The Dynamics of Firms' Product Portfolio in Response to International Competition: An Empirical Assessment*

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Thoroughly Revised Version, Comments Welcome

Abstract

We use a new dataset containing detailed information about the production structure of a large and representative sample of French manufacturing firms to investigate whether aggregate reallocations of production are (at least partly) driven by within-firm product portfolio strategies. Using instrumental variable techniques, we obtain that firms experiencing a high low-cost country competitive pressure are significantly more diversified, whereas firms exposed to northern competition rather choose to re-focus their product portfolios. More productive firms combine more often these productive reallocations with genuine innovative activities. Furthermore, the correlation between diversification and southern competition is non-linear, thus suggesting that this diversification strategy is transitory.

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Keywords: International Trade, Multi-product Firms, Heterogeneous Firms, R&D

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1 Introduction

The analysis of firm level responses to globalization is one of the core challenges in applied economic research: at stake is our understanding of the firms' ability to face new, worldwide competitive pressures, with consequences in terms of employment, economy-wide industrial structures, and economic growth. Our contribution to this research field is to empirically investigate product portfolio strategies of firms that are highly exposed to an increasing international competitive pressure. The starting point of our analysis is the fact that French firms that are more exposed to low-cost country competition are on average more diversified than firms operating in more sheltered areas. In our sample, which is constructed from large scale surveys and is representative of the French manufacturing industry over the 1999 to 2004 period, 45% of the firms report more than one activity, which is close to the proportion reported by Bernard, Redding and Schott [2009] for US manufacturing plants (41%). Many of these multi-activity firms report non-manufacturing activities, e.g. trade or accounting services, but even leaving these activities aside, we still get a proportion of 16% of manufacturing multi-product firms. However, the most striking feature of the data is that this proportion varies a lot depending on the degree of exposure to southern competition[1]: 17.6% of highly exposed firms are multi-product firms, whereas the proportion drops to 10.7% among weakly exposed entreprises. Furthermore, among multi-product firms, highly exposed firms are also significatively more diversified than weakly exposed firms as shown in figure 1[2].

The main purpose of our paper is to further analyze the static and dynamic phenomena underlying this cross-sectional correlation, which at first sight appears to be somewhat at odds with several recent results derived in the international trade literature, although in a different setting and focusing more on "North-North" type of trade integration (e.g. Bernard, Redding and Schott [2009, 2006])[3].

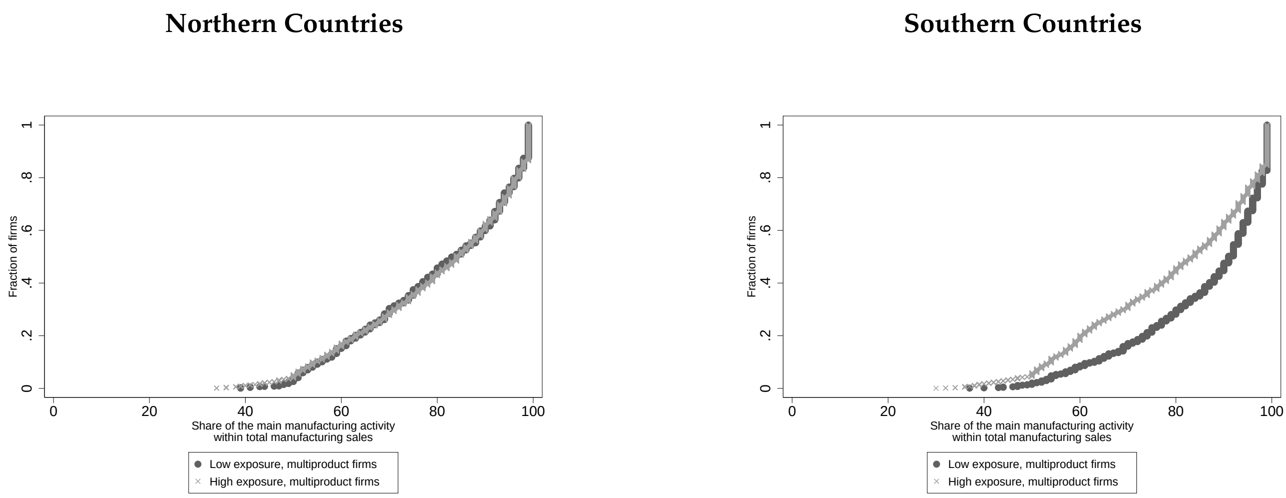
This aspect might however be of first order empirical relevance. In alternative strands of the literature, theories such as the international product life-cycle (Vernon [1966]) or the technological gap (Posner [1961]) suggest that competing with less-developed countries is fundamentally different from competing with developed countries. Indeed, competitors from advanced economies (as well as French domestic competitors) have access to similar technologies, absorptive capacities and factor costs, whereas less developed countries lack access to the more recent technologies, but enjoy significant advantages in terms of factor (especially labor) costs. Responses to these two kinds of competitive pressure may therefore be contrasted: in particular, firms in advanced countries might not find it sustainable to rely

[1] See notes to figure 1 for a precise definition.

[2] See graphic 5 in the appendix for the entire, non-conditional distribution.

[3] The literature about multi-product firms (e.g. Yeaple and Nocke [2006], Bernard Redding and Schott [2006], Eckel and Neary [2006]) relies most frequently on the assumption that firms have a specific *core competency* for which they achieve the highest level of efficiency. As a consequence, trade integration leads firms to shed marginally less productive products and therefore to re-center on their core activities, as demonstrated by Bernard, Redding and Schott [2006]. Note however that Eckel and Neary [2006] obtain that with symmetric industries, an increase in the productivity of foreign firms raises industry output, increases the product range of multi-product firms and lowers the domestic real wage. It also flattens the distribution of outputs within a multi-product firm's product range: products at the margin of the product range always expand while those near the core may contract. Last, Feenstra and Ma [2007] do not make the same assumption of core competencies, so that in their modeling, opening trade leads to fewer firms surviving in each country but more varieties produced by each of those firms.

Figure 1: Northern and Southern Penetration Indices and Firms' Main Activity Share



Kolmogorov-Smirnov Test	
$\mathbf{H_0}$: $\mathbf{F_W}(\bullet) < \mathbf{F_H}(\bullet)$, $\mathbf{D}^+ = \max_{\mathbf{x}} \{\mathbf{F_W}(\mathbf{x}) - \mathbf{F_H}(\mathbf{x})\}$	
$D^+ = 0.018$, p-val = 0.629	$D^+ = 0.000$, p-val = 1.000
$\mathbf{H_0}$: $\mathbf{F_W}(\bullet) > \mathbf{F_H}(\bullet)$, $\mathbf{D}^- = \min_{\mathbf{x}} \{\mathbf{F_W}(\mathbf{x}) - \mathbf{F_H}(\mathbf{x})\}$	
$D^- = -0.018$, p-val = 0.617	$D^- = -0.170$, p-val = 0.000
$\mathbf{H_0}$: $\mathbf{F_W}(\bullet) = \mathbf{F_H}(\bullet)$, $\mathbf{D} = \max\{\lvert\mathbf{D}^+\rvert, \lvert\mathbf{D}^-\rvert\}$	
$D = 0.018$, p-val = 0.966	$D = 0.170$, p-val = 0.000

Notes: Multi-product firms only, manufacturing activities only. "High exposure" is defined as belonging to an industry with a high (above the 66$^{\text{th}}$ sample percentile) southern penetration index. Conversely, "low exposure" relates to firms experiencing low penetration indices (below the 33$^{\text{th}}$ sample percentile). These descriptive statistics relate to the year 2004.
This figure reports the cumulative density function of the share of the firm's main activity in its total sales (indicator of *concentration*). Highly exposed firms are on average less specialized (and therefore more diversified) than weakly exposed firms, and the difference is statistically significant as evidenced by the Kolmogorov-Smirnov test. The difference is not significant when performing the symmetrical experiment with the northern import penetration index.

on *price-based* strategies in order to rule out low-cost competitors. Thoenig and Verdier [2003] show that when globalization triggers an increased threat of technological leapfrogging or imitation by southern countries, firms in developed countries tend to respond by biasing the direction of their innovations towards technologies that are intensive in skilled labor, which they call "defensive skill-biased innovation". In their reduced form setting however, these defensive innovations might be either process or product based. The literature in management provides more precise insights in this respect (Bernard and Koerte [2007]) and makes the point that firms in developed countries would seldom find profitable to engage a race with low-cost countries in terms of production costs, since this dimension is not likely to be their comparative advantage. It rather suggests the more intuitive idea that low-cost country (henceforth southern) competition leads to product innovation rather than to process innovation, so that the observed skill bias may be more related to R&D activities than to standard production activities[4].

[4]Note that R&D expenditures typically consist in wages of high-skilled workers (researchers), so that in regard of this aspect, the modeling of Thoenig and Verdier [2003] could indeed be considered as a reduced form of a more complex productive reality. However, the literature in industrial organization often considers R&D expenditures as a sunk cost, and not as a variable production cost as they do.

These insights from the managerial literature have not been fully incorporated in the recent international trade literature yet. Several margins of adjustment to globalization have been identified, both theoretically and empirically, but few papers distinguish between northern (relatively high-tech) and southern competitive pressure. Similarly, few empirical papers are akin of articulating firm-level together with product level information, which is necessary to get a complete view of firm level strategic responses to globalization. The existing empirical evidence about the "intensive" (within firms) margins of adjustment remains therefore relatively scarce.

Among analyses relying on product level data, Hummels and Klenow [2005] investigate the export gap between large and small economies and show that the extensive margin (wider set of goods) accounts for around 60 percent of the greater exports of larger economies. Their empirical evidence therefore suggests that product level reallocations may play an important role in explaining country level specialization processes. However, their contribution is silent about the underlying micro-dynamics: is it driven by firms' exits and entries, or rather by internal changes in firm-level product portfolios? What are the drivers of these micro-dynamics?

At the firm level, the previous literature has mainly focused on entry/exit (Bernard, Jensen and Schott [2006]) and export participation (Eaton, Kortum and Kramarz [2005]) decisions as responses to globalization and increased international competition. Bernard, Jensen and Schott [2006] investigate the relations between low-cost country competition and plant survival or growth, but also plants' main industry switching. The results obtained by the authors along this latter dimension are barely significant, most probably because the main activity is a too coarse description of the firms' productive activity. Overall, this body of the empirical literature tends to provide only a partial view about firms' responses to globalization, since it broadly suggests that the only relevant trade-off is between survival (of the most productive firms) or exit. In this paper, we propose to investigate whether reallocations of production triggered by globalization also occur within surviving organizations (firms), via product switching or diversification strategies. This hypothesis is closely related to the literature analyzing dynamic firm-level strategies such as (R&D) investment in productivity-enhancing activities; see e.g. Aw, Roberts and Xu [2008, 2009] and Costantini and Melitz [2007] for theoretical contributions and Aw, Roberts and Xu [2008], Bustos [2007] or Bloom, Draca and Van Reenen [2010] for empirical investigations.
It is also closely related to Bernard, Redding and Schott [2009] who show that firm-level product switching is prevalent in the United States; Goldberg *et al.* [2009] and Navarro [2008] also provide similar empirical insights for the cases of India and Chile. However, the authors do not investigate the potential relations between these firm-level strategies and globalization (and aggregate specialization) processes[5].

[5] In their article, product switching in the steady state is induced by idiosyncratic shocks to consumer tastes.

Our work yields the following results: in the cross-section as well as in dynamic, firms experiencing a high southern competitive pressure tend to significantly diversify their product portfolios, whereas firms exposed to the northern competition rather choose to re-focus their product scope. These results are robust to the inclusion of a variety of competition indicators, and to alternative IV estimation strategies. The underlying magnitudes are large, since a back - of - the - enveloppe calculation suggests that "within firms" productive reallocations are as prevalent as "between firms" reallocations, via entry and exit flows. Further analysis shows that more productive firms combine more often these productive reallocations with genuine innovative activities, which may explain why they achieve higher survival rates (Bernard, Jensen and Schott [2006]). Last, the correlation between diversification and southern competition is non-linear, thus suggesting that the underlying diversification strategy might be a transitory one.

The remaining of the paper is organized as follows. Section 2 motivates our general empirical specification and our IV estimation strategies while section 3 describes the data, as well as the empirical indicators of international competition and product portfolio strategies. Section 4 presents the obtained results and section 5 concludes.

2 An Empirical Setting for the Analysis of Firms' Product Portfolio Strategies

2.1 Extending the Empirical Framework of Production Function Estimation Firm Level Policy Functions Associated to Portfolio Strategies

We consider the programme faced by a firm when defining its product scope[6].

Let $E^g_{i,t}$ $(g = 1, ..., G)$ denote the dummy variables indicating whether the firm i decides to produce good g or not. We assume that entering a new market g involves a (e.g. R&D) sunk cost γ^g which may depend on the firm's (unobserved) "efficiency" $\tilde{\omega}_{i,t-1}$ at the beginning of the period. As in Olley and Pakes [1996], we assume that $\tilde{\omega}_{i,t-1}$ follows an exogenous first order Markov process[7]. Last, let Φ_t capture all the aggregate states that firms take as exogenous. This vector contains in particular the state variable describing the magnitude of international (southern and northern) competition.

The firm's value function can be written as:

$$V\left[\tilde{\omega}_{i,t-1}, \left(E^g_{i,t-1}\right)_g; \Phi_t\right] = \max_{\left(E^g_{i,t}\right)_g} \left\{ \sum_g \mathbb{I}_{(E^g_{i,t}=1)} .\pi^g_i \left[\left(E^k_{i,t}\right)_{k\neq g}, \tilde{\omega}_{i,t-1}; \Phi_t\right] - \sum_g \mathbb{I}_{(E^g_{i,t}-E^g_{i,t-1}=1)} .\gamma^g[\tilde{\omega}_{i,t-1}] + \beta.V\left[\mathbb{E}(\tilde{\omega}_{i,t}|I_{t-1}), \left(E^g_{i,t}\right)_g; \Phi_{t+1}\right]\right\} \quad (2.1)$$

[6]In this setting, the decision to create a new firm is implied in the initial decision to enter at least one market, while the decision to exit is embedded in the decision to exit *all of the markets* at the same time. However, this aspect remains sketch in what follows since our sample is composed of firms employing more than 20 workers, i.e. of "established" firms mainly, and does not allow to investigate these aspects accurately.

[7]See appendix B.1.

Following Eckel and Neary [2006] or Feenstra and Ma [2007], we allow profits on a specific market g to depend on firms' diversification since potential "cannibalization" effects might arise depending on the elasticity of substitution of demand between product varieties[8].

The previous program results in policy functions describing the dynamic evolution of firm i's product portfolio that are implicit functions of the state variables at the beginning of the considered period:

$$E_{i,t}^{g} = E^{g}(\tilde{\omega}_{i,t-1}, \left(E_{i,t-1}^{k}\right)_{k}; \Phi_t), \quad g = 1, ..., G \tag{2.2}$$

Variations in the assumptions of this modeling alter the shape of the obtained policy functions. In particular, if there are additional costs associated to product switching, such as sunk (capital) costs, then these variables also enter the policy functions. In our empirical investigations, we adopt a rather flexible specification allowing to test these various alternatives.

However, we do not estimate one equation per potential market, which would require to run more than 400 equations at the four digit level (for manufactured goods only). We rather use more synthetic indices describing the firms' product portfolios as proxies for $\left(E_{i,t}^{g}\right)_{g}$ (e.g. index of diversification, see below section 3.3 for further details), or their evolution over time.

The difficulty at this stage is that $\omega_{i,t}$ is typically not observed. However, the previous firm-level dynamic programme can be interpreted as an extension of the empirical setting which has been proposed for the estimation of production functions (see Ackerberg *et. al.* [2007]) and precisely allowing to estimate firm level TFPs as a by-product of the estimation strategy. It is explained in detail in appendix B.1.

2.2 Empirical Analysis of Product Portfolio and Innovation Strategies

The estimation procedure for TFP does not require to explicitly estimate the policy functions associated to the determination of product portfolios. It only relies on the timing assumption regarding diversification decisions, especially the fact that this feature of the production function is pre-determined ("fixed")[9].

We take advantage of the previous TFP estimates in order to specifically investigate these policy functions[10]:

[8] In this section (equations 2.1 and 2.2), we abstract from additional potential state variables (specifically, productive capital) which are momentarily embedded in the profit functions $\pi_i^g(\cdot)$ and are explicitly re-introduced in appendix B.1 containing our detailed estimation strategy.

