The Impact of Trade Liberalization on Employment, Capital and Productivity Dynamics: Evidence from the Uruguayan Manufacturing Sector

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Abstract

This paper studies the impact of trade liberalization on labor and capital gross flows and productivity in the Uruguayan Manufacturing Sector. Uruguay opened its economy in the presence of strong –at least initially- unions and structural different industry concentration levels. Higher international exposure implied a slightly higher job creation and an important increase in job and capital destruction. Unions were able to ameliorate this effect. Although not associated with higher creation rates, unions were effective in reducing job and capital destruction. Industry concentration also was found to mitigate the destruction of jobs but had no effect on job creation nor in capital dynamics. The changes in the use of labor and capital brought an increase in total factor productivity specially in sectors where tariff reductions were larger and unions were not present. We found no evidence of varying productivity dynamics across different industry concentration levels.

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I. Introduction

The development strategy of the Uruguayan economy evolved from inward looking, based on state interventionism and import substitution protectionist policies, towards an outward looking orientation, with more reliance on markets as resource allocation mechanisms and exports as the growth engine. This change started in the seventies, when a first phase of trade reform took place accompanied by a quick financial liberalization process. During the nineties, a second phase of trade liberalization took place. This phase combined a deepened gradual unilateral tariff reduction with the creation of Mercosur, an imperfect customs union between Argentina, Brazil and Paraguay and Uruguay

The trade liberalization had two distinctive characteristics. First, it took place in a context in which unions still maintained significant power, and in many cases such changes were negotiated with them. Second, the manufacturing industry in Uruguay was in the mid-eighties basically composed of a reduced number of traditional-products exporting firms and by sectors developed under the import substitution process. Most industries showed high concentration levels. This gave firms considerable market power, that allowed them to set prices substantially above marginal costs (see Laens, Noya and Casares, (1985)).

This paper focuses on the impact of trade liberalization on productivity dynamics and the creation and destruction of jobs and capital. We examine how this impact varies with the strength of unions and the level of concentration across industries.

Several papers addressed the effects of trade liberalization on employment, capital and productivity dynamics. In the empirical literature, three basic strategies were followed. The first one is through cross country comparisons (Ben David (1993), Sachs and Warner (1995). The second is through sector-level analysis (Keller (2000), Kim (2000)). This second approach is not subject to criticism on the arbitrariness of the openness measures and of potential endogeneity problems that the first approach raised but it can not capture micro-level effects. This paper is part of a third approach that uses establishment level panel data to address the effects of higher international trade exposure (see for example Baily, Hulten and Campbell (1992), Tybout (2001), Aw Chen and Roberts (1997), Levinsohn (1999), López-Cordoba (2002), Muendler (2002) and Pavcnik (2002)).

Muendler (2002) using a panel of Brazilian firms, analyses the relationship between trade openness and productivity. He identifies three channels by which trade reform may affect productivity. In this paper we refer to these tree channels and expand on their effects on factor flows.

The first, called the foreign input push, is the process by which in a more open economy firms have access to a higher quality or a cheaper pool of intermediate inputs and capital goods in foreign markets, that allow them to adopt new production methods and substitute other relatively more expensive factors of production. This implies therefore capital creation, job destruction and higher productivity. The second, is the competitive push in which increased competition in the product market may lead to innovation and removal of agency problems. Hence productivity gains are to be expected. With respect to factor flows there are two extreme cases. On one hand, that in which higher productivity is passed on in higher factor payments with factor quantities fixed, and in the other hand, that in which we observe both capital and job creation. There is a third channel observed only at the sector level which is termed competitive elimination: increased foreign competition forces the least efficient firms to close down while the more efficient ones gain market share, hence raising average productivity. The capital and jobs of exiting firms are destroyed.

Although there is agreement in the literature on the wage effects of unions[2], the results on the non wage dimensions are less robust in particular in what respect to employment growth, investment and productivity. On a theoretical basis three aspects of union behavior can be differentiated: monopoly costs, participatory benefits and rent seeking activities. On the monopoly costs Rees (1963) points that the increased in the wage on unionized workers induces substitution for non unionized workers. This argument can be extended to substitution of labor for other factors of production, e.g. capital. McDonald and Solow (1981) show that this effects is mitigated when the negotiations are over both wages and employment. Moreover, since unionized firms share their profits with the union, this creates a hold up problem that may induce lower investment (Grout (1984)). The second theoretical aspect associated with the “organizational view” of unions (Freeman (1980) and Freeman and Medoff (1979, 1984)), stresses their economic benefits. The unions acting as a "collective voice" may be effective in transmitting worker preferences to the management and can participate in establishing seniority provisions that reduce rivalry between workers with different levels of experience. This effect reduces job turnover and increases the incentives to give informal on the job training. In Malcomson (1983) unions may help to enforce contracts between workers and managers. More generally, in this view unions can induce better practices in the part of the managment (reduce the so called X-inefficiency). Thirdly, considering unions as rent seekers, Pencavel (1995) point out that on a general basis unions push for lower competition in labor and product markets. In the latter ones unions interests are in line with firms' interest[3] but they disagree with respect to market labor regulations.

Which of all those theoretical effects dominates is an empirical matter. Most studies conclude that unionized sectors tend to grow at a lower rate (for instance see Boal and Pencavel (1994), Freman and Kleiner (1990) and Standing (1992)). Also, there is no agreement on the empirical effect of unions on productivity. For instance, Brunello (1992) finds unions to be associated with lower productivity while the opposite was find by Standing (1992). The results of Hirsh (1990) and Denny and Nickell (1991) suggest that unionized firms underinvest.

With respect to concentration, Borjas and Ramey (1995) present a model in which the impact of trade liberalization on wages and employment will be smaller the more competitive an industry.

[2] On his survey on the effects of unionization Kuhn (1998) states that unions raise wages by about 15% according to empirical studies on USA and Canada. Aidt and Tzannatos (2002) report the results of other studies including less developed countries that are consistent with a positive wage differential between unionized and non unionized workers (Park (1991) and Butcher and Rouse (2001)).

[3] This coalition is modeled in Rama and Tabellini (1998).

Our paper contributes to the existent literature in three ways: i) presents evidence on the direct effects of trade liberalization on job, capital and productivity dynamics for a less developed country, ii) presents evidence on the mitigating or enhancing effects of unions and industry concentration on the job, capital and productivity dynamics produced by an increase in international exposure, iii) presents evidence on how these effects vary for blue and white collar workers.

The paper proceeds as follows: section two presents an overview of the Uruguayan trade liberalization and previous relevant work on the Uruguayan case; section three describes the data; section four the statistics on labor and capital dynamics and productivity; section five presents the estimates of the impact of trade liberalization on employement, capital and productivity dynamics and how this varies over union density and industry concentration. Finally, section six concludes.

II. Trade Liberalization, Unions and Industry Concentration in Uruguay

Although Uruguay started to open its economy in the seventies, in the nineties the process was intensified, along with the signature of the Mercosur treaty with Argentina Brazil and Paraguay. As a result, flows from and to these countries increased their share in Uruguay's trade. In addition, a stabilization program based on an exchange rate anchor was undertaken. This policy considerably reduced inflation –which had climbed to three digits figures at the beginning of the decade- to an annual rate of around 42% in 1995, but it was simultaneously accompanied by a significant real appreciation of the peso, especially vis a vis non Mercosur countries. Concurrently, firms in the manufacturing sector were strongly affected and, in order to remain competitive, had to undergo a process of technological and organizational update.

The trade liberalization process in Uruguay is described in Vaillant (2000) as going through different phases during our period of analysis. From 1988 to 1994, this author finds that trade policy sought to continue and deepen the openness process started in the seventies, intended to end the anti export bias that characterized previous import substitution policies. With the recovery of democratic institutions in 1984, political pressure for the modification of trade policy grew, but the government did not modify the main policies. There was only a slightly higher protection as a result of increased use of non tariff barriers. In 1991, with the signature of the Mercosur treaty a program of scheduled tariffs reductions began that ended in 1995 with the establishment of an imperfect trade union.

Vaillant (2000) points to a modification in the political economy of the trade policy setting process in Uruguay. After 1958, the trade policy was regulated mostly by Presidential decrees rather than Parliament-approved laws. The main organized lobby groups were the pro-openness exporters and the pro-protection import competing sectors. The early stages of the reforms were carried on with a significant ability on the part of organized lobbies to maintain sectors prerogatives.

The most important change in the nineties was that, through the signing of binding international treaties (Mercosur and World Trade Organization), the government significantly curtailed its ability to provide discretionary protection to specific sectors. At any rate, the tailored made protection was for most cases introduced trough non tariff instruments. Therefore - despite we recognize the existence of a vast literature on the endogeneity of trade policy - this motivates the treatment of tariff reductions as an exogenous stimulus to firms and sectors. Moreover we claim that given the relative bargaining weights of Mercosur partners, the endogeneity of the common external tariff is likely a problem for studies of Argentina and fundamentally Brazil but not Paraguay and Uruguay. Again, this does not mean that protectionist policies in Uruguay are exogenous, but since they were channeled trough non tariff barriers the changes in the exchange rate can be treated as exogenous.

