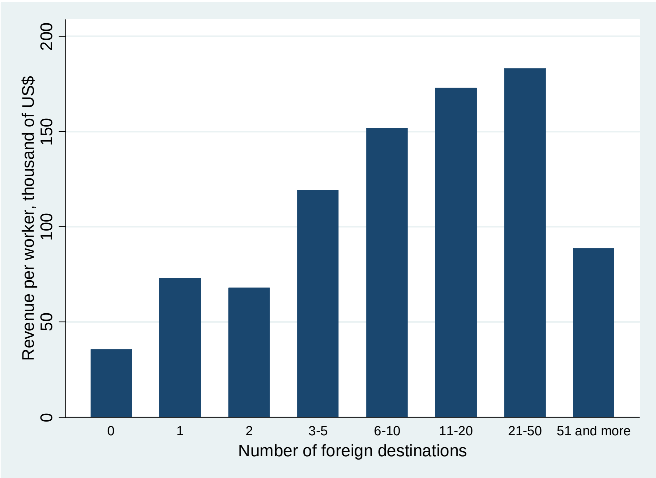

Figure 1 Productivity and number of export destinations

Most of exporters serve only one foreign market and elasticity of the number of exporters with respect to number of served destinations is equal to -1.9 (-2.5 in France, Eaton et al., 2004). That is, the number of exporting firms serving more destinations falls faster in Russia than in France

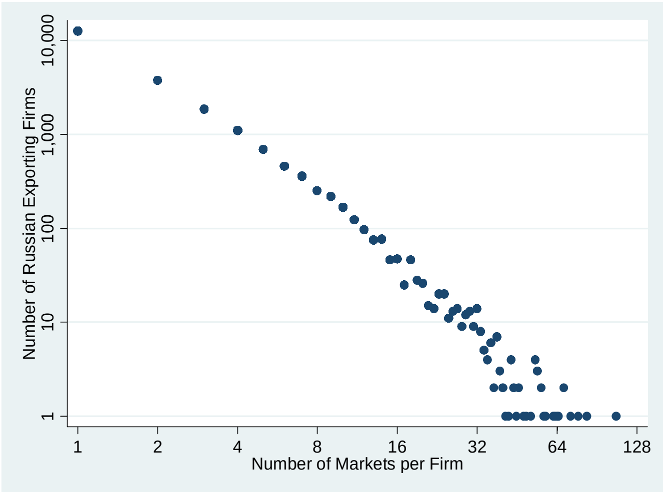

Figure 2 Entry by Russian firms

One of the important determinants of the entry to the foreign market is the size of that market. As Figure 3 shows the number of Russian firms selling to the destination normalized by the share of Russian export in this destination increases systematically with the size of the destination but with elasticity less than 1.

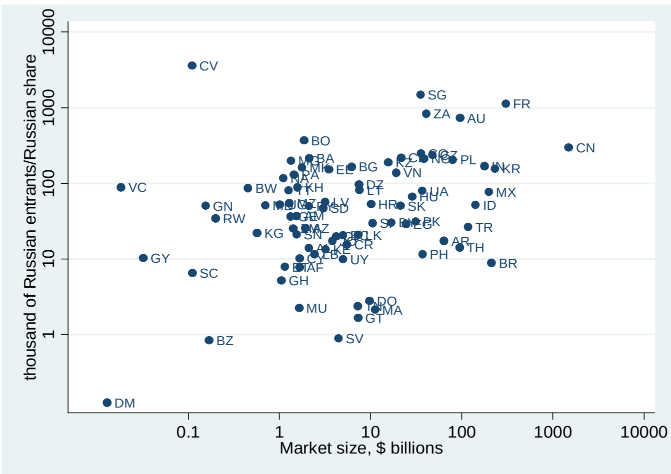

Figure 3 Entry and market size

Following Eaton et al. (2008) we decompose the overall volume of Russian export to any given destination into the export per firm (intensive margin) and number of firms selling to the destination (extensive margin). We obtain the following results.

- Given the size of the foreign market, an increase in the share of Russian export in this market is typically due to 60% more Russian firms selling in this destination and 40% more export per firm (88% and 12% respectively for French firms)
- Given Russian share in the destination market, sales to a bigger market corresponds to 38% of more firms and 62% more export per firm (62% and 38% respectively for French firms).

Summing up, while in general the pattern of heterogeneity of Russian firms with respect to export follows the ones documented in other countries, there are quantitative differences. We observe too few exporters in Russia, that enjoy higher exporter premia compared to France or US. There are more smaller exporters. More productive exporters sell to more destinations (except for the largest exporters). While an increase in foreign market penetration by Russian export is associated mainly with increase in the number of exporters, the extensive margins of trade are less pronounced in Russia than in France. We believe that these observations are consistent with a higher fixed cost of becoming an exporter in Russia. We estimate these costs in chapter 5.

3. Firm heterogeneity and export costs

In this study we use data on the concentration of firms' within industries and its relation to the openness of industry measured by export to output ratio to estimate empirically the costs of exporting. We obtain this relation by extending symmetric Melitz (2003) model of heterogeneous firms to more general asymmetric case and deriving the explicit equilibrium relation between firms' concentration in industry and its export to output ratio for a special case of Pareto distribution of firms' productivities in industry. The model setup and its solution are presented in Appendix 1.

The above mentioned relation is:

$$Gini = 1 - \frac{2(\mu-\sigma+1)}{2\mu-\sigma+1} \frac{1+\frac{f_d^H}{f_x^H}\left(\frac{e_H}{1-e_H}\right)^2}{1+\frac{f_d^H}{f_x^H}\left(\frac{e_H}{1-e_H}\right)} \quad (2)$$

where *Gini* stands for Gini concentration index of firms' revenues, employment, output etc. within the industry and e_H is equal to the export to output ratio of the industry.