[9] Appendix B.1 shows that whether product scope is a dynamic or static "input" is not a crucial feature for our TFP estimation strategy, since in either case, the relevant parameter is identified in the second stage and enables to retrieve consistent TFP estimates.

[10] Equation 2.3 is the analog of equation B.7 or to the investment equation (Olley and Pakes [1996] setting) with respect to product portfolios. An important difference is however that the function denoted f is not *a priori* likely to be monotonic in $\tilde{\omega}$, and could therefore not be inverted to provide a further identifying dimension of ($\tilde{\omega}$ in) the production function.

$$(\Delta)div_{it} = f\left(\tilde{\omega}_{it-1}, \underbrace{k_{it-1}, div_{it-1}}_{\text{state var.}}, \underbrace{\Phi_{t-1}}_{\text{environment}}\right) \tag{2.3}$$

More specifically, we actually estimate three alternative approximations of the previous unknown function:

$$\begin{aligned}
(\Delta)div_{it} &= \theta_0 + \theta_1.\widehat{\omega}_{it-1} + \theta_2.div_{it-1} + \theta_3.k_{it-1} + \theta_4 \ln PEN^S_{t-1} + \theta_5 \ln PEN^N_{t-1} + \theta_6 \ln HHI_{t-1} + \delta_t + \eta_i + \epsilon_{it} \\
&\approx \theta_0 + \theta_1.\widehat{\omega}_{it-1} + \theta_2.div_{it-1} + \theta_{3a}.(k_{it-1} - \ln(\text{size}_{it-1})) + \theta_{3b}.\ln(\text{size}_{it-1}) \\
&\qquad + \theta_4 \ln PEN^S_{t-1} + \theta_5 \ln PEN^N_{t-1} + \theta_6 \ln HHI_{t-1} + \delta_t + \eta_i + \epsilon_{it} \qquad (2.4) \\
&\approx \theta_0 + \theta_1.\widehat{\omega}_{it-1} + \theta_2.div_{it-1} + \theta_{3a}.(k_{it-1} - \ln(\text{size}_{it-1})) + \theta_{3b}.\ln(\text{size}_{it-1}) \\
&\qquad + \theta_{4a} \ln PEN^S_{t-1} + \theta_{5a} \ln PEN^N_{t-1} + \theta_{4b} \ln PEN^S_{t-1} \times \widehat{\omega}_{it-1} + \theta_{5b} \ln PEN^N_{t-1} \times \widehat{\omega}_{it-1} \\
&\qquad + \theta_6 \ln HHI_{t-1} + \delta_t + \eta_i + \epsilon_{it} \qquad (2.5) \\
&\approx \theta_0 + \theta_1.\widehat{\omega}_{it-1} + \theta_2.div_{it-1} + \theta_{3a}.(k_{it-1} - \ln(\text{size}_{it-1})) + \theta_{3b}.\ln(\text{size}_{it-1}) \\
&\qquad + \sum_Q \theta_{4Q}\mathbb{I}_PEN^{S,Q}_{t-1} + \sum_Q \theta_{5Q}\mathbb{I}_PEN^{N,Q}_{t-1} + \theta_6 \ln HHI_{t-1} + \delta_t + \eta_i + \epsilon_{it} \qquad (2.6)
\end{aligned}$$

In these equations, PEN^S and PEN^N are indicators of international competition (import penetration indices computed for Northern and Southern countries respectively), and HHI is the herfindahl index of domestic market concentration. Specification 2.4 is a direct first order linear approximation of the policy function, where we simply allow for potential additional size effect (in case size is also to be considered as a state variable on top of capital intensity). Specification 2.5 is an alternative, second order polynomial specification where we introduce the interactions between productivity and international competition. Last, specification 2.6 is a simple variation of specification 2.4 where we allow the impact of international competition to be non-linear by introducing dummy variables for each of the quartiles of our indicators of international competition. In most of our reported specifications, we follow Hallak [2006] and introduce the share of shipments to northern countries as an additional control for unobserved quality.

Overall, our three-step estimation procedure amounts to use materials (as well as lags in materials and capital) as instrumental variables for TFP in our equation of interest modeling portfolio strategies. This strategy allows us to retrieve an estimate of parameter θ_1, which is of direct interest, as well as purging the estimation of parameters θ_5 and θ_6 from endogeneity biases in a "control function" setting.

We make use of this empirical specification in order to investigate various aspects of the firms' product portfolio strategies: diversification (product scope) and concentration indices, product adding and dropping as well as R&D effort.

2.3 Further Endogeneity Issues: IV Strategies for Penetration Indices

We also recognize that the import penetration indices may be endogeneous in equation 2.4 (as well as in equations 2.5 and 2.6). First, endogeneity concerns may arise in the cross-sectional dimension due to reverse causality or omitted variables biases (Bertrand [2007]). For example, bad (past) strategy choices might affect the competitive position of a firm or an industry and therefore might affect the penetration indices they face. Bad or lazy managers might decide insufficient portfolio reallocations, while these "inefficient" firms might become specifically targeted by their (southern) competitors[11]. Two features of our setting help mitigate these potential biases. First, the use of lagged values of the penetration indices might mitigate the magnitude of the bias arising from pure simultaneity phenomena. Second, we also report estimates obtained using average distances (as proxies of freight costs) as instrumental variables for southern penetration (see section 3.2.2 below). We argue that these types of costs have a direct impact on openness and penetration indices, but do not affect directly the portfolio strategies of French firms.

A second source of endogeneity might arise in the longitudinal dimension. Indeed, unobserved technological shocks experienced by French ("northern") firms[12] may have an impact on both French firms' product portfolio strategies *and* on their competitiveness and therefore on the overall degree of openness of the French economy and on southern penetration indices (see Thoenig and Verdier [2003]). Furthermore, unobserved domestic (French) demand shocks may also generate endogeneity issues at this stage since they may affect both the level of domestic demand directed towards domestic producers, and the level of domestic demand directed towards foreign producers (imports), thus generating attenuation biases in our setting. We follow Thoenig and Verdier [2003] and Bertrand [2007] and propose to use exchange rates (corrected for differential domestic inflation) to address this "dynamic" endogeneity concern[13]. We argue that exchange rates are primarily determined by macro-economic variables that, at least conditional on year dummies, can reasonably be regarded as exogenous to the behavior of firms in a certain industry in a certain period.

Depending on the nature of the dependent variable (continuous or limited), we implement these IV strategies using 2SLS (e.g. in linear probability models) or maximum likelihood estimation in non-linear settings.

[11]These two examples would generate downward biases on our estimates but alternative stories might generate upward biases, e.g. in the case of inefficient but "hyper-active" managers.

[12]Note that on the contrary, southern technological shocks are not a source of endogeneity, but of identification in our setting.

[13]Bernard, Jensen and Schott [2006] or Bloom, Draca and Van Reenen [2010] take advantage of changes in tariffs or quotas to provide causal estimates in the same type of setting. However, a drawback of these instrumental variables is that they are only valid "locally" in time or for a limited subset of industries. Second, over our estimation period, changes in tariffs do not appear to be reasonably exogenous, as the first stage estimates show counter-intuitive correlations (see see table 17 in the appendix). Bloom, Draca and Van Reenen [2010] also propose using penetrations indices at the beginning of the period, interacted with the global growth of imports as IVs. This procedure hypothesizes a pure homothetic subsequent evolution of imports and enables to smooth out any subsequent differential technological shock. However, this procedure does not address the potential endogeneity of penetration indices in the cross-section.

3 Data and Measurement

3.1 Data Sources

The firm level information required for the empirical analysis has been sourced from a variety of datasets. First, exhaustive firm level information about imports and exports over the period 1999 - 2004 are sourced from the information system of the French Custom Administration[14]. These files provide information about the value and volume of each firm's export flow, defined at the product 6 digit level. The symmetrical information is available for import flows, and we also use the information about the country of origin (see below the definition of the penetration indices).
Second, complementary information about the firms' innovative effort is sourced from the "Innovation" (CIS) and "R&D" surveys. These two sources matched together enable us to determine which firms do invest in innovation, which ones *do not*, and the corresponding amount of R&D expenditures. These surveys are not exhaustive[15] but are large and representative of the population of manufacturing firms having more than 20 workers. Together, they provide information on 10,000 firms over the 1999-2004 period, each of them being present on average three (adjacent) years. This sample is also matched with the exhaustive datasets of patent applications to the French National Patent Office (INPI), with priority years also ranging from 1999 to 2004.
Lastly, standard accounting information such as value added, employment, capital, labor costs, and the main firm industry affiliation are sourced from exhaustive fiscal files (FICUS and FUTE files), as well as the entire decomposition of each firm's sales into each of the 4 digit market where it operates[16].

We end up with a file containing 30,790 observations when broken down in the firm and year dimensions. This set of firms corresponds to a yearly total of 1.3 millions of employees, where the median firm has 62 employees over the period. Our sample includes roughly 40% of the entire population of manufacturing firms having more than 20 employees which were active over the considered period. On average, 44% of the sample firms report positive investments in innovation.

3.2 Measuring Low-Cost Country (and High-Tech Country) Competitive Pressure

3.2.1 Construction of the Penetration Indices

Our indicator of southern competition is directly derived from Bernard, Jensen and Schott [2006], except that we furthermore explicitly take account of multi-product firms. First, countries are classified as low-cost, or "southern" if their GDP per capita is lower than 5% of the French GDP per capita[17].

[14] See Eaton, Kortum, and F. Kramarz [2005] as an example of analysis performed using the same data. The dataset is in fact at the "flow" level. Exports are reported "franco-on-board" (FOB), i.e. exclusive of tariffs and freights, whereas imports are reported "CAF", inclusive of tariffs and transport costs.

[15] Except for firms having more than 250 employees.

[16] This information is only available for (all of the) manufacturing firms having more than 20 employees. Note that the industry affiliation of multi-product firms corresponds to the largest share in terms of sales, and that there is correspondence between the (NAF) activity classification of the FUTE files and the (CPF) product classification used in the customs files when both aggregated at the 3 digit level.

[17] Results are robust to the choice of alternative thresholds (e.g. 5% or 10%). The list of countries obtained in 2004 is reported in appendix A; on average over the 1999-2004 period, 73 countries (out of 161) are classified as low-wage countries.

Second, we compute industry level southern penetration indices using the *exhaustive* (six digit aggregated at the 4 digit level) import flow level information available from the customs administration. We then aggregate this information at the firm level using weights corresponding to the different (four digit) markets where the firm operates. The obtained indicator takes the following form:

$$PEN_{it}^{S} = \sum_{j} \omega_{ijt} \cdot \frac{M_{Fjt}^{S}}{M_{Fjt} + Q_{Fjt} - X_{Fjt}} \tag{3.1}$$

where ω_{ijt} denotes the share of sales of firm i in sector j at year t. We refer to M_{Fjt} and M_{Fjt}^{S} as French total imports and imports from low-cost countries respectively (in terms of products j at time t - this information is sourced from the customs files), and to Q_{Ft} and X_{Ft} as domestic production and French exports in the same productive segment j (this information is sourced from the exhaustive fiscal files).

The northern penetration index is defined symmetrically as:

$$PEN_{it}^{N} = \sum_{j} \omega_{ijt} \cdot \frac{M_{Fjt}^{N}}{M_{Fjt} + Q_{Fjt} - X_{Fjt}} \tag{3.2}$$

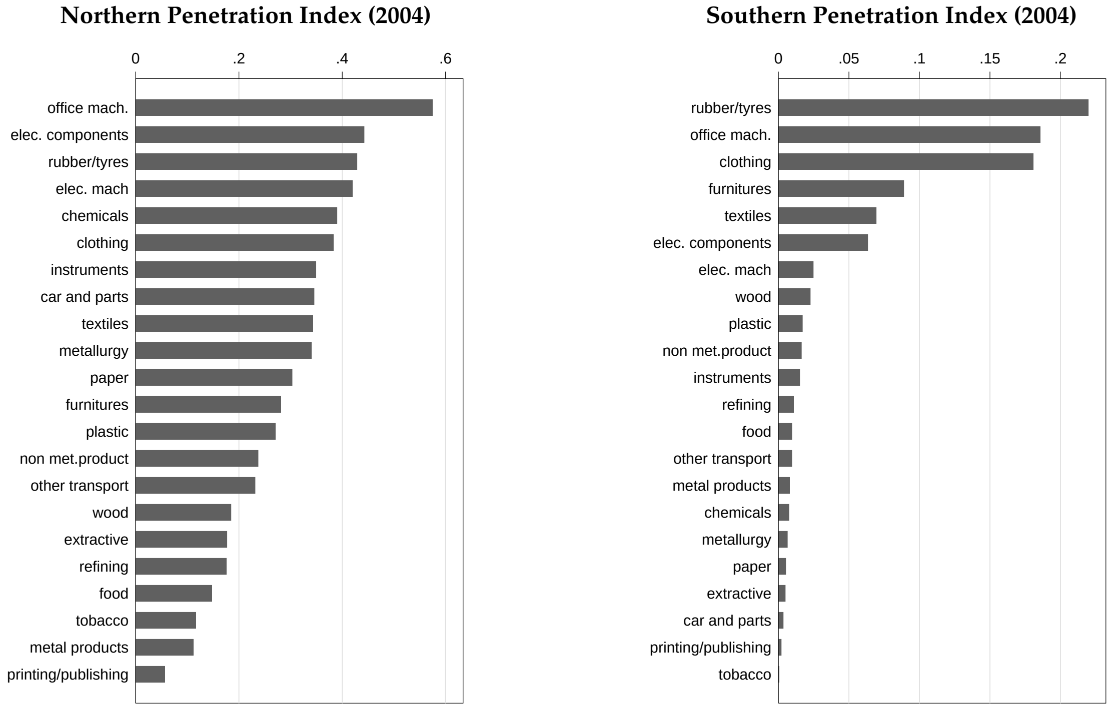
where M_{Fjt}^{N} denotes French imports form northern countries in sector j at year t. The two indices add up to the total penetration index of imports for the markets that are relevant for the considered firm.

These two variables have a firm level variation due to the weights used to aggregate the industry level penetration indices. However, it is useful to check that the obtained indicators are close to common wisdom when they are aggregated according to the firms' main activity[18]. Graph 2 depicts the average penetration indices experienced in 2004 by firms whose two-digit main activity belongs to the specified category[19]. Unsurprisingly, the southern import penetration index suggests that French firms operating in the rubber / tyres, clothing and office machinery are most exposed to low-wages countries competition. It is furthermore worth noticing that the index of southern competition is much lower but more differentiated across industries than the northern index, which provides a greater industry level potential for identifying variability. Graph 3 shows that even on a short time period (6 years between 1999 and 2004), the increase in the southern penetration indices has been substantial in many industries, especially in medium to high-tech segments: "office machinery", "car and parts" or "electric and electronic components". Although the magnitude of variations in northern penetration indices was more limited over the period, graph 3 also shows that there is no clear correlation pattern, at the industry level, between changes in northern and southern penetration indices, which also provides an interesting identifying variability in the time dimension between northern and southern competition.

[18]Figures 2 and 3 present descriptive statistics aggregated at the 2-digit level, but regression analysis is performed at the 4 or 6 digit level.

[19]Table 13 in Appendix C provides detailed sample statistics for these penetration indices, in particular standard deviations used below to provide insights about the economic significance of the obtained results.

Figure 2: "Southern" and "Northern" Penetration Indices Across Firms' Main Industries



Note: These descriptive statistics relate to the year 2004 and are based on the average penetration indices experienced by the sample firms whose main activity belongs to the specified category.

3.2.2 Instrumental Variables

As explained is section 9, we use distances (usually considered as proxies for freight costs in gravity equations) as instrumental variables for the penetration indices presented above.

