# Productivity and Export Intensity to High-Income and Low-Income Countries*

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**Abstract**

We use a sample of Italian manufacturing firms to study the relationship between productivity (proxied by Total Factor Productivity) and the intensity of firm participation in heterogeneous foreign markets (proxied by the ratio of exports to total sales, i.e., export intensity). We find that firm productivity is strongly negatively correlated with export intensity to low-income countries and unrelated to export intensity to high-income countries. To account for these facts, we formulate a simple model that builds on two plausible assumptions: first, the preference for high-quality goods is higher in high-income countries and, second, high-productivity firms produce higher-quality goods. The two assumptions jointly imply that export intensity is higher the higher is foreign income (relative to domestic income) and the higher is firm productivity. We test this implication using a panel of export intensities to different geographic areas. Our data strongly supports this prediction.

**JEL Numbers:** F1.

**Keywords:** Export Intensity; Non-Homothetic Preferences; Product Quality; TFP; Heterogeneous Firms.

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# 1 Introduction

A recent and rapidly growing literature has placed firms, rather than industries, at center stage in the analysis of international trade, thereby unveiling a number of interesting characteristics of exporters.[1] In this paper, we aim to contribute to this literature by documenting a new empirical regularity and providing an explanation for it. Using a representative sample of Italian manufacturing firms, we study how the intensity of firm participation in heterogeneous foreign markets (proxied by the ratio of exports to total sales, i.e., export intensity) is related to productivity. Our most interesting result is that productivity and export intensity to low-income countries are strongly negatively correlated. This result is at odds with the standard heterogeneous firms model, according to which export intensity and productivity are unrelated (conditional on exporting).[2] We show, however, that a straightforward extension of the basic model can naturally deliver our result once we embed two plausible assumptions: first, the preference for high-quality goods is higher in high-income countries and, second, high-productivity firms produce higher-quality goods. The two assumptions jointly imply that less productive exporters tend to sell relatively more to low-income countries.

Our empirical analysis builds on a firm-level data set providing information on exports across broad destination markets, as well as on inputs and a number of other characteristics, such as location, industry affiliation, R&D and internationalization activities. We rely on Total Factor Productivity (TFP) estimates to measure firm productivity. To ensure that our main results do not crucially depend on the estimation procedure, we estimate a battery of different TFP measures, thereby allowing for different specifications of the underlying production function (Cobb-Douglas versus translog), for different estimators (parametric versus semiparametric, OLS versus Instrumental Variables, single-equation versus multi-equation),

[1] Exporters have been shown to be generally larger, more productive, more capital-intensive and more skill-intensive than non-exporters. See, in particular, Bernard and Jensen (1995, 1999). See also Tybout (2003), Lopez (2005), Bernard et al. (2007), Greenaway and Kneller (2007) and Wagner (2007) for comprehensive surveys of the empirical literature. These findings have pushed toward a new paradigm, initiated by Melitz (2003), which points at the self-selection of more efficient firms into foreign markets as the likely explanation for the observed correlations. The basic idea is that, due to fixed and variable costs of exporting, only the most productive firms are profitable enough to afford paying the additional costs needed to break into foreign markets.

[2] Bernard, Redding and Schott (2007) have recently extended the Melitz model by allowing for country heterogeneity on the supply-side (endowment-based comparative advantage). Their model also implies, however, that export intensity is unrelated to firm productivity (conditional on exporting), and hence it cannot explain the negative correlation between productivity and export intensity to low-income countries. This stylized fact cannot be easily explained either by the models in Melitz and Ottaviano (2008) and Bernard et al. (2003).

and for a rich set of controls. We then construct the ratio of exports to total sales (export intensity) for two groups of high- and low-income countries and regress our TFP measures on them. We find that, independent of how we estimate TFP, productivity and export intensity to low-income countries are negatively correlated. In contrast, productivity and export intensity to high-income countries are essentially unrelated.

To account for these facts, in the second part of the paper we formulate a simple model, in which per capita income affects the relative demand for high-quality products, implying that markets of low-income countries are *relatively* more profitable for firms producing low-quality goods. Moreover, productivity and product quality are positively correlated, because more productive firms have a larger market and hence a greater incentive to invest in quality upgrading. Our model suggests that the degree of firm involvement in foreign markets depends on the interplay between firm productivity and foreign preference for quality. In particular, it predicts that the relationship between export intensity and productivity is positive (negative) if foreign income is higher (lower) than domestic income. To test this implication, we use a panel of export intensities to nine different geographic areas, which we regress on an interaction term between firm TFP and relative per capita income of each area: our model suggests the coefficient of the interaction term to be positive, and our data strongly supports this prediction.

As mentioned earlier, our paper is related to a growing empirical literature that studies the characteristics of exporting firms. In particular, it is related to Brooks (2006), who documented an interesting fact: although Colombia's market size is very small compared to that of its main trading partners (for instance, the US market is one hundred times larger), most Colombian plants export a tiny share of their output. She then conjectured that the typical Colombian plant produces low-quality products for which demand may be low in wealthier countries, and found that industry-level evidence is consistent with this conjecture. Her data does not allow, however, to study whether the export intensity of Colombian plants is correlated with the characteristics of export markets.[3]

As for the theoretical literature, we borrow our framework from an established line of re-

[3] A few contributions have studied the link between productivity, exports and other firm characteristics in Italy. Notably, Castellani and Zanfei (2007) find that TFP differences between exporters and non-exporters vanish once accounting for firm size, industry and geographic location. Moreover, using older releases of our data set, Castellani (2002) finds evidence of learning-by-exporting in Italian manufacturing. Finally, Parisi, Schiantarelli and Sembenelli (2006) use the same data set to investigate the impact of firm innovative strategies on the growth of TFP.

search initiated by Shaked and Sutton (1983), and recently applied to international trade by Johnson (2007), Hallak and Sivadasan (2006) and Sutton (2007); in this framework, product quality is a choice variable, consumers have a preference for quality, and quality upgrading involves higher fixed costs.[4] We nest in this setting the assumption of non-homothetic preferences to show how firm heterogeneity interacts with the heterogeneity of export markets in determining the degree of firm involvement in foreign trade. Our paper is therefore also related to Verhoogen (2008), where the interplay between non-homothetic preferences and firm heterogeneity in product quality proves useful to explain skill upgrading in developing countries.

Our results provide a bridge between the recent literature on the characteristics of exporters and an earlier literature, inspired by the work of Linder (1961), on the role of product quality and quality consumption for the pattern of bilateral trade.[5] In particular, our results are complementary and strongly consistent with recent findings by Hallak (2006), who provides support for the Linder hypothesis that richer countries tend to import more from countries that produce high-quality goods using industry-level data.

The remainder of the paper is organized as follows. Section 2 presents the data and some preliminary evidence. Section 3 discusses the empirical strategy for TFP estimation and the main results. Section 4 shows the stylized facts on TFP and export intensity. Section 5 illustrates our model and Section 6 tests its main implications. Section 7 briefly concludes.

## 2 Data and Preliminary Evidence

### 2.1 Data

Our data comes from the 9th survey "Indagine sulle Imprese Manifatturiere", administered by the Italian Commercial Bank *Capitalia*. The survey is based on a questionnaire sent to a sample of 4,289 manufacturing firms and contains information for the period 2001-2003. The sample is stratified by size class, geographic area and industry to be representative of the population of Italian manufacturing firms with more than 10 employees.[6] Data in the survey

[4] See also Alcalà (2007) and Baldwin and Harrigan (2007) for related works on product quality and productivity with heterogeneous firms.

[5] See, in particular, Falvey and Kierzkowski (1987), Flam and Helpman (1987), Stokey (1991) and Murphy and Shleifer (1997).

[6] The strata are defined according to five size classes, four industry groups based on the Pavitt classification, and two geographic areas (Northern and Central-Southern Italy).

is complemented with balance sheet data. Due to missing data and after dropping some clearly erroneous values, we are left with roughly 3,000 observations for most of the analysis.

The survey reports information on firm exports to nine geographic areas for the year 2003: EU15, North America, New EU Members, Other European countries, Latin America, China, Other Asian countries, Africa, and Oceania. In order to show the main stylized facts, we start by aggregating these export markets into two groups of high-income and low-income countries: the former includes North-America, EU15 and Oceania, the latter the remaining areas.[7] In the second part of the paper, to test our model's implications, we will also study export markets individually.

We compute firm output as the sum of sales, capitalized costs and change in final goods inventories (Parisi, Schiantarelli and Sembenelli, 2006). Materials are computed as the difference between purchases of intermediate goods and change in inventories of intermediate goods. Capital is measured using the book value reported in the balance sheet data. As for the labor input, we use two standard measures of skill. The first is based on the educational attainment of employees. We define as high-skill workers those with at least a high-school degree and as low-skill workers all the others.[8] The second measure is based instead on occupational data, available for the period 2001-2003. We proxy for high-skill workers with non-production workers (the sum of entrepreneurs, managers, technical and administrative employees) and for low-skill workers with manual workers.[9]

Table 1 reports descriptive statistics for the year 2003. Labor productivity (value added per worker) equals 90,000 Euros in the median firm, which has 50 employees (29% are non-production workers and 37% are high-school or college graduates). Average export intensity equals 30%, a value fairly close to the manufacturing average reported by the Italian Statistical Office (26% in 2002). Markets of high-income countries are more important than those of low-income countries for Italian exporters: almost all of them (96%) sell to the former and only a subset (62%) to the latter. Similarly, average export intensity to high-income countries is higher than that to low-income countries (22% versus 9%). This data suggests that low-income

[7]As a robustness check, in Section 4 we will exclude Other Europe and Other Asia from the sample, as countries in these two areas are more heterogeneous in terms of per capita income.

[8]The survey reports three different levels of educational attainment for the year 2003: college degree, high school degree, less than high school degree.

[9]The simple correlation between the two proxies equals 0.92 for high-skill workers and 0.97 for low-skill workers.

markets are harder to penetrate by Italian firms.

### 2.2 Preliminary Evidence

We start by showing how export intensity is correlated with labor productivity, the simplest measure of firm efficiency. We run regressions of the following form:

$$EXP_j = \alpha_0 + \alpha_1 \ln(VA/L)_j + \boldsymbol{\beta}'\mathbf{F}_j + \boldsymbol{\eta}'\mathbf{IND} + u_j$$

where $j$ indexes firms, $EXP$ is export intensity (the ratio of exports to total sales), $VA/L$ is labor productivity (value added per worker), $\mathbf{F}$ is a vector of factor-intensities, $\mathbf{IND}$ is a full set of 2-digit industry dummies, and $u$ is an error term.[10] The main results are reported in Table 2. In column (1), we show estimates of our baseline specification. Note that the coefficient of labor productivity is positive, but imprecisely estimated. Factor-intensities are instead jointly significant, as shown by the $p$-value of the $F$-test. In column (2), we add total employment, to proxy for firm size, and a rich set of additional controls: the share of part-time workers in total employment, the ratio of R&D expenditures to sales, a dummy variable equal to one if a firm is quoted on the stock market, a full set of dummies for Italian administrative regions, and a set of three dummy variables equal to one in the presence, respectively, of stand-alone firms, firms that belong to a group in the position of leader, and controlled firms. Our additional controls are jointly significant. Moreover, as in most other studies, the coefficient of firm size is large and precisely estimated. The coefficient of labor productivity is still insignificant, however, and closer to zero.

In columns (3)-(4) and (5)-(6) we re-estimate the same specifications using export intensity to high-income countries and to low-income countries, respectively, as the dependent variable. The results suggest a positive, but imprecisely estimated correlation between productivity and export intensity to high-income countries, and a robust negative correlation between productivity and export intensity to low-income countries. Finally, in columns (7) and (8) we use exports to low-income countries over total exports (instead of the ratio of exports to total sales) as the dependent variable, and find that it is also strongly negatively correlated with

[10] Factor-intensities include skill-intensity (the log ratio of non-production to production workers), capital-intensity (the log of capital stock per worker) and material-intensity (the log of materials per worker). Industries are classified according to the ATECO system (the standard classification in Italy), which is equivalent to NACE.

labor productivity. These results are *prima facie* evidence of a negative correlation between firm productivity and export intensity to low-income countries.

## 3 TFP Estimation

We now turn to the harder task of estimating Total Factor Productivity (TFP), a more precise measure of firm efficiency. We start by illustrating how we address the main issues raised by TFP estimation, and then present our main results.

