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Schumpeterian Micro-Economics, International Trade and Macro-Economic Policy

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I. Introduction

Macroeconomic policy could be much improved if we had a better understanding of the working of the capitalist mechanism.

Schumpeter – along with many other economists of the Austrian School – warned the Neoclassical School that the premise on which they were building their models, diminishing returns, was not supported by the evidence. Schumpeter held that with the industrial revolution, increasing rather than decreasing returns were the rule. Schumpeter demonstrated the importance of economies of scale by tracing the trajectories of enterprises in five industries – textiles, railroads, steel, automobiles and electric power - in three countries- The US, Germany and the UK. His main conclusion is that creative destruction is the engine of capitalism. Creative destruction can be decomposed into two terms:

1. The contribution from entry and exit.
2. The contribution of economies of scale.

Schumpeter arrived at these conclusions by describing a panel of enterprises in five industries across time in three countries. The purpose of this paper is to replicate

Schumpeter´s experiments with a longitudinal database for Colombia. In this paper we seek to examine the relevance of entry and exit as compared to economies of scale in the process of creative destruction.

Schumpeter rejects the idea that his model only refers to significant innovations like the railroad or electricity: "There is, however, some danger in overstressing such obvious instances, because this may easily lead to the familiar attitude of confining the phenomenon to this class and overlooking it in all others – hence, to missing its true dimensions."[1]

If the processes described by Schumpeter pervade the whole economy, then, with a longitudinal database, it should be possible to describe the paths of firms and inquire into the importance of entry and exit and economies of scale.

We verify that there exists a high correlation between economies of scale, productivity and exports. The examination of this relationship lets us spell important policy prescriptions. For example: in this time of crisis, any move toward protectionism would lead to the destruction of economies of scale and the loss of thousands of jobs. In addition, macroeconomic policies aimed at particular enterprises may be more efficient and transparent than the promotion or protection of whole sectors.

[1] Schumpeter, (1939), p.101.

Thus, at the international level every effort should be made to resume the Doha Round of Trade Negotiations. At the domestic level the provision of help to new and growing firms would be more efficient than providing sectoral help. More can be attained by promoting the foundation and growth of enterprise than the maintenance of old and obsolete technologies. Resources should be directed to the retraining of labor so that it can easily move from low to high productivity enterprises within the same sectors.

The structure of this paper is the following: in the second section, we present the description of the micro-economic process formulated by Schumpeter. Here we abstract from the two strands of the literature proposed to handle economies of scale – endogenous growth and monopolistic competition. These are described in detail in James M. Buchanan's The Return of Increasing Returns. To fix ideas we formulate a descriptive picture of the decision facing the entrepreneur: to invest more and get lower labor costs per unit of production or to invest less and face a steeper marginal cost curve. To empirically establish the plausibility of the model we test two hypothesis derived from the model: the wide dispersion in the size of firms, even in very narrowly defined sectors, and the idiosyncratic behavior of firms in the same sectors at the same time. Next we investigate the productivity of entry, continuing and exit firms and evaluate the relative importance of entry and exit relative to economies of scale. These two phenomena lead to the famous creative destruction proposed by Schumpeter.

In the third section we establish the tradeoff between machinery and labor costs in Colombia. In this examination we implicitly use the models derived by List and Zhou and

Aghion and Howitt. We find that the expectation of a larger market leads to a greater investment in plant and machinery. The larger investment in machinery is conducive to lower labor costs per unit of production. The higher labor productivity enables to firm to compete in international markets.

In the fourth section we examine the introduction of economies of scale in the explanation of international trade flows. In the fifth section we examine the macro economic implications of the Schumpeter model of the micro-economy.

Section II. Theoretical and Empirical foundations of the Schumpeter Model

The microeconomic model developed by Schumpeter (1939) differs from the classical supply and demand model in that it stresses the role of the entrepreneur, innovation, creative destruction and economies of scale. Schumpeter was wary of the classical model because it relies on the constancy of the number of goods, diminishing returns to scale, and zero profits for firms. Although the classical microeconomic model is useful in a number of specific situations, "we hold, however, that this model covers less ground than is commonly supposed and that the whole economic process cannot be adequately described by it... "[2] Therefore Schumpeter sets out to explain the capitalist engine from a

[2] Schumpeter (1939), p.98.

different perspective. We feel this perspective helps to explain international trade flows and also provides the basis for a new approach to macroeconomics. Therefore, it stands to reason that we should try to explain the Schumpeter model in a way that might find its' way into microeconomic textbooks.[3]

Another big difference between the Schumpeterian and the classical model is that in the Schumpeterian microeconomics the economy is supply driven. Innovation – new products or new ways of making the same things but cheaper – drives the capitalistic system. Consumption is not the driver of change: "Railroads have not emerged because any consumers took the initiative … Nor did consumers display any such initiative to have electric lamps or rayon stocking, or to travel by motorcar or airplane, or to listen to radios, or to chew gum"[4]

The objectives of this section are to:

1. Present the "economic mechanism" described by Schumpeter.
2. Examine how this mechanism translates into graphical terms.
3. Review the firm level evidence that confirms the working of the Schumpeterian model.

[3] Diamond (2007).

[4] Schumpeter (1939), p. 73.

Schumpeter leaves no doubt as to his intentions to add to the body of existing microeconomics. In Chapter 3 of his *Business Cycles* (1939) he states:

> "*Internal Factors of Change.* – We start from the picture, sketched in the preceding chapter, of an economic process which merely reproduces itself at constant rates and is in equilibrium at every point in time. We recall that there are two motives for doing so. We wish to guard effectively against circular reasoning, and to use the relations which link economic quantities in such a process as an ´apparatus of response.´ And we ask the question: What is it that makes that process change in historic time?"[5]

Schumpeter also states:

> "that a picture drawn on the Walrasian-Marshallian lines ceases to be true… The reasonable thing for us to do, therefore, seems to be to confine the traditional analysis to the ground on which we find it useful and to adopt other assumptions for the purpose of describing a class of facts which lies beyond that ground." [6]

The elements Schumpeter wants to introduce are(pp. 93-98):

- 1. New plant and equipment which leads to "a change in some production function"

[5] Schumpeter (1939), p. 72.