More precisely, assuming that transportation costs are proportional to distances, our IVs are computed as the average distance between France and the exporting countries:

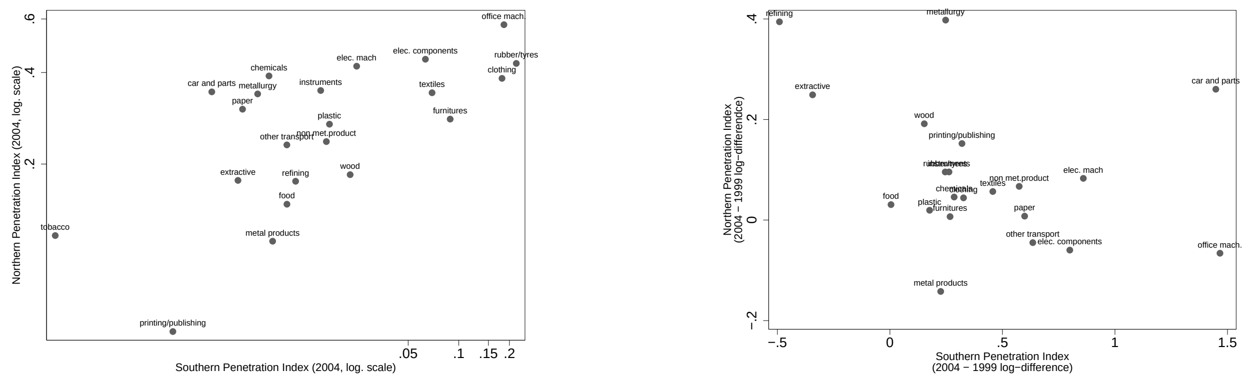
$$DIST\_IMP_{it}^{X} = \sum_{j} \omega_{ijt_0} . \left(\sum_{c} \frac{M^{c}_{Fjt}}{M^{X}_{Fjt}} . d_{cF} \right), \quad X = S, N \tag{3.3}$$

where c denotes countries, d_{cF} denotes the distance in kilometers between France and country c, and $\frac{M^{c}_{Fjt}}{M^{X}_{Fjt}}$ denotes the share of imports accounted for by country c (for good j) in the total of French imports.The geographical information is sourced from Mayer and Zignago [2006]; bilateral distances are calculated following the great circle formula, which uses latitudes and longitudes of the most important city (in terms of population) or of the official capital in each considered country. Note also that in equation 3.4, the firm specific weights ω_{ijt_0} are taken at the first period where the considered firm enters our sample in order to avoid any endogeneity bias generated by the variation of these weights.

The second set of instrumental variables is constructed from exchange rates. Real exchange rates

Figure 3: Comparison of the "Southern" and "Northern" Penetration Indices

Correlation of levels (2004) **Correlation of changes (99/04)**



Note: These descriptive statistics relate to the 2004 - 1999 time difference and are based on the average penetration indices experienced by the sample firms whose main activity belongs to the specified category.

are nominal exchange rates (expressed in foreign currency per euro) multiplied by the French consumer price index (CPI) and divided by the foreign country CPI. The information about exchange rates is sourced from the European Central Bank, while CPIs are gathered from the IMF website. All evolutions are relative to the 2005 year. Our final exchange rate indicators take the following form:

$$\Delta_t EXCH\_IMP_{it}^X = \Delta_t \sum_j \omega_{ijt_0}.\left(\sum_c \frac{M_{Fjt}^c}{M_{Fjt}^X}.e_{cF}.\frac{CPI_{Ft}}{CPI_{ct}}\right), \quad X = S, N \tag{3.4}$$

3.3 Describing Firms' Product Portfolios

We rely on the information about the yearly decomposition of each firm's sales at the four digit level in order to track detailed firm level portfolio strategies. Note that our indicators of product portfolios are based on the (French / European) classification of activities rather than on the product classification constructed by the customs administration and contrasts in this respect with most existing empirical contributions to the field. We believe that this feature of our indicators is important, since we do not have to rely on a classification which was constructed mainly for purposes related to the design of tariffs and the levying of taxes (by the customs administration) at the product level, and which is therefore highly suspected of endogeneity in our setting[20].

We start with two synthetic indicators of (respectively) concentration and diversification of the firms' production. Let $\omega_{ipt} = \frac{S_{ipt}}{\sum_j S_{ijt}}$ denote the share of sales represented by activity / product p in the total

[20] In contrast, this is not the case of the activity classification, which was built by the Statistical Institute for purposes related to the measurement of production, in the perspective of national growth accounting.

turnover of firm i in year t. Our indicator of concentration is the share represented by the main activity in the firm's portfolio:

$$SH_{it}^{max} = \max_{p} \{\omega_{ipt}\} \ \in]0;1] \tag{3.5}$$

The indicator of diversification is defined as the inverse[21] of the Herfindahl concentration index of firms' sales, computed using the entire information about firms' productive profiles:

$$DIV_{it} = \left(\sum_{p} \omega_{ipt}^{2} \right)^{-1} \ \in \ [1; +\infty[\tag{3.6}$$

Our further empirical indicators follow Bernard, Redding and Schott [2009] and are simply dummy variables indicating whether the considered firm has introduced at least one new product in its portfolio between years $t-2$ and t, or whether on the contrary it has removed at least one:

$$ADD_{it} = \mathbf{1}\{ \sum_{p/\omega_{ipt-2}=0} \omega_{ipt} > 0 \} \tag{3.7}$$

$$DROP_{it} = \mathbf{1}\{ \sum_{p/\omega_{ipt}=0} \omega_{ipt-2} > 0 \} \tag{3.8}$$

Last, the synthetic indicator of inertia captures (the opposite of) the magnitude of all types of portfolio reallocations:

$$INERTIA_{it} = 1 - \frac{1}{2} \sum_{p} |\Delta \omega_{ipt}| \tag{3.9}$$

Descriptive statistics are reported in table 1 and show that product "churning" (both adding and dropping) is more prevalent among R&D active firms than among their non - innovative competitors, although the difference in terms of diversification is small. It is also worth noticing that in both sub-populations, the share of firms experiencing a *decrease* in diversification is larger than the share of firms experiencing an *increase* (19% against 14% on average), but the difference is larger in the population of R&D active firms.

3.4 Measures of Firms' Innovative Effort

All of the previously described indicators heavily rely on the existing activity or product classifications, which renders them in particular inadequate to measure "true" (new to market) product innovation. We therefore rely on three additional indicators in order to capture this additional dimension.

[21] We use the inverse in order to obtain a variable which has the same dimension as a simple counting of activities at the 4 digit level. Note that in the case where $\{\omega_{ipt} > 0 \Longrightarrow \omega_{ipt} = \bar{\omega}\}$ then DIV_{it} coincides with the number of 4-digit activities of the considered firm.
The "activity" classification is at the 4-digit level and provides a description of manufacturing industries in about 300 different classes. The product classification constructed by the custom administration is at the 6-digit level which enables to describe the production of French manufacturing firms using circa 1,500 classes, i.e. at a more detailed and arguably homogenous level, but with higher endogeneity (and selectivity) concerns as explained above.

The innovative effort of our sample firms is first proxied by their Research and Development (R&D) expenditures[22].

We also use patent applications at the French National Patent Office (INPI) in order to assess whether firms have launched new products on to the market over the estimation period. The main limit of patent - based indicators of innovation is that they are only able to capture a small proportion of all innovations introduced by the firms, in particular in low-tech industries where the patenting propensity is low, but southern competition high and evolving rapidly. Note however that, in contrast to previous work (e.g. Bloom *et al.* [2010]), we have information about national French patents, which are typically more accessible and less costly for French firms than EPO[23] patents, and therefore more common - and more useful to track firms' innovations in these industries.

3.5 Descriptive Statistics

Our empirical analysis also relies on a variety of standard firm level controls such as employment, capital intensity and the Herfindahl index measuring the average concentration of the firm's domestic markets (at the four-digit level):

$$HH_{it} = \sum_p \omega_{ipt} \cdot \left[\sum_{i'} \left(\frac{S_{i'pt}}{S_{pt}} \right)^2 \right]$$

The information required for the estimation of firm -level TFP (see section B.2) is retrieved from fiscal and customs files; in particular, the demand shifters (industry level indicators of "absorption") are calculated using exhaustive files describing the productive and exporting activities of the entire population of French firms and the exhaustive list of import flows.

Descriptive statistics are reported in table 1. Unsurprisingly, in our sample, R&D active firms are both larger and more capital intensive; they are also more productive on average. They are more exposed to Northern competition, and less to Southern competition, than non - R&D performers. These findings are consistent with previous empirical evidence (e.g. Bloom *et al.* [2010] among others).

[22]This indicator is preferred to the "qualitative" indicators available from the Innovation (CIS) surveys because of his yearly availability over the 1999-2004 period, and for his (often argued) higher "objectivity": accounting information is often more reliable than self-assessed innovative performances.

[23]EPO: European Patent Office.

Table 1: Sample descriptive statistics

Sample:	Full	Non R&D	R&D
Description of product portfolios (t, 4 dig.)			
Share of main activity	0.941	0.956	0.920
Diversification (# activities)	1.155	1.115	1.200
Dynamics of product portfolios ($t/t-2$, 4 dig.)			
Product adding (dummy)	0.076	0.044	0.116
Share of added products	0.034	0.019	0.052
Product dropping (dummy)	0.100	0.060	0.149
Share of dropped products	0.033	0.018	0.050
Increase in diversification (dummy)	0.140	0.106	0.180
Decrease in diversification (dummy)	0.193	0.137	0.262
Inertia Index	0.942	0.962	0.918
Indicators of innovation			
R&D expenditures	4,333	-	11,260
National (INPI) patents	0.961	0.024	2.460
Measures of international competition			
Northern penetration	0.284	0.235	0.362
Southern penetration	0.029	0.035	0.019
Average distance of North. imports (km)	1884	1735	2102
Average distance of South. imports (km)	7769	7702	7867
Annual growth of exhange rate, North	0.008	0.007	0.009
Annual growth of exhange rate, South	0.048	0.051	0.419
Share of exports to North in the firm's sales	0.201	0.122	0.328
Control variables			
Employment	346	117	713
Capital intensity	128	58	240
TFP (estimated)	0.549	0.502	0.623
Herfindahl index of domestic market conc.	0.107	0.106	0.109
Observations	15592	9592	6000

Note: French manufacturing firms over the 1999 to 2004 period, except for the indicators describing the dynamics of product portfolios, which are available for the 2000/2002 and 2002/2004 periods. All remaining indicators are available on a yearly basis, and all amounts are expressed in thousand euros.

4 Results

4.1 International Competition and Diversification of Production

Tables 2 and 3 document the relation between international competition and the concentration (or diversification) of productive activities at the firm level using specifications 2.4, 2.5 and 2.6. These two empirical indicators are complementary since the share represented by a firm's main activity in its total sales measures the "weight" of firms' supposed "core competencies", while the indicator of diversification, defined as the inverse of the Herfindahl concentration index of sales across 4-dig. products, adds information about the "length" of the productive profile.

Table 2 shows that in the cross-section, when the northern penetration index only is introduced without its southern counterpart, then the obtained coefficient is significatively negative in the equation specified in terms of concentration (col. 1), and significatively positive in the equation specified in terms of diversification (col. 4). This means that a higher competitive pressure arising from international trade is associated with a lower specialization of productive activities. However, the southern penetration index, when introduced in the regression, attracts this significatively negative (resp. positive) sign. Therefore the correlation between international trade competition and firms' diversification seems to be mainly driven by the southern competitive pressure rather than by the northern competitive pressure. It should be noted, however, that the Herfindahl index of concentration on the domestic markets turns out to be significant in all specifications, with a positive sign in the case of the indicator of concentration, and a symmetric negative sign in the case of diversification. This means that the more intense the domestic competition, the higher the diversification. This domestic indicator might in fact attract the entire impact of the "technologically advanced" competitive pressure, which would explain why the northern index is not significant in our specifications. Last, we also obtain that larger firms tend to be more diversified, while this feature of firms' productive profile appears to be *uncorrelated* with their capital intensity or with their productivity index.

Further experiments are reported in table 3, where we investigate potential non-linearities in the relationship between international competition and diversification. Columns 1 and 5 only replicate columns 3 and 6 from table 2 as a benchmark. In columns 3 and 7, we introduce the interaction between penetration indices and the firms' productivity. The obtained coefficients are low and non-significant, which means that more productive firms are neither more nor less diversified when they experience more intense international competitive pressure, either southern or northern. In contrast, Bernard, Jensen and Schott [2006] show that the probability of plant death is relatively lower for more productive plants facing intense southern competition. At this stage, our indicators of concentration and diversification of product portfolios are too synthetic and do not allow to show whether, and how portfolio strategies might determine these differences in survival abilities.

Table 2: International Competition and Diversification

Dependent variable:	Share of main activity in sales (t) mean = 0.94			ln Diversification (t) [ln-] mean = [0.11] 1.16		
	(1)	(2)	(3)	(4)	(5)	(6)
ln Employment$_{t-1}$	-0.029***	-0.029***	-0.029***	0.015***	0.015***	0.015***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
ln (Capital/VA)$_{t-1}$	-0.003	-0.003	-0.003	0.001	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
ln Herfindahl$_{t-1}$	0.026***	0.027***	0.026***	-0.026***	-0.027***	-0.027***
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)
ln Diversification$_{t-1}$	-0.611***	-0.600***	-0.599***	0.561***	0.554***	0.553***
	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)
ln North exp. sh$_{t-1}$	-0.001*	-0.001	-0.001	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
ln TFP$_{t-1}$	-0.005**	-0.004**	-0.004**	0.002*	0.001	0.002
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
ln North pen.$_{t-1}$	-0.034***	-	0.025***	0.023***	-	-0.032***
	(0.004)		(0.008)	(0.004)		(0.007)
ln South pen.$_{t-1}$	-	-0.034***	-0.049***	-	0.027***	0.046***
		(0.003)	(0.005)		(0.003)	(0.005)
Observations	15592	15592	15592	15592	15592	15592
Estimation method	tobit	tobit	tobit	OLS	OLS	OLS

Note: Robust standard errors in parentheses with *** , ** and * respectively denoting significance at the 1%, 5% and 10% levels. The estimation period is 2000 to 2004. All equations include year and industry 3 dig. fixed effects.

The positive correlation between southern competitive pressure and diversification in columns 1 and 5 might be primarily driven by the cross-sectional heterogeneity between firms active in highly exposed industries as opposed to those operating in relatively more sheltered areas. However, the specifications with firm fixed effects reported in columns 2 and 6 provide a first evidence that there also exists a "dynamic" correlation (identified in the longitudinal dimension) between the magnitude of the southern competition and diversification. Indeed, the obtained correlations appear to be robust to the inclusion of such firm level fixed effects. Lastly, in columns 4 and 8, we replace our (log-) linear indicators of penetration with two sets of three dummies corresponding to the different sample quartiles of the penetration indices: the "4th quartile" indicates that competition is intense, while the first quartile (used as a reference) indicates a weak competition. In the southern case, the obtained coefficients increase weakly (in absolute value) with the magnitude of competitive pressure, which implies that firms tend to stop diversifying when displacing their productive profiles towards more sheltered "niches". In contrast, we obtain a symmetric pattern in the northern case (col. 8), which means that, consistent with the theoretical predictions in Bernard, Redding and Schott [2009, 2006], firms facing intense *northern* competition tend to focus on "core" activities.

It is also useful to compute the orders of magnitude implied by these regressions, and more precisely by our central specification reported in columns 3 and 6 of table 2, and in columns 1 and 5 of table 3. A one percent increase in the baseline southern penetration index is associated with a decrease of 0.05 percentage point in the sales share associated to the average firm's main activity, as measured at the 4-dig. level. Alternatively, increasing the southern penetration index by one (sample) standard deviation induces an increase of 5 percentage points ($[\ln(0.029 + 0.053) - \ln(0.029)] \times 0.049$) in the share of sales accounted for by the main activity[24]. This corresponds to 5% of the average concentration index (95%), and to one third of its sample standard deviation. The same change in the southern penetration index induces an increase of around 5% in the diversification indicator, which represents an additional 0.06 activity for the average firm (see table 1).

Last, we investigate in table 4 whether the previously reported correlations might be mainly driven by specific subsets of industries. In this table[25], we only report the most demanding specifications with firm level fixed effects. This way, we are able to assess structural differences in the equation of interest across various populations of firms rather than differences in unobserved firm level heterogeneity. In columns 1 and 2, we exclude the population of "low-tech" firms according to the OECD definition (Hatzichronoglou [1997]), thus running regressions on a sub-sample of relatively "high-tech" firms. The obtained coefficient associated to the southern penetration index is no longer significant in the case of portfolio concentration, while it remains positive and significant at the 5% level for the indicator of diversification. Among these firms, a one standard deviation increase in the southern penetration index is associated to a 1% increase in the number of activities, which corresponds at the (sub-)sample mean to an additional 0.013 activity. In the symmetric "low-tech" sample, where we excluded all high-tech firms, significativity is preserved in both specifications (concentration and diversification of production). The implied magnitude is somewhat larger, with a one standard deviation increase in the southern penetration index being associated to an additional 0.015 activity on average. Therefore, the competition/diversification story appears to be mainly driven by relatively low-tech industries. This insight is further confirmed by the third experiment, presented in columns 5 and 6 and focusing on the textile industries. It is well-known that these sectors have experienced a very large increase in the Chinese (thus, southern) competitive pressure over the last decade (Bloom *et al.* [2010][26]). In this subsample, we obtain very large effects: a one standard deviation increase in the southern penetration index is associated to a 5% increase in the number of activities, which corresponds at the (sub-)sample mean to an additional 0.067 activity for these firms.

