Exposure to Low-Wage Competition, Activity Changes and Quality Upgrading: An Empirical Assessment*

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Preliminary and Incomplete, Comments Welcome

Abstract

In this paper, we study the responses of French firms to the competitive pressure arising from low wage countries. More specifically, we test whether the "defensive innovation" assumption is compatible the observed "avoidance", product switching strategy. We use unique French firm level data sourced from various matched datasets and covering the 1999-2004 period which enable to track precisely (at the three digit level) the productive activities of a large sample of French manufacturing firms, their innovative (R&D) effort and the competitive pressure they face on each of their markets, in particular from Southern countries. Our work yields several results. First, Southern competition turns out to be an important driver of R&D spendings. Both the level of R&D spendings and the decision to conduct R&D spendings are affected by Southern competition. Furthermore, the impact of Southern competition on R&D spendings is larger for more productive firms. Third, higher R&D spendings are associated with more frequent changes in firms' activities and with higher increases in the quality of their exported products. Fourth, we find no evidence of market segmentation at the firm level, suggesting that firms progressively get rid of lower quality goods and climb the quality ladder.

JEL classification: D21, E23, F14, L60, O31
Keywords: International Trade, R&D, Heterogeneous Firms, Product Differentiation

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1 Introduction

Analyzing firms responses to globalization is one of the core empirical challenges in both micro and macroeconomics, and one of the most crucial policy debate. At stake are their ability to face new, worldwide competitive pressures, with consequences in terms of industrial and employment structures and specialization, and economic growth.

As stated by Bernard and Koerte (2004), theories such as the international product life-cycle (Vernon 1966) or the technological gap theory (Posner, 1961) suggest that competing with less-developed countries is fundamentally different than competing with developed countries. Similar technologies, absorptive capacities (Griffith et al., 2004) and factor costs are accessible to domestic competitors as well as to competitors from advanced economies, whereas less developed countries lack access to more recent technologies, but enjoy significant advantages in factor (especially labor) costs. Responses to these two kinds of competitive pressure are therefore contrasted: firms in advanced countries cannot rely on *price-based* strategies in order to rule out Southern competitors. Instead, they have to focus on strategies based on their comparatives advantages, i.e. technology- and skill- intensive *products* which cannot be immediately imitated in low-cost countries (see the analysis of "defensive innovation" proposed by Thoenig and Verdier, 2003). This large strand of the literature therefore suggests that southern competition leads to product (as opposed to process) and skill biased innovations[1].

The empirical evidence remains quite coarse and one step behind these theoretical insights. Bernard, Jensen and Schott (2005) examine the role of international trade in the reallocation of U.S. manufacturing within and across industries from 1977 to 1997. They show that plant survival and growth are negatively associated with industry exposure to low-wage country imports so that manufacturing activity is disproportionately reallocated towards capital-intensive plants. Plants are also more likely to switch industries when exposure to low-wage countries is high. But these results are stated for surviving firms only and may understate the magnitude of their response to southern competitive pressure because the data are too highly aggregated. Indeed, product switching is far more widespread than main industry switching: for example, Bernard, Redding and Schott (2006) state that two-thirds of firms alter their mix of five-digit SIC products every five years.

In this paper, we add to the empirical literature thanks to a new dataset which enables us to observe the firm level level of R&D expenditures, i.e. firm level innovation effort, along with their product mix decomposition at a precise (3 digit level) level of definition. Therefore, we add new evidence on the missing link between foreign (southern) competition and the observed firm-level reallocation of production. In other words, do we observe that globalization (also) leads to innovation, or only to delocalization, outsourcing, re-centering on "core" activities?

The last literature to which this paper contributes is characterized by empirical research on inter-

[1] The literature focusing on firms' responses to globalization in Northern countries stretches across fields as diverse as international trade (Pavcnik 2002, Tybout 2003, Bernard, Jensen and Schott 2006 and 2007), industrial economics (Kortum and Klette 2004, Bernard Jensen and Schott 2006, Bernard Redding and Schott 2007), product cycle (Antras 2005, Thoenig and Verdier 2003), endogenous growth (Grossman and Helpman 1991, Baldwin and Robert-Nicoud 2005) and strategic and management literature (Bernard and Koerte 2007). Bernard and Koerte (2007) built on Porter (1980, 1985) to itemize different answers to low cost countries competition: "Organizational strategies" include costs reduction, product differentiation, and relocation of production to low cost countries; "Environmental strategies" include changing products ("avoidance") and deterrence of entry through pricing strategies or government action. The "avoidance" strategy is seen as a switch to other products that are more skill intensive.

national trade that examines how exporting firms differ from other firms in a industry. Among the central findings of this literature are that exporters tend to be larger, more productive and tend to supply higher-quality products than non-exporting firms. These findings have led researchers to ask whether firms export because they are more productive, or whether their activity on the export market that confers a productivity advantage. Studying their innovative behavior adds new evidence to this complex puzzle.

Looking at production reallocations requires to track firm production at the more disaggregated level available, since firms may modify their product mix and not only their main activity. Our analysis of firms defense strategy is made possible by the construction of a longitudinal dataset that tracks French manufacturing output at the firm-sector level from 1999 to 2004. These data enable us to break down any firm's total turnover into the different sectors (3 digit industries) where the firm operates.

Acknowledging for multi-sector firms have major implications for us. First, we can compute firm level import penetration index taking care of the different markets where the firm operates. This is motivated by the fact that import penetration may vary widely from one sector to the other, and by the importance of activity diversification for multi-sector firms. Note that our measures of foreign exposure also take account of *where* imports originate: following Bernard, Jensen and Schott (2006), we define low-wage country import penetration as import penetration from countries with less than 5% of French per capita GDP[2]. Throughout the analysis we also control for import penetration issued from other countries.

Second, the breakdown of firms turnover into all their productive activities enables us to track any product switch due to foreign competition. Our analysis is not restricted to changesin firms' main activities, and our results suggest that activities switches are more important than what was previously acknowledged (Bernard Jensen and Schott 2006). Yeaple and Nocke (2005) provide a model of multi-sector firms where the firms' scope (product mix) is endogenously determined. In this framework, globalization leads to the flattening of the firm size distribution. Bernard, Redding and Schott (2006) also endogenize firms scope in a framework allowing for firms heterogeneity and trade liberalization. Their model provides a micro foundation to firm production rationalization due to international competition. In their framework, trade causes firms to concentrate their production in the "core" of their business. This trend should be higher in comparative advantage industries.

Our empirical analysis can be broken down into two steps. First, we investigate whether southern competition favors French firms innovation effort, which we measure through firm level R&D expenditures. Models of firms heterogeneity allowing for both single product firms [3] and multi-sector firms [4] show that firms would react differently to international competition according to their efficiency. In models with single product firms, trade integration leads to the selection of most productive firms that expand their production at the expenses of less productive firms. In models with multi-sector firms, trade integration leads firms to shed marginally productive products and to specialize on their core

[2]This definition is motivated theoretically by the standard factor proportions framework and empirically by widespread concerns about the impact of low-wage countries competition on northern firms.

[3]See Melitz 2003, Eaton and Kortum 2000, Bernard *et al* 2004, Eaton *et al.* 2005.

[4]See Yeaple and Nocke 2005, Bernard Redding and Schott 2006, Eckel and Neary 2005.

activities. We test these predictions in an appropriate empirical setting.
Our second step consists in assessing whether innovation modifies firms scope (activity mix) and/ or increases the quality of their products. We are only able to observe the quality of firms' exports. Following Schott (2003), the quality of a firm export (product) is proxied by its export unit value. This strategy is motivated by the fact that countries specialize not across products but within products (Schott 2003, Hummels and Klenow 2005). We also investigate whether firms produce different qualities of goods and in this case whether they ship these different varieties goods in different foreign markets. This "segmentation strategy" would be in contradiction with the "core" concentration paradigm in so far as this latter predicts that a firm gets rid of marginal profitable goods, i.e. the goods of lowest quality. More broadly, this strategy would be in contradiction with the "defensive innovation" hypothesis and with the idea of a real southern competitive pressure, since segmenting firms would keep competing with southern firms on their own (southern) markets, instead of avoiding this latter competitive pressure.