[6] Schumpeter (1939), p.99.

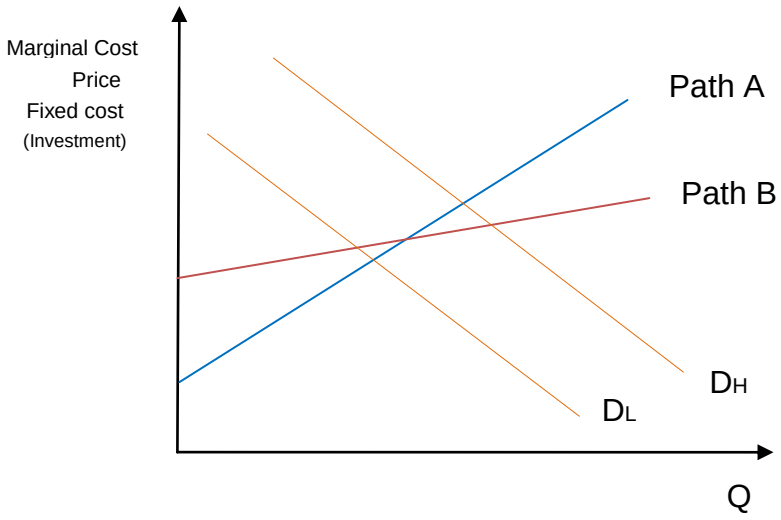
- 2. Creation and destruction: “Most new firms are founded with an idea or for a definite purpose. The life goes out of them when that idea or purpose has been fulfilled or has become obsolete or even if, without having become obsolete, it has ceased to be new”

- 3. The role of the entrepreneur: “innovations are always associated with the rise to leadership of New Men”.

In order to describe the wide heterogeneity of firms and the different dynamics of firms within narrowly defined sectors we develop an elementary version of the Schumpeter[7] decision process. In figure 1 we sketch two of the many possible alternatives open to the firm. Thus, the firm could invest little and face large marginal costs as depicted by path A or the firm could chose a higher investment and lower marginal costs as shown by path B. The optimal path would obviously depend on demand. However, if this demand is uncertain as depicted by the two demand curves D_L (low) and D_H (high), the choice for the firm becomes more difficult.

Figure 1: The Decision of the Firm

[7] Schumpeter, (1939), chapter III.



Given the demand uncertainty and the wide range of choices open to firms, it is only natural to expect firms to make very different choices with respect to size. The dispersion with respect to size could be magnified and the firms could opt for more sophisticated technology if the D_H schedule were to shift to the right by the possibility of exporting.

The empirical evidence for the model is presented in table 1 that shows the size distribution of firms by 3-digit ISIC sector. In most sectors we find firms in all quintiles. There are only three sectors – dressing and dyeing of fur, manufacture of coke oven products, manufacture of insulated wire and cable – where we do not find small enterprises (quintiles 1 and 2). There are only three sectors – casting of metals; manufacture of office, accounting and computing machinery; and manufacture of watches and clocks – where we do not find enterprises belonging to quintiles 4 and 5.

Table 1

Distribution of firms according to sector, quintile and exports (2006)

3-digit ISIC sector *	Quin 1	Quin 2	Quin 3	Quin 4	Quin 5	Total	# firms export	Firms that export (%)
Production, processing and preservation of meat and fish	18	23	26	37	68	172	8	5
Processing and preserving of fruit and vegetables	11	14	16	28	45	114	39	34
dairy products	13	22	27	31	46	139	16	12
starches and starch products	25	26	53	48	70	222	10	5
macaroni, noodles, couscous and similar farinaceous products	123	112	97	87	64	483	16	3
Coffee	21	23	25	28	13	110	45	41
Sugar	0	2	2	5	18	27	13	48
other food products n.e.c.	25	24	27	31	44	151	42	28
Beverages	23	22	11	36	45	137	10	7
tobacco products	2	1	2	0	3	8	2	25
Preparation and spinning of textile fibres	2	1	1	4	14	22	7	32
weaving of textiles	3	4	4	14	22	47	15	32
Finishing of textiles	4	9	10	17	21	61	4	7
other textiles n.e.c.	20	19	28	35	32	134	31	23
crocheted fabrics	7	15	9	29	31	91	29	32
wearing apparel	119	131	160	168	203	781	214	27
Dressing and dyeing of fur	0	0	0	0	1	1	1	100
Tanning and dressing of leather	12	9	7	8	7	43	7	16
Footwear	46	54	56	54	29	239	66	28
luggage, handbags and the like	13	10	19	12	17	71	38	54
Sawmilling and planing of wood	22	21	9	9	1	62	1	2
veneer sheets	0	2	3	3	6	14	4	29
builders' carpentry and joinery	2	8	4	7	7	28	2	7
wooden containers	1	6	5	4	1	17	0	0
other products of wood	1	11	6	3	0	21	7	33
paper and paper products	21	35	56	65	82	259	63	24
Publishing of books, brochures, musical books and other publications	23	17	26	28	31	125	35	28
Printing	57	66	63	47	34	267	31	12
Service activities related to printing	5	12	8	9	2	36	0	0
coke oven products	0	0	0	0	2	2	2	100
refined petroleum products	9	10	9	4	5	37	6	16
basic chemicals	23	21	35	38	32	149	48	32
other chemical products	67	59	83	132	151	492	134	27
man-made fibres	0	1	0	0	2	3	2	67
rubber products	11	21	16	22	14	84	20	24
plastics products	53	84	93	130	146	506	134	26
glass and glass products	6	9	16	15	17	63	23	37
non-metallic mineral products n.e.c	35	44	66	89	98	332	51	15
basic iron and steel	7	24	23	18	33	105	29	28
basic precious and non-ferrous metals	3	8	12	7	9	39	15	38
Casting of metals	1	0	0	0	0	1	0	0
structural metal products	28	33	35	40	27	163	21	13
other fabricated metal products	48	70	75	50	69	312	72	23