4.2 International Competition and "Dynamic" Product Portfolio Strategies

In table 5, we further investigate the dynamics of product portfolios using a variety of indicators of "change", rather than "levels" as in tables 2 to 4[27]. In columns 1 to 4, we replicate the same specifications as previously, but using indicators of *change* in diversification: increase in columns 1 to 3, and

[24] An analogous linear prediction based on the difference between the average northern and southern penetration indices leads to a decrease of 11 percentage points ($(\ln(0.284) - \ln(0.029)) \times 0.049$) in the concentration index (see table 13). This "experiment" would correspond to the evolution of firms' productive profiles from the actual state of the world to a situation where the southern competitive pressure would catch up with the northern one.

[25] See table 3 columns 2 and 6 for a benchmark using the entire estimation sample.

[26] Unfortunately, the removal of quotas depicted in Bloom *et al.* [2010] and De Loecker [2010] only happened in 2004, at the very end of our sample period.

[27] The specifications which follow therefore build on the regressions reported in table 3, column 2 and table 4 which included firm level fixed effects .

Table 3: International Competition and Diversification, cont'd

Dependent variable:	Share of the main activity in sales (t) mean = 0.94				ln Diversification (t) [ln-] mean = [0.11] 1.16			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln Employment$_{t-1}$	-0.029***	-0.013**	-0.029***	-0.029***	0.015***	0.024**	0.015***	0.015***
	(0.002)	(0.006)	(0.002)	(0.002)	(0.001)	(0.011)	(0.001)	(0.001)
ln (Capital/VA)$_{t-1}$	-0.003	-0.006	-0.003	-0.003	0.002	0.011	0.002	0.001
	(0.002)	(0.004)	(0.002)	(0.002)	(0.001)	(0.007)	(0.001)	(0.001)
ln Herfindahl$_{t-1}$	0.026***	0.004	0.027***	0.025***	-0.027***	-0.007	-0.027***	-0.026***
	(0.004)	(0.003)	(0.004)	(0.004)	(0.003)	(0.006)	(0.003)	(0.003)
ln Diversification$_{t-1}$	-0.599***	-0.031***	-0.599***	-0.603***	0.553***	0.053***	0.553***	0.555***
	(0.008)	(0.012)	(0.008)	(0.008)	(0.009)	(0.020)	(0.009)	(0.009)
ln North exp. sh.$_{t-1}$	-0.001	0.000	-0.001	-0.001	0.000	0.000	0.000	0.000
	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
ln TFP$_{t-1}$	-0.004**	-0.002	-0.004**	-0.005**	0.002	0.003	0.003*	0.002*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.004)	(0.001)	(0.001)
ln North pen.$_{t-1}$	0.025***	0.004	0.025***	-	-0.032***	-0.009	-0.031***	-
	(0.008)	(0.005)	(0.008)		(0.007)	(0.008)	(0.007)	
ln South pen.$_{t-1}$	-0.049***	-0.004**	-0.049***	-	0.046***	0.009**	0.046***	-
	(0.005)	(0.002)	(0.005)		(0.005)	(0.004)	(0.005)	
ln North pen.$_{t-1}$ $\times$ ln TFP$_{t-1}$	-	-	-0.002	-	-	-	0.002*	-
			(0.002)				(0.001)	
ln South pen.$_{t-1}$ $\times$ ln TFP$_{t-1}$	-	-	0.002*	-	-	-	-0.001	-
			(0.001)				(0.001)	
North pen.$_{t-1}$, 2nd quartile	-	-	-	-0.015	-	-	-	0.041**
				(0.020)				(0.018)
North pen.$_{t-1}$, 3rd quartile	-	-	-	0.011	-	-	-	0.036*
				(0.023)				(0.020)
North pen.$_{t-1}$, 4th quartile	-	-	-	0.018	-	-	-	0.023
				(0.026)				(0.021)
South pen.$_{t-1}$, 2nd quartile	-	-	-	-0.124***	-	-	-	0.092***
				(0.013)				(0.009)
South pen.$_{t-1}$, 3rd quartile	-	-	-	-0.154***	-	-	-	0.128***
				(0.016)				(0.013)
South pen.$_{t-1}$, 4th quartile	-	-	-	-0.153***	-	-	-	0.121***
				(0.021)				(0.018)
Observations	15592	15592	15592	15592	15592	15592	15592	15592
Estimation method	tobit	OLS FE	tobit	tobit	OLS	OLS FE	OLS	OLS

Note: Robust standard errors in parentheses with *** , ** and * respectively denoting significance at the 1%, 5% and 10% levels. The estimation period is 2000 to 2004. All equations include year and industry 3 dig. fixed effects. Columns 2 and 6 correspond to specifications with (5,854) firm level fixed effects.

Table 4: International Competition and Diversification, Industry Analysis

Sub-sample:	"High-tech"		"Low-tech"		Textile ind.	
Dependent variable:	Sh.	ln Div.	Sh.	ln Div.	Sh.	ln Div.
[ln] mean:	0.94	0.11	0.94	0.11	0.93	0.12
	(1)	(2)	(3)	(4)	(5)	(6)
ln Employment$_{t-1}$	-0.015*	0.029**	-0.008	0.017*	-0.004	-0.004
	(0.008)	(0.014)	(0.005)	(0.010)	(0.015)	(0.025)
ln (Capital/VA)$_{t-1}$	-0.007	0.013	-0.005	0.007	-0.006	0.009
	(0.005)	(0.010)	(0.004)	(0.006)	(0.007)	(0.012)
ln Herfindahl$_{t-1}$	0.008*	-0.014**	0.004	-0.008	0.009	-0.010
	(0.004)	(0.007)	(0.004)	(0.006)	(0.010)	(0.017)
ln Diversification$_{t-1}$	-0.041***	0.069***	-0.033***	0.059***	-0.024	0.049
	(0.013)	(0.023)	(0.012)	(0.021)	(0.039)	(0.065)
ln North exp. sh$_{t-1}$	0.000	0.000	0.000	0.000	0.001	-0.001
	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)
ln TFP$_{t-1}$	0.000	-0.001	-0.001	0.002	-0.011	0.022*
	(0.002)	(0.005)	(0.002)	(0.004)	(0.007)	(0.012)
ln North pen.$_{t-1}$	0.001	-0.004	0.006	-0.012	0.074**	-0.124**
	(0.006)	(0.010)	(0.005)	(0.009)	(0.037)	(0.057)
ln South pen.$_{t-1}$	-0.004	0.008**	-0.005**	0.010***	-0.039**	0.066**
	(0.002)	(0.004)	(0.002)	(0.004)	(0.019)	(0.031)
Observations	10699	10700	13611	13612	1935	1935

Note: Robust standard errors in parentheses with *** , ** and * respectively denoting significance at the 1%, 5% and 10% levels. In this table, all equations include year and *firm* fixed effects. In the "High-tech" sub-sample, we excluded firms belonging to the low-tech industries (as defined in Hatzichronoglou [1997]). In the "Low-tech" sub-sample, we excluded firms belonging to the high-tech industries. In the "Textile" sub-sample, we only considered firms (mainly) active in the textile, clothing, leather, fur and shoe industries.

decrease in column 4. This specification confirms the results presented in table 2: exposure to southern competitive pressure is positively associated to the probability of increasing portfolio diversification (col. 1). This effect is constant in magnitude across quantiles of the southern penetration index (col. 3) and is *not* more pronounced for more productive firms (col. 2). In contrast, the northern penetration index turns out to be negatively correlated (if anything) with increases in diversification.

Column 4 also shows that although the positive relation between southern competition and diversification is the dominant effect, southern competition is in fact associated with higher product churning in general. In this case however, the effect is entirely driven by the last quantiles of the penetration index, i.e. by the sub-population of firms experiencing highest exposure to southern competition. This finding is consistent with the fact that increases in diversification are likely to be "active" responses on the part of French firms ("à la" Thoenig and Verdier [2003]), whereas in contrast, decreases in the length of the product portfolios might rather be "passive" consequences of increased southern competition, with French firms being outperformed and quickly crowded out of markets when the competition arising from southern low cost firms becomes too intense.

Columns 5 and 6 allow further investigation of this hypothesis. Indeed, the previous indicators described the "net" entries and exits of products in or out of a firm's product portfolio - as well as the evolution of the overall shape (kurtosis) of its productive profile. In columns 5 and 6 on the contrary, we analyze "gross" portfolio entries and exits using dummy variables indicating the introduction or removal of a 4-dig. product. We obtain highly non-linear patterns: the probability of introducing a new product is significantly higher when northern competition is really high, or southern competition

Table 5: International Competition and Product Portfolio Strategies

Dependent variable:	Increase in Diversification ($t/t-2$)			Decrease in Div.	Product Adding	Product Dropping	Inertia
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ln Employment$_{t-2}$	0.025***	0.025***	0.026***	0.022***	0.007*	0.014***	- 0.012**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.006)
ln (Capital/VA)$_{t-2}$	0.002	0.002	0.002	-0.002	-0.002	0.001	-0.002
	(0.005)	(0.005)	(0.005)	(0.006)	(0.004)	(0.004)	(0.007)
ln Herfindahl$_{t-2}$	-0.008	-0.008	-0.007	-0.012	0.008	-0.005	-0.018
	(0.009)	(0.009)	(0.009)	(0.010)	(0.006)	(0.006)	(0.012)
ln Diversification$_{t-2}$	0.238***	0.238***	0.243***	0.489***	0.052***	0.168***	-0.481***
	(0.024)	(0.024)	(0.024)	(0.025)	(0.017)	(0.020)	(0.023)
ln North exp. sh$_{t-2}$	0.000	0.000	0.000	0.002	0.001	0.000	-0.004**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
ln TFP$_{t-2}$	0.000	0.000	0.000	0.005	0.006***	0.009***	-0.008
	(0.004)	(0.005)	(0.004)	(0.004)	(0.002)	(0.002)	(0.007)
ln North pen.$_{t-2}$	-0.068**	-0.068**	-	-	-	-	-
	(0.030)	(0.030)					
ln South pen.$_{t-2}$	0.069***	0.069***	-	-	-	-	-
	(0.022)	(0.022)					
ln North pen.$_{t-2}$ $\times$ ln TFP$_{t-2}$	-	0.001	-	-	-	-	-
		(0.004)					
ln South pen.$_{t-2}$ $\times$ ln TFP$_{t-2}$	-	-0.001	-	-	-	-	-
		(0.003)					
North pen.$_{t-2}$, 2nd quartile	-	-	0.083	0.063	0.022	-0.010	-0.198**
			(0.087)	(0.077)	(0.022)	(0.025)	(0.080)
North pen.$_{t-2}$, 3rd quartile	-	-	0.025	0.094	0.029	0.002	-0.239**
			(0.095)	(0.082)	(0.023)	(0.026)	(0.096)
North pen.$_{t-2}$, 4th quartile	-	-	0.059	0.008	0.054**	0.027	-0.133
			(0.104)	(0.092)	(0.028)	(0.030)	(0.109)
South pen.$_{t-2}$, 2nd quartile	-	-	0.114***	0.082*	0.036***	0.042***	-0.144***
			(0.038)	(0.041)	(0.014)	(0.016)	(0.036)
South pen.$_{t-2}$, 3rd quartile	-	-	0.105**	0.145**	-0.027	0.012	-0.082
			(0.053)	(0.057)	(0.018)	(0.021)	(0.051)
South pen.$_{t-2}$, 4th quartile	-	-	0.084	0.249***	-0.049**	-0.006	-0.122*
			(0.070)	(0.076)	(0.024)	(0.027)	(0.071)
Observations	4443	4443	4443	4443	4443	4443	4443

Note: Robust standard errors in parentheses with *** , ** and * respectively denoting significance at the 1%, 5% and 10% levels. The estimation period is 2000/2002 and 2002/2004. All equations include year and industry 3 dig. fixed effects.

mild enough, while it is significantly lower when southern competition is intense. Similarly, we obtain in column 6 that firms facing a mild southern competitive pressure only also remove more often segments from their productive profile, which together with the regression shown in column 5 indicates that these firms tend to translate their productive activities towards products they were not previously producing. Appendix D.1 describes the results obtained in the case of export portfolios, with a more detailed product classification (at the 6 digit level). These more accurate indicators enable to estimate a more precise (and more significant) positive relation between product adding and southern competition, which seems to be mainly driven by high-tech industries (see below).

Last, column 7 provides a more synthetic view about the relation between international competition and portfolio strategies using the indicator of "inertia". We obtain that both southern and northern competitive pressure are associated with more frequent portfolio reallocations of all sorts, the relation with the northern index being in fact stronger. Of more interest is however again the non-linear pattern: we obtain higher magnitudes and significance either for relatively "mild" levels of both northern and southern competition, or for high values of the southern penetration index. These features reinforce again the interpretation presented above.

It is not straightforward to assess the relative importance of reallocations on the extensive (firms' entries and exits) and intensive (portfolio strategies) margins which are induced by globalization and in particular higher southern competitive pressure. One major hurdle is that the information required for the latter is usually available in survey based samples which most often over-weight mature firms and do not allow to precisely assess the magnitude of entry and exit flows. However, a back of the enveloppe calculation provide insightful orders of magnitude. Bernard, Jensen and Schott [2006] report that a one standard deviation increase in the Southern penetration index is associated with a 2.2 percentage point increase in the probability of (firm) death within a 5 year period. Unfortunately, they were not able to include controls for multi-product firms in their regression analysis, but we know that in our sample, firms typically produce around 1.2 four-digit products (see table 1). We can therefore re-interpret their result in the following way: a one standard deviation increase in the Southern penetration index is associated with a 2.2 percentage point increase in the probability of removing at least $1.2 \approx 2$ products (exit of a firm) within 5 years.

On the other side, if we follow Klette and Kortum [2004] and assume that the evolution of a firm product portfolio follows a poisson process, it is possible to translate our own results and to compare them to the Bernard, Jensen and Schott [2006] benchmark. We eventually obtain that a one standard deviation increase in the Southern penetration translates into a 4.5 percentage point increase in the probability to remove at least one product from a firm's product portfolio within two years, or in a 3.0 percentage point increase in the probability to remove at least 2 products within 5 years[28]. The benefit of this back of the

[28]Results from the corresponding specification are available upon request. This result is obtained the following way. We first translate our baseline result as the impact of increased southern competitive pressure on the probability to remove at least one

envelope computation is to show that the reallocations of production *between*[29] and *within* firms driven by the southern competitive pressure seem to be equally relevant in terms of their economic significance and potential contribution to aggregate reallocations of production.

Last, we replicate our sub-sample analysis using the "dynamic" indicators of portfolio strategies. Table 6, columns 1 and 5 show that the positive relation between southern competition and the probability to become more diversified holds true in both the high-tech and the low-tech sub-samples, but it is stronger in the high-tech case. Columns 9 shows that in the specific "low-tech" case of the textile industries, the positive correlation is entirely driven by the sub-population of firms facing the most intense southern competition. This suggests that the positive correlation between southern competition and the introduction of new products is mostly driven by low-tech industries, and in particular by textile industries. We also obtain confirmation that firms active in relatively "high-tech" industries (only) tend to remove product segments when they are expose to a high northern, "high-tech" competitive pressure[30]. Most of the previous findings are preserved when using alternative indicators of product churning measured in terms of the share of sales represented by the added or removed segments (results are delayed in appendix D.2, table 16). Specifically, we obtain that product churning is highest for firms facing relatively mild southern or intense northern competition. The fact that southern competition is correlated with both product adding and product dropping suggests that the increase in diversification experienced by firms exposed to this type of competition might be only transitory. However, significance drops in the case of the textile industries because of the low variability of the dependent variable: in this sector, product reallocations are quite frequent (5% of firms), but correspond to very low shares of sales (less than 2% only on average).