Table 1 shows the evolution in Uruguayan import tariffs for raw materials, three types of intermediate goods and final goods. The progressive simplification and lower protection levels of the regime are evident in the table. Table 2, in turn, shows how the share of Uruguayan intra-Mercosur trade increased over the whole period. This is the result of the block liberalization strategy followed by Uruguay.

Table 1. Custom Global Tax Structure (1982-1995)

	Since:										
	Jan. 82	**Jan. 83**	**Jun. 85**	**Aug. 86**	**Aug. 87**	**Jun. 89**	**Apr. 90**	**Sep. 91**	**Apr. 92**	**Jan. 93**	**Jan. 95**
Raw Materials	10-15%	10%	15%	10%	10%	10%	15%	10%	10%	6%	0-14%
Intermediate Goods (1)	25-35%	20%	25%	20%	20%	20%	25%				
Intermediate Goods (2)	45-55%	35%	40%	35%	30%	30%	35%	20%	17%	15%	0-20%
Intermediate Goods (3)	65%	45%	50%	45%	40%	35%	35%				
Final Goods	75%	55%	60%	50%	45%	40%	40%	30%	24%	20%	0-20%

Note: Intermediate goods were classified in three different categories. Source: Vaillant (2000)

Table 2. Uruguayan Intra-Mercosur Trade in Total Trade

	Exports	**Imports**
1982	25%	20%
1983	20%	24%
1984	22%	28%
1985	24%	30%
1986	35%	39%
1987	27%	38%
1988	23%	41%
1989	33%	41%
1990	35%	40%
1991	36%	41%
1992	37%	58%
1993	42%	48%
1994	46%	49%
1995	47%	46%

Source: Central Bank of Uruguay

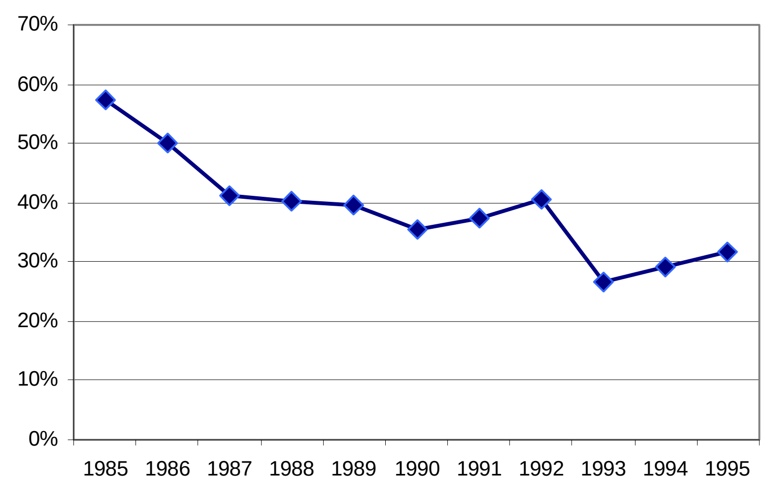
Several authors have analyzed the relation between productivity and trade policy in manufacturing in Uruguay. Tansini and Triunfo (1999) estimate a stochastic frontier production function and compute a measure of the distance between each establishment's production choice and the best practice frontier. They found efficiency to be positively associated with foreign ownership of firms, import penetration and, somewhat surprisingly, negatively with the exporter status of firms. Arimón and Torello (1997) estimate total factor productivity (TFP) by index numbers methods for the 1982-1992 period, for manufacturing 4 digit ISIC sectors. They conclude that increases in TFP are observed in those sectors more strongly affected by foreign competition, moderately exporting and import competing sectors.

Protection and unions are related in Rama (1994). The main finding is that from 1978 to 1986, there is no significant effect of tariffs in wage levels, though there is an employment effect. In a previous paper, Rama (1992) presents cross sectional regressions of affiliation rates by industry on market power related variables (concentration, effective protection).

Different institutional settings characterized the labor market during the eighties and nineties. Following the loss of democracy and until 1984 unions were banned. After that, with the democratic recovery in 1985 and until 1991, there was tripartite (worker, entrepreneur and government representatives) wage bargaining at the industry level with mandatory extension to all firms within the sector. The centralization level was mainly identified to be at 4 or 5 digit ISIC industries, though this is not uniform across sectors.

Forteza (1991) argues that the objective of the government's involvement in these negotiations was to mitigate the inflationary process. In any case, the government's attempts to influence expectations of future inflation were not credible. Wages observed at the firm level tended to follow or even to exceed the negotiated wage levels. From 1991 onwards, the government stepped out of negotiations, coincident with the implementation of an exchange rate based stabilization program. This radically changed the entrepreneurs and unions incentives to participate in sectoral negotiations. After 1992, negotiations carried out at the firm or group of firms level were an increasing proportion of all agreements registered at the Ministry of Labor, and in 1996-1997 they clearly become the majority (64% according to Rodriguez et al.(1998)). Figure 1 presents the decrease in union density after the democratic recovery.

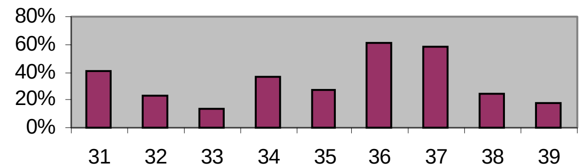
Figure 1. Manufacturing Industry Unionization Rate



There was also a change in the scope and objectives of negotiations. Cassoni and Labadie (2001) show that wage negotiations dominate in the years prior to 1991. Hence they argue that a plausible model for wage and employment determination was a 'right to manage' model, in which wages are first agreed between unions and employers, with firms subsequently determining employment. Since 1993, they observe that clauses concerning employment start to be added to the agreements. Hence the appropriate framework seems to be an 'efficient contract' model in which firms and unions bargain over both wages and employment.

Finally, with respect to concentration there is not a clear pattern of concentration or de-concentration over the period but there are structural differences across industries. Figure 2 presents the average industry concentration over the whole period -measured as the share of the three largest firms on total sales- by two digit ISIC.

Figure 2. Average Industry Concentration



(average over 4 digit ISIC C3 indexes for ISIC= 31 average of 3 digit ISIC C3 indexes for the rest)

III. Data

This study is based on annual establishment level observations from the Manufacturing Survey conducted by the Instituto Nacional de Estadística (INE) for the period 1982-1995. The survey-sampling frame encompasses all Uruguayan manufacturing establishments with five or more employees.

The INE divided each four-digit International Standard Industrial Classification (ISIC) sector in two groups. All establishments with more than 100 employees were included in the survey; the random sampling process of firms with less than 100 employees satisfies the criterion that the total employment of all the selected establishments must account at least for 60% of the total employment of the sector according to the economic Census (1978 or 1988).[4] This selection criteria makes our database biased towards large firms.

Although the survey is basically establishment-based, it is not equivalent to databases used in previous plant level studies (Dune *et al*. (1989), Baldwin (1996) and Davis and Haltiwanger (1992)). Our data enables us to distinguish plants of the same firm in different industries -five digit ISIC-, but we cannot distinguish between plants of the same firm in the same sector, which are all computed as one establishment.

The data for the whole period are actually obtained from two sub sample sets: from

[4] For a detailed discussion see INE (1996).

1982 until 1988 and from 1988 until 1995. In 1988 the Second National Economic Census was conducted. After that, the INE made a major methodological revision to the manufacturing survey and changed the sample of establishments.

In 1988, the Census year, information was collected for both the old and the new samples. A subset of the establishments of the old sample were also included in the new one, while others do not continue and others not previously surveyed were inducted into the sample.

In total we have 1283 different establishments present in at least one period. There are 574 starting in 1982, of which just 240 make it to 1995. The 1988 sample is composed of 601 establishments included for the first time in that year and 573 from the old sample that not old are to be followed in subsequent years. Table 3 displays the number of observations by year.

Table 3. Establishments per year

1982	574
1983	611
1984	610
1985	602
1986	598
1987	584
1988	1174
1989	955
1990	923
1991	876
1992	826
1993	781
1994	735
1995	680

Entry and Exit

Due to death of firms, the INE periodically revises the sample coverage and if necessary includes new firms. Once a firm enters into the survey, it is supposed to be followed until its death. Therefore, when we have no more data for a particular establishment, we interpret this as a plant closure (exit). However, we can not distinguish which of the establishments that exit the sample in 1988 do so because they ceased their activity, and which only were dropped out of the sample. In our empirical work we assumed that in 1988 all firms that do not continue in 1989 were taken out of the sample and therefore we register no deaths in that year.

There are additional difficulties concerning entry. As mentioned, the INE periodically includes new establishments, but these do not necessarily belong to newborn firms. The survey does not report the age of establishments, but the firm's date of birth is reported in most (but not all cases) in the Economic Census. We complement the survey with the Census data and construct an age variable. By definition it is not available for establishments in the 1982-1988 subsample that do not survive until the census year. Newborn entrants before 1988 can be identified from the Census. Whenever after 1988 we found a new establishment in the data set that was not included in the Census, we asked the INE to specify if the establishment was really a newborn and some information about starting dates was added. However, our data show no newborn establishments after 1988.