The other parameters are

μ – shape parameter of Pareto distribution of productivities

σ – constant elasticity of substitution between varieties

f_d^H - overhead production cost and f_x^H – per period value of fixed costs of exporting.

The intuition behind this relation is straightforward. Each type of fixed costs implies a minimum level of productivity that satisfies the corresponding zero profit condition. Only firms productive enough to cover fixed costs of production will sell at domestic market and those productive enough to cover fixed costs of exporting will sell abroad. We assume partitioning condition to hold that ensures that minimum level of productivity for export operations exceeds the one for domestic.

Starting with closed economy equilibrium with zero export to output ratio let's open economy for international trade. The most productive firms will start selling goods abroad; their revenues, employment, etc. will rise at the expense of the least productive firms. So along with the increase in export to output ratio there will be an increase in firms' inequality in terms of various parameters. The more open is the economy, the higher is export to output ratio, the closer are the two threshold levels of productivity. At some point as more firms are exporting the inequality among firms will start to decline. Ultimately, when all firms are exporting the inequality is back to the level of autarky one but with smaller mass of active firms. So we obtain the inverse U-shape relation between Gini index for firms' revenue or employment distribution and the common proxy for industry openness, export to output ratio.

The nice feature of the relation is the lack of partner country parameters. All those parameters are already incorporated into export to output ratio which is endogenously defined in equilibrium. It allows us to extend it to cross regional cross industry analysis despite the heterogeneity of export destinations for industries in various regions.

Now, when we consider this relation as a Gini function of export to output ratio we can apply non-linear least square analysis to estimate a very important model parameter, fixed production to export costs ratio which define a number of structural characteristics of the economy. The share of exporters, the extent of export premia, intensive vs. extensive margins of trade – all depend on the size of fixed costs ratio.

To estimate this ratio for Russia we use data for 2008 and calculate Gini indexes for firms' employment within 2-digit NACE industries in all Russian regions. Then we use the following specification of equation (2)

$$Gini_{kj} = 1 - a\frac{1+\frac{f_d^H}{f_x^H}\left(\frac{e_{Hkj}}{1-e_{Hkj}}\right)^2}{1+\frac{f_d^H}{f_x^H}\left(\frac{e_{Hkj}}{1-e_{Hkj}}\right)} + \epsilon_{kj}, \text{ where} \qquad (3)$$

k – industry and *j* – Russian region, to estimate a Russian-wide fixed costs ratio. Using the structure of data we can also introduce region-specific or industry-specific fixed effects to estimate the region-specific or industry-specific fixed costs ratios.

Non parametric estimation of the relation between Gini index and export to output ratios in 2-digit manufacturing industries in Russian region presented at Figure 4.

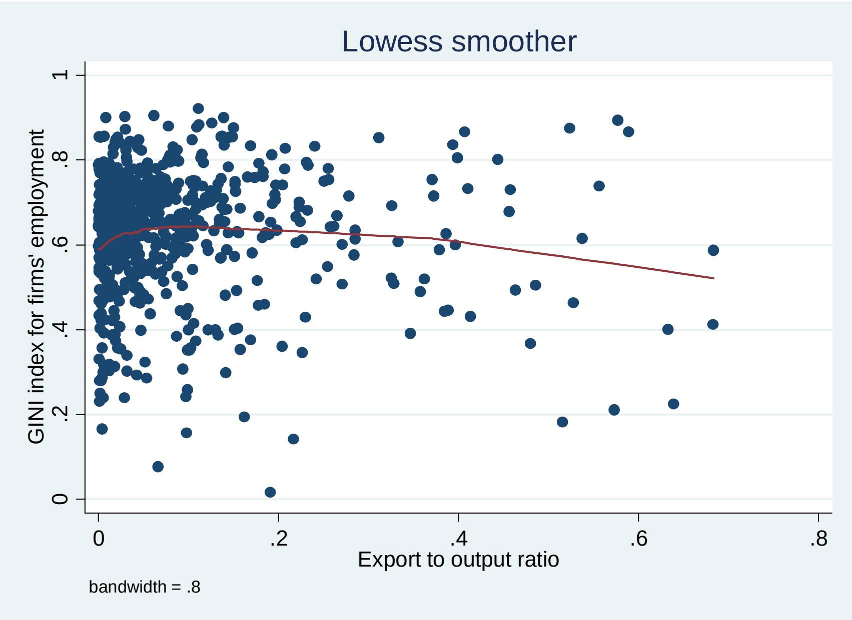

Figure 4 Nonparametric estimation of Gini on export to output ratio, 2-digit manufacturing industries in Russian regions, 2008

The results of non-linear least square estimations for Russian-wide fixed costs ratios are reported in Table 3.

Table 3 Non linear estimation of Gini on export to output ratio, 2008

Dependent variable: Gini index for employment	
a	0.38 **
	(0.008)
f_d/f_x	0.20 *
	(0.11)
Industry FE	NO
Region FE	NO
Observations	964
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1	

Comparing our results for Russia with similar estimations for Chile (1990-1996, industry) and Colombia (1981-1989, industry) we conclude that the ratio of fixed costs of production to fixed costs of exporting in Russia is similar to the one in Colombia in 1980-s (0.27± 0.12) and much smaller than in Chile (0.99±0.44)[2]. So Russian exporters face much higher costs of foreign market entry than Chilean firms and comparable one to Colombian firms.