### 3.1 Methodology

Consider the following production function for firm $j$:

$$Y_j = f(S_j, U_j, M_j, K_j) \cdot \epsilon_j, \tag{1}$$

where $S$ is the number of high-skill workers, $U$ is the number of low-skill workers, $M$ is materials, $K$ is the capital stock and $\epsilon$ is TFP.[11]

Estimating equation (1) involves choosing a functional form for $f(\cdot)$ and an appropriate estimator of its parameters. Consider the choice of functional form first. We start by estimating a Cobb-Douglas production function:

$$\ln Y_j = \beta_0 + \beta_S \ln S_j + \beta_U \ln U_j + \beta_K \ln K_j + \beta_M \ln M_j + \varepsilon_j, \tag{2}$$

where $\beta_r$, $r \in V = \{S, U, K, M\}$, is the elasticity of output with respect to input $r$, and $\varepsilon = \ln \epsilon$. The Cobb-Douglas specification is appealing due to its simple log-linear form, but restricts the elasticity of substitution between any pair of inputs to be constant and equal to one. We therefore also estimate a translog production function:

$$\ln Y_j = \beta_0 + \sum_{r \in V} \beta_r \cdot \ln r_j + 0.5 * \sum_{r \in V} \sum_{z \in V} \beta_{rz} \cdot \ln r_j \cdot \ln z_j + \varepsilon_j, \tag{3}$$

where the elasticity of output with respect to input $r$, $\lambda_r$, now equals:

[11] To the purpose of estimation, we will treat $\epsilon$ as a stochastic variable equal to TFP plus a white-noise disturbance.

$$\lambda_{r,j} \equiv \frac{\partial \ln Y_j}{\partial \ln r_j} = \beta_r + \sum_z \beta_{rz} \cdot \ln z_j. \quad (4)$$

The translog production function does not impose any restrictions on the substitutability among inputs and provides a second-order local approximation to any twice-continuously differentiable production function (Diewert and Wales, 1987). Estimation of (3) is however more demanding in terms of identifying variance and tends to exacerbate bias due to measurement error. Following Hellerstein, Neumark and Troske (1999), and Hellerstein and Neumark (2004), among others, we estimate both production functions to ensure that our main results do not crucially depend on the choice of functional form.

Consider now the choice of appropriate estimators. Due to the short time dimension of our panel (three years), we will mainly rely on cross-sectional variation to estimate the production function parameters. We start by estimating equations (2) and (3) by OLS. As is well known, these estimates are generally affected by simultaneity bias, due to possible correlation of unobserved determinants of productivity with input choices.[12] To address this problem, we will follow two different approaches. First, we will estimate Instrumental Variable (IV) regressions on the cross-section of firms, using production inputs in the years 2002 and 2001 as instruments for their levels in 2003.[13] In particular, we will run both Two-Stage Least Squares (2SLS) estimates and Generalized Method of Moments (GMM) estimates.[14] Second, we will use the semiparametric estimator proposed by Levinsohn and Petrin (LP, 2003), which relies on functions of the observed state variable (capital) and of the freely variable inputs (materials) to proxy for the unobservable productivity shocks, and fully exploits the panel dimension of our data set.

Finally, following the empirical literature (see, e.g., Yasar and Morrison, 2008) we use two different approaches to estimate the translog production function. One is based on single equation estimation of (3). The other consists instead of estimating a system of two equations obtained by combining the production function with the expression for the output share of one

[12] Due to measurement error, OLS estimates are also affected by attenuation bias, which may however point in opposite direction with respect to simultaneity bias, thereby reducing the overall bias of some coefficient estimates.

[13] In this we follow, among others, Hellerstein, Neumark and Troske (1999).

[14] In the presence of arbitrary heteroskedasticity in the error term, 2SLS estimates are consistent but inefficient. GMM estimates are instead efficient, but the efficiency gain may be offset by poorer performance in small samples (Baum, Schaffer and Stillman, 2003).

of its inputs. To see how, note that the generic elasticity $\lambda_r$ can be written as:

$$\lambda_r \equiv \frac{\partial Y}{\partial r} \cdot \frac{r}{Y} = MP_r \cdot \frac{r}{Y},$$

where $MP_r$ is the marginal product of input $r$. Profit maximization under perfectly competitive markets implies that $p_r = p_y MP_r$, where $p_r$ is the price of input $r$ and $p_y$ is the price of output. Hence, the elasticity of output with respect to input $r$ equals $\lambda_r = \frac{p_r r}{p_y y} = Sh_r$, where $Sh_r$ is the share of revenue of input $r$. Thus, we can write:

$$Sh_{r,j} = \beta_r + \sum_z \beta_{rz} \cdot \ln z_j. \tag{5}$$

A subset of parameters can therefore be identified by jointly estimating equations (3) and (5) and imposing the appropriate cross-equation restrictions. Following Yasar and Morrison (2008), we combine (3) with the equation for the revenue share of labor. Although we do not observe wages for high-skill and low-skill workers, but only the overall wage bill, we can exploit the fact that $Sh_S + Sh_U = Sh_L$ (where $Sh_L$ is the overall revenue share of labor) to obtain:

$$Sh_{L,j} = \gamma_L + \gamma_S \ln S_j + \gamma_U \ln U_j + \gamma_K \ln K_j + \gamma_M \ln M_j, \tag{6}$$

where the coefficients satisfy the following restrictions:

$$\begin{aligned} \gamma_L &= \beta_S + \beta_U; \quad \gamma_S = \beta_{SS} + \beta_{SU}; \quad \gamma_U = \beta_{SU} + \beta_{UU}; \\ \gamma_M &= \beta_{SM} + \beta_{UM}; \quad \gamma_K = \beta_{SK} + \beta_{UK}. \end{aligned}$$

The system of equations (3) and (6) will be estimated by Iterated Three-Stage Least Squares (I3SLS). Joint estimation leads to efficiency gains relative to single equation estimation, as it allows to exploit the information contained in the firm optimization process and the resulting parametric restrictions. However, if the system is miss-specified, all parameters may be biased and inconsistent and inference incorrect (McElroy, 1987). We will therefore also rely on single equation estimation.

To sum up, we will estimate both a Cobb-Douglas production function and a translog production function; as for the latter, we will rely on both single equation and system estimation. We will use OLS, Instrumental Variables and semiparametric estimators for single equation estimation and Iterated Three-Stage Least Squares for system estimation.

### 3.2 Results

Having illustrated our estimation strategy, we now turn to the results. Table 3 reports ten different production function estimates: Cobb-Douglas estimates are in columns (1)-(5), and translog estimates in columns (6)-(10). The table reports the output elasticities of the four inputs, i.e., estimates of $\beta_r$ in equation (2) for the Cobb-Douglas specification, and estimates of $\lambda_r$ in equation (4) for the translog specification. The latter are evaluated at the sample mean with standard errors computed by the delta method.[15]

In column (1), we start with a baseline specification without controls. All output elasticities are precisely estimated and the model fit is high: this simple production function accounts for 94% of the variance of firm output. Estimated elasticities are also similar to those found in other studies, e.g., in Griffith (1999), who uses a dynamic Cobb-Douglas specification for a panel of UK firms, or in Hellerstein and Neumark (2004), who estimate a Cobb-Douglas production function for a cross-section of US plants. In columns (2) to (10), we add a battery of controls to our baseline specification: a full set of industry and region dummies, the share of part-time workers in total employment, the ratio of R&D to sales, the dummy for firms quoted on the stock market and the dummies for ownership structure. By comparing columns (1) and (2), note that these controls raise the R-squared by less than one percentage point and leave output elasticities almost unaffected.

In column (3), we use occupations instead of educational attainment to proxy for skill. Although most output elasticities are essentially unchanged, that of high-skill labor is now higher, which suggests that using different proxies for skill may be an important robustness check. In column (4), we estimate the production function by 2SLS, using two lags of each input as excluded instruments.[16] The table reports the minimum and maximum value of the $F$-statistics of excluded instruments and the $p$-value of the Hansen $J$-statistic of overidentifying restrictions. The $F$-statistics are high, suggesting that our instruments are relevant, and the Hansen $J$-statistic is insignificant, pointing against the endogeneity of our instruments.

[15] The whole list of translog production function parameters is reported in the Appendix Table A1.

[16] We use lagged values of production and non-production workers as instruments for high- and low-educated workers. We deflate output with producer price indexes at the 3-digit industry level. Capital is deflated by a common price index for investment goods and materials by a common price deflator for intermediate inputs. All deflators are drawn from the Italian Statistical Office (ISTAT).

Compared to OLS estimates, the coefficient of high-skill labor is now higher, whereas the remaining coefficients are lower. This suggests that simultaneity bias may be stronger than attenuation bias for all inputs except high-skill labor. In column (5), we use the LP estimator, which exploits the full time dimension of the data set. LP estimates are similar to 2SLS in the case of low-skill labor and materials, but are closer to OLS in the case of high-skill labor. This is consistent with the fact that the LP estimator mainly addresses simultaneity bias, which seems to dominate over measurement error in the case of low-skill labor and materials. Finally, the coefficient of capital is imprecisely estimated, probably because the LP estimator identifies this coefficient in a two-step procedure.

In columns (6), we estimate the translog production function by OLS. The fit improves by one percentage point relative to the Cobb-Douglas specification. Moreover, the coefficient of high-skill labor is lower and that of low-skill labor is higher. In column (7), we use occupations instead of educational attainment to proxy for skill and find a higher coefficient for high-skill labor, as in the Cobb-Douglas case. In column (8), we use 2SLS and again find that the estimated output elasticity is higher for high-skill labor and lower for the other inputs. GMM results in column (9) confirm this pattern. Finally, in column (10) we jointly estimate equations (3) and (6) by I3SLS. The output elasticities for capital and materials are higher than those obtained from single equation estimation, whereas those for the labor inputs are lower. The table also reports, for each specification, estimated returns to scale.[17] Note that most estimates are not far from constant returns to scale.

In Table 4, we report the simple correlation among the ten TFP measures obtained from the above production function estimates. Note that the correlations are reassuringly high (they range from a minimum of 0.70 to a maximum of 0.99), thereby suggesting that these measures are all proxies for the same thing, (hopefully) the TFP. They are not, however, the same thing, as the correlation among them is, with a few exceptions, far from one. Hence, given that each of the above estimates has pros and cons, in the following we will show results for all of them, so as to ensure that our main results are not driven by measurement error.

[17] Returns to scale are computed as $RS \equiv \sum_r \beta_r$ in the Cobb-Douglas specifications, and as $RS \equiv \sum_r \lambda_r$ in the translog specifications.

Armed with a battery of TFP estimates, we can now study the correlation between export intensity and productivity. The main results are summarized in Table 5. In panel a), we regress our TFP estimates on overall export intensity ($EXP$): the coefficient is positive in four specifications and negative in the other six, and is always small and insignificantly different from zero, except in one specification, where it enters with the negative sign. Productivity and overall export intensity are therefore essentially unrelated.

We next decompose export intensity according to the characteristics of destination markets. In particular, in panels b) and c) we regress our TFP estimates on export intensity to high-income countries ($EXP_{HI}$) and low-income countries ($EXP_{LI}$), respectively. Note that export intensity to high-income countries is still unrelated to productivity. Interestingly, however, the coefficient of export intensity to low-income countries is always negative and significant at conventional levels. This result is confirmed in panel d), where we regress our TFP estimates on the two export intensities jointly. Finally, in panel e) we use exports to low-income countries as a share of total exports ($EXP_{sh}$) as the dependent variable (rather than the ratio of exports to total sales), and find that the negative correlation with productivity is equally robust.

Next we check whether the pattern of correlations differs across sectors. To this purpose, we split our sample into two groups: the former includes firms belonging to traditional industries (according to the Pavitt classification), and the latter all other firms (i.e., firms belonging to specialized suppliers, science-based and scale-intensive industries). The two groups are roughly of equal size. We then re-estimate the production functions for the two groups, using the same methodology as for the whole sample. This also allows us to soften the restriction of an identical production function across industries.[18] Panels f) and g) report the results for the traditional industries and the other industries, respectively. Due to the smaller sample size, coefficients are now slightly less precisely estimated. The pattern of correlations is however unchanged: in both the traditional and the other industries, export intensity to low-income countries is negatively correlated with productivity (the export coefficient is negative and significant in eight out of ten specifications in both cases). In contrast, export intensity to high-income countries seems unrelated to productivity in both groups of industries.

[18] Note that all our TFP estimates except the baseline control for unobserved industry heterogeneity, as they include 2-digit industry dummies.