general purpose machinery	20	49	42	58	40	209	56	27
special purpose machinery	33	44	48	40	20	185	36	19
domestic appliances n.e.c	4	7	2	1	12	26	10	38
office, accounting and computing machinery	2	1	0	0	0	3	0	0
electric motors, generators and transformers	4	9	7	8	10	38	8	21
electricity distribution and control apparatus	5	3	4	11	8	31	10	32
insulated wire and cable	0	0	3	2	3	8	2	25
accumulators, primary cells and primary batteries	1	0	0	5	5	11	6	55
electric lamps and lighting equipment	12	9	6	7	6	40	7	18
other electrical equipment n.e.c.	2	6	7	7	11	33	12	36
electronic valves and tubes and other electronic components	2	0	4	3	1	10	2	20
television and radio transmitters and apparatus for line telephony and line telegraphy	1	0	0	0	3	4	2	50
television and radio receivers	2	1	2	1	1	7	3	43
instruments and appliances for measuring	6	10	10	10	10	46	11	24
optical instruments and photographic equipment	0	2	2	4	2	10	2	20
watches and clocks	1	0	0	0	0	1	0	0
motor vehicles	4	2	3	5	5	19	2	11
coachwork for motor vehicles; trailers and semi-trailers	12	15	9	18	13	67	4	6
parts and accessories for motor vehicles and their engines	21	16	14	24	30	105	35	33
Building and repairing of ships	1	1	3	1	1	7	0	0
aircraft and spacecraft	1	1	0	2	3	7	0	0
transport equipment n.e.c.	4	5	5	9	8	31	8	26
Furniture	64	65	75	80	52	336	46	14
Manufacturing n.e.c.	39	32	30	38	31	170	46	27

Source: Calculations of the authors on the basis of the Annual Manufacturing Survey

* International Standard Industrial Classification (**ISIC**) revision 3.

A surprising finding is that there is at least one exporter in each of 60 of the 67 sectors described. That is, in all but seven of the sectors there is a high productivity firm that can compete internationally. Visual inspection of table 1 also reveals that there is a close correlation between the number of exporters and the number o quintile 5 enterprises.

The firms in figure 1 may differ in their evaluation of demand and adopt different marginal/investment cost strategies. A good number of these firms will not have made the right decision and will find the need to contract or expand. Thus, for example, a firm on path A that finds that the demand is D_H will find that its costs are higher than those of its competitors. If investment is lumpy and sunk, such a firm would tend to shrink and,

eventually, close. On the other hand, a firm that had estimated a demand between D_L and D_H and had chosen path B would be in a good situation to expand. Thus, evenly in narrowly defined sectors, we find firms that are expanding while others are contracting. In the same sectors we also find the establishment of new firms while others are closing.

Table 2: The Divergent behavior of firms in Sectors in Expansion
2000-2006

			Creation of employment		Destruction of employment	
2-digit ISIC	Total employment year 2000	Net change in the employment %	New firms %	Firms in expansion %	Firms in contraction %	Exit Firms %
food products and beverages	133314	0,8	2,9	14,9	13,7	3,3
Textiles	46147	8,4	7,4	15,9	10,0	4,9
wearing apparel	71207	1,7	5,9	21,9	13,4	12,6
paper and paper products	19697	2,5	5,3	16,2	14,1	4,9
refined petroleum products	4607	16,7	0,6	20,8	2,9	1,8
chemicals and chemical products	51146	11,8	3,7	24,3	12,0	4,2
rubber and plastics products	33359	12,2	4,0	21,3	10,2	2,9
other non-metallic mineral products	27236	6,1	6,9	18,6	13,8	5,5
basic metals	12771	16,2	3,7	21,4	6,2	2,6
fabricated metal products	21185	4,0	4,0	19,8	11,9	7,8
machinery and equipment n.e.c.	20317	1,7	3,2	21,4	13,1	9,9
electrical machinery and apparatus n.e.c.	11354	12,7	4,8	25,4	11,4	6,0
communication equipment	2422	30,5	1,2	48,9	8,2	11,4
medical appliances and instruments and appliances	2349	17,3	1,1	26,7	5,9	4,7
motor vehicles, trailers and semi-trailers	9398	12,4	4,4	27,7	12,7	6,9
other transport equipment	3908	16,8	0,5	27,0	9,5	1,2
manufacturing n.e.c.	20860	5,1	3,2	20,8	12,4	6,4

Table 2 shows the 17 sectors that grow in terms of employment and we find firms closing and destroying employment at the same time that firms are starting and creating employment. Other firms are expanding and creating jobs while others are contracting. Thus, for example, in the rubber and plastics sector, total employment grew by 12.2%. This growth is accounted for the creation of jobs by new firms (4.0%) and expanding

firms (21.3%), less the destruction of jobs by contracting firms (10.2%) and exit firms (2.9%).

We find the same behavior in contracting sectors as shown in table 3. Even in contracting sectors we find new firms being started up and expanding firms creating employment.

Table 3: The divergent behavior of firms in contraction sectors 2000-2006.

			Creation of employment		Destruction of employment	
2-digit ISIC	Total employment year 2000	Net change in the employment %	New firms %	Firms in expansion %	Firms in contraction %	Firms that close %
tobacco products	1091	-5,96	0,00	15,67	9,53	12,1
Tanning and dressing of leather and manufacture of footwear	17623	-6,77	3,84	17,35	20,24	7,72
wood	4277	-2,83	4,4	19,06	17,63	8,65
Publishing and printing	23812	-4,1	4,32	12,89	15,74	5,57

The paradox of job losses in expanding sectors and job generation in contracting sectors shows up in all sectors. This behavior corresponds much more clearly to the Schumpeter model than to the traditional Marshallian equilibrium with a collection of representative firms that enter or exit a sector according to the latter´s expansion or contraction. The results presented in the tables 2 and 3 also suggest that the net employment statistics by sector are not very useful to understand what is happening in the labor market.