4.3 More Evidence about Induced Product Innovation?

An important limit of the previous analysis is that it heavily relies on the existing activity classification. However, new products, when introduced by a firm, seldom appear instantaneously as a new item in the classification system defined by the National Institute of Statistics. We therefore propose an extension of our analysis based on alternative indicators, aiming at investigating whether the previously described within - firm productive reallocations were in fact associated to product innovations and in-

product within 2 years. In a poisson setting, this probability can be written as:

$$\mathbb{P}_{(2)}\left(X \geq 1\right) = p = 1 - \exp(-\lambda_{(2)})$$

Therefore: $\lambda_{(2)} = -\ln(1-p)$ and $\mathrm{d}\lambda_{(2)} = -\ln\left(\frac{1-p}{1-p-\mathrm{d}p}\right)$ where $\mathrm{d}p \approx 0.045$ is the estimated impact of a one standard deviation increase in the southern penetration index. Using a 5 year period, we get: $\lambda_{(5)} = \frac{5}{2}\lambda_{(2)}$ and $\mathrm{d}\lambda_{(5)} = \frac{5}{2}\mathrm{d}\lambda_{(2)}$. Last, we obtain that:

$$\mathrm{d}\mathbb{P}_{(5)}\left(X \geq 2\right) = \exp(-\mathrm{d}\lambda_{(5)}).\left(\sum_{k\geq 2}\frac{(\mathrm{d}\lambda_{(5)} + \lambda_{(5)})^k - \lambda_{(5)}^k}{k!}\right) \approx 0.030$$

[29] Bernard, Jensen and Schott [2006].

[30] However, no clear pattern emerges for these firms in terms of the evolution of their overall index of diversification. This suggests that the shortening of the length of the product portfolio is associated with a flattening of the sales' profile across the remaining activities.

Table 6: International Competition and Product Portfolio Strategies, Industry Analysis

Sub-sample:	"High-tech"				"Low-tech"				Textile ind.			
Dependent variable:	IDiv.	DDiv.	New	Drop	IDiv.	DDiv.	New	Drop	IDiv.	DDiv.	New	Drop
Mean (dummies):	0.15	0.20	0.09	0.12	0.14	0.20	0.07	0.10	0.16	0.18	0.05	0.04
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ln Employment$_{t-2}$	0.024***	0.020***	0.008*	0.014***	0.026***	0.019***	0.008**	0.015***	0.021	0.023	0.001	-0.004
	(0.006)	(0.006)	(0.004)	(0.005)	(0.006)	(0.006)	(0.004)	(0.004)	(0.020)	(0.017)	(0.012)	(0.008)
ln (Capital/VA)$_{t-2}$	0.008	-0.004	-0.002	0.001	-0.001	-0.001	-0.007	-0.001	-0.023	0.020	0.000	0.004
	(0.006)	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.015)	(0.013)	(0.009)	(0.009)
ln Herfindahl$_{t-2}$	-0.003	0.002	0.006	-0.005	-0.004	-0.012	0.007	-0.005	-0.048*	- 0.057**	-0.011	0.001
	(0.012)	(0.012)	(0.008)	(0.009)	(0.010)	(0.010)	(0.006)	(0.007)	(0.027)	(0.026)	(0.018)	(0.016)
ln Diversification$_{t-2}$	0.210***	0.436***	0.059***	0.186***	0.243***	0.513***	0.065***	0.157***	0.218***	0.612***	-0.006	0.047
	(0.028)	(0.029)	(0.020)	(0.024)	(0.026)	(0.027)	(0.018)	(0.021)	(0.077)	(0.075)	(0.043)	(0.040)
ln North exp. sh$_{t-2}$	0.001	0.003*	0.001	0.000	-0.001	0.001	0.001	0.000	-0.004	-0.001	0.004**	0.004***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.004)	(0.003)	(0.002)	(0.001)
ln TFP$_{t-2}$	-0.001	0.004	0.008***	0.012***	-0.001	0.005	0.004**	0.008***	0.010	0.009	-0.001	0.004
	(0.005)	(0.006)	(0.003)	(0.002)	(0.004)	(0.004)	(0.002)	(0.002)	(0.011)	(0.013)	(0.003)	(0.003)
North pen.$_{t-2}$, 2nd quartile	0.022	-0.004	-0.006	0.004	0.024	0.072	0.018	-0.002	0.039	0.023	0.031	-0.036
	(0.065)	(0.055)	(0.020)	(0.021)	(0.077)	(0.081)	(0.022)	(0.026)	(0.063)	(0.113)	(0.045)	(0.056)
North pen.$_{t-2}$, 3rd quartile	0.000	0.043	0.016	0.052**	-0.048	0.198**	0.018	-0.008	0.071	0.220	-0.010	-0.025
	(0.076)	(0.066)	(0.021)	(0.023)	(0.102)	(0.098)	(0.026)	(0.029)	(0.117)	(0.148)	(0.031)	(0.039)
North pen.$_{t-2}$, 4th quartile	-0.061	-0.158**	0.025	0.056**	0.004	0.128	0.039	0.009	0.224	0.083	0.066*	-0.036
	(0.085)	(0.077)	(0.025)	(0.027)	(0.109)	(0.104)	(0.031)	(0.034)	(0.149)	(0.187)	(0.034)	(0.032)
South pen.$_{t-2}$, 2nd quartile	0.212***	0.060	0.044**	0.022	0.177***	0.029	0.087***	0.083***	0.146	0.170	0.105***	0.050
	(0.052)	(0.047)	(0.018)	(0.020)	(0.045)	(0.048)	(0.019)	(0.022)	(0.227)	(0.187)	(0.035)	(0.035)
South pen.$_{t-2}$, 3rd quartile	0.220***	0.109*	-0.012	-0.006	0.186***	0.117*	-0.011	0.027	0.087	0.252	0.120**	0.131**
	(0.064)	(0.061)	(0.019)	(0.020)	(0.064)	(0.067)	(0.020)	(0.023)	(0.238)	(0.202)	(0.052)	(0.055)
South pen.$_{t-2}$, 4th quartile	0.281***	0.234***	-0.061***	-0.036	0.201**	0.112	-0.007	0.020	0.803***	-0.296	0.071**	0.044
	(0.078)	(0.075)	(0.023)	(0.026)	(0.082)	(0.084)	(0.026)	(0.030)	(0.249)	(0.216)	(0.030)	(0.031)
Observations	3217	3217	3217	3217	3811	3811	3811	3811	480	480	480	480

Note: Standard errors in parentheses with *** , ** and * respectively denoting significance at the 1%, 5% and 10% levels. In the "High-tech" sub-sample, we excluded firms belonging to the low-tech industries (as defined in Hatzichronoglou [1997]). In the "Low-tech" sub-sample, we excluded firms belonging to the high-tech industries. In the "Textile" sub-sample, we only considered firms (mainly) active in the textile, clothing, leather, fur and shoe industries. "IDiv." stands for "Increase in Diversification" while "DDiv." stands for "Decrease in Diversification" (both are dummy variables).

novative activities at the firm level - or not. These further analyses will enable us to interpret the skill bias of defensive innovation usually obtained in the literature (Thoenig and Verdier [2003]): is the role of skilled work (human capital) confined to production activities, or is it rather related to R&D activities[31]? Bloom *et al.* [2010] provide evidence that the Chinese competitive pressure fostered IT investment, and previous literature has shown that this type of investment generates skill bias on the level of the production process (e.g. Bresnahan *et al.* [2002]). Bustos [2007] also provides evidence of a positive correlation between globalization and "spending in technology" or "improvements in products and production processes" at the (Argentinean) firm level. However, not much is known about the impact of globalization on product (as opposed to process) innovations. We contribute to the literature by investigating the relationships between international competitive pressure and alternative measures of innovative efforts, such as patents (see also Bloom *et al.* [2010]) or R&D expenditures at the firm level. It is well-known that these two types of indicators of innovation are biased towards product innovation (e.g. Cohen *et. al.* [2000]).

Table 7 provides the results obtained when estimating the correlation between international trade pressure and firm level R&D effort, both on the extensive (R&D participation, col. (1) to (4)) and intensive (R&D intensity, col. (5) to (6)) margins.
We obtain that the probability to be involved in R&D activities increases with southern competition in our main specification (col. 1). The coefficient is only weakly significant, but remains correctly signed, in the saturated fixed effect specification (col. 2). Furthermore, we obtain in col. 3 that more productive firms facing intense southern competition are more often involved in R&D activities than their less productive competitors. The underlying magnitudes are again large: in column 1, a one standard deviation increase in the southern penetration index is therefore associated to an increase of 2.3 percentage point in the probability of being involved in R&D activities. For firms having a one-standard deviation higher productivity than the industry average (col. 3), we obtain a 2.9 percentage point increase.
Concerning the northern penetration index, we are not able to show any significant effect in the most simple specification (col. 1 and 2). However, we obtain a highly significant positive interaction between our indicator of productivity and the northern penetration index, with an associated marginal effect at the sample mean which is twice as large as in the southern case. The underlying economic magnitude is however not as large, with increases of one standard deviation in both penetration index and TFP associated with a 0.5 percentage point higher probability of R&D activities. Futhermore, the lack of significance of the linear specification in columns 1 and 2 might hide a non-linear pattern which emerges in column 4, with intermediate levels of competitive pressure associated to more frequent R&D activities.

The same patterns emerge in columns 5 and 6 in the case of R&D intensity; however, the interaction term between the southern penetration index and productivity is no longer significant. Last, looking

[31] In the first case, skilled work would be interpreted as a variable input as in Thoenig and Verdier [2003], whereas in the second case, it would be considered as a sunk cost (IO literature).

at patent applications in columns 7 and 8, we obtain a positive coefficient for the southern penetration index, and for the interaction between northern penetration and productivity, but these marginal effects are barely significant, and very low in magnitude[32].

Last, all of the previous results are globally preserved within industries: table 8 shows no huge differences between high-tech and low-tech industries, except for patenting, where a higher southern competitive pressure induces more patent applications in low-tech industries. The associated "standard" magnitude in this sample remains however very low: 0.001 additional patent. Note also that it is impossible to detect any pattern in terms of innovative effort concerning French textile industries. In this case, involvement in R&D activities and patenting appear to be really rare events.

4.4 Further IV Evidence

Last, in table 9, we consider the potential endogeneity of penetration indices and report results obtained using instrumental variable strategies. The corresponding first stage regressions are reported in table 17 in appendix E[33].

In columns 1 and 2, we check the robustness of the positive correlation between diversification and southern competition in the baseline specification, which is linear in the penetration indices. Column 1 shows the reduced form estimation. As expected, we obtain that average remoteness of northern competitors is significantly positively correlated with diversification, whereas remoteness of southern suppliers, and therefore a lower southern competitive pressure, is negatively correlated with diversification. We also obtained that the increase in the northern average exchange rate, which corresponds to the case where the European currency can be converted into a higher amount of foreign currency, and therefore to a higher competitiveness of northern countries as compared to France, is negatively correlated with the indicator of diversification, which again is consistent with the hypothesis of firms choosing to refocus on their main core activities when they are exposed to a high northern competitive pressure. The coefficient obtained in the southern case is correctly signed, but barely significant. The results of the second stage estimation are reported in column 2 and show that the results presented in tables 2 and 3 are preserved, with the same magnitudes. This suggests that endogeneity might not be a huge concern in our empirical setting. The same diagnostic applies for columns 3 and 4 with the corresponding dummy variable denoting increases in diversification (rather than the log-level of diversification in columns 1 and 2), although we obtain larger magnitudes than in table 5.

[32] The associated orders of magnitude are the following: starting from the sample average, an additional standard deviation in the penetration index is associated to less than 0.002 more patent application(s). The interaction between northern penetration and productivity is associated to a 3.10E-4 increase...

[33] Table 17 also contains the first stage estimates obtained using changes in tariffs as IVs. We constructed the associated empirical indicators using the dataset constructed and made available by Mayer *et al* [2008], and containing bilateral information (in terms of countries) about tariffs and alternative non-tariff barriers at the industry level. However, these IVs turn out to be too weak in the case of the northern penetration index, and incorrectly signed, and therefore highly suspected of endogeneity in the case of the southern index. This might be explained by the fact that the French/European administration decides tariffs specifically in order to protect specific domestic activities that face a high southern competitive pressure. In this case, tariffs would therefore be regulatory response to this competitive pressure.

Table 7: International Competition and Innovative Effort

Dependent variable:	R&D dummy				ln R&D exp.		Patents	
Mean:	0.38				2.73		0.51	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln Employment_{t-1}	0.119***	0.002	0.118***	0.119***	1.092***	1.073***	0.813***	0.498***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.020)	(0.019)	(0.062)	(0.037)
ln $(\text{Capital/VA})_{t-1}$	0.035***	0.003	0.036***	0.035***	0.229***	0.224***	0.398***	0.242***
	(0.003)	(0.002)	(0.003)	(0.003)	(0.017)	(0.017)	(0.060)	(0.036)
ln Herfindahl_{t-1}	0.023***	-0.001	0.017***	0.022***	0.145***	0.133***	-0.067	-0.046
	(0.005)	(0.004)	(0.005)	(0.005)	(0.023)	(0.023)	(0.054)	(0.034)
ln $\text{Diversification}_{t-1}$	0.013	0.000	0.016	0.014	-0.288***	-0.285***	0.006	0.002
	(0.011)	(0.006)	(0.011)	(0.011)	(0.050)	(0.049)	(0.010)	(0.064)
ln North exp. sh_{t-1}	0.018***	0.000	0.018***	0.018***	0.093***	0.087***	0.203***	0.124***
	(0.001)	(0.000)	(0.001)	(0.001)	(0.008)	(0.008)	(0.018)	(0.011)
ln TFP_{t-1}	0.018***	0.001	0.030***	0.017***	0.164***	0.186***	0.176***	0.107***
	(0.002)	(0.001)	(0.002)	(0.002)	(0.015)	(0.017)	(0.053)	(0.031)
ln North pen._{t-1}	-0.017*	-0.001	-0.006	-	-0.043	-0.019	-0.082	-0.004
	(0.010)	(0.003)	(0.010)		(0.046)	(0.047)	(0.111)	(0.074)
ln South pen._{t-1}	0.022***	0.003*	0.023***	-	0.087***	0.088***	0.154*	0.096*
	(0.007)	(0.002)	(0.007)		(0.033)	(0.033)	(0.079)	(0.050)
ln North pen._{t-1} × ln TFP_{t-1}	-	-	0.013***	-	-	0.033**	-	0.045*
			(0.002)			(0.015)		(0.027)
ln South pen._{t-1} × ln TFP_{t-1}	-	-	0.006***	-	-	-0.011	-	-0.016
			(0.001)			(0.013)		(0.023)
North pen._{t-1}, 2nd quartile	-	-	-	0.077***	-	-	-	-
				(0.019)				
North pen._{t-1}, 3rd quartile	-	-	-	0.081***	-	-	-	-
				(0.024)				
North pen._{t-1}, 4th quartile	-	-	-	0.058**	-	-	-	-
				(0.027)				
South pen._{t-1}, 2nd quartile	-	-	-	0.058***	-	-	-	-
				(0.012)				
South pen._{t-1}, 3rd quartile	-	-	-	0.033*	-	-	-	-
				(0.018)				
South pen._{t-1}, 4th quartile	-	-	-	0.058**	-	-	-	-
				(0.025)				
Observations	16172	16172	16172	16172	16172	16172	16123	16123
Estimation method	Probit (ME)	OLS FE	Probit (ME)	Probit (ME)	Tobit		Neg. bin. MLE (ME)	

Note: Robust standard errors in parentheses with *** , ** and * respectively denoting significance at the 1%, 5% and 10% levels. The estimation period is 2000 to 2004. All equations include year and industry 3 dig. fixed effects. In columns (1), (3) and (4), marginal effects computed from Probit MLE have been reported. In column (2), 6,189 firm fixed effects are controlled for. In columns (7) and (8), marginal effects multiplied by 100 are reported.