Weights

The weights are based on employment and/or capital stock sample proportions by three digit ISIC sector. In the case of capital, we calculate the total capital stock in the sample and in the census (K^S_j and K^C_j respectively), and compute the capital weight associated to establishments belonging to sector j as $w^K_{ij} = K^C_j / K^S_{j}$. In the case of employment, we calculate the total employment in the sample and in the census by sector and size class -less than 49, 50-99 and 100 and more- (E^S_{js} and E^C_{js} respectively) and compute the employment weight associated to establishments belonging to industry j and class size s as $w^E_{ijs} = E^C_{js} / E^S_{j.}$. The aggregate statistics are computed for weighted establishments.

Capital

Our database allows us to construct three different types of capital variables: machinery, buildings and other capital assets. However, due to differences in the criteria utilized by reporting firms, especially with respect to building investment and its depreciation, we are not confident of the accuracy of this variable and report results only for total capital, machinery and other capital.

The Manufacturing Survey does not directly report capital. In order to construct an establishment capital series, we follow a methodology closely related to the one proposed by Black and Lynch (1997). Due to data limitations this is done only for the period 1988-1995.

Although the 1988 Census reports information on the capital stock, there have been various unsuccessful attempts to calculate a time series using that initial capital together with annual depreciation, investment and assets sold. The reasons behind this lack of success are probably linked to the accounting policies of firms. We avoid overestimation of the amount of depreciation by calculating an average depreciation rate by type of asset – building, machinery and others – by industrial sector and by year. The resulting depreciation rate is then used for all firms within each sector yearly. We further exclude the value of assets sold in our measure of capital, assuming assets have been totally depreciated at that point. Thus, the equation for estimating the capital stock is:

$$K_{ijt}^{x} = K_{ijt-1}^{x} + I_{ijt}^{x} - \delta_{jt}^{x} K_{ijt-1}^{x}$$
$$\delta_{jt}^{x} = \frac{\sum_{i} D_{ijt}^{x}}{\sum_{i} K_{ijt-1}^{x}}$$

where i indexes firms; j the industrial sector, t the year and x stands for: machinery, buildings or other capital assets. As generally noted in papers on the subject, K is the capital stock; I is amount invested; δ is the depreciation rate; and D is the dollar amount of depreciation.

Price Indexes

In order to express all variables in constant pesos we need to use several price indexes. Gross output is deflated using the wholesale price index computed by the INE. Intermediate consumption is the sum of material inputs, production performed by third parties, rents, fuel, electricity and others. For electricity we use an Electricity Price Index computed by the INE, for material inputs and fuel we use two different specific price indexes constructed by Picardo and Ferre (2003) based on INE data. The rest of the components are deflated by the wholesale price index. Value added at constant prices is computed as the difference between real gross output and intermediate consumption. Finally, in order to deflate investment and capital we use a specific price index constructed by Cassoni, Fachola and Labadie (2001). All indexes vary over years and sectors.

IV. Employment, Capital and Productivity Dynamics

IV.1. Job and Capital Flows

The goal of this section is to summarize the facts regarding the creation, destruction and reallocation of two categories of jobs and capital. The definitions follow Davis and Haltiwanger (1992) and Davis, Haltiwanger and Shuh (1996). The measure of size for establishment i at time t, is the simple average of employment in periods t and $t-1$, $\phi_{it} = [E_{it} + E_{it-1}]/2$. In order to facilitate comparison of our results with other studies in the area, the rate of growth of employment is defined as has become the norm of the literature as $Net_{it} = [E_{it} - E_{it-1}]/\phi_{it}$ where E_{it} is total employment of establishment i at time t (the definitions for white collar, blue collar and total employment and machinery and other capital are analogous). This growth rate varies from –2 to 2. Using these definitions aggregate net job creation, job reallocation, job creation, and job destruction can be respectively defined as follows:

$$Net_t = \sum_i \phi_{it} Net_{it}$$

$$Sum_t = \sum_i \phi_{it} |Net_{it}|$$

$$Pos_t = \sum_i \phi_{it} \max(Net_{it}, 0)$$

$$Neg_t = \sum_i \phi_{it} |\min(Net_{it}, 0)|$$

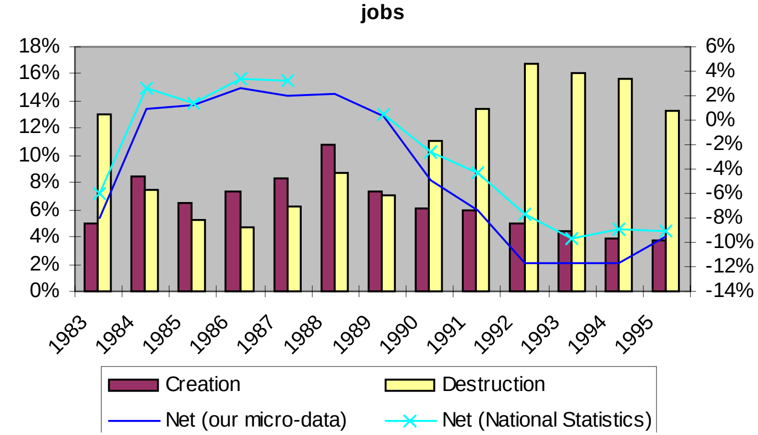
Net creation is the change in total employment, job creation is the sum of all newly created jobs in the sample, job destruction is the sum of all destructed jobs. Job reallocation summarizes the heterogeneity in plant level employment outputs, by adding the number of jobs that were destroyed and created in the period. Note that from these definitions $Net_t=Pos_t - Neg_t$ and $Sum_t=Pos_t + Neg_t$

Over the fourteen years covered in this study there was a net job contraction of 4.5%. Annual gross job flow rates vary considerably over time. Job creation rates vary between 4% and 11% while job destruction rates vary between 5% and 17%. Job net creation and job reallocation rates vary between –12% and 3% and between 12% and 22% respectively (see Table 4 and Figure 3).[5] Capital creation and destruction rates are more stable ranging from 6% to 13% and from 7% to 14% respectively.

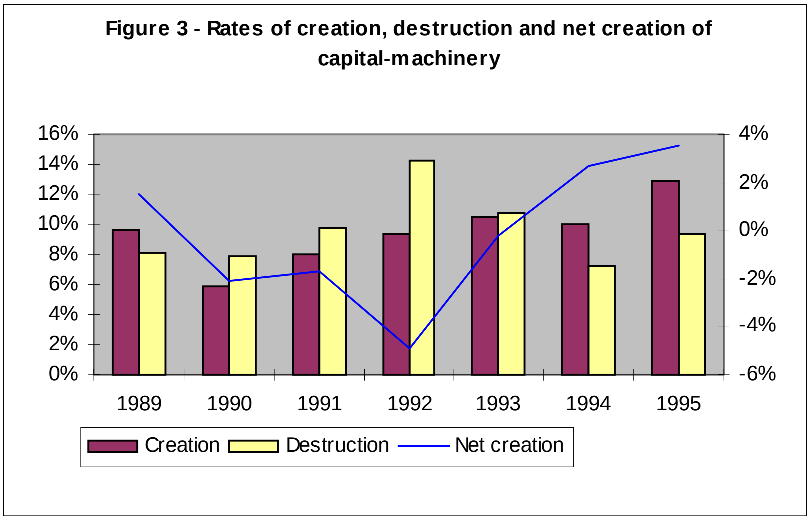
Table 4. Jobs and Capital flow rates

		Total Employment	White Collar	Blue Collar	Total Capital	Machinery	Other Capital
1983-1987	Net creation	-0,4%	-2,3%	0,4%			
	Reallocation	14,5%	12,6%	16,1%			
	Creation	7,1%	5,2%	8,3%			
	Destruction	7,5%	7,5%	7,8%			
1988-1995	Net creation	-7,1%	-5,4%	-7,4%	-3,3%	-0,2%	-1,7%
	Reallocation	18,9%	20,8%	20,8%	11,2%	19,1%	17,5%
	Creation	5,9%	7,7%	6,7%	4,0%	9,5%	7,9%
	Destruction	13,0%	13,1%	14,1%	7,2%	9,6%	9,6%
1982-1995	Net creation	-4,5%	-4,1%	-4,4%			
	Reallocation	17,2%	17,6%	19,0%			
	Creation	6,4%	6,7%	7,3%			
	Destruction	10,9%	10,9%	11,7%			

Figure 2. Rates of creation, destruction and net creation of jobs



[5] Figure 3 pre… creation that results from t… ear 1988 net creation is no… nples are not comparable).



In 1983 Uruguayan firms were still suffering the effects of the sudden change in the exchange rate policy that occurred in November of 1982. Manufacturing output fell by 22% in 1981-1983. This process was naturally accompanied by a significant net job destruction. After that, over the rest of the eighties it is possible to observe an increase in jobs. It was during the nineties, when the government abandoned the role it played in previous years in the bargaining process and when the process of trade barrier reduction was stronger that most of the destruction took place.