Thus, we have that in the same sectors, whether these are expanding or contracting, we find optimistic businessmen who are willing to establish new enterprises or expand the

volume of production while others consider the perspectives as bleak and are contracting their enterprises and even closing them.

Another surprising fact that we discover is that the reallocation of labor occurs within the same narrowly defined sectors. In practice, this may not appear to be such a startling fact since it might be expected that a sewing machine operator displaced from one garment firm would try to either find a job in another garment firm or start his own enterprise. Nonetheless, the fact that the reallocation of labor occurs within narrowly defined sectors indicates that increases in production and productivity are not associated with the movement of resources from one sector to another but by the movement of resources from low productivity firms to high productivity firms in the same sector.

The fact that the reallocation of work occurs within narrowly defined sectors can be empirically verified by decomposing the gross rate of job reallocation to:[8]

1. The increase or decrease in net employment.
2. The intersectoral movement of jobs, and
3. The intrasectoral reallocation of labor.

GJR = MIN + [ISR – MIN] + [GJR-ISR][9]

[8] This decomposition follows the formulations pur forward by Dunne, Roberts and Samuelson (1989) and Davis, Haltiwanger and Schuh (1996).

[9]GJR (gross job reallocation) is calculated as:

Where:

GJR – stands for gross job reallocation.

MIN – the increase or decrease in net employment.

ISR – the intersectoral (between sectors) reallocation.

This decomposition with narrowly defined sectors (at the 4-digit ISIC level) indicates that between 1997 and 2006 net employment grew by 5,8 %, inter-industry job flows accounted for 38,7 % of job flows and the intra-sectoral reallocation accounted for 55,4 % of the gross job reallocation.

Table 4: Job reallocation within and between sectors
End point analysis 1997-2006 (percentages).[10]

		Reassignment	
	MIN	Intersectorial	Intrasectorial
4-digit ISIC	5,88	38,71	55,41

$$GJR = \sum_{i=c,ctr}^{S} \left| empl_{i,t} - empl_{i,t-1} \right| + \sum_{i=c,e}^{S} (empl_{i,t} - empl_{i,t-1}) + \sum_{i=new} empl_{i,t} + \left| \sum_{i=exit} empl_{i,t} \right|$$

Where i = c,,E continue and expand

i=c, ctr continue and contract

ISR is the inter-sectoral (between sectors) reallocation and is calculated as:

$$ISR = \sum_{s=1}^{S} \left| N_{s,t} - N_{s,t+n} \right|$$

Where $N_{s,t}$ refers to the total employment in sector s at time t.

[10] We limited our analysis to the 1997-2006 period because prior to 1997 the sectoral classification is ISIC-rev -2

Table 4 covers a rather long period where inter-sectoral job flows gain in importance. With a shorter horizon of one year, we have that on average the intra-sectoral job flows account for nearly 70% of gross job reallocation as shown in table 5.

Table 5: Job reallocation with and between
Yearly decomposition (1997-2006)

		Reassignment	
Period	MIN	Intersectorial	Intrasectorial
97-98	27,31	16,77	55,93
98-99	47,53	6,96	45,51
99-00	1,52	23,98	74,50
00-01	7,24	17,73	75,03
01-02	3,01	19,79	77,20
02-03	12,28	7,77	79,95
03-04	22,64	2,55	74,81
04-05	15,83	12,15	72,02
05-06	22,05	11,23	66,72
Average	17,71	13,22	69,07

Tables 4 and 5 thus indicate that the lion's share of job reallocation occurs within narrowly defined sectors and those gains in production and productivity are achieved by the movement of labor from low to high productivity firms rather than the movement of labor between sectors.

Thus, in line with the graphic depiction of the Schumpeter model we find that in narrowly defined sectors some firms expand while others contract. In the same sectors some entrepreneurs are starting new firms while others are closing theirs.

We have already shown that the model depicted in figure 1 can account for the wide dispersion in the size of firms and for the simultaneous growth and contraction of firms. Next we would like to delve into Schumpeter´s proposition that "Most new firms are

founded with an idea or for a definite purpose. The life goes out of them when that idea or purpose has been fulfilled or has become obsolete or even if, without having become obsolete, it has ceased to be new."[11] Thus, we look at the productivity of new, continuing and exit firms.

Table 6 presents the labor productivity of new, continuing and exit firms. Since our data spans the 1995 to 2006 period we can only compare entry and exit firms between 1996 and 2005. The table shows that on average the productivity of entry firms is 41 % higher than that of exit firms. Also, the productivity of entry firms is less than half or that of continuing firms presumably because the entry firms still need to learn and grow.

Table 6: The relative productivity of the firms that entry and exit of the market

	Numbers of firms				Productivity (value attaché / employment)		
	Exit	Entry	Continues	Total	Exit/Cont	Entry/Cont	Entry/Exit
1996	959	794	7291	9044	0,37	0,64	1,74
1997	841	747	7240	8828	0,43	0,64	1,48
1998	595	505	7317	8417	0,52	0,68	1,3
1999	417	272	7383	8072	0,55	1,09	1,99
2000	532	338	7117	7987	0,53	0,9	1,69
2001	436	183	6990	7609	0,45	0,68	1,52
2002	596	351	6587	7534	0,55	0,66	1,22
2003	405	706	6542	7653	0,47	0,44	0,93
2004	290	360	6945	7595	0,88	0,46	0,52
2005	531	557	6790	7878	0,26	0,45	1,71

Having examined the productivity of entry, continuing and exit firms, it is still necessary to ascertain the importance to the growth of overall productivity of the entry and exit process as compared to the relative importance of the productivity improvements achieved within continuing firms. To answer this question we have to decompose the

[11] Schumpeter, "Business cycles", p.

increase of the productivity registered between 1997 and 2006 to the shares attributable to the entry and exit of firms and to the share derived from the increase in productivity by continuing firms. This decomposition is obtained by using a simplified form of the formula suggested by Foster, Haltiwanger and Krizan (2001).