In Table 6, we run some further robustness checks. In panel a), we exclude Other Asia (i.e., other than China) and Other Europe (i.e., other than EU25) from the group of low-income countries. These two areas are in fact fairly heterogeneous in terms of per capita income, as they also include some rich countries, and this may weaken the negative correlation between productivity and export intensity to low-income countries.[19] The results strongly confirm our prior: compared to panel d) of Table 5, the coefficient of export intensity to low-income countries is now roughly twice as large and is always significant at the 1 percent level, except in one specification where it is significant at the 5 percent level only.

The above results concern unconditional correlations between productivity and export intensity. In panel b), we exclude firms that do not export to low-income countries. We find that, conditional on exporting to these markets, the negative coefficient of $EXP_{LI}$ is larger in eight out of ten specifications and is always precisely estimated.[20]

Finally, we check that our results are not spuriously driven by other forms of participation in foreign markets that may be correlated with export intensity, such as Foreign Direct Investment (FDI), offshoring and inshoring.[21] To this purpose, we construct the following variables: $IMPINT$, a proxy for material offshoring defined as the share of imported inputs in total input purchases in the year 2003;[22] $SERV$, a dummy for service offshoring equal to 1 if a firm purchased services from abroad in the year 2003; $INSH$, a proxy for inshoring defined as the share of sales arising from productions subcontracted by foreign firms in 2003; $FDI$, a proxy for foreign direct investment defined as the ratio of outward FDI to sales over the period 2001-2003. The correlation between these variables and export intensity ranges from a minimum of 0.03 for $FDI$ to a maximum of 0.65 for $INSH$.

The results are reported in panel c), where we add these controls to our baseline specification. Note, first, that the two proxies for material and service offshoring are unrelated to

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[19] For instance, the former group includes Japan as well as Afghanistan, whereas the latter group includes Russia and the Balkans, as well as Switzerland and Norway.

[20] Note however that, by including only firms with more than 10 employees, our data set is likely to exclude a large number of low-productivity non-exporting firms. As a consequence, differences between conditional and unconditional results may be underestimated.

[21] Inshoring is the practice through which domestic firms perform activities subcontracted by foreign enterprises. See, e.g., Slaughter (2006) on this point. This information is reported in the section of the questionnaire on internationalization strategies. In particular, data on offshoring and inshoring are for the year 2003, whereas data on FDI are relative to the cumulative flow of outward investment in the period 2001-2003.

[22] We have computed this variable according to the 'broad' definition of offshoring proposed by Feenstra and Hanson (1999), which includes both the imported intermediate components that are further processed in Italy, and imported finite goods that are sold under the brand-name of the firm. We have also experimented with a 'narrow' measure of offshoring that includes only the former type of goods, with no change in the results.

productivity. Second, despite the high correlation with export intensity, the proxy for inshoring is not correlated with productivity. Third, consistent with other studies, outward FDI is negatively correlated with TFP, suggesting that in the period of analysis less productive firms have relied more on outward investment.[23] Fourth, and most important, the new controls do not affect our main result: TFP is still strongly negatively correlated with export intensity to low-income countries and unrelated to export intensity to high-income countries.

Having shown that the above stylized fact is robust, we next try to explain it.

## 5 A Simple Model of Export Intensity and Productivity

We now illustrate a one-sector, partial equilibrium model of a high-income country open to international trade. The model provides an explanation for why firm productivity is negatively correlated with export intensity to low-income countries and unrelated to export intensity to high-income countries. We illustrate a minimalist version of the model to highlight the key ingredients needed to account for these facts. In the Appendix, we show that the main results are robust to relaxing some of the most restrictive assumptions.

Consider a representative consumer characterized by the following preferences (see Manasse and Turrini, 2001):

$$U = \left[ \int_{v \in V} q(v)^{1-\rho} c(v)^{\rho} dv \right]^{\frac{1}{\rho}}, \quad 0 < \rho < 1, \tag{7}$$

where $V$ is a continuous set of varieties available for consumption, indexed by $v$, $c(v)$ is consumption and $q(v)$ is quality of variety $v$, as perceived by the representative consumer. Each variety is therefore a Cobb-Douglas bundle of physical quantity and perceived quality. Consumers maximize (7) subject to the budget constraint:

$$y = \int_{v \in V} p(v) c(v) dv,$$

where $y$ is the exogenously given per capita income. Solving this problem yields the following demand for variety $v$:

$$c(v) = q(v) \frac{p(v)^{-\sigma} R}{P^{1-\sigma}}, \tag{8}$$

[23]See, e.g., the empirical studies surveyed in Olsen (2006) on this point.

where $R = Ny$ is total income ($N$ is the exogenously given population), $p(v)$ is the price of variety $v$, $\sigma = (1-\rho)^{-1} > 1$ is the constant elasticity of substitution among varieties and $P$ is the ideal price index associated to (7):

$$P = \left[ \int_{v \in V} q(v) p(v)^{1-\sigma} dv \right]^{\frac{1}{1-\sigma}}. \tag{9}$$

Although $P$ is endogenous to the industry, firms treat it as exogenous, because their size is negligible relative to the size of the industry.[24] Our first crucial assumption is that the preference for quality by the representative consumer is non-homothetic with respect to per capita income, $y$. In particular, we assume that $q(v)$ takes the following form:

$$q(v) = \lambda(v)^{\alpha(y)}, \quad \alpha(y) > 0, \quad \alpha'(y) > 0, \tag{10}$$

where $\lambda(v) \geq 1$ denotes "true" product quality and $\alpha(y)$ is a function capturing how income affects the intensity of preference for quality.[25] To see the implications of this assumption, consider two firms, $v_1$ and $v_2$, with $\lambda(v_1) > \lambda(v_2)$. Using (10) into (8), the demand for variety $v_1$ relative to variety $v_2$ is:

$$\frac{c(v_1)}{c(v_2)} = \left( \frac{\lambda(v_1)}{\lambda(v_2)} \right)^{\alpha(y)} \left( \frac{p(v_1)}{p(v_2)} \right)^{-\sigma}.$$

Note that, for given relative price, the relative demand for higher-quality products is higher (lower) in high-income (low-income) countries.

Consider now the production side of the model. Firms produce differentiated products under monopolistic competition. Technology is summarized by the following total cost function:

$$TC(\theta) = F(\lambda(\theta)) + MC(\theta) x(\theta, \lambda(\theta)),$$

where $F$ is a fixed cost, $MC$ is marginal cost, $x$ is output and $\theta \geq 1$ is firm productivity (henceforth, $\theta$ will also index domestic firms). As in Melitz (2003), firms are heterogeneous in terms of productivity and marginal costs. We also assume, and this is our second key

[24] See Helpman (2006) for an illustration of the heterogeneous firms model in partial equilibrium.

[25] See Hallak (2006) for a similar formulation. We assume that $\lambda$ is defined over the range $[1, \infty)$ or otherwise a rise in the intensity of preference for quality, $\alpha(y)$, would have ambiguous effects on the demand.

assumption, that higher-quality products require higher fixed costs. This captures the well-established idea that quality upgrading involves more intensive R&D and marketing activities, which are mainly fixed costs in nature. In particular, we assume the following functional forms:

$$F(\lambda(\theta)) = \phi\lambda(\theta)^{\gamma} + \phi; \quad MC(\theta) = \frac{1}{\theta}, \tag{11}$$

where $\phi$ and $\lambda(\theta)^{\gamma}$ represent, respectively, the exogenous and endogenous components of the fixed cost, and $\gamma > 0$ is the elasticity of the fixed cost to product quality. As in Melitz (2003), we assume that the marginal cost is inversely related to firm productivity and that it is independent of product quality. This latter assumption is relaxed in the Appendix, where we consider the case in which higher-quality products require (also) a higher marginal cost.

The profit maximizing price is a constant markup $\left(\frac{\sigma}{\sigma-1} = \frac{1}{\rho}\right)$ over marginal cost:

$$p(\theta) = \frac{1}{\rho\theta}. \tag{12}$$

Using (8), (10) and (12), we can write revenue of domestic firms in the domestic market, $r(\theta, \lambda(\theta))$, as a function of productivity and product quality:

$$r(\theta, \lambda(\theta)) = R\left(\rho\theta P\right)^{\sigma-1} \lambda(\theta)^{\alpha(y)}. \tag{13}$$

What is the relationship between productivity and product quality, i.e., between $\theta$ and $\lambda$? Following a recent literature, we assume that product quality is endogenous.[26] In particular, firms choose product quality to maximize profits. For simplicity, we assume that firms target product quality to domestic market conditions only (i.e., to maximize domestic profits). In the Appendix, we show that the results are unaffected in the more general case in which firms choose product quality to maximize overall profits. Firms therefore solve the following problem:

$$\max_{\lambda} \left\{ \frac{1}{\sigma} R\left(\rho\theta P\right)^{\sigma-1} \lambda^{\alpha(y)} - \phi\lambda^{\gamma} - \phi \right\}, \tag{14}$$

where the first term in brackets represents operating profits, which are a constant share, $\sigma^{-1}$, of firm revenue. We assume that $\alpha(y) < \gamma$, which implies that the elasticity of revenue with respect to product quality is less than the elasticity of fixed costs. This restriction ensures that

[26] See, in particular, Johnson (2007) and Hallak and Sivadasan (2006).

the second-order conditions for a maximum are satisfied. Solving this simple problem yields the optimal value of $\lambda$:

$$\lambda = \left(\overline{\lambda}\theta^{\sigma-1}\right)^{\frac{1}{\gamma-\alpha(y)}}, \quad \text{where } \overline{\lambda} = \frac{\alpha(y)\,(\rho P)^{\sigma-1} R}{\gamma\phi\sigma}. \tag{15}$$

Note that more productive firms choose higher product quality.[27] The intuition for this result is the same as for why only more productive firms export in the basic heterogeneous firms model: given that quality upgrading involves higher fixed costs, only more productive firms are profitable enough to afford paying these additional costs. Note, also, that optimal product quality is higher the higher the preference for quality, $\alpha(y)$, and the larger the size of the domestic market (as captured by the term $P^{\sigma-1}R$).

Using (15) into (13) gives:

$$r(\theta) = R\,(\rho P)^{\sigma-1}\,\overline{\lambda}^{\frac{\alpha(y)}{\gamma-\alpha(y)}}\,\theta^{\frac{(\sigma-1)\gamma}{\gamma-\alpha(y)}}. \tag{16}$$

Equation (16) shows that, as in the basic heterogeneous firms model, more productive firms enjoy a higher revenue in the domestic market. The only difference is that a higher preference for quality makes the relationship between revenue and productivity more convex. The reason is that, with endogenous product quality and non-homothetic preferences, more productive firms have an additional advantage over less productive firms: not only they enjoy a lower marginal cost, they can also afford producing higher-quality products, for which demand is higher, the more so the higher is per capita income.

Consider now exports to a foreign country $f$. For simplicity, we assume that exporting does not involve any additional fixed costs, implying that all firms that are active in the domestic market are also exporters. This assumption will be relaxed in the next section. Denoting foreign variables by a subscript $f$, export revenue of domestic firms, $r_f(\theta)$, can be written as:

$$r_f(\theta) = \tau^{1-\sigma} R_f\,(\rho\theta P_f)^{\sigma-1}\,\lambda^{\alpha(y_f)}, \tag{17}$$

where the term $\tau^{1-\sigma}$ captures the revenue-reducing effect of a standard iceberg trade cost

[27] We assume that $\overline{\lambda} > 1$ to ensure that there is quality upgrading in equilibrium. This condition is always satisfied for sufficiently low $\phi$.