4. Conclusions

In this study we presented stylized facts about Russian exporting firms. In general the pattern of heterogeneity of Russian firms with respect to export follows the ones documented in other countries. There are however quantitative differences. We observe too few exporters in Russia,

[2] The nonparametric estimation for Chile and the results of nonlinear OLS for Chile and Colombia are in appendix 2.

which enjoy higher exporter premia compared to France or US. There are proportionally more smaller exporters. While increase in foreign market penetration by Russian export is associated mainly with increase in the number of exporters, the extensive margins of trade are less pronounced in Russia than in France. We estimate the fixed costs of exporting and show that they are higher than the one estimated for Chilean firms over the period 1990-1996.

Based on our findings we conclude that the successful economic policy aimed at export promotion and diversification should specifically deal with relaxing entry constraints for new exporters.

Literature

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Appendix

A1. Non-symmetric Melitz model: 2 countries case

<u>Basic assumptions and notations</u>
CES preferences (elasticity of substitution $\sigma = \frac{1}{1-\rho} > 1$) and monopolistic competition
Two countries: $= H, F$.
Countries' exogenous characteristics :
size of labor force L_j, fixed entry costs f_e^j, fixed overhead costs of domestic production f_d^j, fixed overhead costs of exporting f_x^j, variable costs of exporting τ_j from country j .
δ is an exogenous rate of firm's exit, $g(\varphi), \varphi \in [\varepsilon, \infty)$ - distribution of productivity draws (assume Pareto with shape parameter μ)

Firm's profit maximization (for a firm in H country).

Domestic market operations:
Price and quantity supplied
$p_d^H(\varphi) = \frac{w_H}{\rho\varphi}$, $\quad q_d^H(\varphi) = Y_H P_H^{\sigma-1} (\frac{w_H}{\rho\varphi})^{-\sigma}$

The corresponding revenue and operation profit
$r_d^H(\varphi) = Y_H P_H^{\sigma-1} \rho^{\sigma-1} \, w_H^{1-\sigma} \varphi^{\sigma-1} = B_H W_H^{1-\sigma} y^{\sigma-1}$, where $B_j \equiv Y_j P_j^{\sigma-1} \rho^{\sigma-1}$.
$\pi_d^H(\varphi) = \dfrac{r_d^H(\varphi)}{\rho} - f_d^H$
Labor demanded
$l_d^H(\varphi) = f_d + \frac{q_d^H(\varphi)}{\varphi} = f_d + \frac{\rho}{w_H} r_d^H(\varphi)$.

Export market operations:
Price and quantity
$p_x^H(\varphi) = \frac{\tau_H w_H}{\rho\varphi}$, $\quad q_x^H(\varphi) = Y_F P_F^{\sigma-1} \left(\frac{\tau_H w_H}{\rho\varphi}\right)^{-\sigma} = B_F \rho \tau_H^{-\sigma} w_H^{-\sigma} \varphi^{\sigma}$
The corresponding revenue and operation profit
$r_x^H(\varphi) = B_F \tau_H^{1-\sigma} w_H^{1-\sigma} \varphi^{\sigma-1}$, $\quad \pi_x^H(\varphi) = \frac{r_x^H(\varphi)}{\rho} - f_x^H$
Labor demanded
$l_x^H(\varphi) = f_x^H + \dfrac{\tau_H q_x^H}{\varphi} = f_x^H + \dfrac{\rho}{w_H} r_d^x(\varphi)$

Cutoff levels
$\pi_d^H(\varphi_d^H) = \frac{r_d(\varphi_d^H)}{\sigma} - f_d^H w_H = 0 \quad \rightarrow \quad r_d(\varphi_d^H) = \sigma f_d^H w_H \quad \rightarrow \quad (\varphi_d^H)^{\sigma-1} = \frac{\sigma f_d^H w_H^{\sigma}}{B_H}$
$\forall\varphi$: $r_d(\varphi) = r_d(\varphi_d^H) \left(\dfrac{\varphi}{\varphi_d}\right)^{\sigma-1} = \sigma f_d^H w_H \left(\dfrac{\varphi}{\varphi_d}\right)^{\sigma-1}$
$\pi_x^H(\varphi_x^H) = \frac{r_x(\varphi_x^H)}{\sigma} - f_x^H w_H = 0 \quad \rightarrow \quad r_x(\varphi_x^H) = \sigma f_x^H w_H$
$\forall\varphi$: $r_x^H(\varphi) = r_x(\varphi_x^H) \left(\dfrac{\varphi}{\varphi_x^H}\right)^{\sigma-1} = \sigma f_x^H w_H \left(\dfrac{\varphi}{\varphi_x^H}\right)^{\sigma-1}$

$$\left(\frac{\varphi_d^H}{\varphi_x^H}\right)^{\sigma-1} = \frac{r_d(\varphi_d^H)}{r_d(\varphi_x^H)} = \frac{r_d(\varphi_d^H)}{\frac{r_x(\varphi_x^H)(B_H)}{B_F \tau_H^{1-\sigma}}} = \frac{B^F}{B_H} \tau_H^{1-\sigma} \frac{f_d^H}{f_x^H}$$