Equation 1:

$$\Delta P_{it} = s_{Ct-1}\Delta p_{Ct} + (p_{Ct-1} - P_{it-1)}\Delta s_{Ct} + \Delta p_{Ct}\Delta s_{Ct} + s_{Nt}(p_{Nt} - P_{it-1}) - s_{St-1}(p_{St-1} - P_{it-1})$$

Where:

P_{it} – Stands for productivity according to size.

$S_{C,t-1}$ – relative weight of continuing firms in period t-1.

P_{Ct} - It is the productivity of the firms that continue in the period t.

S_{Nt} - It is the participation of the new firms in the period t.

P_{Nt} - It is the productivity of the new firms in the period t.

S_{st-1} - It is the participation of the firms that go out in the period t-1.

P_{st-1} - It is the productivity of the firms that go out in the period t-1.

Equation 1 establishes a decomposition of the quintile change in productivity in five terms. The first one corresponds to the increase of the productivity of the firms that continue, using as weights the participation in the labor force in the initial period. The second one corresponds to the increase of the productivity attributable to the changes in the shares of enterprises. The third corresponds to a residual fraction for continuing firms that is the result of the product of the change in productivity and the change in weights.

The fourth term of the decomposition presented in the equation 1 evaluates the contribution of new firms. The fifth term presents the contribution of the firms that exit.

Table 7 presents the evolution of productivity according to firm size. As a whole, the manufacturing sector registered a productivity growth of nearly 75%in the period 1997-2006. Fifty-two percent of this increase in productivity is attributable to increases in productivity achieved by continuing firms. Adding the results of the changing weights, we have that roughly 60% of the increase in productivity can be attributed to improvements in productivity by continuing firms. The contribution to overall productivity by the establishment of new firms amounts to 31%. The exit of low productivity firms accounts for 7% of the overall increase in productivity.

The calculations of productivity according to quintiles suggest the following conclusion: The increases in productivity are larger for the smaller quintiles and are to a greater extent associated with entry and exit. The increases in productivity obtained in the larger quintiles are more closely associated with improvements in productivity in continuing firms.

Table 7: Increase in the productivity according to scale of workers in the period 1997-2006 (End points Analysis).

Scale/Quintiles	% change of the productivity	1st term	2nd term	3rd term	4th creation	5 th Destruction
1	187,75	0,36	0,05	0,33	0,21	0,05
2	40,35	0,24	0,01	0,02	0,61	0,12
3	55,96	0,83	0,00	-0,02	0,23	-0,04
4	57,21	0,42	0,00	0,01	0,48	0,07
5	32,46	0,78	0,01	0,03	0,02	0,14
Average	74,75	0,52	0,01	0,08	0,31	0,07

Thus we have that in the period analyzed about half of the gains in productivity can be attributed to entry and exit and the other half is derived from gains in productivity internal to the firm. These internal gains in productivity are examined in the next section.

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Section III. Economies of Scale: Volume, investment and productivity

The objective of this section is to explain the internal gains of productivity by firms. These gains, depicted in figure 1, can be expressed more formally from the firm production function with economies of scale proposed by List and Zhou. They propose that in a context of economies of scale a firm is going to invest more in plant and equipment to reduce marginal cost. Therefore, the firm is going to maximize:

$$\pi = px - f(n)R - B(n)wx$$

Where:

π– corresponds to the profits,

p – price

x – The quantity to be produced / sold.

f(n) - The investment in fixed plant and equipment for a particular technology n, where a larger n represents a higher level of technological sophistication.

R – The rate of interest

B (n) – The marginal cost for technology n.

w – The wage rate

Following List and Zhou we can simplify the equation 1 if we assume the following:

$f(n) = n$

$B(n) = Y / n$

Then we obtain:

$f(n) = B(n)\, wx$

Where f (n) can be approximated by the investment in machinery and equipment and B (n) by the productivity of the labor measured as the value added by employee.

Therefore, the decision of the firm is to invest more if:

1. It contemplates increases in the volume of production.
2. It wants to increase the productivity.

Wages and the rate of interest are assumed to be constant. Nevertheless, in practice, we found that a higher level of productivity is positively related to wages, as we show later on. At this point we investigate the relation between investment, volume and productivity.

There are two ways to investigate the influence of expected sales (measured as value added) on investment. One, we can use the cross section information for any one year and estimate an OLS regression with investment in machinery as the dependent variable and sales as the independent variable. Two we can use the whole panel with a "between effects" estimation of investment in machinery on expected sales. The "fixed effect"

panel estimation provides us with the short term relationship between investment and sales.

Using the cross section information for 2006 we obtain the following estimate for the long term of the elasticity of investment respect to the size:

Table 8: OLS regression (2006)

ln(machinery)	Coefficient	P>| t |	[95% Conf. Interval]	
ln(value added)	0.9073	0.000	0.8889361	0.9257781
Constant	0.3751	0.004	0.1223256	0.6280692

Number of obs = 7330
R-squared=0.559
Adj R-squared = 0.5599

The same long term coefficient for the relationship between volume and investment in machinery can be obtained using a data panel with "between effects" estimation. Because the panel covers 11 years we would have to deflate both the value of production and that of investment in machinery and equipment by the corresponding price indices. We sidestep this problem by using the relative values of production and investment with respect to the sectoral values for the same variables. That is, we use the investment in machinery by a firm relative to the sectoral average and the value added by the firm relative to the value added in the sector.

Table 9: Investment in machinery as a function of the value added (long term)

Panel regression "between effects"

ln(relmaq)	coefficient	P>| t |	[95% Conf. Interval]	
ln(rel_valueadded)	0.8959	0.000	0.8823847	0.9094367
Constant	-0.5942	0.000	-0.6281359	-0.5604466

Number of obs = 93120

R-squared: within = 0.1399
between = 0.5680
overall = 0.5594

In both cases – the OLS regression on the 2006 cross section and the panel estimation - we obtain that an increase of one per cent in the volume of production leads to an increase of 0.9 per cent in the value of machinery and equipment.