$\tau > 1$.[28] Using equation (15) into equation (17) gives:

$$r_f(\theta) = \tau^{1-\sigma} R_f \left(\rho P_f\right)^{\sigma-1} \overline{\lambda}^{\frac{\alpha(y_f)}{\gamma-\alpha(y)}} \theta^{\frac{(\sigma-1)\left[\gamma-\alpha(y)+\alpha(y_f)\right]}{\gamma-\alpha(y)}}. \tag{18}$$

Note that, if $f$ is a low-income country (i.e., for $y_f < y$), then $\alpha(y) - \alpha(y_f) > 0$; together with the second-order condition for a maximum ($\alpha(y) < \gamma$), this implies $0 < \alpha(y) - \alpha(y_f) < \gamma$. Hence, more productive firms enjoy a higher revenue in the foreign market, as in the standard model. However, the elasticity of $r_f(\theta)$ with respect to productivity is less than the elasticity of $r(\theta)$, because a lower foreign income implies a weaker preference for higher-quality products. Finally, taking the ratio of exports to domestic sales, $r_f(\theta)/r(\theta)$, we obtain an expression for export intensity of domestic firms to country $f$:

$$EXP_f(\theta) = \tau^{1-\sigma} \frac{R_f}{R} \left(\frac{P_f}{P}\right)^{\sigma-1} \left(\overline{\lambda}\theta^{\sigma-1}\right)^{-\frac{\alpha(y)-\alpha(y_f)}{\gamma-\alpha(y)}} \tag{19}$$

Equation (19) shows that, for given firm productivity, export intensity is higher the lower the trade costs, $\tau$, and the larger the relative size of the foreign market, as captured by the term $R_f P_f^{\sigma-1}/RP^{\sigma-1}$. Note also that $\overline{\lambda}$, which is increasing in $\alpha(y)$, enters with a negative exponent for $\alpha(y) - \alpha(y_f) > 0$. This term captures the trade-reducing effect of non-homothetic preferences: for given $\theta$, export intensity to a low-income country is lower the higher the relative domestic income. This is a robust implication of trade models embedding non-homothetic preferences.[29] More importantly, equation (19) shows that export intensity to a low-income country is inversely related to the productivity of exporters located in a high-income country. The intuition is that high-productivity firms produce higher-quality goods, for which *relative* demand is lower in low-income countries. Instead, in trade between similar countries (i.e., for $\alpha(y) \simeq \alpha(y_f)$), $\theta$ disappears from equation (19) and the model boils down to the standard heterogeneous firms model in which, conditional on exporting, export intensity is unrelated to productivity. Finally, by comparing equations (18) and (19) note that, although cross-country differences in $\alpha(\cdot)$ have only second-order effects on the relationship between productivity and export revenue, they have first-order effects on export intensity. Looking at firm-level data

[28] Note that, with iceberg trade costs, markup pricing implies that the price of a domestic variety in the foreign country is $p_f(\theta) = \frac{\tau}{\rho\theta}$.

[29] For an analysis of the implications of non-homothetic preferences for international trade see, among others, Markusen (1986), Hunter (1991) and Matsuyama (2000).

on export intensity is therefore crucial to test for the empirical relevance of non-homothetic preferences in international trade.

### 5.1 Productivity Cutoffs

We now allow for an exogenous fixed cost of exporting to show how it affects the selection of domestic firms into foreign markets and the relationship between export intensity and productivity. We first derive the productivity cutoff for domestic producers (i.e., the productivity level at which a firm makes zero profits in the domestic market), and then compare it with the productivity cutoff for exporters (i.e., the productivity level at which a firm is indifferent between exporting and serving only the domestic market). Using (15) into (14), domestic profits, $\pi_d$, can be written as:

$$\pi_d = \phi \left( \frac{\gamma - \alpha(y)}{\alpha(y)} \right) \left( \overline{\lambda} \theta^{\sigma-1} \right)^{\frac{\gamma}{\gamma - \alpha(y)}} - \phi \tag{20}$$

Imposing $\pi_d = 0$ gives the productivity cutoff for domestic producers, $\theta_d$:

$$\theta_d = \left( \frac{\alpha(y)}{\gamma - \alpha(y)} \right)^{\frac{\gamma - \alpha(y)}{\gamma(\sigma-1)}} \overline{\lambda}^{-\frac{1}{\sigma-1}}. \tag{21}$$

Consider now profits in the foreign market, $\pi_f$. Using (18) and assuming that exporting involves (in addition to variable trade costs) an exogenous fixed cost $\phi_f$, we obtain:

$$\pi_f = \frac{1}{\sigma} \tau^{1-\sigma} R_f \left( \rho P_f \right)^{\sigma-1} \overline{\lambda}^{\frac{\alpha(y_f)}{\gamma - \alpha(y)}} \theta^{\frac{(\sigma-1)\left(\gamma - \alpha(y) + \alpha(y_f)\right)}{\gamma - \alpha(y)}} - \phi_f. \tag{22}$$

Imposing $\pi_f = 0$ gives the productivity cutoff for exporters, $\theta_f$:

$$\theta_f = \left[ \frac{\sigma \phi_f \tau^{\sigma-1}}{\overline{\lambda}^{\frac{\alpha(y_f)}{\gamma - \alpha(y)}} R_f \left( \rho P_f \right)^{\sigma-1}} \right]^{\frac{\gamma - \alpha(y)}{(\sigma-1)\left(\gamma - \alpha(y) + \alpha(y_f)\right)}}. \tag{23}$$

As in the standard heterogeneous firms model, $\theta_f$ can be greater or smaller than $\theta_d$. More interestingly, $\theta_f$ is decreasing in $\alpha(y_f)$, implying that (for given total income, $R_f$) a lower foreign per capita income increases the export productivity cutoff.[30] The reason is that a lower income reduces the elasticity of export revenue to productivity and therefore requires, ceteris paribus, a higher productivity to offset the fixed cost of exporting. By comparing $\pi_d$ and $\pi_f$ note also that, in trade with a similar country (i.e., for $\alpha(y_f) = \alpha(y)$), the elasticities of $\pi_f$ and $\pi_d$ with respect to $\theta$ are identical. In contrast, in trade with a low-income country (i.e., for $\alpha(y_f) < \alpha(y)$), the elasticity of $\pi_f$ with respect to $\theta$ is less than that of $\pi_d$, as illustrated in Figure 1. The different elasticities of domestic and export profits (and revenues) with respect to productivity imply that, whatever the position of the export productivity cutoff, conditional on exporting the ratio of exports to domestic sales is decreasing in productivity, the more so the lower the foreign income. In the next section, we will focus on exporting firms for consistency with the model's implications in the presence of fixed costs of exporting.[31]

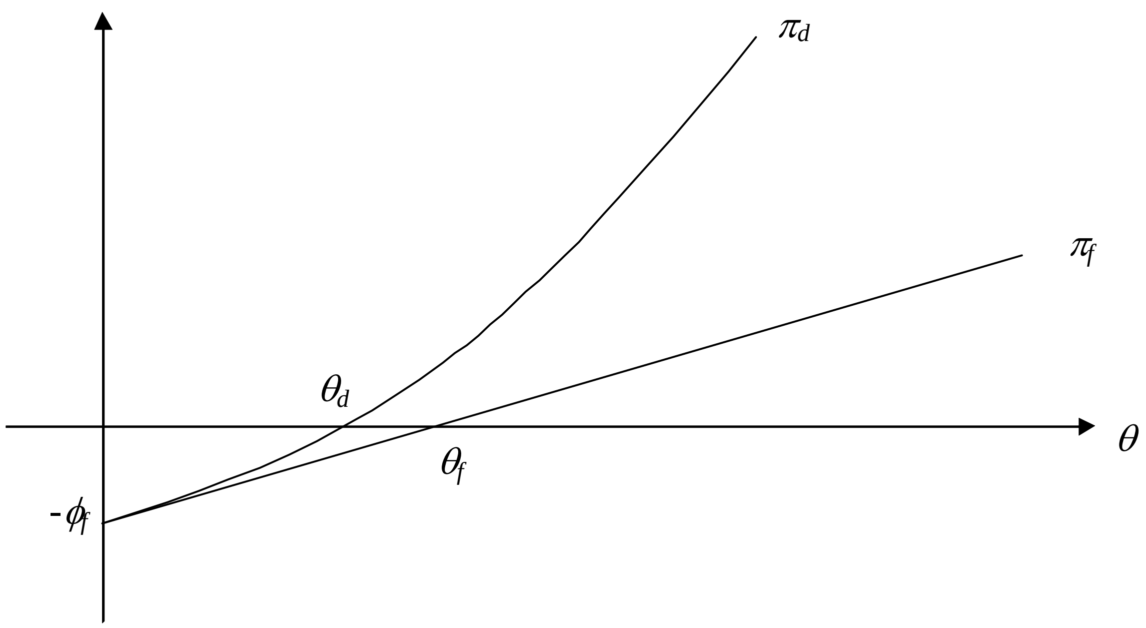


**Figure 1. Productivity Cutoffs**

[30]Provided that $\theta_f > 1$, namely, that the export productivity cutoff is in the relevant range (recall that we assumed $\overline{\lambda} > 1$, $\theta \geq 1$).

[31]As shown in Section 4, the negative correlation between productivity and export intensity to low-income countries holds both unconditionally and conditional on exporting, and is stronger in the latter case. This is consistent with $\theta_f > \theta_d$, because firms in the range $[\theta_d, \theta_f]$, i.e., non-exporters, have a lower productivity and therefore weaken the negative correlation between export intensity to low-income countries and productivity.

## 6 Evaluating the Model's Implications

Our model suggests (see equation 19) that, conditional on exporting to area $f$, the ratio of exports to domestic sales is negatively correlated with firm productivity if per capita income of area $f$ is less than domestic income, i.e., if $y_f < y$. The correlation vanishes for $y_f \simeq y$, and turns positive for $y_f > y$. As a first step toward testing these implications, we estimate a set of cross-sectional regressions of the following form:

$$\ln EXP_j = \alpha_0 + \alpha_1 TFP_j + u_j, \tag{24}$$

where $EXP_j$ is the ratio of exports to a given geographic area over domestic sales, $\alpha_1$ is its elasticity with respect to productivity ($TFP_j$), and $u_j$ is an error term. Note that the log transformation implies that correlations are now conditional on exporting. The expected sign of $\alpha_1$ is negative for exports to low-income areas and zero or positive for exports to high-income areas. We consider the following major geographic areas: Africa, China, Latin America, New EU Members, EU15 and North America. The results are reported in Table 7. Note that, for all of the four areas with an average per capita income substantially lower than Italy's (i.e., Africa, China, Latin America and New EU Members), the ratio of exports to domestic sales is negatively correlated with all of the TFP measures and the regression coefficients are always precisely estimated. In contrast, in the case of both EU15 and North America, two rich areas with a per capita income similar to Italy's, the correlation disappears: estimated coefficients are always insignificantly different from zero and their sign does not show any pattern at all.

Next, we pool observations on export intensities to all geographic areas and estimate panel regressions. Our baseline specification is:

$$\ln EXP_{j,f} = \beta_0 + \beta_f + \beta_1 TFP_j + \beta_2 \left[(y_f/y) \times TFP_j\right] + u_{j,f} \tag{25}$$

where $EXP_{j,f}$ is exports of firm $j$ to geographic area $f$ over domestic sales, $\beta_f$ is an area fixed-effect and $(y_f/y) \times TFP_j$ is an interaction term between per capita income of area $f$, relative to Italy's, and productivity of firm $j$. Our main interest is in the coefficient $\beta_2$, whose expected sign is positive, as the model implies that more productive exporters have a higher export intensity to higher-income countries. We use data on per capita GDP in PPP for the year 2003 (from the World Development Indicators). In panel a) of Table 8, we report our baseline results. Note that the coefficient of the interaction term is always positive and is precisely estimated in seven out of ten specifications. The coefficient of the linear productivity term, $\beta_1$, is instead always negative and significantly different from zero at conventional levels. Note, also, that the absolute value of $\beta_2$ is of the same order of magnitude as $\beta_1$. This suggests that, just as implied by our simple model, the correlation between export intensity and productivity is positive in the case of export markets with a per capita income greater than Italy's, and negative otherwise.

In panel b), we add an interaction term between TFP and relative population (also from WDI) to control for spurious results due to the fact that per capita income is also correlated with market size. The results are striking: the coefficient $\beta_2$ is now very precisely estimated in all specifications and is larger in magnitude. The coefficient of the linear TFP term is also very precisely estimated and of similar absolute size. The coefficient of the interaction term between TFP and population is instead smaller and less precisely estimated. In panel c), we add industry dummies and find no change in the main results. Finally, in panel d) we add the same set of variables used in Table 6 to control for potential correlation of export intensity with other forms of internationalization, such as material and service offshoring, FDI and inshoring. Note that, except for FDI, which is strongly negatively correlated with export intensity (i.e., exports and FDI are substitutes in Italy), the other proxies of internationalization are positive and generally strongly correlated with export intensity. Importantly, however, these controls leave the main results unaffected.

As a final robustness check, in Table 9 we re-estimate the same specifications using as the dependent variable the log of exports to area $f$ as a share of total exports (instead of the ratio of exports to domestic sales). It is in fact immediate to show that our model also implies that less productive exporters make a higher share of their total exports in low-income countries.[32] Note that the results are equally strong: in all specifications, the coefficient of TFP interacted with income is positive and significant at conventional levels, while the coefficient of the linear term is negative and also precisely estimated.

To sum up, in line with our model and the evidence that inspired it, these results strongly suggest that the degree of firm involvement in foreign trade is crucially affected by the interplay between firm and export market characteristics.

[32] In this case, income and population of area $f$ are measured relative to the world's (rather than relative to Italy's, as in Table 8).