Over the entire period the rate of net destruction is approximately equal for white and blue collar jobs, although it is slightly stronger for the latter than the former. This general result for the whole period hides a different evolution over time. While during the economic recovery from 1984 onwards, creation was higher in less qualified jobs, blue collar jobs suffered higher destruction rates over the nineties. This is in line with the view that the recovery during the second half of the eighties in Uruguay is explained by the increased use of existent previously idle capacity and not the introduction of new capital or technologies.

Between 1988-1995, capital experienced a negative net creation both in its total and in its components that contrasts with the much higher net destruction of employment on that period. While there was continuous net destruction of employment in the nineties (both for white and blue collar jobs but especially for the latter), in 1994 and 1995 there was positive net creation of capital (see Figures 3 and 4). This is indicative of technological change towards a more capital intensive production function.

IV.2. Productivity

In this section we lay the main stylized facts of productivity estimates for our panel of firms. We present both employment and capital average productivity measures (output/employment and output/capital ratios) and a measure of total factor productivity estimated econometrically by two different methodologies.

Labor and capital average productivity are defined as the ratio between firm value added and the amount of each factor of production used in the period:

$$p_{it}^{E} = \frac{Y_{it}}{E_{it}}; \quad p_{it}^{K} = \frac{Y_{it}}{K_{it}}$$

where Y_{it} , E_{it} and K_{it} are value added, employment and capital of establishment *i* at time *t*. [6]

Aggregate factor productivity is then a weighted average of establishment level productivities. Letting the share of firm *i* employment in total employment be $\phi_{it}^{E} = E_{it} / E_{t}$ (and similarly for capital), aggregate factor productivity is defined by:

$$p_{t}^{E} = \sum_{i} \phi_{it}^{E} p_{it}^{E} \quad ; \quad p_{t}^{K} = \sum_{i} \phi_{it}^{K} p_{it}^{K}$$

We have also estimated the establishment level total factor productivity using the methodologies proposed by Olley and Pakes (1996) and Levinshon and Petrin (2000) (OP and LP onwards). The details of both methodologies are summarized in the appendix. Both are essentially methods for estimating the parameters of an underlying production function that provide a remedy for two main problems associated with these estimates. These are the selection problem (i.e. in a panel a researcher would only observe the surviving firms, hence those likely to be the most productive), and the simultaneity problem (the input choices of firms conditional on the fact that they continue to be in activity depend on their productivity).

In Table 5 we display the coefficients of a production function estimated by OP and LP methodologies. Since LP uses electricity to proxy for unobservables rather than investment (as OP), there is about the triple of observation in LP than in OP.

Table 5.
Production function estimations

	Olley-Pakes	Levinsohn-Petrin
Unskilled labor	0.350	0,132
	(0.032)***	(0,040)
Skilled labor	0.317	0,367

[6] We also explored defining productivity using gross production. Given that the accounting problems in the building capital variable translate to total capital, capital productivity refers to machinery capital productivity and not total capital productivity.

	(0.024)***	(0,029)
Materials	0.295	0,254
	(0.017)***	(0,024)
Electricity		0,122
		(0,042)
Capital stock	0.250	0,135
	(0.045)***	(0,028)
Observations.	1436	4120

Standard errors in parenthesis

Aggregate total factor productivity is then a weighted average of establishment total factor productivity. Letting the share of firm i output be $\phi_{it}^{Y} = Y_{it} / Y_t$, aggregate total factor productivity is defined by:

$$TFP_t = \sum_i \phi_{it}^{y} TFP_{it}$$

Table 6 shows the estimated productivity growth rates. Over the whole period, employment productivity grew at an average annual rate of 2.4%. But again the existence of two differentiated periods should be noted: from 1982 until 1988 and from that year until 1995. In the first period we observe a low annual growth rate of 0.9% in labor productivity that is more than compensated by a productivity boom mostly occurring in the nineties. From 1988 until 1995 total employment productivity grew at an annual 3.7% rate. The net creation rates presented in the previous section document the increase in the capital to labor ratio. This more abundant use of capital translates into a –2.6% average annual growth rate for capital productivity.

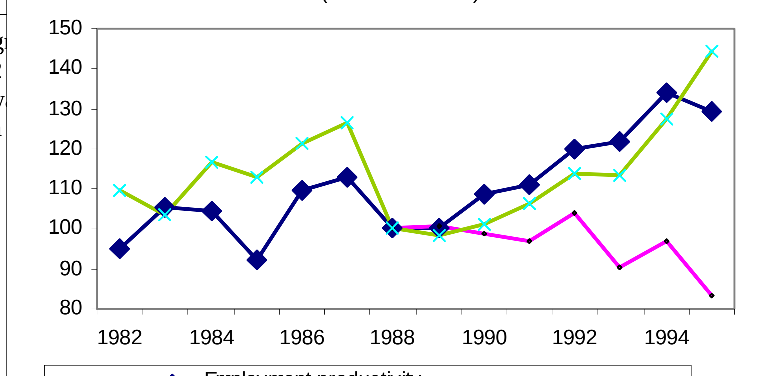
Total factor productivity also grew at a very high rate, 3.3% according to the OP methodology and 3.7% according to the LP.

Table 6. Average Annual productivity growth rates

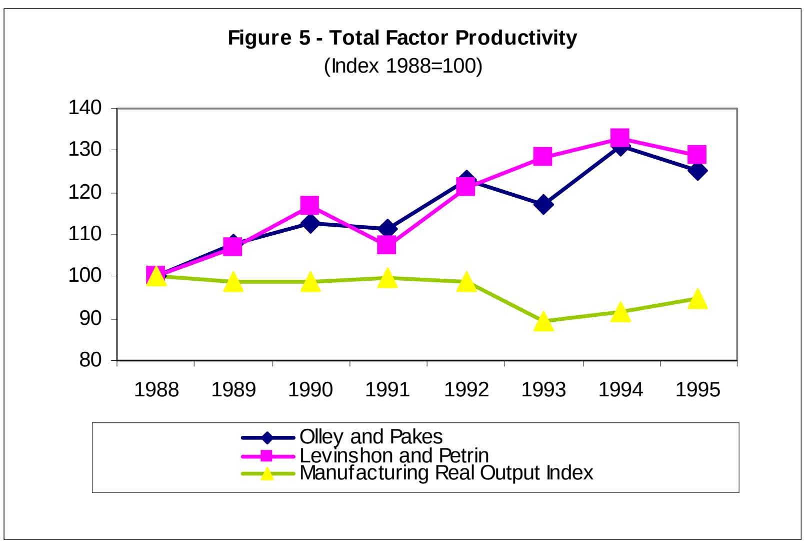
	Employment Productivity	Capital Productivity	TFP Olley-Pakes	TFP Levinshon-Petrin
1982-1987	0,9%			
1988-1995	3,7%	-2,6%	3,3%	3,7%
1982-1995	2,4%			

Figure 5 plots the annual values for average capital (machinery) productivity, and average employment productivity from our micro data and from the published aggregate statistics.[7] Figure 6 plots an index of total factor productivity by OP and LP methodologies and in order to have a sense of the cyclical movements it includes the evolution of manufacturing real output.

Figure 4 - Emplyment and Capital Productivity
(Index 1988=100)



[7] The high deg[...] . After the November 1982 [...]he decrease in production w[...]ıctivity fell significantly. In [...]apacity and without making [...]ductivity in that year.



V. Estimates of the Impact of Trade Liberalization on Employment and Capital flows and Productivity

As argued previously it is reasonable for the Uruguayan experience to assume that firms face a mainly exogenous shift in trade policy towards lower tariffs. Additionally, although we take unionization to be endogenous, we will assume that the changes in negotiation regimes arising out of changes in government participation in the negotiations process are also exogenous to both firms and unions. Firms and unions adapt their behavior in the face of the disappearance of the incentives to negotiate at a centralized level. As a result, changes were induced in several parameters of firms and unions behavior: the scope of negotiations (bargaining over employment vs. over wages), and finally, the very incentives for union activity were weakened, as is probably reflected in the ever decreasing affiliation rates through the period.

There are three channels through which trade policy is expected to affect factor flows and productivity at a firm level. First, the foreign input push may imply for firms the access to a better or cheaper pool of intermediate inputs and capital goods, implying therefore capital creation, job destruction and higher total factor productivity. Naturally, unions will resist capital for labor substitution, hence we will expect that the presence of unions will mitigate (or eliminate) the magnitude of this effect. Second, a competitive push will imply that the fiercer competition will force firms to innovate, hence productivity gains are to be expected. Two extreme cases of this will be, on the one hand, that in which higher productivity is passed on in higher factor payments with factor quantities fixed, and in the other hand, that in which we observe both capital and job creation. Third, the competitive elimination process may induce exit of the least productive firms. Productivity at a sector level increases since there remain only the most productive firms. The capital and jobs of exiting firms are destroyed. Summing up all of the mentioned effects, we expect the openness measures to be associated with higher capital creation and capital destruction, with higher job creation and higher job destruction, and fundamentally, with higher total factor productivity.