In the short term, we expect this relationship to be much smaller. To estimate this relationship we use fixed effects estimation.

Table 10: Investment in machinery as function of the value added (short term)

Panel regression "fixed effects"

ln(relmaq)	Coefficient	P>| t |	[95% Conf. Interval]	
ln(rel_valueadded)	0.3277	0.000	0.3221752	0.3334183
Constant	-14.634	0.000	-1.473.118	-1.453.725

Number of obs = 93120
R-squared: within = 0.1399
between = 0.5680
overall = 0.5594

Here we find that in the short term an one per cent in the increase in the volume of production or sales (given here as value added) leads to an increase of a third of a one per cent in machinery investment.

The relationship between investment in machinery and labor productivity can also be estimated in two ways. The long term relationship is obtained from a panel estimation with "between effects while the short term relationship is obtained with fixed effects.

Table 11: Productivity as function of the investment in machinery (long term)

Panel regression "between effects"

ln(relat_pvity)	Coefficient	P>| t |	[95% Conf. Interval]	
ln(relmaq)	0.2196	0.000	0.2130917	0.2262644
Constant	-0.3548	0.000	-0.3747575	-0.3349807

Number of obs = 93066
R-squared: within = 0.0327
between = 0.2500
overall = 0.2201

Table 12: Productivity as function of the investment in machinery (short term)

Panel regression "fixed effects"

ln(relat_pvity)	Coefficient	P>| t |	[95% Conf. Interval]	
ln(relmaq)	0.1676	0.000	0.1612948	0.1739064
Constant	-0.4309	0.000	-0.4440275	-0.4177939

Number of obs = 93120
R-squared: within = 0.1399
between = 0.5680
overall = 0.5594

An increase of one per cent in the value of machinery leads to an increase in productivity of 0.22 per cent in the long term and of 0.17 per cent in the short term.

In the List and Zhou equation wages and the rate of interest are assumed to be constant or exogenously determined. Nevertheless, as mentioned above, larger firms with a greater investment in machinery also exhibit higher wages. The response of the wages to the productivity in the long and short term is:

Table 13: Wages as function of the productivity (long term)

Panel regression "between effects"

ln(relwage)	Coefficient	P>| t |	[95% Conf. Interval]	
ln(relpvity)	0.2228	0.000	0.2143985	0.2313779
Constant	-0.0802	0.000	-0.0910166	-0.0695767

Number of obs = 69144

R-squared: within = 0.0487
between=0.1943
overall =0.1628

Table 14: Wages as function of the productivity (long term)

Pannel regression "fixed effects"

ln(relwage)	Coefficient	P>| t |	[95% Conf. Interval]	
ln(relpvity)	0.111	0.000	0.107078	0.1150542
Constant	-0.1506	0.000	-0.1544671	-0.1468177

Number of obs = 69144
R-squared: within = 0.0487
between = 0.1943
overall = 0.1628

In the long term we have that an increase of one per cent in productivity leads to an increase of 0.22 % in wages. In the short term the response of the wages is 0.11 %.

In conclusion we find that a desired increase in the volume of production is directly associated with an increase in investment that translates into an increase in labor productivity.

Section IV. Productivity and Exports

A second strand of the literature that relates economies of scale to productivity seeks to explain exports by firms. On the basis of the empirical work carried out by Bernard, Eaton, Jensen and Kortum (2003) (BEJK), Melitz (2005) developed a model to explain that:

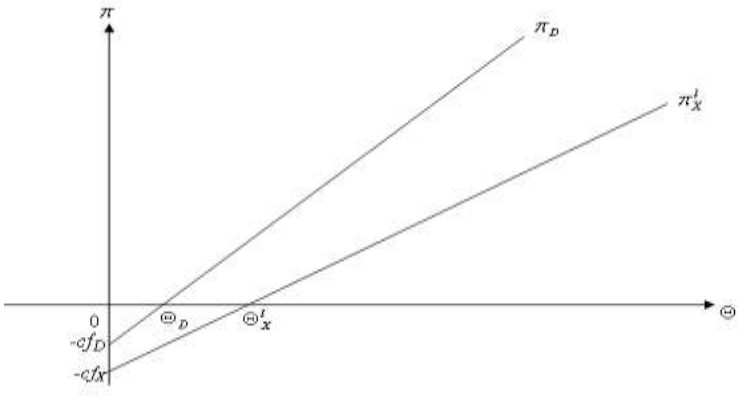
1. Only a small fraction of all firms exports.
2. Exporting firms only export a small fraction of this total output.

3. Exporting firms are more productive than non-exporters.
4. Exporting firms are larger than firms that do no export.

The Melitz model is explained graphically in figure 2 derived from Helpman (2006).

The π_D curve represents the profit function for domestic firms that have to make a fixed investment of Cf_D before starting production. Then, if the firms achieves a productivity θ that is greater than $\theta_{D,}$ the firms survives and continues to produce. If the firm does not achieve the threshold θ_D the firm has to close (exit). Among the firms that survive, some will incur in an extra fixed cost (Cf_x) and become exporters if their productivity exceeds the θ_x cut-off point. Exporting firms will thus have a higher productivity and because they serve both the domestic and the foreign markets, they will also be larger.

Figure 2: Profit function for domestic and exporting firms



The purpose of this section is to investigate whether the Melitz model may also be applicable to Colombia. That is, we try to corroborate the BEJK finding for Colombia.

Table 15 shows that not all firms export. As a matter of fact, only 21.4% of firms exported in 2006. The table also shows that exporting firms are larger than non-exporting firms with an average of 174 employees compared to 56 employees in non-exporting firms. As a consequence we also find that exporting firms provide more than half (54.0%) of the employment in the manufacturing sector.

Table 15: Comparison of the firms that export and that don´t export 2006

Concepts	Don´t export	Export
Firms %	78,60%	21,40%
Job%	54,01%	45,99%
Average size (number of employments by firm)	56	174

Source: DANE Annual Manufacturing Survey

Concentrating on exporting firms we also find that the majority only export a small fraction of their output.