Distributions

<u>For Pareto:</u> $g(\varphi) = \frac{\mu}{\varepsilon}\left(\frac{\varepsilon}{\varphi}\right)^{\mu+1} \quad \rightarrow$

$$P_{in} = k(\varphi_d) = \int_{\varphi_d}^{\infty} \frac{\mu}{\varepsilon}\left(\frac{\varepsilon}{\varphi}\right)^{\mu+1} d\varphi = \left(\frac{\varepsilon}{\varphi_d}\right)^{\mu} \quad \rightarrow \quad \mu(\varphi) = \frac{g(\varphi)}{P_{in}} = \frac{\mu}{\varphi_d}\left(\frac{\varphi_d}{\varphi}\right)^{\mu+1}$$

$$\tilde{\varphi_d}^{\sigma-1} = \int_{\varphi_d}^{\infty} \varphi^{\sigma-1}\mu(\varphi)d\varphi = \frac{\mu}{\mu-\sigma+1}(\varphi_d)^{\sigma-1} = \frac{\mu}{\mu-\sigma+1}(\varphi_d)^{\sigma-1}$$

$$\tilde{\varphi_x}^{\sigma-1} = \int_{\varphi_x}^{\infty} \varphi^{\sigma-1}\mu(\varphi)d\varphi = \frac{\mu}{\mu-\sigma+1}\left(\frac{\varphi_d}{\varphi_x}\right)^{\mu-\sigma+1}(\varphi_d)^{\sigma-1}$$

$$p_x = \int_{\varphi_x}^{\infty} \mu(\varphi)dy = \left(\frac{\varphi_d}{\varphi_x}\right)^{\mu}$$

Free Entry condition (without country index)

$\varphi: g(\varphi)$ Expected payoff: $\begin{cases} 0, & \varphi < \varphi_d \\ \frac{\pi_d}{\delta}, & \varphi_d \leq \varphi \leq \varphi_x \\ \frac{(\pi_d+\pi_x)}{\delta}, & \varphi_x < \varphi \end{cases} \quad \rightarrow$

Expected payoff $= \int_{\varphi_d}^{\infty} \frac{\pi_d(\varphi)}{\delta} g(\varphi)d\varphi + \int_{y_x}^{\infty} \frac{\pi_x(\varphi)}{\delta} g(\varphi)dy =$

$$= \frac{P_{in}}{\delta}\left[\int_{\varphi_d}^{\infty}\left(\frac{r_d}{\sigma} - wf_d\right)\mu(\varphi)d\varphi + \int_{\varphi_x}^{\infty}\left(\frac{r_x}{\sigma} - wf_x\right)\mu(\varphi)d\varphi\right] =$$

$$= \frac{P_{in}}{\delta}\left[-(wf_d + wp_x f_x) + \frac{1}{\sigma}(\bar{r_d} + p_x\bar{r_x})\right] = \frac{P_{in}}{\delta}\left[-(f_d + p_x f_x)w + \frac{1}{\sigma}\bar{r}\right] \quad \rightarrow$$

Free-entry condition:

$$f_e w = \frac{P_{in}}{\delta} w\left[-(f_d + p_x f_x) + \frac{1}{\sigma w}\bar{r}\right] \quad \leftrightarrow$$

$$\frac{f_e \delta}{P_{in}} = \frac{1}{\sigma w}\bar{r} - (f_d + p_x f_x)$$

$\bar{r} \equiv \bar{r_d} + p_x \bar{r_x}$, where

$$\bar{r_d} \equiv \int_{\varphi_d}^{\infty} r_d(\varphi)\mu(\varphi)d\varphi = \frac{r_d(\varphi_d)}{\varphi_d^{\sigma-1}}\int_{\varphi_d}^{\infty}\varphi^{\sigma-1}\mu(\varphi)d\varphi = r_d(\varphi_d)\left(\frac{\tilde{\varphi_d}}{\varphi_d}\right)^{\sigma-1} = \sigma f_d w\left(\frac{\tilde{\varphi_d}}{\varphi_d}\right)^{\sigma-1}$$

$$p_x\bar{r_x} \equiv \int_{\varphi_x}^{\infty} r_x(\varphi)\mu(\varphi)d\varphi = \int_{\varphi_x}^{\infty} r_x(\varphi_x)\left(\frac{\varphi}{\varphi_x}\right)^{\sigma-1}\mu(\varphi)d\varphi = \sigma f_x w\left(\frac{\tilde{\varphi_x}}{\varphi_x}\right)^{\sigma-1} \quad \rightarrow$$

$$\bar{r} = \sigma f_d w\left(\frac{\tilde{\varphi_d}}{\varphi_d}\right)^{\sigma-1} + \sigma f_x w\left(\frac{\tilde{\varphi_x}}{\varphi_x}\right)^{\sigma-1} = \sigma w\left[f_d\left(\frac{\tilde{\varphi_d}}{\varphi_d}\right)^{\sigma-1} + f_x\left(\frac{\tilde{\varphi_x}}{\varphi_x}\right)^{\sigma-1}\right] =$$

$$= \sigma w[f_d + f_x\left(\frac{\tilde{\varphi_x}}{\tilde{\varphi_d}}\right)^{\sigma-1}\left(\frac{\varphi_d}{\varphi_x}\right)^{\sigma-1}]\left(\frac{\tilde{\varphi_d}}{\varphi_d}\right)^{\sigma-1}$$

<u>For Pareto</u>

$$p_x\bar{r_x} = \sigma w f_x\left(\frac{\tilde{\varphi_x}}{\varphi_d}\right)^{\sigma-1}\left(\frac{\varphi_d}{\varphi_x}\right)^{\sigma-1} = \frac{\mu}{\mu-\sigma+1}\left(\frac{\varphi_d}{\varphi_x}\right)^{\mu} = \frac{\mu}{\mu-\sigma+1}\sigma w f_x p_x$$

$$\bar{r_d} = \sigma f_d w \frac{\mu}{\mu-\sigma+1} \quad \rightarrow$$

$$\bar{r} = \bar{r_d} + p_x\bar{r_x} = \frac{\mu}{\mu-\sigma+1}\sigma w(f_d + p_x f_x) \quad \rightarrow$$

$$\frac{f_e\delta}{P_{in}} = \frac{\mu}{\mu-\sigma+1}(f_d + p_x f_x) - (f_d + p_x f_x) = \left(\frac{\mu}{\mu-\sigma+1} - 1\right)(f_d + p_x f_x)$$