Table 8: International Competition and Innovative Effort, Industry Analysis

Sub-sample:	"High-tech"		"Low-tech"		Textile ind.	
Dependent variable:	R&D	Pat.	R&D	Pat.	R&D	Pat.
Mean:	0.49	0.70	0.33	0.45	0.10	0.05
	(1)	(2)	(3)	(4)	(5)	(6)
ln Employment$_{t-1}$	0.118***	6.455***	0.127***	0.387***	0.100***	-
	(0.003)	(0.531)	(0.003)	(0.034)	(0.008)	
ln (Capital/VA)$_{t-1}$	0.039***	2.880***	0.034***	0.188***	0.035***	-
	(0.004)	(0.529)	(0.003)	(0.034)	(0.005)	
ln Herfindahl$_{t-1}$	0.016***	-0.737	0.024***	0.010	-0.006	-
	(0.006)	(0.449)	(0.005)	(0.028)	(0.013)	
ln Diversification$_{t-1}$	0.019	-0.194	0.021*	0.019	-0.021	-
	(0.013)	(0.873)	(0.012)	(0.053)	(0.022)	
ln North exp. sh$_{t-1}$	0.025***	1.631***	0.015***	0.091***	0.003***	-
	(0.001)	(0.154)	(0.001)	(0.009)	(0.001)	
ln TFP$_{t-1}$	0.043***	1.468***	0.015***	0.083***	0.004	-
	(0.003)	(0.390)	(0.002)	(0.028)	(0.004)	
ln North pen.$_{t-1}$	0.001	-0.555	-0.025**	-0.040	0.032	-
	(0.013)	(1.062)	(0.011)	(0.058)	(0.089)	
ln South pen.$_{t-1}$	0.020***	1.019*	0.022***	0.082**	-0.034	-
	(0.007)	(0.684)	(0.007)	(0.041)	(0.063)	
Observations	11213	11167	14158	14124	1969	1969

Note: Robust standard errors in parentheses with *** , ** and * respectively denoting significance at the 1%, 5% and 10% levels. In the "High-tech" sub-sample, we excluded firms belonging to the low-tech industries (as defined in Hatzichronoglou [1997]). In the "Low-tech" sub-sample, we excluded firms belonging to the high-tech industries. In the "Textile" sub-sample, we only considered firms (mainly) active in the textile, clothing, leather, fur and shoe industries.

Concerning R&D effort, the IV experiment reported in columns 5 and 6 however does not allow to confirm the positive correlation obtained in table 7 between southern competition and R&D activity. As shown in column 5, this is due to the fact that the southern IVs turn out to be insignificant in the reduced form equation, which implies that our IVs do not allow to identify any correlation between southern indices and the R&D dummy. However, our two sets of instruments allow us to obtain a positive second-stage coefficient for the northern index which is in range (in terms of magnitude) with the results reported in table 7, column 4.

Table 9: Robustness check: Instrumental variables

Dependent variable	ln Diversification		Increase in Div.		R&D dummy	
[ln-] mean:	[0.11] 1.17		0.15		0.40	
	(1)	(2)	(3)	(4)	(5)	(6)
ln Employment	0.014***	0.015***	0.025***	0.024***	0.123***	0.124***
	(0.002)	(0.002)	(0.005)	(0.005)	(0.003)	(0.003)
ln (Capital/VA)	0.005***	0.002	0.005	0.004	0.032***	0.031***
	(0.001)	(0.002)	(0.005)	(0.005)	(0.003)	(0.003)
ln Herfindahl	-0.022***	-0.032***	-0.008	-0.010	0.024***	0.018***
	(0.002)	(0.004)	(0.008)	(0.011)	(0.004)	(0.005)
ln Diversification	0.564***	0.547***	0.258***	0.197***	0.023*	0.033**
	(0.009)	(0.010)	(0.023)	(0.031)	(0.012)	(0.013)
ln North exp. Sh	-0.000	-0.001**	-0.000	-0.000	0.019***	0.018***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
ln TFP	0.002**	0.002	-0.000	-0.001	0.024***	0.023***
	(0.001)	(0.002)	(0.004)	(0.005)	(0.002)	(0.002)
Av. Dist. North. Exp.	0.025***	-	0.025	-	-0.031**	-
	(0.0060		(0.022)		(0.012)	
Av. Dist. South. Exp.	-0.080***	-	-0.137***	-	-0.022	-
	(0.017)		(0.053)		(0.023)	
Weighted av. growth of exch. rate,	-0.373***	-	0.365	-	0.463**	-
North (base 2005)	(0.089)		(0.452)		(0.201)	
Weighted av. growth of exch. rate,	0.051*	-	0.002	-	-0.089	-
South (base 2005)	(0.027)		(0.143)		(0.063)	
ln North pen.	-	0.052	-	-0.380*	-	0.086**
		(0.062)		(0.220)		(0.035)
ln South pen.	-	0.062***	-	0.236***	-	-0.020
		(0.020)		(0.090)		(0.012)
Observations	14275	14275	4113	4113	12126	12126
Estimation method	OLS	2SLS	OLS	2SLS	OLS	2SLS

Note: Robust standard errors in parentheses with *** , ** and * respectively denoting significance at the 1%, 5% and 10% levels.

5 Conclusion

In this paper, we rely on a new firm level dataset containing detailed information about the structure of production of a large sample of French manufacturing firms to investigate whether the observed aggregate reallocations of production are (at least partly) driven by within - firm product portfolio strategies. We obtain that firms experiencing a high low-cost country competitive pressure are significantly more diversified in their productions, whereas firms exposed to northern competition rather choose to refocus their product portfolios. Further analysis shows that more productive firms combine more often these productive reallocations with genuine innovative activities, which may explain why they achieve higher survival rates. The correlation between diversification and southern competition is non-linear, thus suggesting that the underlying diversification strategy might be transitory.

Our analysis may help to explain what are the micro-level phenomena underlying aggregate production reallocations and specialization; it shows that the reallocations of production *between*and *within* firms driven by the southern competitive pressure seem to be equally relevant in terms of their economic significance and potential contribution to aggregate reallocations of production. Moreover, it contributes to the understanding of the underlying phenomena behind the associated skill bias of northern production specialization: indeed, this skill bias may be more associated to sunk costs of production switching, rather than to variable cost of skill-biased production processes. At this stage however, several questions remain open, e.g. further analysis and information is required to assess the relative contributions of firms' intensive (output per product) and extensive (number of products) margins in determining firm growth, either in terms of employment or in terms of TFP, and the aggregate firm size distribution.

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Appendix

A Northern and Southern Countries

The main results of the paper are robust to alternative choices of threshold for the definition of the set of "Southern" countries (results available upon request). 28 more countries get classified as "Southern" when choosing a threshold of 10% of GDP per capita instead of 5%, and 21 more when choosing 15% instead of 10%.

Table 10: Northern and Southern Countries (2004)

Northern countries	Southern countries	Northern countries	Southern countries
Albania	Angola	Kazakstan	Nicaragua
Algeria	Armenia	Korea	Niger
Antigua and Barbuda	Azerbaijan	Latvia	Nigeria
Argentina	Bangladesh	Lebanon	Pakistan
Australia	Benin	Lithuania	Papua New Guinea
Austria	Bhutan	Luxembourg	Paraguay
Bahamas	Bolivia	Macedonia (the former Yugoslav Rep. of)	Philippines
Barbados	Burkina Faso	Malaysia	Rwanda
Belarus	Burundi	Maldives	Sao Tome and Principe
Belgium and Luxembourg	Cambodia	Marshall Islands	Senegal
Bosnia and Herzegovina	Cameroon	Mauritius	Sierra Leone
Botswana	Central African Republic	Mexico	Solomon Islands
Brazil	Chad	Morocco	Sri Lanka
Bulgaria	China	Namibia	Sudan
Canada	Comoros	Netherlands	Syrian Arab Republic
Cape Verde	Congo	New Zealand	Tajikistan
Chile	Côte d'Ivoire	Norway	Tanzania
Colombia	Djibouti	Panama	Togo
Costa Rica	Egypt	Peru	Turkmenistan
Croatia	Eritrea	Poland	Uganda
Cyprus	Ethiopia	Portugal	Ukraine
Czech Republic	Gambia	Romania	Uzbekistan
Denmark	Georgia	Russian Federation	Vanuatu
Dominica	Ghana	Saint Kitts and Nevis	Viet Nam
Dominican Republic	Guinea	Saint Lucia	Yemen
Ecuador	Guinea-Bissau	Saint Vincent and the Grenadines	Zambia
El Salvador	Guyana	Samoa	
Equatorial Guinea	Haiti	Seychelles	
Estonia	Honduras	Singapore	
Fiji	India	Slovakia	
Finland	Indonesia	Slovenia	
Gabon	Kenya	South Africa	
Germany	Kiribati	Spain	
Greece	Kyrgyzstan	Swaziland	
Grenada	Lao People's Democratic Republic	Sweden	
Guatemala	Lesotho	Switzerland	
Hong Kong	Liberia	Thailand	
Hungary	Madagascar	Tonga	
Iceland	Malawi	Trinidad and Tobago	
Iran	Mali	Tunisia	
Ireland	Mauritania	Turkey	
Italy	Moldova	United Kingdom	
Jamaica	Mongolia	United States of America	
Japan	Mozambique	Uruguay	
Jordan	Nepal	Venezuela	

B Estimation of Firm Level Productivity

B.1 Empirical Setting: Extension Levinsohn-Petrin [2003] Framework (Melitz [2001])

In this section, we describe in detail the estimation procedure for firm level TFP. We follow Klette and Griliches [1996] and more recently Melitz [2001] or De Loecker [2010] and explicitly consider a demand function system allowing to control for the biases arising from potential demand shocks[34]. It is important to try and purge our estimates of TFP from these unobserved demand shocks, as they might be alternative determinants of portfolio strategies generating upward biases in our main equations of interest (2.4, 2.5 and 2.6).

As in Melitz [2001], we assume that consumers have Dixit-Stiglitz preferences:

$$u\left[\left(\sum_i \left(\Lambda_{it}Q_{it}\right)^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma-1}{\sigma}}, Z_t\right],$$

with $\sigma > 1$ and where Λ_{it} denotes product quality and Q_{it} product quantity. Product quality is unobserved by the econometrician. This specification results in the following inverse demand functions:

$$Q_{it} = \Lambda_{it}^{\sigma-1}.\left(\frac{P_{it}}{P_t}\right)^{-\sigma}.Q_t.e^{\xi_{it}} \tag{B.1}$$

where P is the Dixit-Stiglitz aggregate price index and Q is the corresponding aggregate consumption index. The term $e^{\xi_{it}}$ represents potential iid demand shocks that are unobserved by the econometrician. Taking logs, we get:

$$q_{it} = q_t - \sigma.\left(p_{it} - p_t\right) + (\sigma-1).\lambda_{it} + \xi_{it} \tag{B.2}$$

However, the available empirical proxy of output is an indicator of firm-level revenue (value added) deflated using 3 digit industry level deflators of value added:

$$\begin{aligned} r_{it} &= q_{it} + (p_{it} - p_t) \\ &= \frac{\sigma-1}{\sigma}.q_{it} + \frac{1}{\sigma}.q_t + \frac{\sigma-1}{\sigma}.\lambda_{it} + \frac{1}{\sigma}.\xi_{it} \end{aligned} \tag{B.3}$$

We further make the standard assumption that output is produced using a standard Cobb-Douglas technology[35]:

$$q_{it} = \alpha_0 + \alpha_l.l_{it} + \alpha_k.k_{it} + \omega_{it} + u_{it} \tag{B.4}$$

In equation B.4, l_{it} and k_{it} denote labour and capital (in logarithm), respectively. ω_{it} is the unobserved firm "technological" efficiency. The timing structure is as in Olley and Pakes [1996], i.e.:

[34] Firm level output y_{it} might be measured with errors because 3 digit industry-level deflators only partially capture firm-level price movements. This implies that the resulting productivity estimates mistakenly capture price and demand shocks.

[35] See section B.4 below for a discussion of this specification.

- Capital is a fixed, dynamic input: in particular, the capital that the firm uses in period t was decided upon at period $t-1$ and is thus orthogonal to ω_{it}.
- Labour is a variable, static input: in particular, it is chosen at period t and can be affected by ω_{it}.

Plugging this production function into the revenue function above, we get:

$$r_{it} = \frac{\sigma-1}{\sigma}.\left(\alpha_0 + \alpha_l.l_{it} + \alpha_k.k_{it}\right) + \frac{1}{\sigma}.q_t + \frac{\sigma-1}{\sigma}.\underbrace{(\lambda_{it} + \omega_{it})}_{\tilde{\omega}_{it}} + \underbrace{\frac{1}{\sigma}.(\xi_{it} - u_{it}) + u_{it}}_{\eta_{it}} \tag{B.5}$$

As pointed out by Melitz [2001], this equation shows that in this stylized setting[36], firm revenue only depends on a single and fixed index (sum) of the firm's unobserved quality and productivity: our estimated proxy for firm efficiency will therefore incorporate these two components. On the demand side, equation B.5 shows that it is possible to control for demand shocks affecting firm revenue in simply introducing a new "input" into the augmented "production function". This demand shifter, which is to be considered as an additional "variable, static" input in the typology proposed by Ackerberg *et. al.* [2007], is akin of capturing shocks in demand which are potentially polluting the estimation of the unobserved productivity / quality index.

The extension of the concept of TFP to the case of multi-product firms is not straightforward. We adopt the approach suggested by Melitz [2001] and estimate the (quality adjusted) productivity index converting X_i/DIV_i inputs into R_i/DIV_i sales, where $X_i = (K_i, L_i)$ denotes production inputs and DIV_i denotes the number of different products produced by firm i (at the 4 digit level in our setting). Equation B.5 generalizes to:

$$\begin{aligned} r_{it} = \frac{\sigma-1}{\sigma}.\left(\alpha_0 + \alpha_l.l_{it} + \alpha_k.k_{it}\right) + \frac{1}{\sigma}.q_t \quad &+ \quad \frac{\sigma-1}{\sigma}.\tilde{\omega}_{it} \\ &+ \quad \frac{\sigma-1}{\sigma}.\left(\frac{1}{\sigma-1} - (\gamma-1)\right).div_{it} + \eta_{it} \end{aligned} \tag{B.6}$$

Where $\gamma = \alpha_l + \alpha_k$ is the parameter of scale. We expect that $\frac{1}{\sigma-1} - (\gamma-1) > 0$ - otherwise a firm could produce the same output using fewer inputs by only producing one single variety. As shown in Melitz [2001], this approach amounts to define an hypothetical baseline (single index) Cobb-Douglas production function over the CES output quantity index[37], and to correct it for the fact that depending on the returns to scale, spreading output over several varieties might impact (e.g. negatively if increasing returns to scale) the total output units a firm can produce with a given bundle of inputs:

$$q^0_{it} = \alpha_0 + \alpha_l.l_{it} + \alpha_k.k_{it} + \tilde{\omega}_{it} + \left[\frac{1}{\sigma-1} - (\gamma-1)\right].div_{it} + u_{it}$$

[36] The Dixit-Stiglitz and Cobb-Douglas assumptions lead jointly to this limit (worst) case.

[37] The quantity index corresponds to the first argument in the utility function of the consumer and takes the following form:

$$\left(\sum_i (\Lambda_i Q_i)^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma-1}{\sigma}}$$

Two firms with the same quality adjusted productivity index $\tilde{\omega}_{it}$ would have different measured productivity levels $\tilde{\omega}_{it} + \left[\frac{1}{\sigma-1} - (\gamma - 1)\right].div_{it}$ if they produce a different number of varieties. However, it is the first parameter ($\tilde{\omega}_{it}$) that is of interest in our setting[38].

Formally again, explicitly considering multi-product firms in this setting amounts to introduce a new control variable, namely the indicator of diversification div_{it}, in equation B.5, which mainly enables to correct the estimates of scale elasticities in the case of multiproduct firms. In our setting, this new "input" in the revenue function is considered as fixed since pre-determined (decided upon before observing $\tilde{\omega}_{it}$) and dynamic if the cost associated to market entry γ^g is sunk as suggested in section 2.1[39].

B.2 TFP Estimation and Identification

We adopt an estimation procedure which is similar to Levinsohn and Petrin [2003], in order to circumvent the problem of potentially zero or low investment levels, which is prevalent especially in low-tech industries. More specifically, we consider the following demand function for material (m) demand:

$$m_{it} = m(k_{it}, div_{it}, \tilde{\omega}_{it}) \tag{B.7}$$

This function is monotonic in $\tilde{\omega}_{it}$ under the same sufficient conditions as in Levinsohn and Petrin [2003][40]. In this case, it is possible to adopt a similar two-step estimation strategy:

- Given the monotonicity of the function m_t, it is possible to invert it into:

  $$\tilde{\omega}_{it} = h(k_{it}, div_{it}, m_{it})$$

  and to plug this into equation B.6:

  $$r_{it} = \beta_0 + \beta_l.l_{it} + \beta_\eta.q_{It} + \underbrace{\beta_k.k_{it} + \beta_{div}.div_{it} + h(k_{it}, div_{it}, m_{it})}_{\varphi(k_{it}, div_{it}, m_{it})} + \eta_{it}$$

  This first stage equation is estimated non-parametrically using a third-order polynomial approximation in k_{it}, div_{it} and m_{it}, and provides estimates of β_l, β_η and $\varphi(\cdot)$.