Our work yields the following results. First, taking into account the different productions of the firm and the competitive pressure arising from low cost countries on these different markets, we find elements in accordance with the "avoidance" strategy : R&D spendings are positively correlated with southern competition, even when taking into account competition from northern countries, specially for the most productive firms. Second, innovation brings about changes in firms activities and increases the quality of exports. Lastly, we find no evidence of market segmentation. Globalization drives firms to get rid of lower quality products, instead of selling these products to poorer markets.

The paper is organized as follows. Section 2 contains a description of the data we use. In section 3, we present our empirical strategy, and the results are exposed in section 4. In section 4.1, we provide empirical evidence on the relationship between southern imports and R&D spendings. Sections 4.2 and 4.3 deal with the link between innovation, product choice and product quality and we assess the market segmentation assumption in section 4.4. The last section concludes.

2 Data and Measurement Issues

2.1 Data Sources

Two types of data need to be collected : information on customs, both for imports and exports ; and information on firms. The time period of the study covers the years 1999-2004. We detail in the following section the different sources used.

Firstly, exhaustive firm level information on imports and exports are sourced from customs data. On the imports side, flows are aggregated at the country and goods levels, for each year. The identity of the country of origin is crucially needed since we compute import penetration variables distinguishing between low-wage and other countries. The goods dimension is also very useful since these import penetration variables are computed using the breakdown of total firms turnover into different sectors. There is a correspondence between the 3 digits goods classification and the 3 digits activity classification. We define a "good" as a line in the 6 digits French goods classification (CPF[5]), which is the most detailed classification available to us. Imports are reported CAF, inclusive of tariffs and transport costs. On the exports side, we rely on firm level information on exports broken down by goods and countries of destination. Exports are reported "franco-on-board" (FOB), namely exclusive of tariffs and freights. Both for imports and exports, value and quantity shipped are available, with quantities expressed in kilo-gramms. Values and quantities are used for exports to compute unit values, which we interpret as prices. The country dimension of exports are useful for the segmentation strategy we study in the last section of the paper.

Secondly, complementary firm level information is sourced from many datasets. We first use the "Innovation" and "R&D" surveys to gather information on the firms' innovation effort. These two sources together enable us to determine which firms invest in innovation, and the corresponding amount of R&D expenditures. These enquiries, though not exhaustive, investigate manufacturing firms with more than 20 workers. Together, these two sources give us information on 10,000 firms, each of them being present on average three (adjacent) years over the period 1999-2004.

Economic variables such as value added, employment, capital, labor costs, and the main firm industry affiliation are sourced from fiscal declarations (source SUSE). We also use the yearly surveys of manufacturing (Enquêtes Annuelles d'Entreprise) to get information on the whole decomposition of each firm' sales into each of the 4 digit market where it operates; in the case of multi-sector firms, the industry affiliation corresponds to the main production of the firm. This very precise information enables us to compute penetration variables taking into account the different markets where the firm operates. It also enables us to follow precisely the product choices made by the firm.
The information on sales decomposition is reported in the French activity classification ("NAF") available at 4 digits. We aggregated these data at the 3 digit level in order to be able to match this information on activities with information on imports (penetration indices, see below), because there is a one to one correspondence between the NAF activity classification and the CPF product classification when both aggregated at the 3 digits level. In the following *we will refer respectively to the 4 and 3 digits level as "industries" and "sectors", and to the 6 digits level of the product classification as "goods".*

We end up with a file containing 30,790 observations when broken down in firms and years dimensions. This set of firms employs every year roughly 1.3 millions of employees. The median firm has 62 employees over the period. On average, every year 44% of firms have positive investments in innovation. This slight over-representation of large, innovative firms comes from the fact that mainly large firms are interviewed in the two enquiries used.

2.2 Descriptive Statistics

It is useful to have a first look at the innovative and export activities of firms in our population. The easiest way is to split our sample into fours exclusive categories according to the innovative (vs. non innovative) and exporter(vs. non exporter) status of each firm.

[5]Classification des Produits Françaises.

Median statistics by firms types and years are reported in figure 1 and correlations among principals variables in table 2. Firms that report neither R&D spendings or exports are denoted "O", "X" and "R&D" firms either exports or invest in innovation activities, and "X_R&D" firms do both. Looking at value added, employment or capital, "X" firms are larger than "R&D" firms, who themselves overcome firms that neither exports or innovate. The largest firms are those that both invest and export. However, total factor productivity [6] does not give such a clear ranking. In fact, firms that invest in R&D spendings are more productive than firms that only exports. This is not surprising since R&D effort is frequently associated with higher productivity levels: in a recent paper Doraszelski and Jamandreu (2006) show how to estimate productivity using R&D expenditures as an input (in the Olley-Pakes sense) for productivity. Using aggregate data on OECD industries, Griffith *et al.* (2004) also show how R&D favours productivity both through innovation and imitation.

Table 1: Descriptive Statistics

Type of Firm	R&D Expenditures						Value Added					
	1999	2000	2001	2002	2003	2004	1999	2000	2001	2002	2003	2004
O	0	0	0	0	0	0	1398	1363	1114	986	985	1039
R&D	191	127	136	156	134	147	574	513	502	542	403	505
X	0	0	0	0	0	0	2508	2686	2356	2252	2247	2290
X_R&D	598	711	595	677	620	525	8567	10191	8387	9091	7766	7354
Type of Firm	Employment						Capital Stock					
	1999	2000	2001	2002	2003	2004	1999	2000	2001	2002	2003	2004
O	37	37	30	27	28	28	662	694	538	514	519	572
R&D	13	11	12	12	11	12	291	207	258	267	213	276
X	60	65	54	51	53	52	2223	2347	1926	1851	2046	2009
X_R&D	165	191	169	186	159	140	8728	10932	8978	10426	9135	8121
Type of Firm	TFP						Exports					
	1999	2000	2001	2002	2003	2004	1999	2000	2001	2002	2003	2004
O	14	14	15	15	14	15	0	0	0	0	0	0
R&D	15	15	17	15	15	16	0	0	0	0	0	0
X	14	14	14	14	14	14	744	931	629	524	559	580
X_R&D	16	16	16	16	16	17	5874	7824	6375	7295	5777	5155
Type of Firm	North Export Share						Number of Observations					
	1999	2000	2001	2002	2003	2004	1999	2000	2001	2002	2003	2004
O	0	0	0	0	0	0	607	609	1701	1206	1230	1243
R&D	0	0	0	0	0	0	157	129	155	155	190	172
X	8	8	6	6	6	6	1346	1399	2827	1786	1819	1854
X_R&D	23	25	24	25	23	22	2101	1730	2039	2010	2098	2227

Note: "O" denotes non R&D performing, non exporting firms; "R&D" denotes R&D performing but non exporting firms; "X" denotes non R&D performing but exporting firms and "X_R&D" denotes R&D performing and exporting firms.

Over the 1999-2004 period, 45% of firms each year operate on multiple markets [7]. However, many of these multi-sector firms also report some non manufacturing activities (e.g. trade). Leaving aside

[6] To construct a TFP variable, we use the shares of capital and wages in value added, taken from national accounts. Formally, we compute the log of firm i year t TFP as

$$\ln TFP_{it} = \ln VA_{it} - 0.3 \ln K_{it} - 0.7 \ln EMP_{it}$$

[7] Using manufacturing censuses from 1972 to 1997, Bernard, Redding and Schott (2006) report that 41% of US manufacturing firms produce more than a single product.

Table 2: Correlations between the Main Variables of Analysis

	R&D	VA	TFP	employ.	cap/VA	advert.	north sh.	N. Pen.	S. Pen.	diver.	HHI
ln R&D	1.0000										
ln VA	0.4365	1.0000									
ln TFP	0.0336	0.2288	1.0000								
ln employ.	0.4236	0.9345	-0.0727	1.0000							
ln capital/VA	0.2155	0.3730	-0.2597	0.2840	1.0000						
ln advert.	0.3285	0.6263	0.0887	0.6108	0.2164	1.0000					
ln north. sh.	0.2986	0.4134	0.0132	0.3813	0.3139	0.3483	1.0000				
ln north. Pen.	0.0793	0.1034	0.0039	0.1040	0.0421	0.0797	0.0743	1.0000			
ln souh. Pen.	0.0894	0.1164	-0.0014	0.1211	0.0395	0.0967	0.0794	0.7550	1.0000		
ln diver.	0.2388	0.2680	-0.0270	0.2859	0.0982	0.3380	0.1258	0.1793	0.2280	1.0000	
ln HHI	0.1146	0.0756	-0.0075	0.0781	0.0297	0.0710	0.0488	0.0500	0.0591	0.0113	1.0000

these non manufacturing activities, only 17% of the firms produce in more than a single manufacturing sector [8]. These latter firms are the largest and account for 40% of the employment every year.