Labor Market Equilibrium

Labor demand:

- for market entry
- for production activity

M - # of active domestic firms

→ Labor demand for production:

$$L^d_{prod} = M\int_{\varphi_d}^{\infty} l(\varphi)\mu(\varphi)d\varphi = M\left(\int_{\varphi_d}^{\infty} l_d(\varphi)\mu(\varphi)d\varphi + \int_{\varphi_x}^{\infty} l_x(\varphi)\mu(\varphi)d\varphi\right) =$$
$$= M\left(\int_{\varphi_d}^{\infty}(f_d + \frac{\rho}{w} r_d(\varphi)\mu(\varphi))d\varphi + \int_{\varphi_x}^{\infty}(f_x + \frac{\rho}{w} r_x(\varphi))\mu(\varphi)d\varphi\right) =$$
$$= M\left(f_d + p_x f_x + \frac{\rho}{W}(\overline{r_d} + p_x\overline{r_x})\right) = M_H\left(f_d + p_x f_x + \frac{\rho}{W}\bar{r}\right)$$

In steady-state equilibrium: $P_{in}M_e = \delta M$ $\rightarrow$

Mass of entering firms $M_e = \frac{\delta M}{P_{in}}$ and it requires $\frac{\delta M}{P_{in}} f_e$ units of labor $\rightarrow$

$L^d = M\left(\frac{\delta f_e}{P_{in}} + f_d + p_x f_x + \frac{\rho}{W}\bar{r}\right) = L$, where L stands for labor supply

For Pareto distribution:

$$L^d = M\left(\frac{\delta f_e}{P_{in}} + \left(1 + \frac{\mu\sigma\rho}{\mu-\sigma+1}\right)(f_d + p_x f_x)\right) = L$$

Trade Balance

$M_H p_x^H \overline{r_x^H} = b M_F p_x^F \overline{r_x^F}$

$b < 1$ $\rightarrow$ Home country is Net importer

$b > 1$ $\rightarrow$ Home country is Net exporter

$b = 1$ $\rightarrow$ Trade is balanced

b: $\frac{b-1}{1+b} = \frac{Exp-Imp}{Exp+Imp} = \frac{Trade\ Balance}{Trade\ Turnover}$

Equilibrium conditions for two countries

For Pareto Distribution

Free Entry:

$$\frac{f_e^H\delta}{P_{in}^H} = \left(\frac{\mu}{\mu-\sigma+1} - 1\right)(f_d^H + p_x^H f_x^H)$$
$$\frac{f_e^F\delta}{P_{in}^F} = \left(\frac{\mu}{\mu-\sigma+1} - 1\right)(f_d^F + p_x^F f_x^F)$$

Labor Market:

$$M_H\left(\frac{\delta f_e^H}{P_{in}^H} + \left(1 + \frac{\mu\sigma\rho}{\mu-\sigma+1}\right)(f_d^H + p_x^H f_x^H)\right) = L_H$$
$$M_F\left(\frac{\delta f_e^F}{P_{in}^F} + \left(1 + \frac{\mu\sigma\rho}{\mu-\sigma+1}\right)(f_d^F + p_x^F f_x^F)\right) = L_F$$

Trade Balance:

$$M_H \frac{\mu}{\mu-\sigma+1}\sigma w_H f_x^H p_x^H = b\, M_F \frac{\mu}{\mu-\sigma+1}\sigma w_F f_x^F p_x^F$$

where $P_{in}^H = \left(\frac{s}{\varphi_d^H}\right)^{\mu}$, $p_x^H = \left(\frac{\varphi_d^H}{\varphi_x^H}\right)^{\mu} = \left(\frac{f_d^H}{f_x^H}\frac{B_F}{B_H}\right)^{\frac{\mu}{\sigma-1}} \tau_H^{-\mu}$

$$(\varphi_d^H)^{\sigma-1} = \frac{\sigma f_d^H W_H^{\sigma}}{B_H} \rightarrow p_{in}^H = s^{\mu}\left(\frac{B_H}{\sigma f_d^H W_H^{\sigma}}\right)^{\frac{\mu}{\sigma-1}}$$

$$p_{in}^H p_x^H = s^{\mu}\left(\frac{B_F}{\sigma f_x^H W_H^{\sigma}}\right)^{\frac{\mu}{\sigma-1}}\tau_H^{-\mu} = s^{\mu}\rho^{\mu}\left(\frac{W_F L_F}{\sigma f_x^H W_H^{\sigma}}\right)^{\frac{\mu}{\sigma-1}}\tau_H^{-\mu}$$

Free entry + cutoffs

$$\frac{f_e^H\delta}{s^{\mu}}\left(\frac{\delta f_d^H W_H^{\sigma}}{B_H}\right)^{\frac{\mu}{\sigma-1}} = \left(\frac{\mu}{\mu-\sigma+1} - 1\right)\left(f_d^H + f_x^H\left(\frac{f_d^H}{f_x^H}\frac{B_F}{B_H}\right)^{\frac{\mu}{\sigma-1}}\tau_H^{-\mu}\right)$$
$$\frac{f_e^F\delta}{s^{\mu}}\left(\frac{\delta f_d^F W_F^{\sigma}}{B_F}\right)^{\frac{\mu}{\sigma-1}} = \left(\frac{\mu}{\mu-\sigma+1} - 1\right)\left(f_d^F + f_x^F\left(\frac{f_d^F}{f_x^F}\frac{B_H}{B_F}\right)^{\frac{\mu}{\sigma-1}}\tau_F^{-\mu}\right)$$