Table 16 shows that 55% of all exporting firms export less than 20% of this production. Less than 20% of the exporting firms export more than 50% of their output.

Table 16: Proportion of production exported by the firms

Percentage of the exported production	Number of firms	Percentage participation	Percentage participation Accumulated
0-10	541	35,70%	35,70%
10-20	294	19,40%	55,00%
20-30	189	12,50%	67,50%
30-40	121	8,00%	75,50%
40-50	89	5,90%	81,30%
50-60	83	5,50%	86,80%
60-70	54	3,60%	90,40%
70-80	38	2,50%	92,90%

80-90	31	2,00%	94,90%
90-100	77	5,10%	100,00%

Source: DANE Annual Manufacturing Survey

Exporters can be shown to be more productive than non-exporters by estimating the following equation suggested by Wagner (2007).

$\text{Ln } LP_{it} = \alpha + \beta \, Dexp_{it} + \delta \, size_{it}$

Where:

LP_{it} = Labor productivity for firms i in period t

$Dexp_{it}$ =Dumy for exports that takes on the value of 1 if firms i exports in period t.

$Size_{it}$= size of firms i in period t as given by the number of employers

Table 17: Cross section estimated of association of productivity and exports

	Dexp				Employment			
year	coefficient	p> I t I	[95% conf. Interval]		coefficient	p> I t I	[95% conf. Interval]	
2000	0,4477	0,0000	0,3880	0,5075	0,2828	0,0000	0,2636	0,3020
2001	0,4019	0,0000	0,3400	0,4600	0,2779	0,0000	0,2600	0,2970
2002	0,3746	0,0000	0,3150	0,4342	0,2598	0,0000	0,2399	0,2797
2003	0,3813	0,0000	0,3238	0,4387	0,2314	0,0000	0,2113	0,2516
2004	0,3001	0,0000	0,2376	0,3625	0,2582	0,0000	0,2386	0,2779
2005	0,3481	0,0000	0,2844	0,4119	0,2415	0,0000	0,2221	0,2608
2006	0,3890	0,0000	0,3282	0,4499	0,2171	0,0000	0,1978	0,2364
avg	0,3775			avg	0,2527			

If we take the average estimated coefficient of 0.3775, using $\{100(\exp(\beta) - 1\}$ we obtain that exporting firms are 45.9% more productive than non exporting firms.

Table 18: Panel Data estimated of the association of productivity and exports

	Dexp			
Variable	coefficient	p> I t I	[95% conf. Interval]	
Dexp	0,562153	0,000000	0,508300	0,620131
Employment	0,191527	0,000000	0,175747	0,207398
Constant	-1,571385	0,000000	-1,619848	-1,529220

Number of obs=53752
R-squared: within=0,0001
between=0,1533
overall=0,1119

We repeat the same exercise with the panel. However with the panel we would have to deflate all the value added entries by the corresponding sectoral deflators. Like we did in the previous section we side-step this issue and relate firm productivity to the sectoral productivity. Thus our dependent variable becomes relative productivity. The estimated coefficient, 0.56, indicates that exporting firms are 75% more efficient than non exporters relative to the same sector.

Although the relationship between productivity and exports is clear the question arises: Do more productive enterprises self-selected into export markets? Or, does learning by exporting increase productivity? We answer this question by estimating the following equation suggested by Wagner (2007)

$$\ln LP_{it-3} = \alpha + \beta\, export_{it} + \delta\, size_{it} + \varepsilon_{it}$$

The estimation of the equation clearly suggest that productivity precedes exports. The estimated coefficient suggest that firms where 66.83% more productive three year prior to the initiation of exports.

Table 19: Panel Data estimated of the equation suggested

	Dexp			
variable	coefficient	p> I t I	[95% conf. Interval]	
dexp	0,511847	0,000000	0,460674	0,563020

empleo	0,164154	0,000000	0,150038	0,178270
constant	-1,342436	0,000000	-1,385890	-1,298982

Number of obs=53390
R-squared: within=0,0014
between=0,1650
overall=0,1240

Thus, in the end we have that expected sales determine investment which leads to higher productivity and firm exports. The question for policy makers is what lever to pull in the scale-productivity-exports triangle. The estimation results of table 19 indicate that exports should not be ranked first as an instrument to promote the circular cycle. Productivity on the other hand, turns out to be a concept that is difficult to quantify when promotion money is spent in training, education, management seminars, etc. The promotion of economies of scale can be achieved through credit. Following Aghion, Fally and Scarpetta (2007) we might suggest that credit could facilitate entry and enhance the post-entry growth of firms.

Section V. Macroeconomics

The conclusion drawn in the last section might be quoted from Bernard, Jensen, Redding and Schott (p.2, italics added):

> "The ex ante productivity advantage of exporters suggests self selection: exporters are more productive, not as a result of exporting, but because only the most productive firms are able to overcome the costs of entering export markets. *This sort of microeconomic heterogeneity can influence macroeconomic outcomes.* When trade policy barriers fall or transportation costs decline, high-productivity

> export firms survive and grow, while lower-productivity non-exporting firms are more likely to fail. This reallocation of economic activity across firms raises aggregate productivity and provides a non-traditional source of welfare gains from trade."