2.3 Measuring Southern Competitive Pressure: Penetration Indices

Since a significant share of manufacturing firms are multi-sector firms, foreign competition due to imports should be weighted according to the different markets where the firm operates. In fact, a French firm could operate at the same time in highly exposed markets and relatively protected ones. The firm could be encouraged to develop its activities in the most protected sectors. To take into account this potentially contrasted exposition to foreign competition on the different markets where the firm operates, we weight the penetration variables computed by Bernard Redding and Schott (2006) by the share of each sector in total sales, using the correspondence between the 3 digits level of the product and activity French classifications

$$PEN_{it}^{S} = \sum_{j} \omega_{ijt} \frac{M_{Fjt}^{S}}{M_{Ft} + Q_{Ft} - X_{Ft}} \tag{2.1}$$

with ω_{ijt}, the share of firm i sales in sector j year t. We refer respectively to M_{Ft}^{S} and M_{Fjt}^{S} to French total imports and imports in sector j year t from Southern countries respectively, Q_{Ft} and X_{Ft} are domestic production and French exports. Southern countries are defined in a similar way as in Bernard, Redding and Schott (2006) as the set of countries with GDP per capita below the threshold of 5% French GDP per capita. On average over the 1999-2004 period, 73 countries (out of XX) are classified as low-wage countries. In the empirical analysis, we also control for all other French partners, the "North", which we refer to as

$$PEN_{it}^{N} = \sum_{j} \omega_{ijt} \frac{M_{Fjt}^{N}}{M_{Ft} + Q_{Ft} - X_{Ft}} \tag{2.2}$$

with M_{Ft}^{N} French imports form northern countries in sector j, year t. These two variables have a firm-year specific component, since they take into account the potential multi-sector dimension of

[8]We automatically find less multi-sector firms than Bernard Redding and Schott (2006) because we define an industry at a more aggregated level (3 digit vs. 4 digit classifications).

the firm. However the different activities of a multi-sector firm are often quite close to its main industry affiliation. Southern penetration indexes should therefore be close to what we know about aggregated imports from low-wages countries by industries. Graph 1 contains firm average Southern import penetration over its main industry in 1999. Not surprisingly, our southern import penetration index suggests that French firms operating in clothing, office materials, rubbers and tyres, electrical components or textile are more exposed to low-wages countries competition.

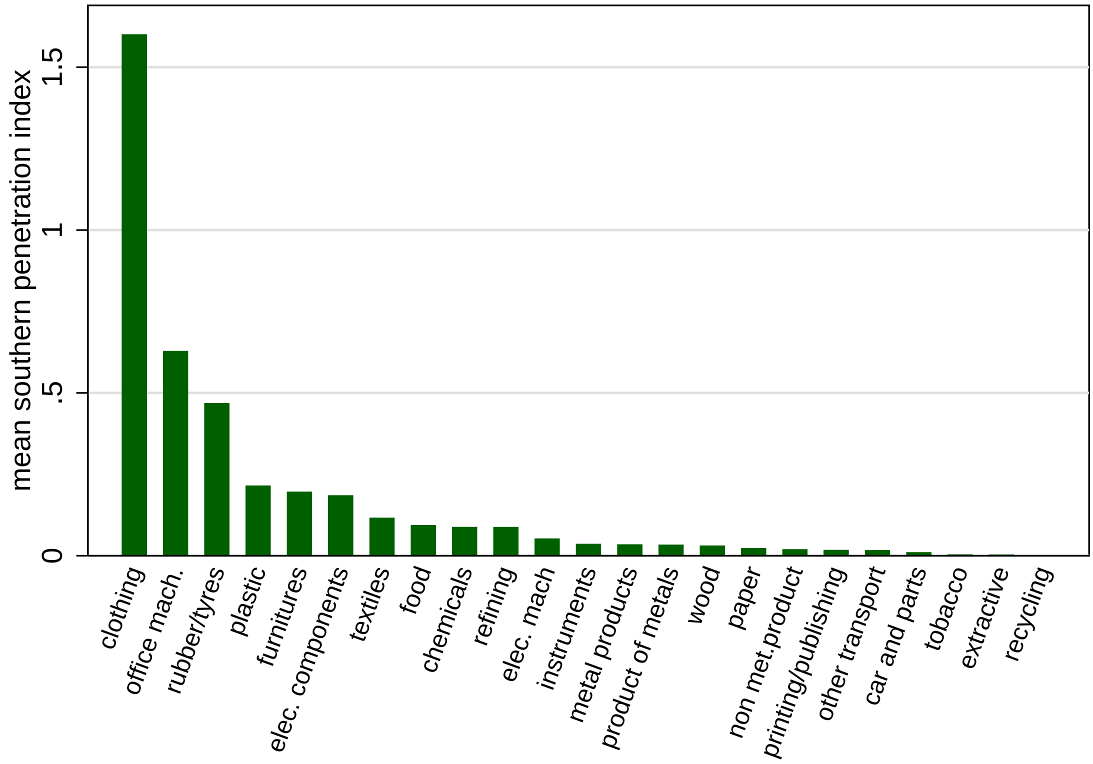

Figure 1: Penetration Indices and Main Firms' Industries (1999)

Following the trade literature, firms that operate in markets where southern competition is fiercer should either modify their product mix, or increase the quality of their products in order to shelter from foreign competition. Thus no single product French firm should operate in industries where southern competition is strong. As a consequence, firms' diversification should increase with southern competition. To investigate this point, we classify each firm in three categories according to low-wages countries competition. Using the 33^{th} and 66^{th} percentiles of the firm southern penetration index, we distinguish between "highly" exposed firms and "weakly" exposed firms. The former are those with southern penetration index above the 66^{th} percentile, and the latter are the firms with index below the 33^{th} percentile. Among highly exposed firms, 17% are multi-sector firms, whereas only 10% among the weakly exposed firms. Hence, firms that operate in sectors where competition from low-wages countries is stronger tend to diversify more their activities. This result is even true when looking at multi-sector firms. In graph 2 we plot the distribution of the share of the main sector of multi-sector firms separately for highly and weakly exposed firms. The share of the main sector tends to be smaller for highly exposed firms, compared to weakly exposed firms, pointing out that higher diversification for highly exposed firms.

The last result suggests a tight link between globalization and product mix. However, theoretical papers on this issue does not describe the channel through which the connection between globalization and product choice is made. In this paper, we advocate the idea that product choice and product quality upgrading come from innovation. In the next section, we investigate the relationship between R&D spendings and globalization. In sections 4.2 and 4.3 we analyse the link between innovation and product choice/quality.