- Then, using the standard markovian assumption $\tilde{\omega}_{it} = g(\tilde{\omega}_{it}) + \nu_{it}$, we get:

[38] Note that we obtain the same empirical equation as in De Loecker [2010], with a different, less ambitious interpretation. De Loecker [2010] takes the alternative approach of assuming that the productive process of multi-product firms can be split into separate production functions, which is not necessarily entirely relevant (complementarities, joint or fatal production). However, due to the fact that the precise allocation of inputs across products is not observed, De Loecker [2010] has to assume that production functions are identical across segments, and that there is no segment specific unobserved productive shock. A limitation of both approaches is that absent a (very) precise description of the productive process of each firm, it is not possible to estimate different productivity indices for core activities and more peripheral ones.

[39] If γ^g is a fixed cost (incurred at each period) rather than a sunk cost, then div_{it} becomes a fixed and static variable which could be identified in the first stage of the described estimation procedure, but which is in any case identified in the second stage in our setting.

[40] With our additional assumption that changes in diversification (product scope) does not respond to the contemporaneous productivity, or that it only affects the level of diversification in the period that follows ($t + 1$).

$$
\begin{aligned}
r_{it} - \widehat{\beta_l}.l_{it} - \widehat{\beta_\eta}.q_{It} = \beta_k.k_{it} &+ \beta_{div}.div_{it} + \beta_0 + g(\widehat{\varphi_{it-1}} - \beta_k.k_{it-1} - \beta_{div}.div_{it-1}) \\
&+ \nu_{it} + \zeta_{it}
\end{aligned}
$$

In this equation, both k_{it} and div_{it} are orthogonal to the residual since they are decided at $t-1$. Estimates of the various parameters are retrieved using non-linear least squares minimization.

- Last, firm level TFP is computed as: $\widehat{\tilde{\omega}}_{it} = \frac{\widehat{\eta}}{\widehat{\eta}+1}.\left(r_{it} - \widehat{\beta_l}.l_{it} - \widehat{\beta_\eta}.q_{It} - \widehat{\beta}_k.k_{it} - \widehat{\beta}_{div}.div_{it}\right)$

We classify each firm of the sample into its main industry (defined in terms of sales) and estimate TFP at the most feasible disaggregate level, i.e. at the 4 digit level if our sample contains at least 100 firms classified in the corresponding industries, else at the 3, 2 or 1 digit level. A sample of the estimation results obtained at the 2 digit level are reported in appendix B.3, and the estimates of firm level TFP resulting from this estimation procedure are described in table 1 below.

B.3 Estimation of Production Functions at the (Industry) 2-digit Level

Table 11: Baseline estimates of production functions at the industry 2-dig. level (1999-2004)

	Reduced form estimates					Structural parameters				w/o Control for Div.	
Industries (2 dig.)	β_k	β_l	β_{div}	β_η	**Mark-up**	α_k	α_l	γ	"Melitz" cond.	α_k	γ
Full sample	0.277***	0.622***	-0.008	0.026***	1.026***	0.284***	0.639***	0.923***	0.103***	0.283***	0.913***
	(0.034)	(0.013)	(0.034)	(0.007)	(0.007)	(0.035)	(0.014)	(0.035)	(0.035)	(0.035)	(0.035)
Food industries	0.320***	0.609***	-0.009**	-0.036*	0.965***	0.309***	0.587***	0.896***	0.069	0.310***	0.897***
	(0.071)	(0.030)	(0.068)	(0.018)	(0.017)	(0.068)	(0.029)	(0.071)	(0.071)	(0.061)	(0.063)
Textile	0.298***	0.534***	-0.015	-0.045	0.957***	0.285***	0.511***	0.796***	0.160***	0.285***	0.796***
	(0.075)	(0.057)	(0.1580	(0.030)	(0.028)	(0.073)	(0.057)	(0.075)	(0.071)	(0.073)	(0.074)
Clothing	0.367***	0.487***	0.050	-0.051*	0.951***	0.350***	0.464***	0.813***	0.138***	0.352***	0.815***
	(0.070)	(0.039)	(0.125)	(0.027)	(0.024)	(0.067)	(0.037)	(0.066)	(0.065)	(0.064)	(0.065)
Shoes and leather	0.240**	0.627***	0.001	-0.002	0.998***	0.239**	0.625***	0.864***	0.133**	0.239**	0.864***
	(0.104)	(0.098)	(0.455)	(0.061)	(0.060)	(0.109)	(0.084)	(0.091)	(0.079)	(0.101)	(0.086)
Wood and wood products	0.336***	0.528***	-0.313*	0.055	1.058***	0.355***	0.558***	0.913***	0.145	0.333***	0.891***
	(0.109)	(0.064)	(0.187)	(0.044)	(0.049)	(0.117)	(0.076)	(0.124)	(0.111)	(0.102)	(0.100)
Paper and related	0.206***	0.805***	-0.364**	0.086	1.094***	0.226***	0.881***	1.106***	-0.012	0.217***	1.099***
	(0.071)	(0.061)	(0.163)	(0.095)	(0.107)	(0.080)	(0.108)	(0.133)	(0.072)	(0.075)	(0.086)
Editing and printing	0.110	0.704***	0.222	0.031	1.032***	0.113	0.727***	0.840***	0.192***	0.119*	0.846***
	(0.081)	(0.073)	(0.186)	(0.054)	(0.061)	(0.084)	(0.092)	(0.093)	(0.082)	(0.078)	(0.081)
Coke, petroleum	0.553**	0.356	-0.813	0.004	1.004***	0.555**	0.358	0.913**	0.091	0.539**	0.897**
	(0.247)	(0.318)	(1.156)	(0.219)	(0.216)	(0.273)	(0.427)	(0.472)	(0.350)	(0.229)	(0.362)
Chemicals	0.096	0.569***	0.054	0.085***	1.092***	0.105	0.622***	0.727***	0.365***	0.106	0.728***
	(0.117)	(0.049)	(0.109)	(0.031)	(0.037)	(0.126)	(0.058)	(0.141)	(0.144)	(0.131)	(0.143)
Rubber and plastic	0.323***	0.612***	0.196	-0.026	0.974***	0.315***	0.596***	0.911***	0.063	0.302***	0.898***
	(0.063)	(0.042)	(0.135)	(0.047)	(0.044)	(0.062)	(0.055)	(0.077)	(0.064)	(0.062)	(0.070)
Mineral products	0.377***	0.588***	-0.050	-0.064*	0.940***	0.354***	0.553***	0.907***	0.033	0.357***	0.910***
	(0.072)	(0.050)	(0.104)	(0.034)	(0.030)	(0.068)	(0.053)	(0.075)	(0.067)	(0.068)	(0.071)

Note: Standard errors in parentheses with *** , ** and * respectively denoting significance at the 1%, 5% and 10% levels. Standard deviations are computed by bootstrap (200 replications). Firms have been classified according their main industry (in terms of sales). See text for a precise description of the estimation strategy.

Table 12: Baseline estimates of production functions, cont'd

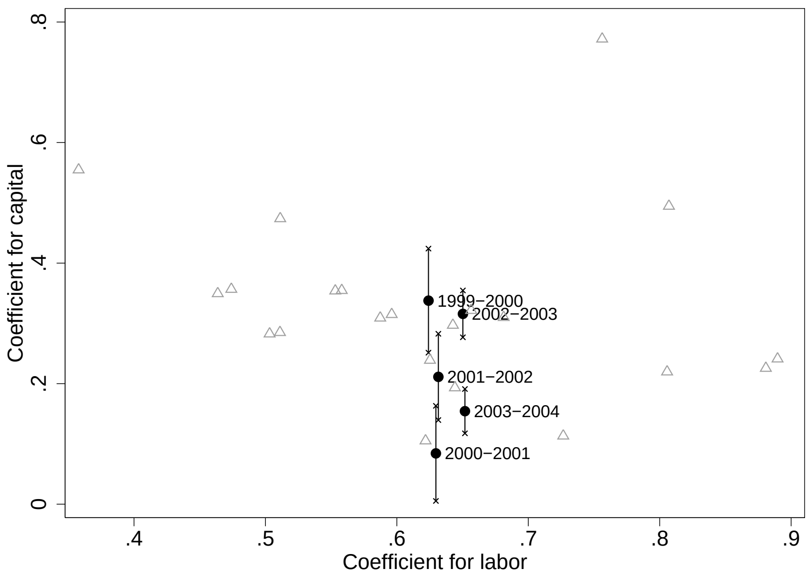
	Reduced form estimates					Structural parameters				w/o Control for Div.	
Industries (2 dig.)	$\beta_{\mathbf{k}}$	$\beta_{\mathbf{l}}$	$\beta_{\mathbf{div}}$	β_η	**Mark-up**	$\alpha_{\mathbf{k}}$	$\alpha_{\mathbf{l}}$	γ	"Melitz" cond.	$\alpha_{\mathbf{k}}$	γ
Full sample	0.277***	0.622***	-0.008	0.026***	1.026***	0.284***	0.639***	0.923***	0.103***	0.283***	0.913***
	(0.034)	(0.013)	(0.034)	(0.007)	(0.007)	(0.035)	(0.014)	(0.035)	(0.035)	(0.035)	(0.035)
Metallurgy	0.220***	0.813***	-0.247	0.086*	1.095***	0.241***	0.890***	1.131***	-0.036	0.228**	1.118***
	(0.068)	(0.073)	(0.202)	(0.050)	(0.061)	(0.074)	(0.104)	(0.095)	(0.066)	(0.098)	(0.103)
Metal work	0.186***	0.621***	0.240	0.036	1.038***	0.193***	0.644***	0.838***	0.200***	0.193***	0.837***
	(0.044)	(0.026)	(0.147)	(0.022)	(0.024)	(0.045)	(0.033)	(0.046)	(0.040)	(0.048)	(0.045)
Machines and equipment	0.295***	0.648***	-0.101	0.049	1.051***	0.310***	0.681***	0.991***	0.060	0.309***	0.9901***
	(0.056)	(0.041)	(0.100)	(0.029)	(0.032)	(0.060)	(0.049)	(0.065)	(0.055)	(0.057)	(0.060)
Computers and related	0.661***	0.647***	0.095	0.144	1.169***	0.772***	0.756***	1.528***	-0.360***	0.761***	1.517***
	(0.110)	(0.102)	(0.142)	(0.119)	(0.261)	(0.209)	(0.201)	(0.318)	(0.156)	(0.152)	(0.224)
Electrical equipment	0.301***	0.651***	0.107	-0.013	0.987***	0.297***	0.643***	0.94***	0.048	0.302***	0.945***
	(0.053)	(0.055)	(0.109)	(0.032)	(0.030)	(0.051)	(0.061)	(0.057)	(0.047)	(0.050)	(0.053)
Radio, TV, telecom.	0.547***	0.590***	0.055	-0.155	0.866***	0.474***	0.511***	0.985***	-0.119	0.478***	0.990***
	(0.105)	(0.073)	(0.171)	(0.109)	(0.103)	(0.101)	(0.092)	(0.133)	(0.107)	(0.092)	(0.111)
Medical, optical instruments	0.465***	0.759***	-0.322***	0.060**	1.064***	0.495***	0.807***	1.302***	-0.238***	0.463***	1.270***
	(0.110)	(0.069)	(0.091)	(0.026)	(0.029)	(0.117)	(0.079)	(0.122)	(0.115)	(0.101)	(0.107)
Car industry	0.320***	0.654***	0.009	0.004	1.004***	0.322***	0.657***	0.978***	0.026	0.322***	0.978***
	(0.077)	(0.091)	(0.175)	(0.037)	(0.037)	(0.079)	(0.087)	(0.077)	(0.083)	(0.073)	(0.075)
Other transport. equip.	0.192	0.703***	0.041	0.128***	1.146***	0.22	0.806***	1.025***	0.121	0.219*	1.025***
	(0.132)	(0.066)	(0.356)	(0.031)	(0.041)	(0.149)	(0.086)	(0.152)	(0.153)	(0.125)	(0.137)
Furniture	0.288***	0.512***	-0.017	-0.018	0.982***	0.283***	0.503***	0.786***	0.196***	0.283***	0.786***
	(0.074)	(0.069)	(0.145)	(0.037)	(0.035)	(0.074)	(0.065)	(0.083)	(0.082)	(0.070)	(0.077)
Recycling	0.402***	0.533***	0.561	-0.125	0.889***	0.357***	0.474***	0.831***	0.058	0.373**	0.847***
	(0.150)	(0.081)	(0.474)	(0.130)	(0.101)	(0.135)	(0.095)	(0.172)	(0.140)	(0.156)	(0.163)

Note: Standard errors in parentheses with *** , ** and * respectively denoting significance at the 1%, 5% and 10% levels. Standard deviations are computed by bootstrap (200 replications). Firms have been classified according their main industry (in terms of sales). See text for a precise description of the estimation strategy.

B.4 Stability of the Production Function over Time and across Industries

An important concern with the (however standard) Cobb-Douglas assumption is that it induces several strong restrictions, in particular a unitary elasticity of substitution between inputs (labor and capital), which is not necessarily empirically relevant. In our setting, where French firms are likely to substitue capital against labor as a response to the competitive pressure arising from low-cost countries, this aspect is potentially harmful - but empirically difficult to investigate, since adopting a more flexible specification (e.g. trans-log) increases the number of parameters to be estimated, while potentially violating the identifying assumptions required by the Levinsohn-Petrin approach.

Figure 4: Stability of Production Function Estimation over Time and across Industries



Note: Each point corresponds to a different estimation of the production function, using the methodology presented in section B.2. Dots correspond to estimations performed over the entire industry scope, but for restricted time periods, while triangles correspond to industry level estimations over the entire available time period (1999-2004).

In figure 4, we rather choose a more pragmatic approach and split our estimation sample into narrow time windows, to investigate whether the Cobb-Douglas parameters for labor and capital are stable over time or not. The underlying idea is that if firms actually distorted their capital to labor ratio over the 1999 to 2004 period, but the unitary elasticity of substitution imposed by the Cobb-Douglas functional form is not relevant, then this will induce the estimated parameters to be instable over time. The obtained results are reported on figure C and show that the technological parameter for labor turns out to be highly stable, while the variations of the estimated capital coefficients are not significant, and do not show a clear time pattern. As a comparison, the industry level heterogeneity in terms of technology appears to be much more relevant than the time evolution for this period, which contributes to validate our empirical choice.

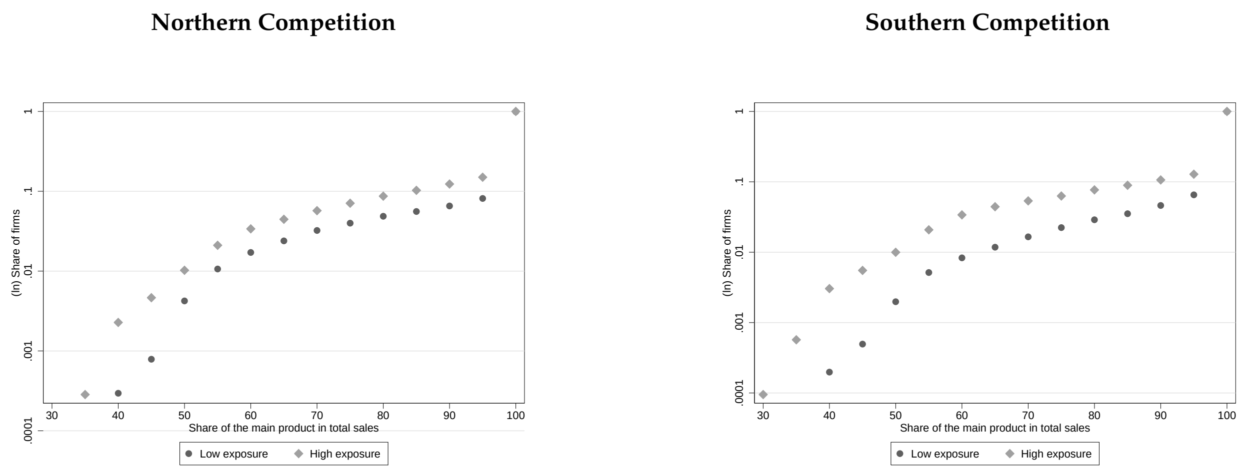
C Detailed Descriptive Statistics for Penetration Indices and TFP

Table 13: Penetration Indices and TFP by Subsample

		Penetration Indices		TFP
		North	South	estimates
Full sample	mean	0.284	0.029	0.549
(15592 obs.)	sd	0.171	0.053	0.633
"High-tech"	mean	0.313	0.017	0.550
(10700 obs.)	sd	0.160	0.033	0.604
"Low-tech"	mean	0.272	0.030	0.536
(13612 obs.)	sd	0.171	0.054	0.600
"Textile"	mean	0.364	0.126	0.634
(1935 obs.)	sd	0.108	0.074	0.754

Note: French manufacturing firms over the 1999 to 2004 period. In the "High-tech" sub-sample, we excluded firms belonging to the low-tech indutries (as defined in Hatzichronoglou [1997]). In the "Low-tech" sub-sample, we excluded firms belonging to the high-tech indutries. In the "Textile" sub-sample, we only considered firms (mainly) active in the textile, clothing, leather, fur and shoe industries.