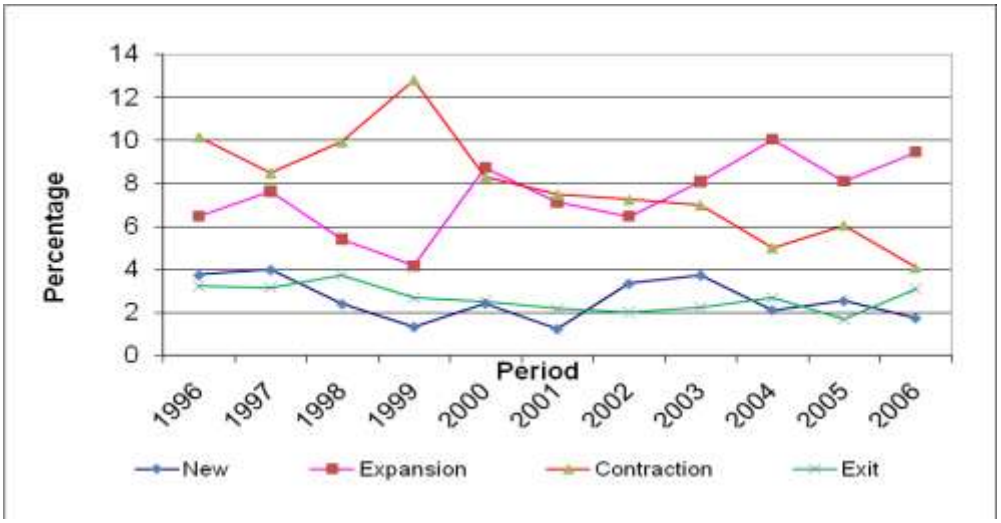
When the opposite happens and countries pursue protectionist policies, like they did in the Great Depression, high-productivity export firms have to contract. The export firms are large employers and their contraction may lead to thousands of lost jobs. Productivity will decline and the recession will be made worse. It remains an open question whether small firms will benefit.

Thus, both the developed and the developing nations have a vested interest in maintaining open markets. A good way for countries to signal this interest would be to promote the resumption of the Doha Round of Trade Negotiations.

At the domestic level we find that during recessions the rate of job destruction – due to firm contractions and plant closures – peaks as shown in figure 3. At the same time the rate of job creation declines but it does not disappear. In such circumstances sectoral support might be wasteful since it might go to contracting firms that might contract or close anyway. Worse still, the managers of these firms might take the government money and spend it on something else. Therefore, as a policy conclusion, one might argue for the support of new and growing firms. Such support would encourage the

harnessing of economies of scale, the increase in productivity and the generation of new jobs. Moreover such a system would be more transparent.

Figure 3: Job Creation and destruction



The main avenue of support for new and growing firms would be through the credit markets. In an economies of scale environment, a large investment has to be made up-front. To use Schumpeter´s example: laying down track for a railroad was expensive business. The cost of an additional passenger is very low. Thus, if the finance for economies of scale projects is not forthcoming the capitalist engine might stall.

The finance for these enterprises has to be special since the results are not always known before hand and the time to maturity of the project might be long. This is especially true if one recognizes that the engine is basically supply driven. The fact that the engine is supply driven is one of the causes why economic growth proceeds cyclically rather than

evenly: Innovations are not *´evenly distributed through time,'* but '*appear, if at all, discontinuously in groups or swarms.''*[12]

Recognizing that the capitalist engine is supply driven, another approach that might be taken by policy makers might be the promotion of invention. Although Schumpeter spends considerable effort in explaining that invention and innovation are very different, even he has to admit that they are often intertwined. Advances in science increase the possibilities for new innovations. Given the acceleration of research in all fields of science it may not take long before the world finds itself on another wave of expansion.

Finally, throughout our paper we have talked about the creation and destruction of jobs. One in ten jobs is lost every year. One in ten jobs, in any one year, is new. If the people losing jobs are not the same as those taking new jobs, one might say that some 20 % of the labor force is on the move. Policy makers have to search for ways to make this massive movement of labor less onerous to the working class through unemployment benefits and training so that they may qualify for higher productivity jobs in new and expanding enterprises.

References

Aghion, P., P. Howit (1992). 'A model of growth through creative destruction' , *Econometrica*, 60(2), 323-351.

Aghion, P., T. Fally and S. Scarpetta (2007). 'Credit constraints as a barrier to the entry and post-entry growth of firms' ,*Economic Policy*, 733-779.

[12] Schumpeter, The Theory of Economic Development, (p. 223)

Bartelsman, E., J. Haltiwagner and S. Scarpetta (2004). 'Microeconomic evidence of creative destruction in industrial and developing countries' , IZA Discussion Papers No. 1374.

Bernard, A.B., J.B. Jensen, S.J. Redding and P.K. Schott (2007). 'Firms in international trade' , NBER Working Papers No. 13054.

Bernard, A.B., J. Eathon, J.B. Jensen and S. Kortum (2003). 'Plants and productivity in international trade' , *The American Economic Review*, 93(4), 1268-1290.

Buchaman, J.M, Y.J. Yoon (1994). *The return of increasing returns*, Michigan: Michigan University Press.

Davis, S.J., J.J. Haltiwanger and S. Schuh (1997). *Job creation and destruction*, Cambridge, MA: The MIT press.

Diamond, A.M (2007). 'The neglect of creative destruction in micro-principles texts' , *History of Economic Ideas*, Nebraska: University of Nebraska at Omaha, 197-210.

Dunne, T., M. Roberts and L. Samuelson (1998). 'Patterns of firm entry and exit in US manufacturing industries' , *Rand Journal of Economics*, 19(4), 495-515.

Foster, L., J.C. Haltiwagner and C.J. Krizan (2001). 'Aggregate productivity growth: Lessons from microeconomic evidence' , in Edward Dean, Michael Harper, and Charles Hulten (eds.), *New Developments in Productivity Analysis*, Chicago: University of Chicago Presss.

List, A.J., H. Zhou (2007). 'Internal increasing returns to sale and economic growth' , NBER Working Papers No. 12999.

Melitz, M.J. (2003). 'The impact of trade on intra-industry and aggregate industry productivity' ,*Econometrica*, 71(6), 1695-1725.

Schumpeter, J.A (2005). *Business Cycles: A Theoretical, Historical and Statistical Analysis of the Capitalist Process*, CT: Mannfield centre. (original in English 1934, in german 1912)

Schumpeter, J.A (1938). *The Theory of Economic Development*, NJ: New Brunswick. (original in English 1934, in german 1912)

Wagner, J. (2007). 'Exports and productivity: A survey of the evidence from firm-level data' , *The World Economy*, 60-82.