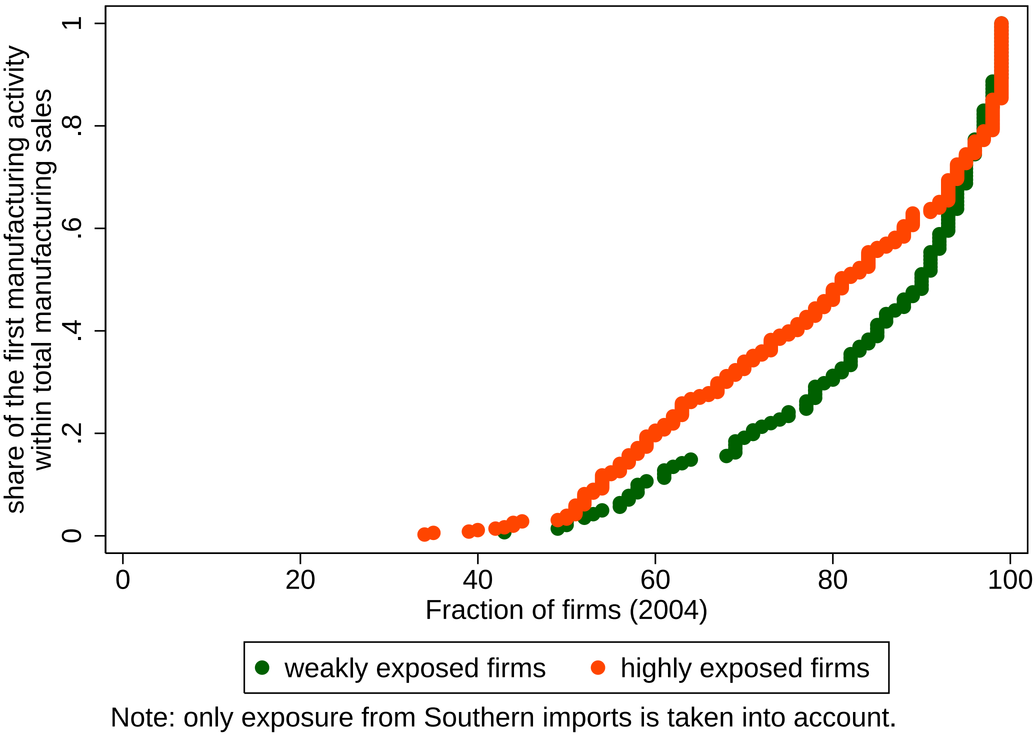

Figure 2: Penetration Indices and Main Activity

2.4 Measuring Firm Level Activity Changes

Bernard, Jensen and Schott (2006) provide evidence of industry switching due to exposure of low-wage countries. However, they are restricted to investigate the change of the main industry. Here, we can deal with any changes that would happened in the product mix. We construct a similarity index from one year to the following one, for each firm. Specifically, our 3 digits similarity index is based on the absolute difference between each sector share in years t and $t-1$:

$$SIM_{it} = 1 - \frac{1}{2} \sum_{j} |\omega_{ijt} - \omega_{ijt-1}| \tag{2.3}$$

with $\omega_{ijt} = \frac{S_{ijt}}{\sum_j S_{ijt}}$ the share of sector j sales in total turnover for firm i year t. This similarity index goes from 0 (complete changes between $t-1$ and t) to 1 (no changes). This similarity index is very high in our sample, since the average firm has a similarity index equal to 0.992. However, the average value for firms that are both R&D performers and exporters is lower (0.987).

2.5 Measuring Product Quality

We are only able to observe the quality of firms' exports. Following Schott (2003) among others, the quality of a firm export (product) is proxied by its export unit value. This methodology is standard in the literature studying exports and imports goods quality[9]. Unit value UV_{ipct} is computed as the ratio between value and quantity for firm i in the finest product p definition available to us (6 digits), to destination country c and at year t. Our main indicator of product quality is computed as the maximum unit value for each firm and product:

$$MAXUV_{ipt} = \max_c \{UV_{ipct}\} \tag{2.4}$$

This indicator captures the highest quality a given firm can achieve for a given product, no matter where it is exported[10].

We also use an indicator measuring the range of qualities produced by a single firm, for a considered good. This indicator is defined as:

$$\text{Range}(UV)_{ipt} = \frac{\max_c UVipct - \min_c UV_{ipct}}{\max_{i',c} UV_{i'pct} - \min_{i',c} UV_{i'pct}} \tag{2.5}$$

where the denominator is introduced as a normalization (it enables to compare the different goods produced in the French manufacturing industry).

2.6 Other Firm Level Indicators

We also measure domestic competition through standard Herfindahl indicator. This is constructed in the standard way at the industry level, but it is weighted in a way similar to the penetration indices. We use the sales of the firm in any market where the firm operates as weights[11]. Consequently, it has a firm specific component. This Herfindahl index varies between 0 (low concentration) to 1 (high market concentration). It is computed as

$$HHI_{it} = \sum_k \frac{S_{ikt}}{S_{it}}.H_{kt} \quad \text{with} \quad H_{kt} = \sum_{j \in k} \left(\frac{S_{jkt}}{\sum_{h \in k} S_{hkt}} \right)^2 \tag{2.6}$$

with S_{ikt} the sales of firm i year t in industry k, and S_{it} is firm i total sales.

[9] Schott 2003 and 2006; Hallack and Schott 2005 ; Kandelwahl 2007 ; Fontagne *et al.* 2007.

[10] Similar results are obtained using the median or mean unit values, see below.

[11] The correspondence with the goods classification is not needed for the computation of Herfindhal and Specialization variables, unlike import penetration variables. These variables are computed using the most dissaggregated level available for the breakdown of sales, ie 4 digits.

Lastly, we also introduce a specialization indicator, which is computed as the inverse of the degree to which a firm operates across different industries. This is motivated by studies devoted to firms scope such as Nocke and Yeaple (2005), Bernard, Redding and Schott (2006) and Eckel and Neary (2006). The specialization variable is defined as :

$$SPE_{it} = \sum_k \left(\frac{S_{ikt}}{S_{it}} \right)^2 \tag{2.7}$$

3 Specification and Estimation Strategy

Our empirical analysis aims at (first) sorting out whether globalization induces higher incentives in R&D spendings (consistently with the "defensive innovation" assumption) and (second) analyze whether this potential increased innovative effort leads to product quality upgrading or whether it is correlated with industry switching (e.g. as a part of the fixed entry cost). Our estimation strategy for these two sets of equations is presented below.

3.1 R&D Equation

3.1.1 Specification of the R&D Equation

The specification of the estimated R&D equation can be linked to a standard investment model directly transposed to the case of R&D investment. In this case, innovation is seen as an input in the production function. A profit maximizing firm with constant returns to scale CES production function gets the following function for its desired R&D capital stock (in logarithms):

$$\underbrace{g_{it}}_{\substack{\text{desired} \\ \text{R\&D capital stock}}} = a + \underbrace{y_{it}}_{\text{output}} - \sigma . \underbrace{j_{it}}_{\substack{\text{user cost} \\ \text{of capital}}}$$

This is similar to Caballero, Engel and Haltiwanger (1995) for capital stock. A first difficulty with this equation is that the R&D capital stock is not observed. Rather than computing it thanks to a permanent inventory method[12], we approximate this quantity by its stationary state value. In the stationary state, the growth of the R&D capital stock is constant ν_i:

$$G_{it} = (1 + \nu_i).G_{it-1}$$

Therefore, if δ_i is the R&D firm specific depreciation rate, then:

$$R_{it} = (\delta_i + \nu_i).G_{it-1} = \frac{\delta_i + \nu_i}{1 + \nu_i}.G_{it}$$

Taking logarithms, we obtain:

$$r_{it} = \underbrace{\ln \left(\frac{\delta_i + \nu_i}{1 + \nu_i} \right)}_{\substack{\text{firm specific} \\ \text{intercept}}} + g_{it}$$

[12]For most firms, R&D data are not highly reliable in the time serie dimension.

Unfortunately, it turns out that our panel is too short to estimate firm fixed effect specifications. We will then assume that δ and ν are sufficiently homogeneous at the industry level. The second difficulty is that the user cost of capital is not observed. We will later assume that it can be controlled for using additive year- and firm/sector-specific effects. We also decompose the level of output, y_{it} into TFP, capital intensity and employment. We lastly introduce various competition indicators and other variables as controls. First, we introduce the southern and northern penetration indexes to capture the impact of globalization on innovation spendings. Secondly, we take domestic competition into account through the Herfindahl indicator. Thirdly, we introduce the firm level specialization indicator. Fourthly, we take into account the share of northern exports in total turnover. This is justified if northern consumers have stronger (than southern consumers) preferences for high quality goods. In order to stay in, firms that export in northern markets must innovate to satisfy this demand for high quality products. Hallack (2006) shows that rich countries tend to import relatively more from countries that produce high quality goods.