Labor Market + free entry + cutoffs

$$M_H \frac{\mu(1+\sigma\rho)}{\sigma-1} \frac{f_e^H \delta}{\delta^{\mu}} \left(\frac{\sigma f_d^H W_H^{\sigma}}{B_H}\right)^{\frac{\mu}{\sigma-1}} = L_H$$

$$M_F \frac{\mu(1+\sigma\rho)}{\sigma-1} \frac{f_e^F \delta}{\delta^{\mu}} \left(\frac{\sigma f_d^F W_F^{\sigma}}{B_F}\right)^{\frac{\mu}{\sigma-1}} = L_F$$

By dividing two conditions:

$$\frac{M_H}{M_F} \frac{f_e^H}{f_e^F} \frac{P_{in}^F}{P_{in}^H} = \frac{L_H}{L_F}$$

Expressing relative mass of firms from trade balance condition:

$$\frac{W_F f_x^F f_e^H P_{in}^F P_x^F}{W_H f_x^H f_e^F P_{in}^H P_x^H} = \frac{L_H}{L_F b} \quad \rightarrow \quad \frac{W_F}{W_H} \left(\frac{f_e^H}{f_x^H}\right) \left(\frac{f_x^F}{f_e^F}\right) \frac{P_{in}^F P_x^F}{P_{in}^H P_x^H} = \frac{L_H}{bL_F} \quad \rightarrow$$

$$\frac{W_F}{W_H} \frac{f_e^H}{f_x^H} \frac{f_x^F}{f_e^F} \left(\frac{W_H L_H P_H^{\sigma-1} f_x^H W_H^{\sigma}}{W_F L_F P_F^{\sigma-1} f_x^F W_F^{\sigma}}\right)^{\frac{\mu}{\sigma-1}} \left(\frac{\tau_H}{\tau_F}\right)^{\mu} = \frac{L_H}{bL_F} \quad \rightarrow$$

relation between relative wages and relative price indexes in stationary equilibrium

$$\left(\frac{W_F}{W_H}\right)^{1-\frac{\sigma+1}{\sigma-1}\mu} = \frac{L_H}{bL_F} \frac{f_x^H}{f_x^F} \frac{f_e^F}{f_e^H} \left(\frac{L_F}{L_H} \frac{f_x^F}{f_x^H}\right)^{\frac{\mu}{\sigma-1}} \left(\frac{\tau_F}{\tau_H}\right)^{\mu} \left(\frac{P_F}{P_H}\right)^{\mu} \quad \rightarrow$$

$$\left(\frac{W_F}{W_H}\right)^{1-k} = A \left(\frac{P_F}{P_H}\right)^{\mu}$$, where $k \equiv \frac{\sigma+1}{\sigma-1}\mu$, $A \equiv \frac{L_H}{bL_F} \frac{f_x^H}{f_x^F} \frac{f_e^F}{f_e^H} \left(\frac{L_F}{L_H} \frac{f_x^F}{f_x^H}\right)^{\frac{\mu}{\sigma-1}} \left(\frac{\tau_F}{\tau_H}\right)^{\mu}$

Putting it into the ratio of two free-entry conditions:

$$\frac{f_e^H}{P_{in}^H} \frac{P_{in}^F}{f_e^F} = \frac{f_d^H + P_x^H f_x^H}{f_d^F + P_x^F f_x^F} \quad \rightarrow$$

$$\frac{f_e^H}{f_e^F} \left(\frac{B_F}{B_H} \frac{f_d^H W_H^{\sigma}}{f_d^F W_F^{\sigma}}\right)^{\frac{\mu}{\sigma-1}} = \frac{f_d^H + f_x^H \left(\frac{f_d^H B_F}{f_x^H B_H}\right)^{\frac{\mu}{\sigma-1}} \tau_H^{-\mu}}{f_d^F + f_x^F \left(\frac{f_d^F B_H}{f_x^F B_F}\right)^{\frac{\mu}{\sigma-1}} \tau_F^{-\mu}}$$

$$\frac{f_e^H}{f_e^F} \left(\frac{L_F}{L_H} \frac{f_d^H}{f_d^F}\right)^{\frac{\mu}{\sigma-1}} \left(\frac{P_F}{P_H}\right)^{\mu} \left(\frac{W_H}{W_F}\right)^{\mu} = \frac{f_d^H + f_x^H \left(\frac{L_F f_d^H}{L_H f_x^H}\right)^{\frac{\mu}{\sigma-1}} \left(\frac{P_F}{P_H}\right)^{\mu} \left(\frac{W_F}{W_H}\right)^{\frac{\mu}{\sigma-1}} \tau_H^{-\mu}}{f_d^F + f_x^F \left(\frac{L_H f_d^F}{L_F f_x^F}\right)^{\frac{\mu}{\sigma-1}} \left(\frac{P_H}{P_F}\right)^{\mu} \left(\frac{W_H}{W_F}\right)^{\frac{\mu}{\sigma-1}} \tau_F^{-\mu}}$$

The ultimate equation for relative wages:

$$x^{2m-1} + \frac{f_e^F}{f_e^H} \frac{L_H}{bL_F} \left(\frac{f_x^H}{f_d^F}\right)^{1-\frac{\mu}{\sigma-1}} \tau_H^{-\mu} x^m - \frac{f_e^F}{f_e^H} \left(\frac{f_x^H}{f_d^F}\right)^{1-\frac{\mu}{\sigma-1}} \tau_H^{-\mu} x^{m-1} - \frac{f_e^F}{f_e^H} \frac{L_H}{bL_F} \left(\frac{f_x^H}{f_d^F}\right)^{1-\frac{\mu}{\sigma-1}} \tau_H^{-\mu} \cdot \frac{f_e^F}{f_e^H} \left(\frac{f_d^H}{f_x^F}\right)^{1-\frac{\mu}{\sigma-1}} \tau_F^{\mu}$$