Unions are associated with higher wages and lower turnover but there are several plausible arguments that run in opposite directions on their effects on job creation, job destruction and productivity. Which effect dominates remains an empirical issue. According to Borjas and Ramey (1995) we expect trade liberalization effects to be lower in more competitive sectors.

The preferred estimation technique is Instrumental Variables (IV) in order to control for endogeneity problems. We also report Ordinary Least Squares (OLS) estimations. The models to be estimated are specified as:

$$\begin{aligned} y_{ijt} = {} & \beta_1 Op_{jt} + \beta_2 Op_{jt-1} + \beta_3 Op_{jt-2} + \beta_4 Con_{jt-1}.Op_{jt-1} + \beta_5 Un_{jt-1}.Op_{jt-1} + \\ & + \beta_6 Death_{ijt} + \beta_7 Size_{ijt} + \sum_j \alpha_j d_j + \gamma_i + \lambda_t + \varepsilon_{ijt} \end{aligned} \tag{1}$$

where:

$$y_{ijt} = \begin{Bmatrix} Net_{ijt} \\ Pos_{ijt} \\ Neg_{ijt} \end{Bmatrix} \text{for total employment, white and blue collar, total capital, machinery and other capital}$$

where j is firm i's sector. *Size* is measured as the average of current and past establishment value added and *Death* is a dummy variable that takes the value 1 the year previous to the firm exit. In our regressions, we control by sectoral dummies (d_j), and we allow for fixed establishment and year effects.

Op (openness) is the trade liberalization variable. It is consequently defined as the negative of the annual variation in the average tariff.[8] A positive estimated coefficient means that the greater the degree of trade liberalization, the higher the rate in consideration. We have data on tariffs for the period 1985-1995; therefore including two lags of *Op* the estimations are for 1988-1995.

Un (union density) is defined as the affiliation rate of the industry at the 3 digit ISIC level. This variable is built using data on membership reported by the national federation of unions in each of its periodic congresses and dividing that figure by total employment. The bargaining centralization variable *Cen* is the fraction of employees in the sector that have agreements at sector level registered at the Ministry of Labor. Prior to 1985 when unions where banned and the state played no role in the bargaining process, this variable takes the value of 0 and for most industries it jumps to values close to one over the next five years. After 1991 it starts to fall due to the progressive conclusion of the tripartite agreements of the preceding years and the end of government involvement in labor bargaining.[9]

Con is the concentration variable. It is measured as the sum of the market share of the three largest establishments in the sector. It ranges from a low 6% to full 100% concentration with an average of 34%.

To take into account the fact that union density and concentration are an endogenous result of several sector and firm attributes, our IV regressions instrument *Un* and *Con*, using bargaining centralization (*Cen*) and the ratio between the sales of the two largest firms in the sector.

The dependent variables considered in equation (1) are rates and therefore capture the change between periods. Productivity on the other hand is a level variable and therefore more suitably modeled dynamically.[10] Note that our estimation strategy with respect to openness is different in the case of productivity than that of factor flows. Given that the latter are rates, we use as explanatory variables changes in tariffs, whereas because productivity is a level variable, we use the tariff level as a regressor in the productivity estimations. Therefore the model for productivity is:

[8] In past versions of this paper we experiment with sector implicit tariffs (ratio of internal and external prices) that reflect both tariff and non-tariff protection instruments. Given that Uruguayan protectionist policies were mostly conducted by non-tariff instruments these implicit tariffs have an endogenity problem that is not present in the actual import tariff.

[9] See Cassoni, Fachola and Labadie (2001) for details on the construction of these variables.

[10] Although not reported, we also explored static specifications for productivity and dynamic specifications for the job and capital flow rates.

$$\ln y_{ijt} = \beta_1 \ln Tar_{jt} + \beta_2 \ln Tar_{jt-1} + \beta_3 \ln Tar_{jt-2} + \beta_4 Con_{jt-1}.\ln Tar_{jt-1} + \beta_5 Un_{jt-1}.\ln Tar_{jt-1}$$
$$\beta_6 Death_{ijt} + \beta_4 Size_{ijt} + \beta_7 y_{ijt-1} + \sum_j \alpha_j d_j + \gamma_i + \lambda_t + \varepsilon_{ijt} \quad (2)$$

where:

$$y_{it} = \begin{cases} p^E_{ijt} \\ p^K_{ijt} \\ TFP_{ijt} \end{cases}$$

Tar is the average import tariff constructed at four digit ISIC aggregation level. Productivities and *Tar* are estimated in logs and therefore the coefficients can be directly interpreted as elasticities. A negative sign on *Tar* means that lowering the tariff (i.e. opening the economy) produces an increase in productivity.

It may be that the dependent and some of the explanatory variables are simultaneously determined, introducing biases in the estimations. To deal with this problem, General Method of Moments (GMM) estimates based on instrumenting the past equation by the lagged level values of the variables can be used. We follow the estimation methodology of Arellano and Bond (1991, 1995) and use as instruments *Cen*, the past value of the independent variables and the lag 3 of the log of TFP. For completitude we also run OLS regressions.

Tables 7 and 8 presents the econometric results for job flows and Tables 9 and 10 for capital flows using IV and OLS. The sets of instruments were adequate according to Hausman tests reported in Tables 7 and 9.

As expected, the trade liberalization process implied an increase in job creation and in job destruction. The increase in job creation can be associated with the competitive push channel mentioned before. The increase in job destruction can be the effect of the foreign input push or the downsizing and eventual exiting of inefficient firms (the competitive elimination channel). The effect on job destruction is stronger than the effect in job creation implying therefore a negative effect of trade liberalization on net creation rates.

Trade liberalization is also associated with higher capital destruction and marginally with lower capital creation. Again, the effects on capital destruction point to a competitive elimination channel. What is somewhat more puzzling is the negative coefficient on the open variable (lag 2) in the capital creation regressions. This seems indicative that the technological change in the Uruguayan manufacturing sector is not necessarily linked to sectors that experienced the highest tariff reductions. Probably many firms in these previously highly protected sectors were unable to survive and the switch towards more capital intensive technologies took place in within sectors that originally were more exposed to international competition. The joint result of the creation and destruction capital rates is that the trade liberalization overall is associated with negative net capital creation rates.

Unions are associated with higher net job and capital creation rates. The higher net creation rates in unionized sectors are the result of lower destruction rates. Unions seems to have implied lower destruction rates for both labor and capital but no effects on creation rates. In that sense unions were able to ameliorate the competitive channel elimination of trade liberalization, and by not exiting, more unionized firms had lower destruction of capital and labor.

Allen (1988) finds that while in the private sector existence of unions increases layoffs, unions reduce layoffs in the public sector. Our establishment database is composed only of private firms and although we do not measure layoffs explicitly the job destruction pattern associated with unions seems to show a different picture.

With respect to firms market power, higher concentration mitigates the openness effect on job and capital destruction. We do not find an effect on creation rates of industry concentration. This evidence does not support the model presented in Borjas and Ramey (1995).

Considering the marginal effects, an extra point import tariff reduction has a direct effect that increases the destruction rate by half percentage point (0.53). This effect is mitigated by the presence of unions and degree of concentration. Evaluating the marginal effect at the average unions density, one point reduction in tariffs produces an increase on the destruction rate of only 0.11. Considering also the average concentration the destruction rate increases only by 0.02. Similarly the reduction of one extra point has a direct effect of reducing the net creation rate by -0.80. But once we account for the presence of unions the marginal effect is a reduction of about -0.13 and adding the effects of market power the final marginal effect is of only -0.02. The marginal effect of trade liberalization on job creation is 0.01. Although small in magnitude, this figure hides a different effect on blue and white collars. While a marginal increase in international exposure increases blue collar job creation rate by 0.01, it decreases white collar job creation rate by 0.17.

It does not seems to be a significant difference in the way unions effect white and blue collars. The direct marginal effect of trade liberalization on white collars and blue collars net creation is about -0.54 and -0.57 respectively. Once we account for the mitigating effects on unions these effects are reduced to -0.09 and -0.10. Finally the complete marginal effects accounting for unions and concentration is of -0.01 and -0.02. Thus, we do no find evidence of trade liberalization affecting white and blue collars in a differentiated way neither the mitigating effects of unions is different for blue and white collar workers.

With respect to capital, the direct marginal effect of the reduction of an extra point in tariffs is a decrease in the net creation rate of 0.41. The presence of unions fundamentally but also industry concentration mitigate the effects of the higher international exposure. The effect of trade liberalization considering the direct effect and the interaction with unions is of a much smaller reduction in the net creation rate of 0.07. Considering also the average industry concentration, the marginal effect of trade liberalization on net capital creation is of -0.03. The effect of trade liberalization is mostly channeled trough higher destruction. The very small -but not of the expected sign- marginal effect of trade liberalization on capital creation is -0.01.

The estimated coefficient for *Death* was found to be significant and negative in most flow rate regressions. Establishments in their last year before exiting tend to create less employment and capital and also to destroy less. The former is intuitively appealing, while the latter is somewhat strange. We conjecture that a manager who already anticipated the death of the establishment may have found it cheaper to close the firm all at one than to gradually reduce employment and capital in the period leading up to closure.