Eventually, we interact southern penetration index with productivity. The literature on firms heterogeneity suggests that firms would not react uniformly to foreign competition. We expect most productive firms to innovate relatively more than less efficient firms when low-wage countries competition is strong. We therefore obtain:

$$\begin{aligned} r_{it} = \alpha \quad &+ \quad \beta.\underbrace{\left(\frac{1}{1-\gamma}\ln TFP_{it} + \ln EMP_{it} + \frac{\gamma}{1-\gamma}\ln\left(\frac{K}{VA}\right)_{it}\right)}_{y_{it}} \\ &+ \quad \theta_1 \ln PEN^S_{it} + \theta_2 \ln PEN^N_{it} + \theta_3 \ln TFP_{it} \times \ln PEN^S_{it} \\ &+ \quad \theta_4 \ln HHI_{it} + \theta_5 \ln SPE_{it} + \theta_6 \ln SHXN_{it} + \delta_t + \eta_i + \epsilon_{it} \end{aligned} \tag{3.1}$$

In this equation, r_{it} is either the logarithm of the firm's R&D spendings (see below for the selection problems) or a dummy variable denoting whether the firm has strictly positive R&D spendings. We refer respectively to HHI_{it}, SPE_{it} and $SHXN_{it}$ as the Herfindahl and Specialization indicators, and the share of exports in northern countries in total turnover. Capital, employment and value added are denoted K_{it}, EMP_{it} and VA_{it}. The share of the wage in total value added is $(1-\gamma)$.

3.1.2 Estimation Strategy

The estimation of this latter equation entails both simultaneity and selectivity biases. We start with the simultaneity bias.

Simultaneity Problems in the Linear Model

In our analysis, we are confronted a problem of simultaneity which is standard in the production function estimation framework (simultaneity between the various production factors and the level of output). Let $\mathbf{x}$ denote the vector of the three factors of production, ie TFP, EMP and $\frac{K}{VA}$ and drop the other explanatory variables for simplicity. This reduced model can be written:

$$r_{it} = \beta.\mathbf{x}_{it} + \eta_i + \epsilon_{it} \quad \text{with} \quad \eta_i \perp \epsilon_{it} \quad \text{and} \quad \epsilon_{it} \hookrightarrow MA(0)$$

Endogeneity problems occur because $\mathbf{x}$ is potentially correlated with the unobserved firm fixed effect and with the contemporary shock, for example if we assume the following dynamic process ($|\kappa| < 1$):

$$\mathbf{x}_{it} = \kappa \mathbf{x}_{it-1} + \delta.\eta_i + u_{it} \quad \text{with} \quad \eta_i \perp u_{it} \quad \text{and} \quad u_{it} \hookrightarrow MA(0), \quad \text{but} \quad \mathbf{E}(\epsilon_{it}.u_{it}) \neq 0$$

In this setting we get:

$$\mathbf{x}_{it} = \kappa^{t-2}.\mathbf{x}_{i2} + \sum_{s=0}^{t-3} \kappa^s.u_{it-s} + \frac{1-\kappa^{t-4}}{1-\kappa}.\delta.\eta_i$$

$$\Delta\mathbf{x}_{it} = \kappa^{t-2}.\Delta\mathbf{x}_{i2} + \sum_{s=0}^{t-3} \kappa^s.\Delta u_{it-s}$$

Therefore:

- if $\delta = 0$ and $\mathbf{E}(\epsilon_{it}.u_{it}) = 0$ then OLS estimates are consistent.
- if $\delta = 0$ but $\mathbf{E}(\epsilon_{it}.u_{it}) \neq 0$ then $\mathbf{x}_{it}$ needs to be instrumented (in the level equation), for example by its lagged values $\mathbf{x}_{it-1}, \mathbf{x}_{it-2}$.
- if $\delta \neq 0$ and $\mathbf{E}(\epsilon_{it}.u_{it}) \neq 0$ then the previous IVs are no longer valid except if firm fixed effects are controlled for. Note also that $\Delta\mathbf{x}_{it-1}$ is correlated with η_i only if $\Delta\mathbf{x}_{i2}$ is correlated with η_i. It can be shown that if $\mathbf{x}_{it}$ is a stationary process, then $\Delta\mathbf{x}_{it-1}, \Delta\mathbf{x}_{it-2}$ are valid IVs for $\mathbf{x}_{it}$ in the level equation.

In our empirical analysis, we report estimates corresponding to the first (OLS) and third (GMM using lagged differences as IVs) cases.

The other covariates could also be suspected of endogeneity. The penetration and specialization variables could be suspected of endogeneity if firms choose simultaneously their R&D effort and their activities. We will assume that even if this reverse causality is true, it will probably take a longer time period for the firm to switch across sectors. In order to mitigate this problem, the lagged values of the penetration and specialization variables can be used as IVs[13]. Eventually, the share of northern exports in turnover can also bring about endogeneity in so far as firms simultaneously choose to export in rich countries and to invest in R&D expenditures. Again, we use the lag of northern export share as IV to alleviate this problem.

Taking Account of Selection Problems

All firms are not involved in R&D activities, so that the previous specifications suffer from a potential selection bias. In order to investigate this point more precisely, we also model the probability that a firm gets involved in R&D activities and its corresponding expenditures with a probit and a generalized tobit (Heckman selection) model:

[13] Thoenig and Verdier (2003) use prices (exchange rates) and distances as IVs, but these IVs only have country and time variation.

$$\mathbf{1}_{\{r_{it}^*>0\}} = \Phi\left(\beta^{PROB}.\mathbf{x}_{it} + \eta_i^{PROB}\right)$$

and

$$r_{it} = \mathbf{1}_{\{r_{it}^*>0\}}.\left(\beta^{HECK}.\mathbf{x}_{it} + \eta_i^{HECK} + \epsilon_{it}\right)$$

where r_{it}^* is the R&D expenditures latent variable. We use the Rivers-Vuong (1988) approach in order to take account of the potential endogeneity (discussed above) of the various explanatory variables in the probit specification, which amounts to introducing the estimated residuals of the first-stage regressions in the probit equation. This approach provides furthermore a simple test of the exogeneity of the various suspected variables (the usual probit t-statistic on the estimated residuals introduced in the regressions is a valid test that the corresponding variable is exogenous). A shortcoming of this strategy is that if the residuals are significant, then the usual probit standard errors and test statistics are not strictly valid, and we only estimate the coefficients up to scale (see Wooldridge, 2001).

We also implement the Smith-Blundell (1986) procedure in the Tobit regression (same kind of control function approach), which also amounts to introducing the first-stage regression residuals in the tobit estimation. This procedure gives consistent estimates of all the coefficients (there is no problem of scale here), but as in the Rivers-Vuong approach, when the estimated residuals are siginificatively different from zero, the second-stage tobit standard errors and t-statistics are not asymptotically valid.

3.2 Activity Switching and Product Quality Equations

The previous R&D equation can be interpreted as the first stage of further structural, IV estimates. More precisely, we further study the correlation between the firm level R&D effort and activity changes or quality upgrading. Our main specifications for these latter two equations take a similar form:

$$\ln SIM_{it} = \alpha + \beta \ln R\&D_{it-1} + \gamma X_{it-1} + u_{it} \tag{3.2}$$

$$\Delta \ln MAXUV_{ipt} = \alpha + \beta.\Delta \ln R\&D_{it} + \gamma X_{it-1} + v_{ipt} \tag{3.3}$$

where the vector X_{it} consists of control additional variables, u_{it}, v_{ipt} are error terms and Δ denotes time differences. Our empirical setting provides natural IVs for R&D in this equation: namely, the import penetration indices. Therefore, these equations are estimated through standard IV (GMM) methods.

Control variables included in the "Activity Switching" equation typically consist in local competition indicator (Herfindhal index), firm level capital intensity, firm fixed effects, sector and year dummies. In the "Quality Upgrading" equation, we further include firm level TFP since Schott (2003) suggests that more advanced countries tend to export higher quality goods. Hence productivity should enter with a positive sign if this relationship remains valid using firm level data[14].

[14] On the contrary, if unit values proxy production costs, then following the "new" trade theory, we could expect a negative relationship between unit values and productivity, since more productive firms benefit from lower marginal cost and hence lower prices. See Schott (2003) for a discussion of the "new" and "old" trade theories and their confrontation to data.

4 Empirical Results

4.1 Is Southern Competitive Pressure a Driver of Firms' Innovative Effort?

In this section, we examine the effect of low-wage country competition on firms' R&D activity. Firms' innovation year t is related to firms characteristics, competition variables and other controls year $t-1$. Our estimates follow equation 3.1 and the previous estimation discussion. Results are listed in table 3. Recognizing the potential endogeneity issues, we use the lagged variables in differences as IV in columns (3) to (6) and estimate the equation with GMM. In each case, time fixed effects and sector fixed effects (3 digits) are included to control for unobserved factors potentially affecting R&D expenditures.