=0

Where $x \equiv \frac{w_H}{w_F}$, $m = \frac{\mu\sigma}{\sigma-1}$>1

$$\left(x^{m-1} + \frac{f_e^F}{f_e^H} \frac{L_H}{bL_F} \left(\frac{f_x^H}{f_d^F}\right)^{1-\frac{\mu}{\sigma-1}} \tau_H^{-\mu}\right) \left(x^m - \frac{f_e^F}{f_e^H} \left(\frac{f_x^H}{f_d^F}\right)^{1-\frac{\mu}{\sigma-1}} \tau_H^{-\mu}\right) = \left(\frac{f_e^F}{f_e^H}\right)^2 \frac{L_H}{bL_F} \left(\frac{f_x^H}{f_x^F} \frac{f_d^H}{f_d^F}\right)^{1-\frac{\mu}{\sigma-1}} \left(\frac{\tau_F}{\tau_H}\right)^{\mu} \left(1 - \left(\frac{f_x^H}{f_d^F} \frac{f_x^F}{f_d^H}\right)^{1-\frac{\mu}{\sigma-1}} \tau_F^{-\mu}\right)$$

or $(x^{m-1} + a)(x^m - b) = c,\ m > 1$

Based on the Descartes' Rule of Sign this equation for relative wages always has one and only one real solution.

Cutoff levels then:

$$(\varphi_d^H/\varphi_x^H)^\mu = \frac{f_e^H}{f_e^F}\frac{bL_F}{L_H}\ \frac{f_x^F}{f_x^H}\left(\frac{f_d^H}{f_x^F}\right)^{\frac{\mu}{\sigma-1}}\tau_F^{-\mu}\left(\frac{w_H}{w_F}\right)^{m-1}$$

$(\varphi_d^H)^{\sigma-1} = \frac{\sigma f_d^H w_H^\sigma}{w_H L_H P_H^{\sigma-1}\rho^{\sigma-1}} = \frac{\sigma f_d^H}{\rho^{\sigma-1}}\frac{w_H^{\sigma-1}}{P_H^{\sigma-1}}$ - can be found from free entry condition:

$$\frac{f_e^H\delta}{P_{in}^H} = \left(\frac{\mu}{\mu-\sigma+1}-1\right)(f_d^H + p_x^H f_x^H) \to \frac{f_e^H\delta}{\varepsilon^\mu}(\varphi_d^H)^\mu = \left(\frac{\mu}{\mu-\sigma+1}-1\right)\left(f_d^H + \left(\frac{\varphi_d^H}{\varphi_x^H}\right)^\mu f_x^H\right) \to$$

Absolute levels of cutoff
For active firms

$$(\varphi_d^H)^\mu = \frac{\varepsilon^\mu}{f_e^H\delta}\left(\frac{\mu}{\mu-\sigma+1}-1\right)\left(f_d^H + \frac{f_e^H}{f_e^F}\frac{bL_F}{L_H}f_x^F\left(\frac{f_d^H}{f_x^F}\right)^{\frac{\mu}{\sigma-1}}\tau_F^{-\mu}\left(\frac{w_H}{w_F}\right)^{m-1}\right) \to$$

For exporting firms

$$(\varphi_x^H)^\mu = \frac{\varepsilon^\mu}{f_e^H\delta}\left(\frac{\mu}{\mu-\sigma+1}-1\right)f_x^H\left(\frac{f_e^F}{f_e^H}\frac{L_H}{bL_F}\frac{f_d^H}{f_x^F}\left(\frac{f_x^F}{f_d^H}\right)^{\frac{\mu}{\sigma-1}}\tau_F^\mu\left(\frac{w_H}{w_F}\right)^{1-m}+1\right) \to$$

$$(\varphi_d^F/\varphi_x^F)^\mu = \frac{f_e^F}{f_e^H}\frac{L_H}{bL_F}\frac{f_x^H}{f_x^F}\left(\frac{f_d^F}{f_x^H}\right)^{\frac{\mu}{\sigma-1}}\tau_H^{-\mu}\left(\frac{w_H}{w_F}\right)^{1-m}$$

$$(\varphi_d^H/\varphi_d^F)^\mu = \frac{f_e^H}{f_e^F}\frac{f_x^F}{f_x^H}\frac{bL_F}{L_H}\left(\frac{L_H}{L_F}\frac{f_x^H}{f_x^F}\frac{f_d^H}{f_d^F}\right)^{\frac{\mu}{\sigma-1}}\left(\frac{\tau_H}{\tau_F}\right)^\mu\left(\frac{w_H}{w_F}\right)^{2m-1}$$

Value of output of H country:

$$Output = M_H\left(\int_{\varphi_d^H}^\infty p_d^H(\varphi)q_d^H(\varphi)\mu(\varphi)d\varphi\ + \int_{\varphi_x^H}^\infty p_x^H(\varphi)q_x^H(\varphi)\mu(\varphi)d\varphi\ \right) = M_H(\overline{r_d^H} + p_x^H\overline{r_x^H})$$

Value of export

$$Export = M_H\int_{\varphi_x^H}^\infty p_x^H(\varphi)q_x^H(\varphi)\mu(\varphi)d\varphi\ = M_H p_x^H\overline{r_x^H}$$