As was found in previous studies (for instance Davis, Haltiwanger and Shuh (1996)) larger establishments have higher net creation rates. In the Uruguayan manufacturing case larger firms tend to have lower creation and lower destruction rates but the effect on the latter is stronger. This results holds for all types of employment and capital. In this sense, larger firms have a more stable use of factors of production.

Table 7. Job Flows Regressions IV estimation									
	Total Employment			White Collars			Blue Collars		
	Net	Creation	Destruct.	Net	Creation	Destruct.	Net	Creation	Destruct.
Op	-0,025	0,007	0,023	-0,017	0,009	0,018	-0,020	0,006	0,017
	(0.009)***	(0.003)***	(0.007)***	(0.006)***	(0.005)*	(0.009)**	(0.007)***	(0.003)**	(0.007)**
Op(-1)	-0,760	-0,055	0,492	-0,513	-0,228	0,529	-0,541	-0,058	0,396
	(0.369)**	(0,057)	(0.202)**	(0.173)***	(0.134)*	(0.245)**	(0.291)*	(0,066)	(0.185)**
Op(-2)	-0,015	0,001	0,012	-0,009	-0,001	0,024	-0,013	0,002	0,010
	(0.007)**	(0,003)	(0.007)*	(0,006)	(0,006)	(0.011)**	(0.006)**	(0,004)	(0,006)
UnOp(-1)	1,690	0,099	-1,062	1,151	0,442	-1,189	1,202	0,101	-0,857
	(0.811)**	(0,129)	(0.435)**	(0.388)***	(0,274)	(0.545)**	(0.639)*	(0,146)	(0.399)**
ConOp(-1)	0,371	0,048	-0,283	0,244	0,170	-0,231	0,262	0,053	-0,217
	(0.198)*	(0,034)	(0.133)**	(0.093)***	(0.092)*	(0.134)*	(0.158)*	(0,044)	(0.116)*
Death	0,765	-0,143	-0,795	0,741	0,076	-0,808	0,686	-0,080	-0,726
	(0.101)***	(0.052)***	(0.080)***	(0.068)***	(0,105)	(0.107)***	(0.081)***	(0,065)	(0.064)***
Size	0,101	-0,025	-0,141	0,120	-0,006	-0,161	0,097	-0,031	-0,153
	(0.016)***	(0.008)***	(0.018)***	(0.014)***	(0,014)	(0.023)***	(0.014)***	(0.009)***	(0.017)***
Constant	-0,196	0,164	0,547	-0,265	0,356	0,729	-0,213	0,275	0,644
	(0.060)***	(0.022)***	(0.059)***	(0.044)***	(0.042)***	(0.090)***	(0.051)***	(0.027)***	(0.056)***
Observations	5536	1929	2883	5220	1550	2126	5455	1836	2802
Establishments	1155	834	1018	1101	723	896	1141	818	1005
Hausman test	0,793	0,990	0,669	0,407	0,923	0,804	0,878	0,965	0,801

Note: Op=Change in tariff level, Un=affiliation rate at 3 digit ISIC, Con=concentration rate at 3 digit ISIC, UnOp=Un*Op, ConOp=Con*Op, Death= dummy takes value 1 the year previous the establishment exits, Size=average of current and past value added. Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 8. Job Flows Regressions OLS estimation									
	Total Employment			White Collars			Blue Collars		
	Net	Creation	Destruct.	Net	Creation	Destruct.	Net	Creation	Destruct.
Op	-0,010	0,007	0,013	-0,007	0,009	0,008	-0,010	0,007	0,009
	(0.003)***	(0.002)***	(0.004)***	(0.004)*	(0.004)**	(0,006)	(0.003)***	(0.003)**	(0.004)**
Op(-1)	-0,046	-0,014	0,049	-0,051	-0,023	0,055	-0,042	-0,016	0,039
	(0.010)***	(0.008)*	(0.014)***	(0.012)***	(0,015)	(0.019)***	(0.010)***	(0.010)*	(0.014)***
Op(-2)	-0,007	0,002	0,009	-0,004	-0,001	0,012	-0,007	0,003	0,007
	(0.004)**	(0,003)	(0.005)*	(0,004)	(0,005)	(0.007)*	(0.004)*	(0,004)	(0,005)
UnOp(-1)	0,110	0,021	-0,127	0,119	0,040	-0,134	0,098	0,022	-0,104
	(0.021)***	(0,017)	(0.032)***	(0.026)***	(0,030)	(0.042)***	(0.022)***	(0,021)	(0.031)***
ConOp(-1)	0,010	0,015	0,003	0,024	0,029	-0,012	0,008	0,019	0,001
	(0,013)	(0,011)	(0,019)	(0,016)	(0,019)	(0,024)	(0,014)	(0,014)	(0,018)
Death	0,607	-0,150	-0,686	0,637	0,017	-0,674	0,582	-0,094	-0,675
	(0.036)***	(0.048)***	(0.050)***	(0.045)***	(0,086)	(0.065)***	(0.040)***	(0,060)	(0.050)***
Size	0,101	-0,026	-0,149	0,119	-0,013	-0,174	0,097	-0,032	-0,160
	(0.010)***	(0.008)***	(0.014)***	(0.012)***	(0,012)	(0.018)***	(0.011)***	(0.009)***	(0.014)***
Constant	-0,284	0,164	0,621	-0,323	0,350	0,848	-0,275	0,272	0,706
	(0.025)***	(0.021)***	(0.038)***	(0.032)***	(0.037)***	(0.053)***	(0.027)***	(0.025)***	(0.038)***
Observations	5551	1938	2886	5233	1555	2127	5470	1846	2806
Establishments	1155	836	1019	1101	725	896	1141	819	1006

Note: See table 7

Table 9. Capital Flows Regressions IV estimation									
	Total Capital			Machinery			Other Capital		
	Net	Creation	Destruct.	Net	Creation	Destruct.	Net	Creation	Destruct.
Op	-0,022	-0,003	0,022	-0,024	-0,008	0,019	-0,021	-0,006	0,012
	(0.004)***	(0,004)	(0.004)***	(0.005)***	(0,005)	(0.003)***	(0.005)***	(0,004)	(0.004)***
Op(-1)	-0,374	-0,040	0,064	-0,332	0,006	0,092	-0,257	-0,055	0,048
	(0.139)***	(0,101)	(0.032)**	(0.141)**	(0,047)	(0.028)***	(0.137)*	(0,088)	(0,031)
Op(-2)	-0,018	-0,007	0,019	-0,022	-0,013	0,020	-0,015	-0,006	0,017
	(0.005)***	(0.004)*	(0.005)***	(0.005)***	(0.007)**	(0.004)***	(0.005)***	(0,005)	(0.005)***
UnOp(-1)	0,871	0,104	-0,139	0,799	0,027	-0,213	0,621	0,166	-0,065
	(0.310)***	(0,234)	(0.066)**	(0.331)**	(0,095)	(0.059)***	(0.311)**	(0,205)	(0,066)
ConOp(-1)	0,141	0,001	-0,007	0,084	-0,044	-0,014	0,077	-0,019	-0,053
	(0.076)*	(0,047)	(0,043)	(0,062)	(0,051)	(0,041)	(0,070)	(0,046)	(0,043)
Death	0,756	-0,311	-0,788	0,725	-0,226	-0,769	0,695	-0,175	-0,824
	(0.058)***	(0.092)***	(0.042)***	(0.062)***	(0.128)*	(0.039)***	(0.060)***	(0.082)**	(0.043)***
Size	0,106	-0,003	-0,171	0,115	0,002	-0,135	0,104	-0,010	-0,170
	(0.013)***	(0,011)	(0.016)***	(0.013)***	(0,016)	(0.013)***	(0.013)***	(0,012)	(0.016)***
Constant	-0,132	0,316	0,384	-0,157	0,421	0,365	-0,126	0,408	0,472
	(0.038)***	(0.037)***	(0.034)***	(0.040)***	(0.054)***	(0.030)***	(0.039)***	(0.036)***	(0.036)***
Observations	4114	1526	2588	3979	1159	2816	4044	1647	2397
Establishments	704	537	671	678	468	663	689	562	659
Hausman test	0,384	0,999	0,980	0,582	0,985	0,373	0,842	0,822	0,880

Note: Op=Change in tariff level, Un=affiliation rate at 3 digit ISIC, Con=concentration rate at 3 digit ISIC, UnOp=Un*Op, ConOp=Con*Op, Death= dummy takes value 1 the year previous the establishment exits, Size=average of current and past value added. Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