Column (1) reports the OLS specification as a benchmark for further estimates. Our first concern is about the southern import penetration variable. The coefficient of this variable turns out to be positive and statistically significant, even when northern import penetration index is introduced in the regression. Furthermore, the interaction term between the low-wage country penetration variable and TFP is also positive and significant. It suggests that among firms facing low-wage countries competition, more productive firms invest even more in innovation activities.

Other results are worth being noted. As in Bond *et al.* (2003) on German and English firms, our results confirm that larger and more capital intensive firms have higher incentives to innovate. Furthermore, exporting in northern countries also increase R&D spendings, but as suggested above, we think the underlying innovative effort may be quite different (more frequently process based than product based) although this point can not be observed in our data. This result is consistent with the previous literature suggesting a positive correlation between demand for quality and GDP per capita (Hallack, 2006). In contrast, the northern import penetration term is not significant. Our results therefore suggest that the "pull" effect of exports in the North (see Melitz, 2003) is stronger than the "push" effect of northern imports. They are consistent with Maurin *et al.* (2002) which show the importance of the export channel in affecting the demand for skill labor. Lastly, the coefficient on the Herfindhal index is significant and positive, meaning that firms operating in highly concentrated markets have higher incentives to innovate. This letter result is consistent with business stealing effects due to (northern, national) product market rivalry as found in Bloom *et al.* (2006) with a panel of US firms.

Firm level fixed effects are added to the latter specification in column (2). As previously stated, our panel is too short to allow such a requirement. Coefficients on TFP, employment and capital intensity decrease, whereas the southern penetration index is no longer statistically significant. All the effect of low-wage country competition has been transmitted to the interaction term with productivity, which remains significant and positive.

Endogeneity issues are taken into account in columns (3) to (6) using lagged differences as IVs (GMM estimation). In column (3), we instrument the lag of employment, capital intensity and TFP by their variables in time difference. The interaction between TFP and southern penetration is instrumented by the product of the corresponding 2-period lagged variables. The lagged difference of value added is also used as an IV so that the model is over-identified. The Sargan test does not reject the validity of these IVs. The production factors are no longer significant, but the low-wage penetration term and its interaction with TFP remain positive and significant. The potential endogeneity of the

Table 3: Firms' R&D Spendings

	Dependent Variable: ln (R&D+1)					
Model :	OLS	FE	GMM	GMM	GMM	GMM
	(1)	(2)	(3)	(4)	(5)	(6)
ln TFP_{t-1}	0.66^a	0.05^a	-0.07	-0.06	-0.07	-0.09
	(0.06)	(0.01)	(0.17)	(0.17)	(0.18)	(0.20)
ln EMP_{t-1}	1.08^a	0.06^a	-0.29	-0.28	-0.38	-0.49
	(0.03)	(0.02)	(0.47)	(0.47)	(0.54)	(0.64)
ln $(K/VA)_{t-1}$	0.36^a	0.04^a	0.07	0.07	0.00	-0.01
	(0.03)	(0.02)	(0.30)	(0.30)	(0.33)	(0.37)
ln $Herfindahl_{t-1}$	0.23^a	0.00	0.52^a	0.51^a	0.69^a	0.95^a
	(0.05)	(0.02)	(0.12)	(0.12)	(0.20)	(0.30)
ln $Specialization_{t-1}$	0.05	0.11^a	1.48^a	1.42^a	-0.10	-0.59
	(0.13)	(0.04)	(0.52)	(0.51)	(0.52)	(0.65)
ln North Exp. Sh_{t-1}	0.08^a	0.00	0.23^a	0.23^a	0.25^a	0.01
	(0.01)	(0.00)	(0.06)	(0.06)	(0.08)	(0.03)
ln North Pen_{t-1}	-0.01	-0.08	0.09	-0.03	0.00	0.27
	(0.22)	(0.05)	(0.24)	(0.30)	(0.32)	(0.39)
ln South Pen_{t-1}	0.29^b	0.02	0.41^a	0.64^a	0.91^a	1.16^a
	(0.12)	(0.03)	(0.13)	(0.16)	(0.25)	(0.33)
ln South Pen_{t-1} $\times$ ln TFP_{t-1}	0.60^a	0.11^a	1.01^a	1.08^a	1.06^a	1.27^a
	(0.15)	(0.04)	(0.38)	(0.38)	(0.38)	(0.47)
Year Dummies	yes	yes	yes	yes	yes	yes
Sector Dummies (3 digits)	yes	yes	yes	yes	yes	yes
N	18817	18817	11719	11719	11719	11719
Sargan P-value	-	-	0.312	0.289	0.290	0.373

Note: Standard errors between brackets with ^{a}, ^{b} and ^{c} respectively denoting significance at the 1%, 5% and 10% levels. All standard deviations are clustered at the firm level. In column (2), firm level fixed effects are introduced in the regression.

penetration variables (simultaneity between the choice of productive activities entering the penetration terms and R&D activities) is treated in column (4). In this specification, the import penetration variables are instrumented by their time difference. The obtained coefficients are larger when these variables are instrumented, suggesting a rather a downward simultaneity bias. In column (5), we consider the potential endogeneity of the specialization variable. Again, estimates may be biased by the simultaneous choice of productive activities and innovation spendings. Indeed, the obtained coefficient on this instrumented variable is no longer significant.

Lastly, we deal with the potential endogeneity of the share of exports to northern countries in turnover. This may be due to firms' simultaneous decision to export to northern, highly competitive markets and to engage innovation expenditures in order to face this competition. The share of northern exports is no longer significant in this last specification, but the southern import penetration term remains significant and positive.

We now turn to the selectivity bias. Results are reported in table 4. We first model the probability to invest in innovation activities (column 1). The coefficient on the southern penetration variable is significant at the 10% level, suggesting that competition from low-wage countries has a significant effect on the decision to engage in R&D activities. In column (2) we report the results of a Tobit model for R&D spendings controlling for the previous selection. Together columns (1) and (2) suggest that competition from southern countries is determinant for both the decision to engage R&D activities and the amounts of R&D spendings. Rivers-Vuong (1988) and Smith-Blundell (1986) estimates are reported in columns (3) and (4). These two approaches enable us to tackle the main previously acknowledged endogeneity issues in these non linear (Probit and Tobit) models. Both in the Probit and Tobit estimations, the residuals of the first step regressions turn out to be (jointly and individually) significant, especially for TFP and the share of northern exports in total turnover. This result confirms the high endogeneity for these variables. The coefficient on the southern competition variable is estimated to be 0.223, i.e. Controlling for selectivity results in a much smaller coefficient than in all previous estimations.

In the following sections we investigate whether innovation (i) increases the tendency for a firm to modify the structure of its productive activities, and (ii) contributes to increase the quality of exports. These two strategies are seen as natural responses to low-wage countries competition. We first focus on activity changes, and devote the next paragraph to the quality of exported goods.

4.2 Activity Switches

Estimates presented in this section and in table 5 result from equation 3.2. Column (1) of table 5 reports simple OLS estimation with firm level fixed effects. Innovation expenditures are statistically significant and contribute to alter the firm's activity mix.

In column (2), we add the Herfindahl index, which obtains a significant negative coefficient. This result is quite surprising since capital intensity is a measure of sunk (entry) costs, it suggests that firms most of the time switch activities or diversify their production mix choosing new products that are very closely related to their main activity. Furthermore, once this sunk cost is entailed, firms may try and find out all profitable products allowed by their productive investment. In columns (4) to (6), we report GMM estimates of the previous regressions using the time differenced penetration variables and the 2-period lagged values of R&D expenditures as instruments for R&D. The Sargan test of overidentification does not reject the model, and results using these specification as instrumental variables confirm the previous analysis.

It is usefull to provide a more precise assessment of the economic magnitudes of the precedent effect. A 1% increase in the R&D expenditures involves a 0.003% decrease in the similarity index. Since the sample average of this index is around 0.992, with a standard deviation of 0.042, this represents about 7% of the standard deviation of this latter variable, which is a sizeable effect.