## 7 Conclusion

In this paper, we have studied the relationship between the characteristics of a representative sample of Italian manufacturing firms and the intensity of their participation in heterogeneous foreign markets. We found that, although productivity and export intensity to high-income countries are unrelated, a strong negative correlation emerges between productivity and export intensity to low-income countries. We explained these facts with a simple model built on two plausible, yet often overlooked assumptions: first, that the preference for high-quality goods is higher in high-income countries and, second, that productivity and product quality are positively correlated, as more productive firms have a larger market and a greater incentive to upgrade their products. We found strong empirical support for the main implications of the model.

What is the use of our results? We think that they bear some potentially relevant implications. In particular, they suggest that quality upgrading by developing countries' firms may be a prerequisite for effective access to rich countries' markets. By the same token, and contrary to the conventional wisdom, they suggest that North-South trade liberalization may have not too disruptive effects on rich countries' industrial structure, because of the trade-reducing effect of non-homothetic preferences. Finally, they suggest that poor developing countries that remain close to international trade may be more likely to be caught in an underdevelopment trap, as the small size of the internal market for high-quality products may discourage quality upgrading and human capital accumulation.

Although the empirical regularities documented in this paper are strong and plausible, at this stage we cannot be sure that they hold in general. Testing whether our results extend beyond Italian manufacturing is therefore a promising avenue for future research.

## 8 Appendix

### 8.1 Product Quality and Product Prices

We now assume that higher-quality products require not only a higher fixed cost (as in the baseline model), but also a higher marginal cost. This is the case if, for instance, manufacturing higher-quality products requires higher-quality inputs.[33] Consider, in particular, the following

[33] See, e.g., Verhoogen (2008) and Johnson (2007) on this point.

marginal cost function:

$$MC(\theta, \lambda(\theta)) = \frac{\lambda(\theta)^{\delta}}{\theta}, \tag{26}$$

where $\delta > 0$ is the elasticity of marginal cost to product quality. Markup pricing now implies:

$$p(\theta, \lambda(\theta)) = \frac{\lambda(\theta)^{\delta}}{\rho\theta}. \tag{27}$$

Higher-quality products are therefore more expensive, the more so the higher is $\delta$. Revenue of domestic firms in the domestic and foreign market is:

$$r(\theta, \lambda(\theta)) = R\,(\rho\theta P)^{\sigma-1}\,\lambda(\theta)^{\alpha(y)-\delta(\sigma-1)}, \tag{28}$$

$$r_f(\theta, \lambda(\theta)) = \tau^{1-\sigma} R_f\,(\rho\theta P_f)^{\sigma-1}\,\lambda^{\alpha(y_f)-\delta(\sigma-1)}. \tag{29}$$

Note that a higher $\delta$ implies a lower elasticity of revenue with respect to product quality, and therefore a lower profitability of higher-quality products. As in the baseline setting, firms choose product quality to maximize domestic profits, and therefore solve the following problem:

$$\max_{\lambda} \left\{ \frac{1}{\sigma} R\,(\rho\theta P)^{\sigma-1}\,\lambda^{\alpha(y)-\delta(\sigma-1)} - \phi\lambda^{\gamma} - \phi \right\}.$$

Assuming that $0 < \alpha(y) - \delta(\sigma - 1) < \gamma$ to ensure that the second-order conditions for a maximum are satisfied, we obtain the following expression for the optimal product quality:

$$\lambda = \left(\overline{\lambda}\theta^{\sigma-1}\right)^{\frac{1}{\gamma-[\alpha(y)-\delta(\sigma-1)]}}, \quad \text{where} \quad \overline{\lambda} = \frac{[\alpha(y) - \delta(\sigma-1)]\,(\rho\theta P)^{\sigma-1} R}{\gamma\phi\sigma}. \tag{30}$$

A higher $\delta$ therefore implies a lower optimal product quality and a less convex relationship between product quality and productivity. Using (30) into (29) and (28), and taking their ratio, we obtain a new expression for export intensity:

$$EXP_f(\theta) = \tau^{1-\sigma} \frac{R_f}{R} \left(\frac{P_f}{P}\right)^{\sigma-1} \left(\overline{\lambda}\theta^{\sigma-1}\right)^{-\frac{\alpha(y)-\alpha(y_f)}{\gamma-[\alpha(y)-\delta(\sigma-1)]}}. \tag{31}$$

As in the baseline model, export intensity to a low-income country is negatively correlated with productivity. The novelty is that a higher sensitivity of price and marginal cost to product quality (a higher $\delta$) is now associated to a lower (absolute) elasticity of export intensity to productivity. The reason is that a higher $\delta$ reduces the profitability of quality upgrading and therefore weakens the correlation between productivity and product quality. Hence, the model suggests that, ceteris paribus, the negative correlation between productivity and export intensity to low-income countries should be stronger in industries in which product prices are less sensitive to product quality.

### 8.2 Optimal Product Quality in Open Economy

We finally consider the more general case in which in open economy domestic firms choose product quality to maximize overall profits rather than domestic profits. Assume, in particular, that the domestic country trades with $n_h$ high-income countries (indexed by $i$) and $n_l$ low-income countries (indexed by $z$). For simplicity, we assume that high-income countries have an identical per capita income equal to domestic income ($y_i = y$ for $i = 1, 2, ..n_h$), and that low-income countries have an identical per capita income equal to $y_f$ ($y_z = y_f < y$ for $z = 1, 2..n_l$).[34] Optimal product quality is the solution of the following problem:

$$\max_{\lambda} \left\{ \frac{(\rho\theta)^{\sigma-1}}{\sigma} \left( \lambda^{\alpha(y)} \left[ RP^{\sigma-1} + \sum_{i=1}^{n_h} \tau_i^{1-\sigma} R_i P_i^{\sigma-1} \right] + \lambda^{\alpha(y_f)} \sum_{z=1}^{n_l} \tau_z^{1-\sigma} R_z P_z^{\sigma-1} \right) - \phi\lambda^{\gamma} - \phi \right\}, \tag{32}$$

where $R_k P_k^{\sigma-1}$ denotes market size of country $k$ ($k = i, z$) and $\tau_k$ denotes iceberg transport costs between the domestic country and country $k$. The term in square brackets can be interpreted as the exogenous component of firm revenue from high-income countries (which also includes domestic revenue). Similarly, the second summation term captures (the exogenous component of) revenue from low-income countries. Define by $A = RP^{\sigma-1} + \sum_{i=1}^{n_h} \tau_i^{1-\sigma} R_i P_i^{\sigma-1} + \sum_{z=1}^{n_l} \tau_z^{1-\sigma} R_z P_z^{\sigma-1}$ the exogenous component of overall revenue. Equation (32) can then be rewritten more compactly as:

$$\max_{\lambda} \left\{ \frac{(\rho\theta)^{\sigma-1}}{\sigma} \left[ \lambda^{\alpha(y)} sA + \lambda^{\alpha(y_f)} (1-s) A \right] - \phi\lambda^{\gamma} - \phi \right\},$$

where $s$ is the share of revenue from high-income countries. The first-order condition for a maximum is:

$$\lambda^{\gamma} = \frac{(\rho\theta)^{\sigma-1} A}{\gamma\phi\sigma} \left[ \alpha(y) \lambda^{\alpha(y)} s + \alpha(y_f) \lambda^{\alpha(y_f)} (1-s) \right]. \tag{33}$$

[34] For simplicity, in this section we also assume that $\delta = 0$ and that there are no fixed costs of exporting.

For our purposes, it is sufficient to consider two polar cases. The first is when domestic firms sell most of their output domestically and in other rich countries. For $s$ large, the second term in square brackets of (33) becomes negligible and optimal product quality can be approximated by:

$$\lambda \simeq \left[ \frac{\alpha(y) \left(\rho\theta\right)^{\sigma-1} A}{\gamma\phi\sigma} \right]^{\frac{1}{\gamma-\alpha(y)}} . \tag{34}$$

By comparing (34) and (15), note that, not surprisingly, the elasticity of optimal product quality to productivity is unaffected. By implication, the negative elasticity of export intensity to any low-income country $z$ with respect to productivity is also unaffected:

$$EXP_z(\theta) \simeq \tau_z^{1-\sigma} \frac{R_z}{R} \left( \frac{P_z}{P} \right)^{\sigma-1} \left( \frac{\alpha(y) A \left(\rho\theta\right)^{\sigma-1}}{\gamma\phi\sigma} \right)^{-\frac{\alpha(y)-\alpha(y_f)}{\gamma-\alpha(y)}} .$$

The second polar case is when domestic firms sell most of their output to low-income countries. For $s$ small, the first term in square brackets of (33) is small and optimal product quality can be approximated by:

$$\lambda \simeq \left[ \frac{\alpha(y_f) \left(\rho\theta\right)^{\sigma-1} A}{\gamma\phi\sigma} \right]^{\frac{1}{\gamma-\alpha(y_f)}} . \tag{35}$$

Note that, for given overall market size $A$, optimal product quality is now lower, as a lower preference for quality reduces the profitability of quality upgrading. Using (35), the new expression for export intensity of domestic firms to a low-income country $z$ is approximately:

$$EXP_z(\theta) \simeq \tau_z^{1-\sigma} \frac{R_z}{R} \left( \frac{P_z}{P} \right)^{\sigma-1} \left( \frac{\alpha(y_f) A \left(\rho\theta\right)^{\sigma-1}}{\gamma\phi\sigma} \right)^{-\frac{\alpha(y)-\alpha(y_f)}{\gamma-\alpha(y_f)}} .$$

Export intensity to low-income countries is still inversely related to productivity. The only main difference is that the elasticity to productivity is now lower in absolute value, because a lower preference for quality weakens the positive relationship between optimal product quality and productivity. The reason why our qualitative results do not depend on which markets firms target product quality is that cross-country differences in $\alpha(\cdot)$ have only second-order effects on the relationship between optimal product quality and productivity (see, e.g., (34) and (35)).

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**Table 1 - Descriptive Statistics**

| | Mean | Median | Std. Dev. | Observations |
|---|---|---|---|---|
| Output (€, '000) | 36686 | 9940 | 157100 | 3825 |
| Labor productivity (€, '000) | 109 | 90 | 83 | 3769 |
| Capital stock per worker (€, '000) | 51 | 32 | 71 | 3819 |
| Materials per worker (€, '000) | 142 | 87 | 228 | 3770 |
| Employment | 144 | 49 | 413 | 4144 |
| College + high-school graduates (%) | 44.2 | 36.7 | 26.7 | 3673 |
| Non-production workers (%) | 33.5 | 29.4 | 18.6 | 4105 |
| Exporters (%) | 75.7 | - | - | 4067 |
| Exporters to high-income countries (%) | 73.0 | - | - | 3925 |
| Exporters to low-income countries (%) | 46.8 | - | - | 3925 |
| Export intensity (%) | 30.5 | 20.0 | 30.2 | 4067 |
| Export intensity to high-income countries (%) | 21.5 | 12.0 | 24.4 | 3925 |
| Export intensity to low-income countries (%) | 8.6 | 0.6 | 14.9 | 3925 |

*Output* equals sales plus capitalized costs and change in final goods inventories. *Labor productivity* is value added per worker. *Capital stock* is the book value of capital. *Materials* are the difference between purchases of intermediate goods and change in inventories of intermediate goods. *Non-production* workers include entrepreneurs, managers, technical and administrative employees. *Export intensity* is the ratio of exports to total sales. High-income countries include North America, EU15 and Oceania; low-income countries include Africa, China, Latin America, Other Asian countries, New EU Members, Other European countries. All variables are computed for the year 2003. Source: *Capitalia* .