Figure 5: Exposure to International Competition and Product Scope



Kolmogorov-Smirnov Test

$\mathbf{H_0}$: $\mathbf{F_W}(\bullet) < \mathbf{F_H}(\bullet)$, $\mathbf{D}^+ = \max_{\mathbf{x}} \{\mathbf{F_W}(\mathbf{x}) - \mathbf{F_H}(\mathbf{x})\}$

Northern Competition	Southern Competition
$D^+ = 0.000$, p-val = 1.000	$D^+ = 0.000$, p-val = 1.000

$\mathbf{H_0}$: $\mathbf{F_W}(\bullet) > \mathbf{F_H}(\bullet)$, $\mathbf{D}^- = \min_{\mathbf{x}} \{\mathbf{F_W}(\mathbf{x}) - \mathbf{F_H}(\mathbf{x})\}$

Northern Competition	Southern Competition
$D^- = -0.105$, p-val = 0.000	$D^- = -0.072$, p-val = 0.000

$\mathbf{H_0}$: $\mathbf{F_W}(\bullet) = \mathbf{F_H}(\bullet)$, $\mathbf{D} = \max\{|\mathbf{D}^+|, |\mathbf{D}^-|\}$

Northern Competition	Southern Competition
$D = 0.105$, p-val = 0.000	$D = 0.072$, p-val = 0.000

Note: These descriptive statistics relate to the year 2004.

D Complement to the Analysis of Portfolio Strategies

D.1 Export Portfolio Strategies at the Product 6-dig. Level

In tables 14 and 15, we describe the evolution of the exports structure of manufacturing firms using a decomposition of sales at the 6 digit level. All regressions include an inverse Mill's ratio derived from the estimation of exporting propensities using the same specification (in a "simple" tobit specification).

Table 14: International Competition and Export Portfolio Strategies

	Share of new products (6 dig., $t/t-2$)					
Sample:	all	all	all	HT	LT	Text.
Mean:	0.13	0.13	0.13	0.11	0.13	0.12
	(1)	(2)	(3)	(4)	(5)	(6)
ln Employment$_{t-2}$	-0.004	-0.004	-0.003	-0.006	-0.006	0.028*
	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.015)
ln (Capital/VA)$_{t-2}$	0.012**	0.011**	0.012**	0.016***	0.000	-0.008
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.016)
ln Herfindahl$_{t-2}$	-0.004	-0.004	-0.005	-0.003	0.011*	-0.009
	(0.007)	(0.007)	(0.007)	(0.007)	(0.006)	(0.021)
ln Diversification$_{t-2}$	-0.042***	-0.042***	-0.041***	-0.048***	-0.043***	-0.039
	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)	(0.036)
ln North exp. sh$_{t-2}$	-0.057***	-0.057***	-0.057***	-0.059***	-0.055***	-0.061***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.012)
ln TFP$_{t-2}$	0.000	0.000	0.000	0.001	-0.003	-0.001
	(0.003)	(0.004)	(0.003)	(0.005)	(0.003)	(0.008)
ln North pen.$_{t-2}$	-0.022	-0.022	-	-	-	-
	(0.016)	(0.016)				
ln South pen.$_{t-2}$	0.020*	0.020*	-	-	-	-
	(0.010)	(0.011)				
ln North pen.$_{t-2}$ × ln TFP$_{t-2}$	-	0.000	-	-	-	-
		(0.003)				
ln South pen.$_{t-2}$ × ln TFP$_{t-2}$	-	0.000	-	-	-	-
		(0.003)				
North pen.$_{t-2}$, 2nd quartile	-	-	-0.019	-0.03	-0.016	0.008
			(0.031)	(0.022)	(0.021)	(0.048)
North pen.$_{t-2}$, 3rd quartile	-	-	-0.052	-0.056**	-0.036	0.025
			(0.033)	(0.026)	(0.024)	(0.055)
North pen.$_{t-2}$, 4th quartile	-	-	-0.031	-0.035	-0.013	-0.029
			(0.035)	(0.033)	(0.025)	(0.049)
South pen.$_{t-2}$, 2nd quartile	-	-	0.044*	0.066***	-0.015	-0.063
			(0.023)	(0.022)	(0.017)	(0.081)
South pen.$_{t-2}$, 3rd quartile	-	-	0.055**	0.063**	0.050***	-0.099
			(0.026)	(0.025)	(0.018)	(0.092)
South pen.$_{t-2}$, 4th quartile	-	-	0.090**	0.108***	0.037	0.004
			(0.040)	(0.036)	(0.026)	(0.091)
Inv. Mill's ratio	0.124***	0.123***	0.123***	0.107**	0.095**	0.275**
	(0.041)	(0.041)	(0.041)	(0.047)	(0.038)	(0.139)
Observations	3432	3432	3432	2551	2889	365

Note: Robust standard errors in parentheses with *** , ** and * respectively denoting significance at the 1%, 5% and 10% levels. OLS estimation. "HT" denotes high-tech industries, "LT" denotes low-tech industries, and "Text." denotes textile industries.

Table 15: International Competition and Export Portfolio Strategies, cont'd

	Share of dropped products (6 dig., $t/t-2$)					
Sample:	all	all	all	HT	LT	Text.
Mean:	0.13	0.13	0.13	0.10	0.13	0.10
	(1)	(2)	(3)	(4)	(5)	(6)
ln Employment$_{t-2}$	0.001	0.001	0.001	0.000	0.003	0.031*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.018)
ln (Capital/VA)$_{t-2}$	0.007	0.007	0.007	0.013**	0.004	-0.007
	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.019)
ln Herfindahl$_{t-2}$	-0.009	-0.009	-0.009	-0.007	-0.015**	-0.007
	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.018)
ln Diversification$_{t-2}$	-0.023*	-0.023*	-0.021*	-0.030**	-0.018	-0.016
	(0.013)	(0.013)	(0.013)	(0.013)	(0.014)	(0.037)
ln North exp. sh$_{t-2}$	-0.049***	-0.049***	-0.049***	-0.050***	-0.047***	-0.041***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.012)
ln TFP$_{t-2}$	0.004	0.005	0.003	0.005	0.002	0.007
	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.006)
ln North pen.$_{t-2}$	-0.010	-0.011	-	-	-	-
	(0.017)	(0.018)				
ln North pen.$_{t-2}$ $\times$ ln TFP$_{t-2}$	-	-0.001	-	-	-	-
		(0.004)				
ln South pen.$_{t-2}$	0.012	0.013	-	-	-	-
	(0.011)	(0.012)				
ln South pen.$_{t-2}$ $\times$ ln TFP$_{t-2}$	-	0.001	-	-	-	-
		(0.003)				
North pen.$_{t-2}$, 2nd quartile	-	-	0.007	-0.038	-0.001	0.028
			(0.032)	(0.027)	(0.054)	(0.041)
North pen.$_{t-2}$, 3rd quartile	-	-	-0.034	-0.061**	-0.045	-0.025
			(0.034)	(0.031)	(0.052)	(0.040)
North pen.$_{t-2}$, 4th quartile	-	-	0.027	-0.024	0.000	0.046
			(0.036)	(0.034)	(0.050)	(0.040)
South pen.$_{t-2}$, 2nd quartile	-	-	0.054**	0.073***	0.022	-0.148***
			(0.025)	(0.024)	(0.026)	(0.055)
South pen.$_{t-2}$, 3rd quartile	-	-	0.04	0.052*	0.017	-0.133**
			(0.027)	(0.027)	(0.031)	(0.065)
South pen.$_{t-2}$, 4th quartile	-	-	0.078*	0.132***	0.069	-0.136**
			(0.041)	(0.042)	(0.048)	(0.057)
Inv. Mill's ratio	0.119***	0.121***	0.119***	0.139***	0.121***	0.216
	(0.042)	(0.042)	(0.042)	(0.045)	(0.045)	(0.167)
Observations	3432	3432	3432	2551	2889	365

Note: Robust standard errors in parentheses with *** , ** and * respectively denoting significance at the 1%, 5% and 10% levels. OLS estimation. "HT" denotes high-tech industries, "LT" denotes low-tech industries, and "Text." denotes textile industries.

D.2 Alternative Indicators of Product Adding and Dropping

In table 16 below, as well as in tables 14 and 15, we report the results obtained with the following "intensive" indicators of product adding and dropping:

$$ADD\_I_{it} = \sum_{p/\omega_{ipt-2}=0} \omega_{ipt} > 0 \quad \text{(D.1)}$$

$$DROP\_I_{it} = \sum_{p/\omega_{ipt}=0} \omega_{ipt-2} > 0 \quad \text{(D.2)}$$

All of the previoulsy described results are preserved.

Table 16: Industry Analysis of Portfolio Strategies, Complement to Table 6

Sub-sample:	"High-tech"		"Low-tech"		Textile ind.	
Dependent variable:	Share New	Share Dropped	Share New	Share Dropped	Share New	Share Dropped
Mean:	0.04	0.04	0.03	0.03	0.02	0.02
Model :	(1)	(2)	(3)	(4)	(5)	(6)
ln Employment$_{t-2}$	-0.005**	-0.005**	-0.004**	-0.004**	-0.004	-0.008*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.007)	(0.005)
ln (Capital/VA)$_{t-2}$	0.002	0.001	-0.001	-0.001	0.001	0.001
	(0.003)	(0.003)	(0.002)	(0.002)	(0.006)	(0.006)
ln Herfindahl$_{t-2}$	0.002	-0.003	0.004	0.000	0.005	0.011
	(0.005)	(0.005)	(0.004)	(0.003)	(0.013)	(0.012)
ln Diversification$_{t-2}$	-0.003	0.031***	-0.001	0.025***	-0.027	-0.011
	(0.011)	(0.011)	(0.010)	(0.010)	(0.022)	(0.020)
ln North exp. sh.$_{t-2}$	0.001	0.000	0.000	0.000	0.002*	0.001*
	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)
ln TFP$_{t-2}$	0.004***	0.005***	0.001	0.001	0.002	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
North pen.$_{t-2}$, 2nd quartile	0.011	0.008	0.028**	0.021*	-0.004	-0.009
	(0.012)	(0.011)	(0.012)	(0.012)	(0.038)	(0.036)
North pen.$_{t-2}$, 3rd quartile	0.029**	0.029**	0.029*	0.019	-0.009	-0.020
	(0.012)	(0.011)	(0.015)	(0.014)	(0.024)	(0.024)
North pen.$_{t-2}$, 4th quartile	0.054***	0.057***	0.049**	0.043**	0.027	-0.004
	(0.017)	(0.016)	(0.019)	(0.018)	(0.018)	(0.015)
South pen.$_{t-2}$, 2nd quartile	0.032***	0.031***	0.050***	0.048***	0.025	0.010
	(0.010)	(0.009)	(0.010)	(0.009)	(0.019)	(0.017)
South pen.$_{t-2}$, 3rd quartile	-0.021**	-0.014	-0.014	0.000	0.053	0.034
	(0.010)	(0.009)	(0.011)	(0.010)	(0.037)	(0.030)
South pen.$_{t-2}$, 4th quartile	-0.050***	-0.040***	-0.025*	-0.021	0.019	0.000
	(0.014)	(0.013)	(0.015)	(0.014)	(0.021)	(0.019)
Observations	3217	3217	3811	3811	480	480

Note: Standard errors in parentheses with *** , ** and * respectively denoting significance at the 1%, 5% and 10% levels. In the "High-tech" sub-sample, we excluded firms belonging to the low-tech indutries (as defined in Hatzichronoglou [1997]). In the "Low-tech" sub-sample, we excluded firms belonging to the high-tech indutries. In the "Textile" sub-sample, we only considered firms (mainly) active in the textile, clothing, leather, fur and shoe industries.

E IV Analysis: First Stages

Table 17: First-Stage Regressions

Dependent variable (ln):	Pen. N	Pen. S	Pen. N	Pen. S	Pen. N	Pen. S	Pen. N	Pen. S
[ln-] mean:	[-1.43] 0.30	[-4.87] 0.03	[-1.43] 0.30	[-4.87] 0.03	[-1.43] 0.30	[-4.87] 0.03	[-1.43] 0.30	[-4.87] 0.03
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln Employment$_{t-1}$	-0.067***	-0.021***	-0.012***	-0.042***	-0.020***	-0.050***	-0.017***	-0.050***
	(0.008)	(0.004)	(0.004)	(0.009)	(0.004)	(0.009)	(0.004)	(0.009)
ln (Capital/VA)$_{t-1}$	0.014	0.032***	0.011***	-0.027***	0.023***	-0.008	0.023***	-0.011
	(0.009)	(0.004)	(0.004)	(0.009)	(0.004)	(0.009)	(0.004)	(0.009)
ln Herfindahl$_{t-1}$	0.248***	0.179***	0.158***	0.254***	0.219***	0.322***	0.220***	0.339***
	(0.017)	(0.009)	(0.008)	(0.016)	(0.009)	(0.017)	(0.009)	(0.017)
ln Diversification$_{t-1}$	0.221***	-0.056***	-0.081***	0.184***	-0.067***	0.195***	-0.070***	0.196***
	(0.033)	(0.016)	(0.015)	(0.034)	(0.017)	(0.035)	(0.017)	(0.036)
ln North exp. sh$_{t-1}$	0.032***	0.020***	0.017***	0.032***	0.022***	0.039***	0.023***	0.040***
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.003)	(0.001)	(0.003)
ln TFP$_{t-1}$	0.116***	0.019***	0.024***	0.093***	0.005	0.075***	0.004	0.067***
	(0.007)	(0.004)	(0.003)	(0.006)	(0.004)	(0.006)	(0.004)	(0.006)
Av. Dist. North. Exp.$_{t-1}$	1.347***	0.568***	-	-	-	-	-	-
	(0.047)	(0.019)						
Av. Dist. South. Exp.$_{t-1}$	0.996***	-0.345***	-	-	-	-	-	-
	(0.095)	(0.040)						
Weighted av. growth of exchange rate $_{t-1}$,	-	-	3.353***	7.774***	-	-	-	-
North (base 2005)			(0.298)	(0.746)				
Weighted av. growth of exch. rate $_{t-1}$,	-	-	0.309***	1.870***	-	-	-	-
South (base 2005)			(0.102)	(0.234)				
(ln) av. Tariff / North, $_{t-1}$	-	-	-	-	0.252***	0.514***	-	-
					(0.019)	(0.053)		
(ln) av. Tariff / South, $_{t-1}$	-	-	-	-	-0.249***	-0.011	-	-
					(0.015)	(0.043)		
Change in tariff / South, $_{t-1/t-3}$	-	-	-	-	-	-	0.007	0.117***
							(0.014)	(0.034)
Change in tariff / North, $_{t-1/t-3}$	-	-	-	-	-	-	0.028	0.084*
							(0.019)	(0.043)
Observations	14531	14531	14275	14275	14549	14549	14549	14549

Note: OLS estimation with robust standard errors in parentheses with ***, ** and * respectively denoting significance at the 1%, 5% and 10% levels. The estimation period is 2000 to 2004. All equations include year and industry 3 dig. fixed effects.