Table 10. Capital Flows Regressions OLS estimation									
	Total Capital			Machinery			Other Capital		
	Net	Creation	Destruct.	Net	Creation	Destruct.	Net	Creation	Destruct.
Op	-0,015	-0,003	0,021	-0,016	-0,007	0,017	-0,015	-0,004	0,013
	(0.003)***	(0,003)	(0.004)***	(0.003)***	(0,005)	(0.003)***	(0.003)***	(0,004)	(0.004)***
Op(-1)	-0,03	-0,006	0,042	-0,038	0,014	0,041	-0,025	-0,008	0,029
	(0.010)***	(0,011)	(0.012)***	(0.011)***	(0,017)	(0.010)***	(0.011)**	(0,013)	(0.012)**
Op(-2)	-0,014	-0,007	0,019	-0,018	-0,013	0,018	-0,012	-0,004	0,019
	(0.004)***	(0.004)*	(0.005)***	(0.004)***	(0.007)*	(0.004)***	(0.004)***	(0,005)	(0.005)***
UnOp(-1)	0,075	0,023	-0,075	0,079	-0,016	-0,07	0,075	0,01	-0,06
	(0.021)***	(0,024)	(0.027)***	(0.023)***	(0,036)	(0.023)***	(0.024)***	(0,026)	(0.027)**
ConOp(-1)	0,006	-0,008	-0,014	0,018	-0,017	-0,022	-0,005	0,019	0,001
	(0,013)	(0,015)	(0,016)	(0,014)	(0,024)	(0,014)	(0,015)	(0,017)	(0,016)
Death	0,672	-0,326	-0,781	0,645	-0,236	-0,755	0,637	-0,202	-0,828
	(0.039)***	(0.081)***	(0.041)***	(0.043)***	(0.126)*	(0.038)***	(0.045)***	(0.076)***	(0.042)***
Size	0,106	-0,004	-0,171	0,113	0,002	-0,135	0,104	-0,014	-0,172
	(0.011)***	(0,011)	(0.016)***	(0.012)***	(0,016)	(0.013)***	(0.012)***	(0,011)	(0.016)***
Constant	-0,178	0,312	0,39	-0,205	0,42	0,378	-0,16	0,402	0,465
	(0.028)***	(0.034)***	(0.034)***	(0.030)***	(0.053)***	(0.029)***	(0.031)***	(0.035)***	(0.035)***
Observations	4127	1533	2594	3991	1168	2823	4056	1653	2403
Establishments	704	538	672	678	474	663	689	562	660

Note: See Table 9

Table 11 presents the results for productivity estimated using a GMM and OLS approach respectively. The Sargan tests show that the three models have adequate instruments in the three models. *Tar, Un, Death* and *Size* were found to be significant at high levels and had the expected sign.

The negative sign on the *Tar* variable implies that trade liberalization is associated with increases in employment and capital average productivity and with total factor productivity. This result is qualitatively similar to López-Cordoba (2002) for a panel of Mexican firms. His main findings are that increased foreign competition and access to the US market have a positive impact on total factor productivity.

Consistent with mitigating effects on unions on the trade liberalization factor flows consequences, the coefficient of the interaction between union density and tariffs was found to be positive. This means that unions reduced the productivity enhancing resulting from the higher international exposition. This result is not in line with Freeman and Medoff "organizational view" and closer to those that stress the monopoly costs of unions.

The steady state elasticities of the three productivity measures with respect to the tariff level are between 0.4 and 1 -and additional 1% decrease in tariffs produces an increase in productivities between 0.4% and 1%. Without considering the mitigating effect of unions, the employment productivity elasticity with respect to tariff is of -0.53. Once the interaction with unions is accounted this elasticity is reduces to -0.43. Similarly for capital productivity and TFP, unions reduce in absolute value the productivity elasticity with respect to import tariffs by 0.1 (from 1.02 to 0.93 for capital productivity and from -0.86 to -0.76 for TFP).

In our IV estimation the *Death* variable was not significant for employment productivity and TFP. Therefore, it can not be assured that exiting firms had lower productivity. On the contrary Aw, Chen and Roberts (1997) for Taiwanese manufacturing firms find that exiting firms are less productive than survivors. Our OLS estimation produce this result.

With respect to industry concentration, we do not find evidence that the productivity improvements vary across different industry concentration levels. Finally, larger firms have higher productivity.

Table 12. Productivity						
	GMM estimation			OLS estimation		
	Employment Productivity	Capital Productivity	TFP (LP)	Employment Productivity	Capital Productivity	TFP (LP)
lag 1 dependent variable	0,213	0,335	0,224	0,17	0,326	0,177
	(0,073)***	(0,060)***	(0,088)***	(0.016)***	(0.017)***	(0.020)***
Tar	-0,030	-0,034	-0,025	0,137	0,225	0,116
	(0,107)	(0,106)	(0,096)	(0.056)**	(0.069)***	(0.064)*
Tar(-1)	-0,416	-0,440	-0,331	-0,378	-0,143	-0,253
	(0,139)***	(0,171)***	(0,142)***	(0.091)***	(0,112)	(0.102)**
Tar(-2)	-0,180	-0,241	-0,336	-0,013	0,049	-0,12
	(0,127)	(0,144)**	(0,133)***	(0,085)	(0,105)	(0,095)
UnTar(-1)	0,201	0,155	0,259	0,21	0,277	0,326
	(0.072)***	(0.079)**	(0,073)***	(0.052)***	(0.067)***	(0.061)***
ConTar(-1)	-0,064	-0,012	-0,112	-0,018	-0,248	-0,113
	(0,088)	(0,106)	(0,092)	(0,045)	(0.067)***	(0.060)*
Death	-0,086	-0,250	-0,066	-0,132	-0,297	-0,132
	(0,082)	(0,101)***	(0,080)	(0.044)***	(0.056)***	(0.051)***
Size	0,117	0,152	0,099	0,081	0,114	0,081
	(0,027)***	(0,031)***	(0,025)***	(0.010)***	(0.015)***	(0.013)***
Constant	-0,057	-0,132	-0,076	7,241	-0,225	4,889
	(0,034)**	(0,036)***	(0,032)***	(0.184)***	(0,170)	(0.189)***
Observations	2.113	2.109	2.022	5.358	3.675	3.241
Establishments	532	531	508	1.076	680	618
Sargan test	0,524	0,326	0,272			
Test no autocorreleation order 1	0,000	0,000	0,000			
Test no autocorreleation order 2	0,381	0,241	0,136			

Note: The dependent variable is the log of productivity. Tar= log of the tariff level, Un=affiliation rate at 3 digit ISIC, Con=concentration rate at 3 digit ISIC, UnTar=Un*Tariff, , ConTar=Con*Tar, Death= dummy takes value 1 the year previous the establishment exits, Size=average of current and past gross product. Standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

VI. Conclusion

In this paper we study employment and capital flows and productivity in the Uruguayan manufacturing sector using a panel of establishment level data between 1982 and 1995. Creation and destruction rates were found to be relatively high and pervasive over time. Even during the strong net employment destruction process experienced during the nineties, annual creation rates are above 4%. Although white and blue collar employment evolution is not the same over time, the previous results hold true for both of them.

The Uruguayan manufacturing sector, in response to reductions in trade barriers, undertook a technological update in favor of more capital intensive technologies. The use of such technologies brought about a progressive and systematic increase in the average labor productivities, though not in capital productivity. Concurrently total factor productivity increased during the nineties at an annual average rate above 3%. Higher competition through tariff reductions, and the availability of cheaper and better intermediate inputs and capital goods may be behind that higher productivity. Although we suggest plausible channels, definitive testing on alternative explanations remains an interesting issue for further research.

Though the opening of the Uruguayan economy implied both the creation and destruction of jobs, overall there were very high net destruction rates. These net destruction rates are explained mainly by the downsizing and exiting of less efficient firms. We find no evidence of a differentiated effect on the net creation of jobs for blue collar and white collar workers.

Unions acted as buffers on the effects of higher international exposure. They were able to mitigate the effects of the competitive elimination channel with respect to net creation rates. Although not creating more jobs, unionized sectors are associated with lower destruction rates. It does not seem to be a different pattern for blue and white collar workers in this respect either. The same pattern observed for capital dynamics. The other side of this story is that the mitigating effects of unions negatively affected the increase in productivity brought by the liberalization process.

More concentrated sectors were also able to ameliorate -but in a much lower magnitude than unions did- the effects of higher international exposure on job dynamics but they had very small or no effect at all in capital dynamics. Productivity dynamics were not affected by industry concentration either.

With respect to firms size, we found that larger firms have higher net creation rates. We found no evidence of a different pattern of creation between larger and smaller firms, but larger firms tend to have lower destruction rates. Larger firms were also found to be more productive.

Summing up, Uruguay opened its economy in the presence of strong –at least initially- unions and structural different industry concentration levels. Higher international exposure implied a slightly higher job creation and an important increase in job and capital destruction. Unions were able to ameliorate this effect. Although not associated with higher creation rates, unions were effective in reducing job and capital destruction. Industry concentration also was found to mitigate the destruction of jobs but had no effect on job creation nor in capital dynamics. The changes in the use of labor and capital brought an increase in total factor productivity specially in sectors where tariff reductions were larger and unions were not present. We found no evidence of varying productivity dynamics across different industry concentration levels.