**Table 2 - Export Intensity to High- and Low-Income Countries and Labor Productivity**

Dependent Variables: Export Intensity and Share of Exports to Low-Income Countries

| | Overall Export Intensity | | Export Intensity to High-Income Countries | | Export Intensity to Low-Income Countries | | Share of Exports to Low-Income Countries | |
|---|---|---|---|---|---|---|---|---|
| | Baseline | Adding Controls | Baseline | Adding Controls | Baseline | Adding Controls | Baseline | Adding Controls |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Labor productivity | 0.013 | 0.004 | 0.022** | 0.016 | -0.011** | -0.012** | -0.044*** | -0.035** |
| | [0.013] | [0.014] | [0.011] | [0.012] | [0.005] | [0.006] | [0.014] | [0.015] |
| Size | | 0.075*** | | 0.052*** | | 0.024*** | | 0.006 |
| | | [0.005] | | [0.005] | | [0.003] | | [0.007] |
| *P* - value for factor intensities | 0.000 | 0.000 | 0.012 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 |
| *P* - value for controls | | 0.000 | | 0.000 | | 0.000 | | 0.066 |
| Obs. | 3627 | 3218 | 3522 | 3190 | 3522 | 3190 | 2657 | 2364 |
| R-squared | 0.14 | 0.22 | 0.08 | 0.15 | 0.10 | 0.14 | 0.05 | 0.06 |

OLS regressions with robust standard errors in brackets. ***,**,* = significant at 1, 5 and 10 percent level, respectively. *Labor productivity* is the log of value added per worker. *Size* is the log of total employment. *Factor intensities* include: skill-intensity (the log ratio of non-production to production workers); capital-intensity (the log of capital stock per worker); material-intensity (log of material inputs per worker). *Controls* include: a full set of (ATECO) 2-digit industry dummies; a full set of dummies for Italian administrative regions; the share of part-time workers in total employment; the ratio of R&D expenditures to sales; a dummy variable equal to one if the firm is quoted on the stock market; a set of three dummy variables equal to one in the presence of, respectively, stand-alone firms, firms that belong to a group in the position of leader, firms that belong to a group and are controlled.

**Table 3 - Production Function Estimates**

Dependent Variable: Log of Real Output

| | Cobb-Douglas Production Functions | | | | | Translog Production Functions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Baseline | Adding controls | Prod/non-prod | 2SLS | Lev/Pet | Baseline + controls | Prod/non-prod | 2SLS | GMM | I3SLS |
| **Output elasticity** | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| High-Skill Labor | 0.187*** | 0.172*** | 0.200*** | 0.259*** | 0.183*** | 0.156*** | 0.170*** | 0.226*** | 0.239*** | 0.150*** |
| | [0.011] | [0.014] | [0.016] | [0.017] | [0.008] | [0.009] | [0.012] | [0.018] | [0.015] | [0.011] |
| Low-Skill Labor | 0.127*** | 0.119*** | 0.116*** | 0.083*** | 0.098*** | 0.140*** | 0.131*** | 0.081*** | 0.083*** | 0.026** |
| | [0.008] | [0.010] | [0.012] | [0.016] | [0.008] | [0.008] | [0.010] | [0.014] | [0.013] | [0.012] |
| Capital | 0.055*** | 0.067*** | 0.065*** | 0.044*** | 0.093 | 0.057*** | 0.071*** | 0.059*** | 0.059*** | 0.102*** |
| | [0.007] | [0.009] | [0.008] | [0.007] | [0.059] | [0.007] | [0.007] | [0.008] | [0.008] | [0.006] |
| Materials | 0.603*** | 0.610*** | 0.602*** | 0.588*** | 0.585*** | 0.640*** | 0.626*** | 0.626*** | 0.621*** | 0.663*** |
| | [0.014] | [0.018] | [0.017] | [0.012] | [0.119] | [0.007] | [0.009] | [0.009] | [0.008] | [0.007] |
| Obs. | 3132 | 2812 | 3219 | 2460 | 9759 | 2812 | 3219 | 2460 | 2460 | 2456 |
| R-squared | 0.940 | 0.947 | 0.954 | 0.942 | - | 0.958 | 0.963 | 0.952 | 0.938 | - |
| Returns to scale | 0.972 | 0.967 | 0.983 | 0.975 | 0.959 | 0.993 | 0.999 | 0.992 | 1.002 | 0.940 |
| *P* - value $H_o$: CRS | 0.000 | 0.000 | 0.002 | 0.000 | 0.197 | 0.273 | 0.821 | 0.355 | 0.817 | 0.000 |
| *P* - value Hansen *J* - stat. | | | | 0.276 | | | | 0.185 | 0.185 | 0.185 |
| *F* - Stat. of exclud. instr. (min/max) | | | | 803/1426 | | | | 255/1569 | 255/1569 | 255/1569 |

Columns (2) to (10) include the following controls: a full set of industry and region dummies, the share of part-time workers in total employment, the ratio of R&D to sales, a dummy for firms quoted on the stock market and three dummies for ownership structure. Skills are proxied by occupations in columns (3), (5) and (7), and by educational attainment otherwise. In 2SLS, GMM and I3SLS regressions, all inputs are instrumented using their first and second lags. Translog output elasticities are evaluated at the sample mean and standard errors are computed by the delta method. In column (5), Levinsohn and Petrin standard errors are based on 100 bootstrap replications. ***,**,* = significant at 1, 5 and 10 percent level, respectively.

**Table 4 – Correlation Matrix of TFP Estimates**

| | | Cobb-Douglas Production Functions | | | | | Translog Production Functions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Baseline | Adding controls | Prod/non-prod | 2SLS | Lev/Pet | Baseline+ controls | Prod/non-prod | 2SLS | GMM | I3SLS |
| | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Cobb-Douglas | Baseline | 1.00 | | | | | | | | | |
| | Adding controls | 0.94 | 1.00 | | | | | | | | |
| | Prod/non-prod | 0.91 | 0.96 | 1.00 | | | | | | | |
| | 2SLS | 0.92 | 0.96 | 0.92 | 1.00 | | | | | | |
| | Lev/Pet | 0.91 | 0.95 | 0.99 | 0.90 | 1.00 | | | | | |
| Translog | Baseline + controls | 0.84 | 0.90 | 0.88 | 0.86 | 0.87 | 1.00 | | | | |
| | Prod/non-prod | 0.83 | 0.87 | 0.90 | 0.84 | 0.89 | 0.97 | 1.00 | | | |
| | 2SLS | 0.80 | 0.84 | 0.82 | 0.89 | 0.81 | 0.94 | 0.91 | 1.00 | | |
| | GMM | 0.72 | 0.75 | 0.73 | 0.81 | 0.71 | 0.84 | 0.82 | 0.93 | 1.00 | |
| | I3SLS | 0.70 | 0.74 | 0.75 | 0.76 | 0.74 | 0.86 | 0.85 | 0.93 | 0.93 | 1.00 |

See notes to Table 3.

**Table 5 - Total Factor Productivity and Export Intensity to High- and Low-Income Countries**

Dependent Variable: Total Factor Productivity

| | Cobb-Douglas Production Functions | | | | | Translog Production Functions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Baseline | Adding controls | Prod/non-prod | 2SLS | Lev/Pet | Baseline + controls | Prod/non-prod | 2SLS | GMM | I3SLS |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| *a) Overall Export Intensity* | | | | | | | | | | |
| EXP | -0.020 | -0.020 | -0.022 | -0.039** | 0.006 | 0.000 | 0.002 | -0.016 | -0.018 | 0.003 |
| | [0.017] | [0.017] | [0.016] | [0.018] | [0.016] | [0.016] | [0.014] | [0.017] | [0.017] | [0.018] |
| Obs. | 3080 | 2805 | 3213 | 2805 | 3213 | 2805 | 3213 | 2805 | 2805 | 2805 |
| *b) Export Intensity to High-Income Countries* | | | | | | | | | | |
| $EXP_{HI}$ | -0.014 | -0.020 | -0.017 | -0.036 | 0.011 | 0.009 | 0.013 | -0.008 | -0.018 | 0.008 |
| | [0.024] | [0.024] | [0.021] | [0.025] | [0.021] | [0.022] | [0.020] | [0.024] | [0.029] | [0.027] |
| Obs. | 3063 | 2793 | 3190 | 2793 | 3190 | 2793 | 3190 | 2793 | 2793 | 2793 |
| *c) Export Intensity to Low-Income Countries* | | | | | | | | | | |
| $EXP_{LI}$ | -0.090*** | -0.076*** | -0.088*** | -0.114*** | -0.049* | -0.062** | -0.061*** | -0.092*** | -0.102*** | -0.072** |
| | [0.029] | [0.029] | [0.027] | [0.030] | [0.028] | [0.025] | [0.023] | [0.027] | [0.030] | [0.029] |
| Obs. | 3063 | 2793 | 3190 | 2793 | 3190 | 2793 | 3190 | 2793 | 2793 | 2793 |
| *d) Both Export Intensities Jointly* | | | | | | | | | | |
| $EXP_{HI}$ | -0.007 | -0.014 | -0.010 | -0.027 | 0.015 | 0.015 | 0.019 | 0.000 | -0.009 | 0.015 |
| | [0.023] | [0.023] | [0.021] | [0.025] | [0.021] | [0.022] | [0.020] | [0.024] | [0.029] | [0.026] |
| $EXP_{LI}$ | -0.089*** | -0.073*** | -0.086*** | -0.109*** | -0.052* | -0.065*** | -0.065*** | -0.092*** | -0.100*** | -0.075** |
| | [0.028] | [0.028] | [0.026] | [0.029] | [0.027] | [0.024] | [0.023] | [0.026] | [0.030] | [0.029] |
| Obs. | 3063 | 2793 | 3190 | 2793 | 3190 | 2793 | 3190 | 2793 | 2793 | 2793 |
| *e) Export Share to Low-Income Countries* | | | | | | | | | | |
| $EXP_{sh}$ | -0.049*** | -0.034* | -0.035** | -0.050*** | -0.030* | -0.037** | -0.033** | -0.051*** | -0.054*** | -0.047** |
| | [0.018] | [0.018] | [0.016] | [0.019] | [0.016] | [0.017] | [0.015] | [0.018] | [0.019] | [0.019] |
| Obs. | 2312 | 2069 | 2364 | 2069 | 2364 | 2069 | 2364 | 2069 | 2069 | 2069 |
| *f) Traditional Industries* | | | | | | | | | | |
| $EXP_{HI}$ | -0.009 | 0.001 | -0.004 | -0.030 | 0.206*** | 0.051* | 0.046* | 0.028 | 0.035 | 0.079** |
| | [0.032] | [0.034] | [0.031] | [0.036] | [0.048] | [0.028] | [0.025] | [0.031] | [0.032] | [0.032] |
| $EXP_{LI}$ | -0.117*** | -0.119*** | -0.126*** | -0.158*** | 0.112 | -0.073* | -0.079** | -0.099*** | -0.082** | -0.026 |
| | [0.042] | [0.043] | [0.043] | [0.043] | [0.079] | [0.038] | [0.038] | [0.038] | [0.038] | [0.041] |
| Obs. | 1638 | 1507 | 1705 | 1507 | 1705 | 1507 | 1705 | 1507 | 1507 | 1507 |
| *g) Other Industries* | | | | | | | | | | |
| $EXP_{HI}$ | 0.000 | -0.032 | -0.019 | -0.026 | -0.210*** | -0.039 | 0.004 | -0.031 | -0.037 | 0.022 |
| | [0.029] | [0.033] | [0.029] | [0.034] | [0.041] | [0.034] | [0.029] | [0.045] | [0.047] | [0.049] |
| $EXP_{LI}$ | -0.047 | -0.089** | -0.109*** | -0.133*** | -0.241*** | -0.067** | -0.055* | -0.081** | -0.098** | -0.049 |
| | [0.036] | [0.039] | [0.035] | [0.042] | [0.049] | [0.033] | [0.029] | [0.038] | [0.038] | [0.047] |
| Obs. | 1425 | 1286 | 1485 | 1286 | 1485 | 1286 | 1485 | 1286 | 1286 | 1286 |

OLS regressions with robust standard errors in brackets. ***,** ,* = significant at 1, 5 and 10 percent level, respectively. *EXP* = overall export intensity; $EXP_{HI}$ = export intensity to high-income countries; $EXP_{LI}$ = export intensity to low-income countries; $EXP_{sh}$ = exports to low-income countries as a share of total exports. Traditional industries are defined according to the Pavitt classification; Other industries include specialized suppliers, scale-intensive industries and science based industries.