Ratio of export to output:

$$\frac{Export_H}{Output_H} = \frac{p_x^H\overline{r_x^H}}{\overline{r_d^H}+p_x^H\overline{r_x^H}} = \frac{1}{1+\frac{f_e^F}{f_e^H}\frac{L_H}{bL_F}\left(\frac{f_d^H}{f_x^F}\right)^{1-\frac{\mu}{\sigma-1}}\tau_F^\mu\left(\frac{w_H}{w_F}\right)^{1-m}} \equiv e_H$$

Output per worker = w_H

Gini (for distribution of revenues at Home)

$$Gini_{revenue} = 1 - \frac{2(\mu-\sigma+1)}{2\mu-\sigma+1}\,\frac{1+\left(\frac{B_F}{B_H}\right)^{\frac{2\mu}{\sigma-1}}\tau_H{}^{-2\mu}\left(\frac{f_d^H}{f_x^H}\right)^{\frac{2\mu}{\sigma-1}-1}}{1+\left(\frac{B_F}{B_H}\right)^{\frac{\mu}{\sigma-1}}\tau_H{}^{-\mu}\left(\frac{f_d^H}{f_x^H}\right)^{\frac{\mu}{\sigma-1}}} =$$

$$= 1 - \frac{2(\mu-\sigma+1)}{2\mu-\sigma+1}\,\frac{1+\frac{f_x^H}{f_d^H}(p_x^H)^2}{1+p_x^H} =$$

$$= 1 - \frac{2(\mu-\sigma+1)}{2\mu-\sigma+1}\,\frac{1+\left(\frac{bL_F}{L_H}\frac{f_e^H}{f_e^F}\;f_x^F\right)^2\left(\frac{f_d^H}{f_x^F}\right)^{\frac{2\mu}{\sigma-1}}\tau_F{}^{-2\mu}\left(\frac{1}{f_d^H f_x^H}\right)\left(\frac{w_H}{w_F}\right)^{2(m-1)}}{1+\frac{bL_F}{L_H}\frac{f_e^H}{f_e^F}\frac{f_x^F}{f_x^H}\left(\frac{f_d^H}{f_x^F}\right)^{\frac{\mu}{\sigma-1}}\tau_F{}^{-\mu}\left(\frac{w_H}{w_F}\right)^{m-1}} =$$

$$= 1 - \frac{2(\mu-\sigma+1)}{2\mu-\sigma+1}\,\frac{1+\frac{f_d^H}{f_x^H}\left(\frac{e_H}{1-e_H}\right)^2}{1+\frac{f_d^H}{f_x^H}\left(\frac{e_H}{1-e_H}\right)}$$

where $e_H = \frac{Export_H}{Output_H}$

Note: distribution of other firms' characteristics (output, employment etc.) follows the same pattern as revenue and have similar Gini index.

A2. Estimation of fixed costs ratios for Chile and Colombia

Data: 1) Chile, industry, 1990-1996
2) Colombia, industry, 1981-1989

- Firm level data (2,837 - 5,466 firms depending on the year)
- Data on: output, employment, profit, export, industry (3-digit ISIC, 29 industries)
- From firm-level data to industry-level data:
  - Gini is evaluated for firms' employment within 3-digit ISICs
  - Sum of export to sum of output is measured for 3-digit ISICs

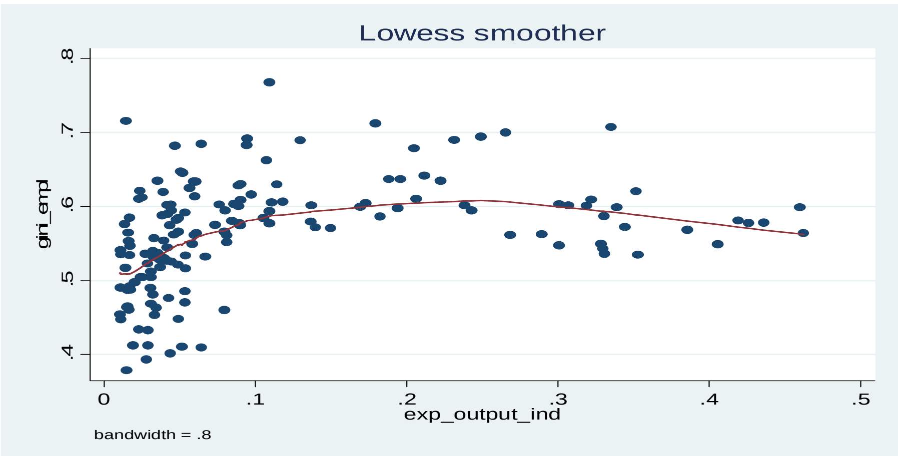

Figure 5 Non parametric estimation. Gini and export to output ratio. Chile, 1990-1996, 3-digit ISIC

Table 4 Non linear estimation of Gini on export to output ratio: Colombia 1981-1989, Chile 1990-1996, 3-digit ISIC

Dependent variable: Gini coefficient for employment								
	Chile				Columbia			
a	0.613***	0.613***	0.441***	0.441***	0.426***	0.426***	0.324***	0.324***
	(0.023)	(0.023)	(0.036)	(0.036)	(0.009)	(0.009)	(0.009)	(0.009)
f_d/f_x	6.253***		0.995**		1.972***		0.273**	
	(1.220)		(0.441)		(0.462)		(0.124)	
$f_d/f_x - 1$		5.252***		-0.004		0.972***		-0.726***
		(1.220)		(0.01)		(0.462)		(0.124)
Industry dummies	No	No	Yes	Yes	No	No	Yes	Yes
Year dummies	No	No	Yes	Yes	No	No	Yes	Yes
Number of observations	173	173	173	173	261	261	261	261

Standard errors are in parentheses. *, **, *** - 10%, 5%, 1% level of significance