4.3 Quality Upgrading

Schott (2003) provides evidence suggesting that countries specialise not *across* products but *within* products (vertical differentiation): developed countries tend to export high quality goods and developing countries low quality goods. Thus far, we have shown several elements suggesting that low-wage countries competition favours innovation activities, which brings about changes in the firms' activity mix. However, another possible strategy for northern firms facing competition from low wage countries consists in upgrading the quality of their products. Products quality is difficult to measure and we are not aware of any source including information on the quality of domestic goods. Therefore, we restrict ourselves to the quality of French firms' *exports* and investigate whether innovation contributes to increase the quality of exported goods. More precisely, we use the maximum unit values to proxy for the highest quality that a firm can achieve.

Results obtained estimating equation 4.3 are reported in table 6. OLS estimates suggest that innovation contributes to increase exports quality, whereas the coefficient of productivity turns out to be non significant. In column (2), we take endogeneity into account and use instruments for both innovation expenditures and productivity. We use one period lagged variables as instruments for each variable in difference. We also add as excluded instrument the lag of import penetration variables. The Sargan test indicates that the instruments are compatible. Innovation remains positive and statistically significant. In column (3), we consider other control variables motivated by the "learning by exporting" assumption (Clerides *et al.*, 1998). This latter claims that firms learn through exporting, which enables them to expand their production, and which suggests a reversal causality link between exporting and production factors. We thus add employment and capital intensity in time difference as controls and instrument these variables in difference by their one period lag. Innovation still remains significant and positive in this specification. In our last robustness check, we consider the possibility for unit value to be simultaneously determine with the destination countries. This is motivated by Hallack (2006) who shows evidence suggesting that wealthier countries tend to consume higher quality goods. We add the share of northern exports in total turnover to capture the correlation between product quality and destination countries (again the time difference of this variable is instrumented by its one period lag). Even when this variable is included, innovation expenditures remain significant and positive.

4.4 Segmentation Strategies

In this section we turn our analysis on its head and investigate whether firms produce different qualities of the same goods (at the same time), and in this case whether they ship these different varieties goods to different foreign markets. This "segmentation strategy" would be in contradiction with the "core" concentration paradigm in so far as this latter predicts that a firm gets rid of marginal profitable goods, i.e. the goods of lowest quality. More broadly, this strategy would be in contradiction with the "defensive innovation" hypothesis and with the idea of a real southern competitive pressure, since segmenting firms would keep competing with southern firms on their own (southern) markets, instead of avoiding this latter competitive pressure.

Low Dispersion of Unit Values at the Firm and Product Level

Graph 4.4 shows that only 48% of total year, firm, (6 digit) product transactions are exported towards several destination countries, 13% simultaneously to north and south, and 80% have less than 5 destinations.

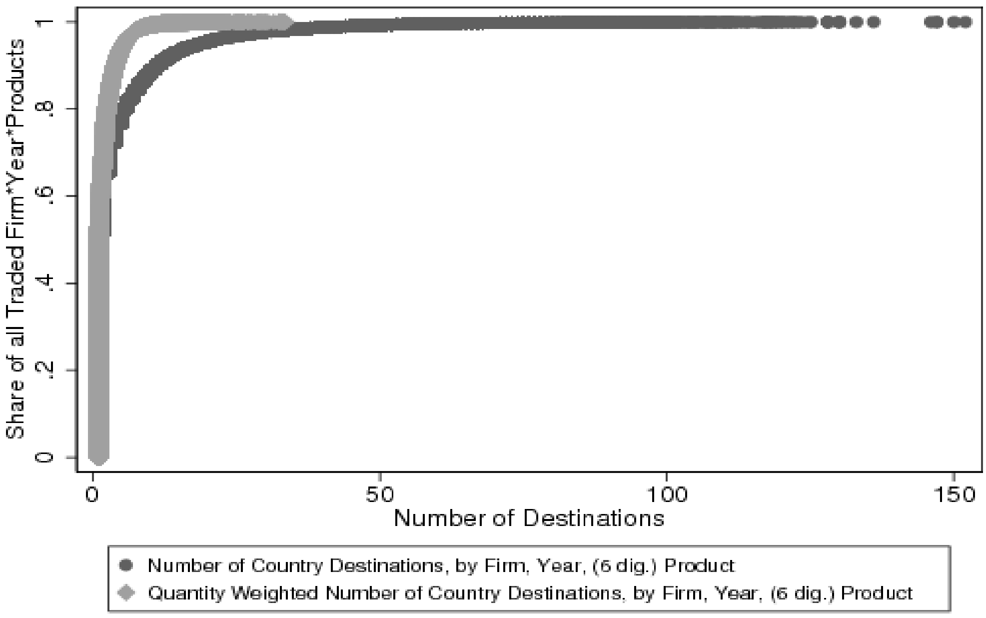

Figure 3: Number of Country Destinations, by Firm, Year, Product

Over the 1999-2004 period, 84% of our sample firms have exported at least one year, at least one (6 digit) good to several country destinations, but only 18% have exported the same good simultaneously to northern and southern destinations, i.e. to developed (high GDP per capita) and developing (low GDP per capita) economies. Conversely, between 1999 and 2004, 96% of the exported goods have been exported by at least one mutli-destination exporting firm, but only 8% have been shipped simultaneously to North and South. It is useful to provide additional descriptive statistics using the previously defined quality range indicator. Computing for each firm the maximum value of this ratio over all its exported products, we get that among multi-destination exporting firms, the median value of this indicator is 11.35% (among all firms this ratio is only 0.91%). In other words, when firms export a single good to multiple destination, most of them use price schemes that represent less than 11.35% of the Unit Value (price) variation observed in total French exportations.

Unit Values and GDP per Capita of the Destination Country are Uncorrelated

Despite this low dispersion of Unit Values at the firm and product level, we go one step further to check whether unit values are correlated with "potential" (wealth) of the destination market. For each firm and product, we estimate equations of the following form (enabling to compute firm product level correlations between "prices" and GDP per capita):

$$\log(UV_{ipct}) = \alpha_{ipt} \log \left(\frac{GDP}{POP} \right)_{ct} + \beta_{ipt} \log(DIST_c) + w_{ipct} \tag{4.1}$$

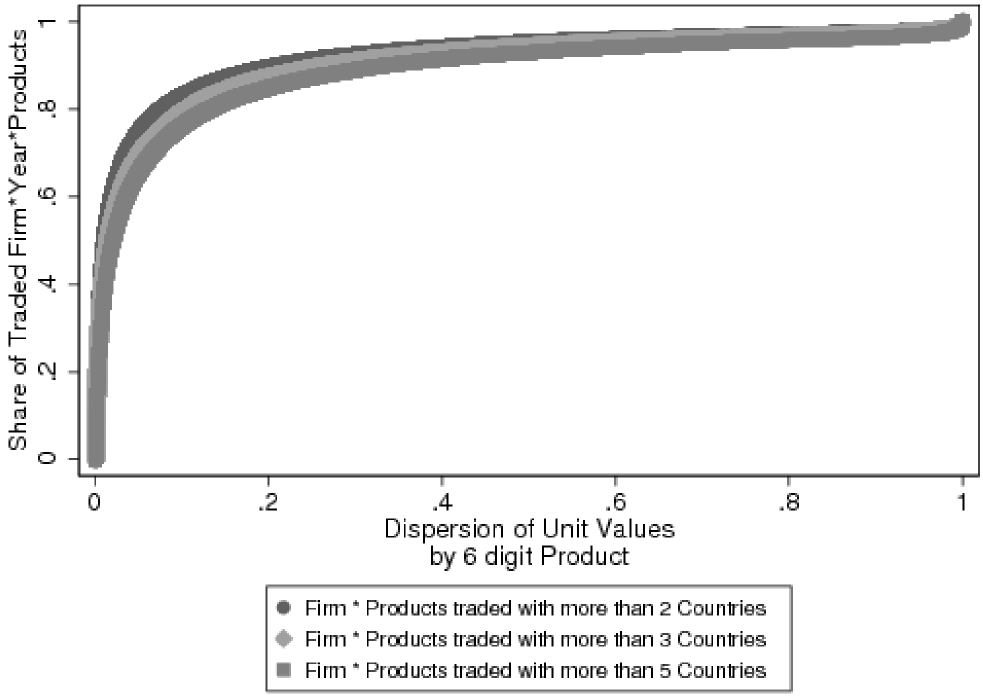

Figure 4: Dispersion of Unit Values (Range$(UV)_{ipt}$), by Firm, Year, Product

We restrict ourselves to the year 2000 for computational reasons, and to firms shipping the same good to at least 10 destinations to ensure the identification of the coefficient of interest, α_{ipt}. Results are plotted on figure 4.4 and show that there is no clear correlation (neither positive, nor negative) between prices and GDP per capita, which further contradicts the "segmentation" hypothesis. This negative result is robust to many robustness checks[15].