**Table 6 - Robustness Check**

Dependent Variable: Total Factor Productivity

| | Cobb-Douglas Production Functions | | | | | Translog Production Functions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Baseline | Adding controls | Prod/non-prod | 2SLS | Lev/Pet | Baseline + controls | Prod/non-prod | 2SLS | GMM | I3SLS |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| *a) Excluding Other Asia and Other Europe from Low-Income Countries* | | | | | | | | | | |
| $EXP_{HI}$ | -0.009 | -0.016 | -0.012 | -0.031 | 0.014 | 0.014 | 0.017 | -0.002 | -0.012 | 0.013 |
| | [0.024] | [0.024] | [0.021] | [0.025] | [0.021] | [0.022] | [0.020] | [0.024] | [0.029] | [0.027] |
| $EXP_{LI}$ | -0.169*** | -0.130*** | -0.138*** | -0.162*** | -0.097** | -0.139*** | -0.117*** | -0.167*** | -0.164*** | -0.152*** |
| | [0.050] | [0.050] | [0.047] | [0.053] | [0.048] | [0.041] | [0.038] | [0.044] | [0.045] | [0.046] |
| Obs. | 3063 | 2793 | 3190 | 2793 | 3190 | 2793 | 3190 | 2793 | 2793 | 2793 |
| *b) Excluding Non-Exporters to Low-Income Countries* | | | | | | | | | | |
| $EXP_{HI}$ | -0.007 | -0.047 | -0.050 | -0.048 | -0.028 | -0.050 | -0.047 | -0.055 | -0.080 | -0.065 |
| | [0.041] | [0.040] | [0.038] | [0.045] | [0.039] | [0.040] | [0.037] | [0.047] | [0.067] | [0.056] |
| $EXP_{LI}$ | -0.152** | -0.164*** | -0.134** | -0.166** | -0.124** | -0.189*** | -0.139*** | -0.185*** | -0.198*** | -0.205*** |
| | [0.062] | [0.062] | [0.058] | [0.066] | [0.060] | [0.050] | [0.046] | [0.053] | [0.053] | [0.054] |
| Obs. | 1190 | 1074 | 1222 | 1074 | 1222 | 1074 | 1222 | 1074 | 1074 | 1074 |
| *c) Adding Controls* | | | | | | | | | | |
| $EXP_{HI}$ | -0.010 | -0.015 | -0.001 | -0.022 | 0.025 | 0.018 | 0.031 | 0.003 | -0.010 | 0.013 |
| | [0.028] | [0.027] | [0.026] | [0.030] | [0.026] | [0.024] | [0.022] | [0.028] | [0.036] | [0.032] |
| $EXP_{LI}$ | -0.089*** | -0.072** | -0.076*** | -0.101*** | -0.041 | -0.059** | -0.050* | -0.086*** | -0.099*** | -0.074** |
| | [0.031] | [0.031] | [0.029] | [0.032] | [0.030] | [0.028] | [0.027] | [0.031] | [0.037] | [0.035] |
| IMPINT | 0.038 | -0.038 | -0.049 | -0.054 | -0.029 | -0.030 | -0.043 | -0.040 | -0.021 | -0.015 |
| | [0.045] | [0.046] | [0.041] | [0.049] | [0.040] | [0.041] | [0.036] | [0.044] | [0.042] | [0.041] |
| SERV | 0.011 | 0.006 | -0.001 | 0.003 | 0.011 | -0.001 | -0.006 | -0.007 | -0.014 | -0.011 |
| | [0.014] | [0.014] | [0.013] | [0.015] | [0.013] | [0.014] | [0.012] | [0.015] | [0.018] | [0.017] |
| INSH | 0.004 | 0.005 | -0.009 | -0.004 | -0.018 | -0.001 | -0.016 | 0.000 | 0.010 | 0.011 |
| | [0.023] | [0.022] | [0.021] | [0.024] | [0.021] | [0.021] | [0.020] | [0.024] | [0.030] | [0.028] |
| FDI | -1.378*** | -1.043* | -0.955* | -0.955* | -0.620 | -1.008* | -0.679 | -0.764 | -0.757 | -0.444 |
| | [0.488] | [0.540] | [0.538] | [0.519] | [0.556] | [0.530] | [0.488] | [0.561] | [0.527] | [0.614] |
| Obs. | 2932 | 2743 | 3135 | 2743 | 3135 | 2743 | 3135 | 2743 | 2743 | 2743 |

OLS regressions with robust standard errors in brackets. ***,**,* = significant at 1, 5 and 10 percent level, respectively. *IMPINT* = share of imported inputs in total input purchases; *SERV* = dummy variable equal to 1 for importers of services; *INSH* = share of sales subcontracted from abroad; *FDI* = ratio of outward FDI to sales over the period 2001-2003.

**Table 7 - Export Intensity and Productivity Across Destination Markets: Cross-Sectional Regressions**
Dependent Variable: Log of Exports to Selected Areas over Domestic Sales

| | Cobb-Douglas Production Functions | | | | | Translog Production Functions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Baseline | Adding controls | Prod/non-prod | 2SLS | Lev/Pet | Baseline + controls | Prod/non-prod | 2SLS | GMM | I3SLS |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| *Africa* | | | | | | | | | | |
| TFP | -0.714* | -0.696* | -0.744** | -0.718* | -0.677* | -1.014** | -0.674 | -1.018** | -0.934** | -0.998*** |
| | [0.368] | [0.397] | [0.374] | [0.383] | [0.359] | [0.436] | [0.411] | [0.398] | [0.396] | [0.373] |
| Obs. | 503 | 449 | 520 | 449 | 520 | 449 | 520 | 449 | 449 | 449 |
| *China* | | | | | | | | | | |
| TFP | -0.835* | -1.309** | -1.760*** | -1.261** | -1.497*** | -2.064*** | -2.336*** | -1.850*** | -1.562*** | -1.757*** |
| | [0.461] | [0.545] | [0.514] | [0.530] | [0.487] | [0.584] | [0.595] | [0.488] | [0.402] | [0.417] |
| Obs. | 290 | 260 | 294 | 260 | 294 | 260 | 294 | 260 | 260 | 260 |
| *Latin America* | | | | | | | | | | |
| TFP | -0.887*** | -1.192*** | -1.035*** | -0.934*** | -1.036*** | -1.385*** | -0.921** | -1.086*** | -0.767*** | -1.056*** |
| | [0.293] | [0.347] | [0.325] | [0.322] | [0.316] | [0.389] | [0.373] | [0.331] | [0.278] | [0.301] |
| Obs. | 444 | 409 | 467 | 409 | 467 | 409 | 467 | 409 | 409 | 409 |
| *New EU Members* | | | | | | | | | | |
| TFP | -0.737** | -0.728** | -0.597** | -0.621** | -0.566** | -0.868*** | -0.599** | -0.636** | -0.550*** | -0.474** |
| | [0.301] | [0.322] | [0.283] | [0.295] | [0.279] | [0.288] | [0.260] | [0.247] | [0.187] | [0.223] |
| Obs. | 776 | 706 | 800 | 706 | 800 | 706 | 800 | 706 | 706 | 706 |
| *EU15* | | | | | | | | | | |
| TFP | -0.076 | -0.059 | -0.007 | -0.062 | 0.126 | -0.022 | 0.052 | 0.017 | -0.035 | 0.029 |
| | [0.165] | [0.175] | [0.163] | [0.167] | [0.159] | [0.189] | [0.175] | [0.173] | [0.135] | [0.145] |
| Obs. | 2132 | 1906 | 2170 | 1906 | 2170 | 1906 | 2170 | 1906 | 1906 | 1906 |
| *North America* | | | | | | | | | | |
| TFP | 0.074 | 0.038 | 0.004 | 0.014 | -0.018 | -0.080 | -0.107 | -0.126 | -0.188 | -0.293 |
| | [0.237] | [0.268] | [0.257] | [0.272] | [0.251] | [0.285] | [0.274] | [0.270] | [0.230] | [0.246] |
| Obs. | 978 | 889 | 1018 | 889 | 1018 | 889 | 1018 | 889 | 889 | 889 |

OLS regressions with robust standard errors in brackets. ***,**,* = significant at 1, 5 and 10 percent level, respectively. See notes to previous tables.

**Table 8 - Export Intensity and Productivity Across Destination Markets: Panel Regressions**

Dependent Variables: Log of Exports to Area *f* Over Domestic Sales ($EXP_{j,f}$)

| | Cobb-Douglas Production Functions | | | | | Translog Production Functions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Baseline | Adding controls | Prod/non-prod | 2SLS | Lev/Pet | Baseline + controls | Prod/non-prod | 2SLS | GMM | I3SLS |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| *a) Baseline* | | | | | | | | | | |
| TFP | -0.361* | -0.424** | -0.665*** | -0.374* | -0.620*** | -0.770*** | -0.730*** | -0.693*** | -0.619*** | -0.760*** |
| | [0.189] | [0.207] | [0.204] | [0.194] | [0.195] | [0.231] | [0.223] | [0.200] | [0.161] | [0.169] |
| **TFP*income** | **0.390** | **0.393** | **0.660**** | **0.345** | **0.683***** | **0.706**** | **0.711**** | **0.643**** | **0.519**** | **0.652***** |
| | **[0.242]** | **[0.268]** | **[0.259]** | **[0.256]** | **[0.248]** | **[0.295]** | **[0.281]** | **[0.263]** | **[0.213]** | **[0.222]** |
| Area Dummies | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Obs. | 7068 | 6394 | 7283 | 6394 | 7283 | 6394 | 7283 | 6394 | 6394 | 6394 |
| R-squared | 0.10 | 0.10 | 0.11 | 0.10 | 0.11 | 0.10 | 0.11 | 0.10 | 0.10 | 0.11 |
| *b) Adding TFP Interacted with Population* | | | | | | | | | | |
| TFP | -0.951*** | -1.007*** | -1.100*** | -0.831*** | -1.041*** | -1.337*** | -1.033*** | -1.120*** | -0.807*** | -0.976*** |
| | [0.264] | [0.288] | [0.276] | [0.269] | [0.268] | [0.301] | [0.294] | [0.268] | [0.214] | [0.229] |
| **TFP*income** | **0.833***** | **0.835***** | **0.987***** | **0.689**** | **1.000***** | **1.132***** | **0.937***** | **0.959***** | **0.649***** | **0.807***** |
| | **[0.275]** | **[0.305]** | **[0.289]** | **[0.291]** | **[0.280]** | **[0.323]** | **[0.311]** | **[0.292]** | **[0.234]** | **[0.248]** |
| TFP*population | 0.027*** | 0.027*** | 0.020** | 0.021** | 0.019** | 0.026** | 0.014 | 0.021** | 0.010 | 0.011 |
| | [0.009] | [0.009] | [0.010] | [0.009] | [0.009] | [0.010] | [0.011] | [0.010] | [0.009] | [0.009] |
| Area Dummies | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Obs. | 7068 | 6394 | 7283 | 6394 | 7283 | 6394 | 7283 | 6394 | 6394 | 6394 |
| R-squared | 0.10 | 0.11 | 0.11 | 0.10 | 0.11 | 0.11 | 0.11 | 0.11 | 0.11 | 0.11 |
| *c) Adding Industry Dummies* | | | | | | | | | | |
| TFP | -0.795*** | -0.796*** | -0.812*** | -0.608** | -0.776*** | -1.121*** | -0.707** | -0.925*** | -0.630*** | -0.786*** |
| | [0.256] | [0.280] | [0.269] | [0.264] | [0.260] | [0.292] | [0.286] | [0.259] | [0.196] | [0.213] |
| **TFP*income** | **0.688***** | **0.652**** | **0.778***** | **0.512*** | **0.811***** | **0.949***** | **0.711**** | **0.800***** | **0.506**** | **0.673***** |
| | **[0.265]** | **[0.294]** | **[0.278]** | **[0.282]** | **[0.269]** | **[0.309]** | **[0.296]** | **[0.279]** | **[0.210]** | **[0.229]** |
| TFP*population | 0.024*** | 0.022** | 0.015 | 0.017* | 0.014 | 0.022** | 0.008 | 0.017* | 0.008 | 0.009 |
| | [0.009] | [0.009] | [0.010] | [0.009] | [0.009] | [0.010] | [0.011] | [0.009] | [0.009] | [0.009] |
| Area Dummies | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Industry Dummies | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Obs. | 7068 | 6394 | 7283 | 6394 | 7283 | 6394 | 7283 | 6394 | 6394 | 6394 |
| R-squared | 0.16 | 0.16 | 0.16 | 0.15 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 | 0.16 |
| *d) Adding Controls* | | | | | | | | | | |
| TFP | -0.829*** | -0.753*** | -0.607** | -0.533** | -0.631*** | -0.961*** | -0.440* | -0.805*** | -0.567*** | -0.725*** |
| | [0.231] | [0.253] | [0.250] | [0.240] | [0.243] | [0.265] | [0.264] | [0.237] | [0.186] | [0.199] |
| **TFP*income** | **0.732***** | **0.608**** | **0.595**** | **0.468*** | **0.663***** | **0.825***** | **0.483*** | **0.709***** | **0.469**** | **0.593***** |
| | **[0.236]** | **[0.262]** | **[0.255]** | **[0.254]** | **[0.249]** | **[0.273]** | **[0.268]** | **[0.249]** | **[0.189]** | **[0.207]** |
| TFP*population | 0.023*** | 0.020** | 0.013 | 0.015* | 0.015* | 0.020** | 0.005 | 0.016* | 0.007 | 0.010 |
| | [0.008] | [0.008] | [0.008] | [0.008] | [0.008] | [0.009] | [0.009] | [0.008] | [0.008] | [0.008] |
| IMPINT | 0.244* | 0.295** | 0.191 | 0.299** | 0.193 | 0.287** | 0.191 | 0.292** | 0.291** | 0.297** |
| | [0.134] | [0.136] | [0.131] | [0.136] | [0.131] | [0.135] | [0.131] | [0.136] | [0.136] | [0.136] |
| FDI | -4.166* | -5.413** | -5.532** | -5.335** | -5.481** | -5.464** | -5.490** | -5.383** | -5.388** | -5.372** |
| | [2.485] | [2.580] | [2.472] | [2.584] | [2.474] | [2.586] | [2.475] | [2.586] | [2.586] | [2.574] |
| SERV | 0.180*** | 0.157*** | 0.166*** | 0.156*** | 0.166*** | 0.156*** | 0.165*** | 0.154*** | 0.152*** | 0.152*** |
| | [0.043] | [0.044] | [0.041] | [0.044] | [0.041] | [0.044] | [0.041] | [0.044] | [0.044] | [0.044] |
| INSH | 2.362*** | 2.375*** | 2.354*** | 2.374*** | 2.355*** | 2.372*** | 2.354*** | 2.372*** | 2.374*** | 2.374*** |
| | [0.067] | [0.069] | [0.064] | [0.069] | [0.064] | [0.069] | [0.064] | [0.069] | [0.069] | [0.069] |
| Area Dummies | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Industry Dummies | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Obs. | 6784 | 6281 | 7163 | 6281 | 7163 | 6281 | 7163 | 6281 | 6281 | 6281 |
| R-squared | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |

OLS regressions with robust standard errors in brackets. ***,**,* = significant at 1, 5 and 10 percent level, respectively. The panel is obtained by pooling data on export intensities to the following geographic areas: EU15, New EU Members, Other European countries, North America, China, Other Asian countries, Latin America, Africa and Oceania. Income equals average PPP per capita income of each area relative to Italy's. Area's population is measured relative to Italy's.

**Table 9 - Export Shares and Productivity Across Destination Markets: Panel Regressions**

Dependent Variables: Log of Exports to Area *f* Over Total Exports

| | Cobb-Douglas Production Functions | | | | | Translog Production Functions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Baseline | Adding controls | Prod/non-prod | 2SLS | Lev/Pet | Baseline + controls | Prod/non-prod | 2SLS | GMM | I3SLS |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| *a) Baseline* | | | | | | | | | | |
| TFP | -0.494*** | -0.330*** | -0.327*** | -0.306** | -0.446*** | -0.380*** | -0.326** | -0.372*** | -0.346*** | -0.394*** |
| | [0.120] | [0.123] | [0.120] | [0.119] | [0.117] | [0.134] | [0.129] | [0.119] | [0.102] | [0.102] |
| **TFP*income** | **0.140*** ** | **0.090** ** | **0.105** ** | **0.101** ** | **0.123*** ** | **0.109** ** | **0.098** ** | **0.126*** ** | **0.109*** ** | **0.125*** ** |
| | **[0.042]** | **[0.044]** | **[0.043]** | **[0.043]** | **[0.042]** | **[0.047]** | **[0.045]** | **[0.043]** | **[0.036]** | **[0.037]** |
| Area Dummies | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Obs. | 7068 | 6394 | 7283 | 6394 | 7283 | 6394 | 7283 | 6394 | 6394 | 6394 |
| R-squared | 0.41 | 0.40 | 0.41 | 0.40 | 0.41 | 0.40 | 0.41 | 0.40 | 0.40 | 0.40 |
| *b) Adding TFP Interacted with Population* | | | | | | | | | | |
| TFP | -0.817*** | -0.589*** | -0.501*** | -0.395** | -0.687*** | -0.638*** | -0.494*** | -0.479*** | -0.346** | -0.454*** |
| | [0.172] | [0.183] | [0.177] | [0.177] | [0.170] | [0.195] | [0.186] | [0.173] | [0.140] | [0.143] |
| **TFP*income** | **0.213*** ** | **0.150*** ** | **0.144*** ** | **0.121** ** | **0.178*** ** | **0.167*** ** | **0.136** ** | **0.150*** ** | **0.109*** ** | **0.138*** ** |
| | **[0.050]** | **[0.054]** | **[0.052]** | **[0.052]** | **[0.050]** | **[0.057]** | **[0.055]** | **[0.052]** | **[0.041]** | **[0.043]** |
| TFP*population | 1.643*** | 1.290** | 0.875 | 0.459 | 1.217** | 1.310** | 0.857 | 0.566 | -0.003 | 0.349 |
| | [0.577] | [0.588] | [0.610] | [0.604] | [0.592] | [0.641] | [0.650] | [0.610] | [0.553] | [0.553] |
| Area Dummies | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Obs. | 7068 | 6394 | 7283 | 6394 | 7283 | 6394 | 7283 | 6394 | 6394 | 6394 |
| R-squared | 0.41 | 0.40 | 0.41 | 0.40 | 0.41 | 0.40 | 0.41 | 0.40 | 0.40 | 0.40 |
| *c) Adding Industry Dummies* | | | | | | | | | | |
| TFP | -0.857*** | -0.625*** | -0.540*** | -0.432** | -0.704*** | -0.686*** | -0.548*** | -0.524*** | -0.387*** | -0.516*** |
| | [0.173] | [0.183] | [0.177] | [0.177] | [0.170] | [0.195] | [0.186] | [0.172] | [0.142] | [0.146] |
| **TFP*income** | **0.218*** ** | **0.156*** ** | **0.150*** ** | **0.128** ** | **0.181*** ** | **0.176*** ** | **0.146*** ** | **0.159*** ** | **0.117*** ** | **0.148*** ** |
| | **[0.050]** | **[0.054]** | **[0.052]** | **[0.052]** | **[0.050]** | **[0.057]** | **[0.054]** | **[0.051]** | **[0.041]** | **[0.043]** |
| TFP*population | 1.722*** | 1.404** | 0.979 | 0.560 | 1.314** | 1.452** | 0.978 | 0.675 | 0.050 | 0.423 |
| | [0.583] | [0.592] | [0.614] | [0.608] | [0.593] | [0.644] | [0.655] | [0.616] | [0.557] | [0.564] |
| Area Dummies | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Industry Dummies | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Obs. | 7068 | 6394 | 7283 | 6394 | 7283 | 6394 | 7283 | 6394 | 6394 | 6394 |
| R-squared | 0.41 | 0.41 | 0.42 | 0.41 | 0.42 | 0.41 | 0.42 | 0.41 | 0.41 | 0.41 |
| *d) Adding Controls* | | | | | | | | | | |
| TFP | -0.880*** | -0.650*** | -0.596*** | -0.458** | -0.737*** | -0.718*** | -0.605*** | -0.561*** | -0.420*** | -0.542*** |
| | [0.176] | [0.186] | [0.178] | [0.179] | [0.171] | [0.197] | [0.186] | [0.174] | [0.143] | [0.146] |
| **TFP*income** | **0.221*** ** | **0.160*** ** | **0.163*** ** | **0.131** ** | **0.192*** ** | **0.179*** ** | **0.157*** ** | **0.162*** ** | **0.121*** ** | **0.151*** ** |
| | **[0.051]** | **[0.055]** | **[0.052]** | **[0.053]** | **[0.050]** | **[0.058]** | **[0.055]** | **[0.052]** | **[0.042]** | **[0.043]** |
| TFP*population | 1.745*** | 1.387** | 0.977 | 0.583 | 1.291** | 1.466** | 0.966 | 0.749 | 0.094 | 0.471 |
| | [0.611] | [0.618] | [0.647] | [0.630] | [0.623] | [0.672] | [0.691] | [0.637] | [0.568] | [0.579] |
| IMPINT | -0.204** | -0.163 | -0.160* | -0.162 | -0.161* | -0.164 | -0.162* | -0.160 | -0.162 | -0.156 |
| | [0.098] | [0.102] | [0.097] | [0.102] | [0.097] | [0.102] | [0.097] | [0.102] | [0.102] | [0.102] |
| FDI | -0.678 | -0.812 | -0.769 | -0.749 | -0.744 | -0.801 | -0.711 | -0.726 | -0.736 | -0.726 |
| | [1.335] | [1.382] | [1.331] | [1.391] | [1.329] | [1.381] | [1.332] | [1.388] | [1.393] | [1.390] |
| SERV | -0.160*** | -0.162*** | -0.183*** | -0.163*** | -0.179*** | -0.164*** | -0.184*** | -0.166*** | -0.167*** | -0.167*** |
| | [0.029] | [0.031] | [0.028] | [0.031] | [0.028] | [0.031] | [0.028] | [0.031] | [0.031] | [0.031] |
| INSH | -0.131*** | -0.137*** | -0.131*** | -0.138*** | -0.132*** | -0.140*** | -0.132*** | -0.140*** | -0.138*** | -0.139*** |
| | [0.045] | [0.047] | [0.044] | [0.047] | [0.044] | [0.047] | [0.044] | [0.047] | [0.047] | [0.047] |
| Area Dummies | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Industry Dummies | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Obs. | 6784 | 6281 | 7163 | 6281 | 7163 | 6281 | 7163 | 6281 | 6281 | 6281 |
| R-squared | 0.41 | 0.41 | 0.42 | 0.41 | 0.42 | 0.41 | 0.42 | 0.41 | 0.41 | 0.41 |

OLS regressions with robust standard errors in brackets. ***,**,* = significant at 1, 5 and 10 percent level, respectively. Income and population of each area are measured relative to the world's.

**Table A1 – Estimated Translog Production Function Parameters**

| | Baseline + controls | Prod/ non-prod | 2SLS | GMM | I3SLS |
|---|---|---|---|---|---|
| $\beta_S$ | -0.054 | -0.087 | 0.081 | 1.116*** | 0.588*** |
| | [0.309] | [0.318] | [0.622] | [0.315] | [0.122] |
| $\beta_U$ | 0.152 | 0.155 | 0.109 | 0.455* | 0.679*** |
| | [0.268] | [0.286] | [0.363] | [0.264] | [0.121] |
| $\beta_K$ | 0.765*** | 0.738*** | 0.505* | 0.022 | 0.100 |
| | [0.214] | [0.214] | [0.280] | [0.141] | [0.071] |
| $\beta_M$ | -0.001 | -0.010 | -0.078 | -0.862*** | -0.623*** |
| | [0.300] | [0.286] | [0.472] | [0.253] | [0.098] |
| $\beta_{KK}$ | 0.012** | 0.013** | 0.030** | 0.049*** | 0.051*** |
| | [0.006] | [0.006] | [0.013] | [0.010] | [0.007] |
| $\beta_{MM}$ | 0.113*** | 0.111*** | 0.111*** | 0.152*** | 0.145*** |
| | [0.022] | [0.023] | [0.027] | [0.017] | [0.010] |
| $\beta_{MK}$ | -0.069*** | -0.068*** | -0.066*** | -0.042*** | -0.047*** |
| | [0.016] | [0.015] | [0.015] | [0.009] | [0.006] |
| $\beta_{SS}$ | 0.042* | 0.055** | 0.049 | 0.102*** | 0.107*** |
| | [0.021] | [0.024] | [0.042] | [0.028] | [0.014] |
| $\beta_{UU}$ | 0.025* | 0.050*** | 0.057* | 0.042 | 0.106*** |
| | [0.013] | [0.016] | [0.034] | [0.027] | [0.014] |
| $\beta_{SK}$ | 0.026** | 0.040*** | 0.028 | -0.003 | 0.012 |
| | [0.012] | [0.013] | [0.018] | [0.011] | [0.008] |
| $\beta_{UK}$ | 0.033*** | 0.024*** | 0.018 | -0.002 | -0.012 |
| | [0.009] | [0.009] | [0.015] | [0.012] | [0.008] |
| $\beta_{SU}$ | -0.060*** | -0.085*** | -0.084*** | -0.041* | -0.056*** |
| | [0.014] | [0.017] | [0.031] | [0.022] | [0.014] |
| $\beta_{SM}$ | -0.006 | -0.010 | -0.008 | -0.065*** | -0.047*** |
| | [0.022] | [0.024] | [0.039] | [0.022] | [0.010] |
| $\beta_{UM}$ | -0.026 | -0.020 | -0.015 | -0.023 | -0.044*** |
| | [0.017] | [0.019] | [0.026] | [0.020] | [0.010] |