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Appendix - Productivity Estimation

A.1. Olley and Pakes' method

Olley and Pakes (1996) estimation of total factor productivity is based on a model in which firms have at the beginning of every period a set of decisions to make, including whether to continue or not in operation. If the firm decides to continue, it must choose levels of variable inputs and investment. Technology is represented by a Cobb-Douglas production function

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_{lw} lw_{it} + \beta_m m_{it} + \beta_{lb} lb_{it} + \omega_{it} + \eta_{it}$$

where k_{it} is capital input, lw_{it} is white collar labor input, lb_{it} is blue collar labor m_{it} is material inputs, ω_{it} is TFP (unobserved by the researcher), all in logs, and η_{it} can be thought of either as an non-forecastable shock or as measurement error. The model generates an exit rule, represented by an indicator function χ_t in which survival depends on ω_{it} exceeding a certain threshold. Pakes (1994) showed that the solution to the optimizing firm's problem yields an investment equation of the form:

$$i_{it} = i(k_{it}\ ,\ \omega_{it})$$

which is monotonically increasing in ω_{it} and therefore invertible. The TFP is then $\omega_{it} = h_t(k_{it}, i_{it})$ and substituting back in the production function we obtain:

$$y_{it} = \beta_{lw} lw_{it} + \beta_{lb} lb_{it} + \beta_m m_{it} + \omega_{it} + \varphi_t(k_{it}\ ,\ i_{it}) + \eta_{it}$$

where

$$\varphi_{it}(k_{it}\ ,\ i_{it}) = \beta_0 + \beta_k k_{it} + h_t(,k_{it}\ ,\ i_{it})$$

Estimation of the last equation only identifies β_{lw}, β_{lb}, and β_m and in order to identify β_k estimates of the probability of survival must be obtained. Probability of survival next period is given by

$$P\ \{\chi_{t+1} = 1\} = \pi\ (k_{it}\ ,\ i_{it}) = P_{it}$$

Writing the expectation

$$E\ [y_{it+1} - \beta_l l_{it+1}\ \mid a_{it+1}, k_{it+1}, \chi_{t+1} = 1\ ] = \beta_0 + \beta_k k_{it+1} + E[\ \omega_{it+1} \mid \omega_{it}, \chi_{t+1} = 1]$$

leads to the estimated equation:

$$y_{it+1} - \beta_{lw} lw_{it} - \beta_{lb} lb_{it} - \beta_m m_{it} = \beta_k k_{it+1} + g(\ P_{it}, \varphi_{it} - \beta_k k_{it}) + \xi_{it+1} + \eta_{it+1}$$

The first stage of the estimation requires the estimation of φ_t and of the probabilities of survival. Hence we generate polynomial terms (of order four) in investment and capital stock and obtain regression estimates of the predicted values of the log of output in an equation having on the right hand side the labor inputs (blue and white collar jobs), raw materials inputs, the polynomial (fourth degree) terms and year and two digit industry dummies.

We also compute the probabilities of survival (P_{it}) by running a logit regression in the polynomial terms, along with industry and year dummies.

Finally, using the estimates of β_{lw}, , β_{lb}, and β_m of φ_t and the probabilities of survival and substituting them in the last equation we can obtain an estimate of β_k by running non linear least squares on:

$$y_{it+1} - \widehat{\beta}_{lw} lw_{it+1} - \widehat{\beta}_{lb} lb_{it+1} - \widehat{\beta}_m m_{it+1} = c + \beta_k k_{it+1} + \sum_{j=0}^{4-n} \sum_{n=0}^{4} \beta_{nj} \widehat{h}_t^n \widehat{P}_t^j + e_t$$

where

$$\widehat{h}_{it} = \widehat{\varphi}_{it} - \widehat{\beta}_k k_{it}$$

We can therefore reconstruct establishment level total factor productivity from the production function. Since for invertibility we have to use only positive levels of investment, this leads to a loss of a significant amount of observations.

A.2. Levinsohn and Petrin's method

We also performed an alternative estimation of total factor productivity, using the algorithm proposed by Levinsohn and Petrin (2002). The Levinsohn-Petrin approach is similar in spirit to that of Olley and Pakes, except for the fact that it uses intermediate inputs rather than investment to proxy for the unobserved productivity shock. The intermediate input demand function (increasing in productivity) is:

$$m_{it} = m(k_{it} , \omega_{it})$$

Invertibility guarantees that $\omega_{it} = \omega_{it} (k_{it} , m_{it})$ and substituting in the production function expression we obtain

$$y_{it} = \beta_{lw} lw_{it} + \beta_{lb} lb_{it} + \varphi_t(k_{it} , m_{it}) + \eta_{it}$$

where

$$\varphi_{it}(k_{it}, m_{it}) = \beta_0 + \beta_k k_{it} + \beta_m m_{it} + h_t(k_{it} , m_{it})$$

This equation is partially linear. To identify the coefficients in *lw, lb,* we estimate the following conditional moments using nonparametric methods:

$$E[y_{it} \mid k_{it}, m_{it}],\ \ E[lw_{it} \mid k_{it}, m_{it}],\ \ E[lb_{it} \mid k_{it}, m_{it}]$$

then we can write

$$y_{it} - E[y_{it} \mid k_{it}, m_{it}] = \beta_{lw} \{lw_{it} - E[lw_{it} \mid k_{it}, m_{it}]\} + \beta_{lb} \{lb_{it} - E[lb_{it} \mid k_{it}, m_{it}]\}_t + \eta_{it}$$

and use non intercept OLS to estimate the coefficients in *lw, lb*.

Then, we generate φ_{it}

$$\widehat{\varphi}_{it} = y_{it} - \widehat{\beta}_{lw} lw_{it} - \widehat{\beta}_{lu} lu_{it}$$

and compute a non parametric estimate of $E(\widehat{\varphi}_{it} | m_{it}, k_{it})$

A key assumption is that the productivity shock ω_{it} follows a first order Markov process, hence

$$\omega_{it} = E(\omega_{it} \mid \omega_{it-1}) + \xi_{it}$$

where ξ_{it} is the "news" in the transmitted shock.

Starting form a pair of candidate values for β_k and β_m, denoted by $\widehat{\beta}_k^*, \widehat{\beta}_m^*$ obtained from OLS estimation, we can compute

$$y_{it} - \beta_{lw} lw_{it} - \beta_{lu} lu_{it} - \widehat{\beta}_k^* k_{it} - \widehat{\beta}_m^* m_{it} - E[\omega_t \mid \omega_{t-1}] = \xi_{it} + \eta_{it}$$

for which we need an estimate of $E(\omega_{it} \mid \omega_{it-1})$

We use that

$$y_{it} - \widehat{\beta}_{lw} lw_{it} - \widehat{\beta}_{lu} lu_{it} - \widehat{\beta}_k^* k_{it} - \widehat{\beta}_m^* m_{it} = \omega_{it} \hat{+} \eta_{it}$$

and that

$$\hat{\omega}_{it-1} = \hat{\varphi}_{it-1} - \widehat{\beta}_k^* k_{it-1} - \widehat{\beta}_m^* m_{it-1}$$

then we compute our objective function,

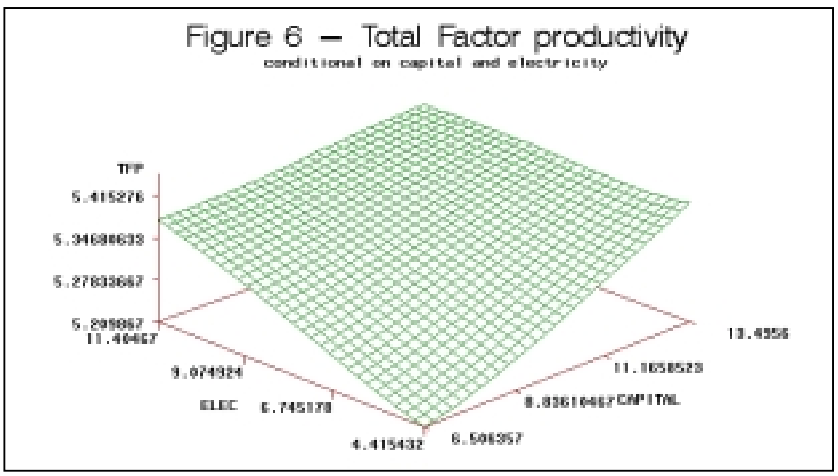
$$SUM = \left[\left(\sum_i \sum_t (\xi_{it} + \eta_{it}) k_{it} \right)^2 + \left(\sum_i \sum_t (\xi_{it} + \eta_{it}) m_{it-1} \right)^2 \right]$$

which we minimize, using a grid search, over β_k, β_m.

Once the full set of parameters of the production function is estimated, we can recover establishment level TFP from them.

A.3. Consistency checks (Levinsohn and Petrin)

Two consistency checks were performed in order to test the plausibility of our estimates. First, an increasing relationship between our proxy variable (in this case, electricity) and our estimates of the TFP (conditional on machinery and equipment capital) has to be observed. This can be seen to hold in Figure 7.



Second, the estimation must be robust to the particular choice of proxy that is used. We performed the same estimation using fuel consumption to proxy for unobserved productivity shocks, and found our estimates (not reported) not to differ significantly to those obtained with the electricity proxy.