5 Conclusion

In this paper, we have studied French firms responses to the competitive pressure arising from low wage countries. Using a dataset detailed enough to describe the different activities of a panel of French firms, we compute a southern competition index that takes care of the different markets where the firm operates. Taking account of both potential endogeneity and selectivity biases, we find that low-wage countries competition is an incentive for innovation expenditures, specifically for the most productive firms. Our results also point out that innovation indeed contributes to the change of firms activities and to the increase in exports quality. These two strategies aims at sheltering firms from low-wage competition.

Our results raise a number of questions that are worth of further inquiry. Firstly, the relationship between domestic activities and goods exported could be better documented. Bernard, Redding and Schott (2006) provides a theoretical model in which firms produce a smaller range of products after

[15]In particular when restricting to products and firms having $Range(UV)_{ipt}$ higher than 50%.

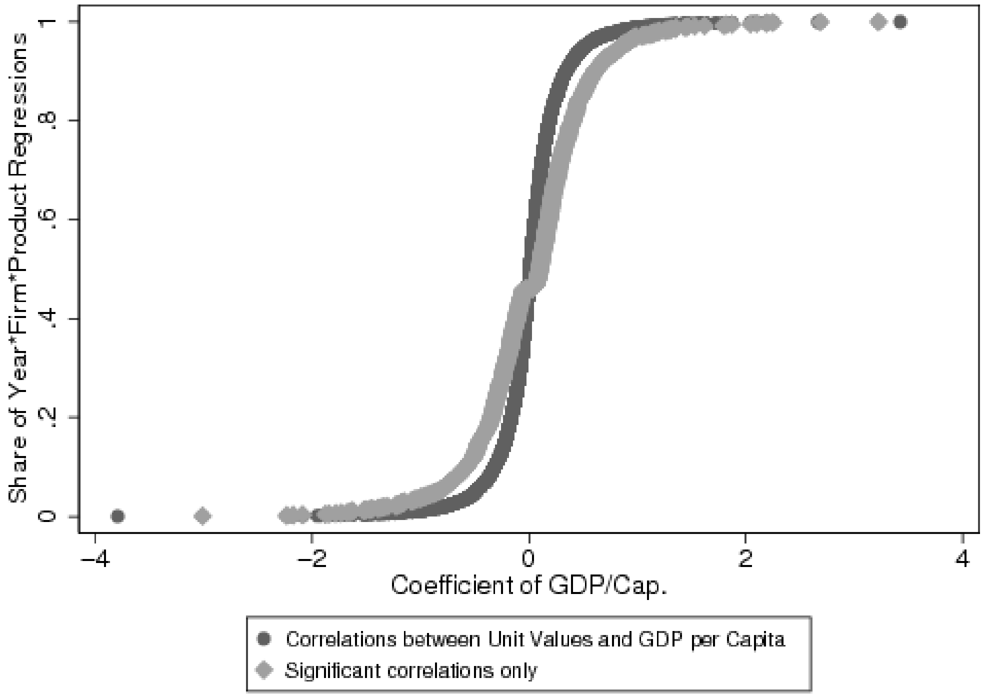

Figure 5: Distribution of the Estimated Firm - Product-Level Correlation Coefficients between UV and GDP per Cap.(2000)

liberalization and increase the share of products exported as well as exports per product. Secondly, we find that productivity has no effect on export unit values, which is a puzzling result when looking at more aggregated data. The relationship between productivity and quality can be more clearly identified using firm level data. We leave these issues for future work.

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Table 4: Firms' R&D Spendings

	Probit	Tobit	Rivers-Vuong	Blundell-Smith
Model :	(1)	(2)	(3)	(4)
ln TFP_{t-1}	0.30^a	0.62^a	0.18^a	0.35^a
	(0.05)	(0.03)	(0.06)	(0.05)
ln EMP_{t-1}	0.42^a	1.07^a	0.03	0.30^a
	(0.02)	(0.02)	(0.08)	(0.06)
ln $(K/VA)_{t-1}$	0.20^a	0.31^a	0.11	0.18^a
	(0.02)	(0.02)	(0.07)	(0.05)
ln Herfindahl_{t-1}	0.18^a	0.19^a	0.37^a	0.38^a
	(0.04)	(0.02)	(0.05)	(0.04)
ln $\text{Specialization}_{t-1}$	-0.03	-0.32^a	0.71^a	0.65^a
	(0.08)	(0.05)	(0.14)	(0.10)
ln North Exp. Sh_{t-1}	0.10^a	0.07^a	0.00^a	0.00^a
	(0.01)	(0.01)	(0.02)	(0.02)
ln North Pen_{t-1}	0.07	0.12	0.24	0.19^b
	(0.13)	(0.08)	(0.15)	(0.10)
ln South Pen_{t-1}	0.14^c	0.14^a	0.26^a	0.23^a
	(0.07)	(0.05)	(0.09)	(0.05)
u^2_{it} TFP Eq.	-	-	0.28^a	0.35^a
			(0.05)	(0.05)
u^1_{it} Employ Eq.	-	-	0.45^a	0.72^a
			(0.08)	(0.06)
u^3_{it} Capital Eq.	-	-	0.11	0.12^b
			(0.07)	(0.05)
u^4_{it} North Exp. Sh. Eq.	-	-	0.12^a	0.06^b
			(0.02)	(0.02)
Year Dummies	yes	yes	yes	yes
Sector Dummies (3 digits)	yes	yes	yes	yes
N	18494	18817	11245	11488

Note: Standard errors between brackets with ^{a}, ^{b} and ^{c} respectively denoting significance at the 1%, 5% and 10% levels. All the results are clustered by firms.

Table 5: Changes in Productivity Activities (Similarity Index)

	Dependent Variable: ln Similarity Index					
Model :	FE	FE	FE	GMM	GMM	GMM
	(1)	(2)	(3)	(4)	(5)	(6)
ln R&D$_{t-1}$	-0.003[a]	-0.003[a]	-0.003[a]	-0.001[a]	-0.001[a]	-0.001[a]
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
ln Herfindahl$_{t-1}$	-	-0.015[a]	-0.015[a]	-	-0.005[a]	-0.005[a]
		(0.00)	(0.00)		(0.00)	(0.00)
ln (K/VA)$_{t-1}$	-	-	-0.004[b]			-0.001[a]
			(0.00)			(0.00)
Year Ddummies	yes	yes	yes	yes	yes	yes
Sector Dummies (3 digits)	yes	yes	yes	yes	yes	yes
N	19614	19606	18975	12421	12415	12052
Sargan P-value	-	-	-	0.295	0.310	0.365

Note: Standard errors in parentheses with [a], [b] and [c] respectively denoting significance at the 1%, 5% and 10% levels. All the results are clustered by firms. FE estimates correspond to OLS with firm level fixed effects.

Table 6: Product Quality Upgrading: Export Unit Values

	Dependent Variable: Δ_t ln $MAXUV_{ipt}$			
Model :	OLS	GMM	GMM	GMM
	(1)	(2)	(3)	(4)
Δ_t ln R&D	0.01[c]	0.13[b]	0.14[b]	0.14[b]
	(0.01)	(0.06)	(0.06)	(0.06)
Δ_t ln TFP	0.00	0.00	0.00	0.00
	(0.01)	(0.01)	(0.04)	(0.04)
Δ_t ln EMP	-	-	0.25[b]	0.24[b]
			(0.11)	(0.11)
Δ_t ln K/VA	-	-	0.15	0.15
			(0.09)	(0.09)
Δ_t ln North Exp. Sh	-	-	-	0.02
				(0.01)
Year Dummies	yes	yes	yes	yes
Sector Dummies (3 digits)	yes	yes	yes	yes
N	140034	140034	140034	140034
Sargan P-value	-	0.924	0.867	0.888

Note: Standard errors in parentheses with [a], [b] and [c] respectively denoting significance at the 1%, 5% and 10% levels. All standard errors are clustered at the firm level.