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# Living with Lower Productivity Growth: Impact on Exports


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# Living with Lower Productivity Growth: Impact on Exports*


## Abstract

This paper investigates the impact of sustained lower productivity growth on exports, by looking at the role of the productivity distribution and allocative efficiency as drivers of export performance. It follows and goes beyond the work of Barba Navaretti et al. (2017), analysing the effects of productivity on exports depending on the dynamics of allocative efficiency. Low productivity growth is a well-documented stylised fact in Western countries – and possibly a reality likely to persist for some time. What could be the impact of persistent sluggish growth of productivity on exports? To shed light on this question, this paper examines the relationship between the productivity distribution of firms and sectoral export performance. The structure of firms within countries or even sectors matters tremendously for the nexus between productivity and exports at the macroeconomic level, as the theoretical and empirical literature documents. For instance, whether too few firms at the top (lack of innovation) or too many firms at the bottom (weak market selection) drives slow average productivity at the macro level has very different implications and therefore demands different policy responses.


*Keywords: productivity, exports*

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This paper investigates the impact of sustained lower productivity growth on exports, by looking at the role of the productivity distribution and allocative efficiency as drivers of export performance. It follows and goes beyond the work of Barba Navaretti et al. (2017), analyzing the effects of productivity on exports depending on the dynamics of allocative efficiency.

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The structure of firms within countries or even sectors matters tremendously for the nexus between productivity and exports at the macroeconomic level, as the theoretical and empirical literature documents. For instance, whether too few firms at the top (lack of innovation) or too many firms at the bottom (weak market selection) drives slow average productivity at the macro level has very different implications and therefore demands different policy responses.

The findings in this paper relate to the literature that uses firm-level data to explore the relation between export and productivity, starting with Melitz (2003). In particular, the paper elaborates on the results of Mayer and Ottaviano (2011) and Gabaix (2011), who show that aggregate economic outcomes are related mostly to the behavior of a small set of large and highly productive firms (the right tail of the productivity distribution).

The paper is organized as follows. The first section presents econometric attempts to quantify the productivity–export nexus for a sample of countries in the European Union, taking into consideration higher moments of the productivity distribution. The second section introduces the role of allocative efficiency and provides some initial results on its possible drivers. The third section pulls the results together and provides initial estimates of a novel specification of export performance that accounts for different moments of the productivity distribution as well as allocative efficiency. The fourth section uses the results to construct alternative export scenarios, based on alternative hypotheses about future productivity. The last section provides some concluding remarks.

## Estimating the Export–Productivity Nexus

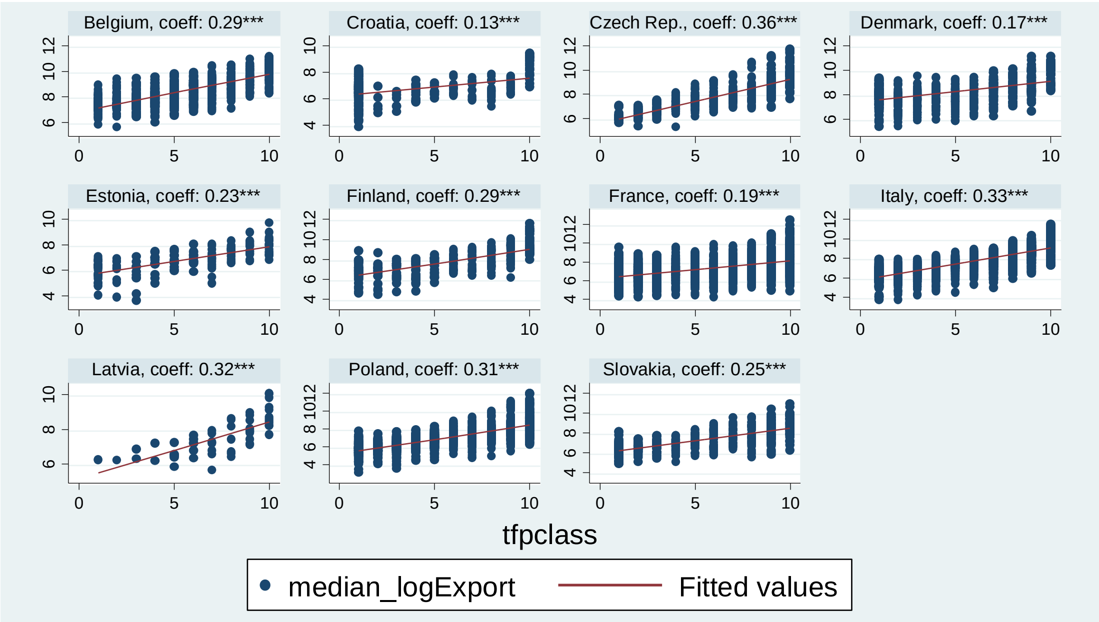
The basic intuition emerging from the literature is that because of fixed export costs, firms have to be productive in order to export. The right tail of the productivity distribution of firms is thus what matters most for the export prowess of an economy.

Testing such a simple theory presents some difficulties, because many factors may confound the effect of productivity dispersion on exports. To overcome this bias, this paper relies on a gravity approach, based on the two-step methodology discussed below.

Data come from the Competitiveness Research Network (CompNet), a unique micro-aggregated database that provides a rich set of information on the variables' distribution at the granular level, together with micro-founded indicators such as the level of allocation efficiency. They are based on firm-level balance sheet information drawn from more than 15

European countries.[1] These data are of particular interest, because they provide the moments of the distributions of the variables of interest. Detailed information on the structure and the methodology of CompNet is available in Lopez-Garcia, di Mauro, and the CompNet Task Force (2015).

**Figure 1**
**Correlation between median export levels and median total factor productivity decile in selected countries**




Note: The figure presents the relationship between the logarithm of exports of the median firm and the total factor productivity decile of each sector-year combination, by country. The distribution of exports is computed over the population of firms in the given sector-year combination. Each point is a sector-year observation.

*Source*: Authors' calculations based on CompNet data.

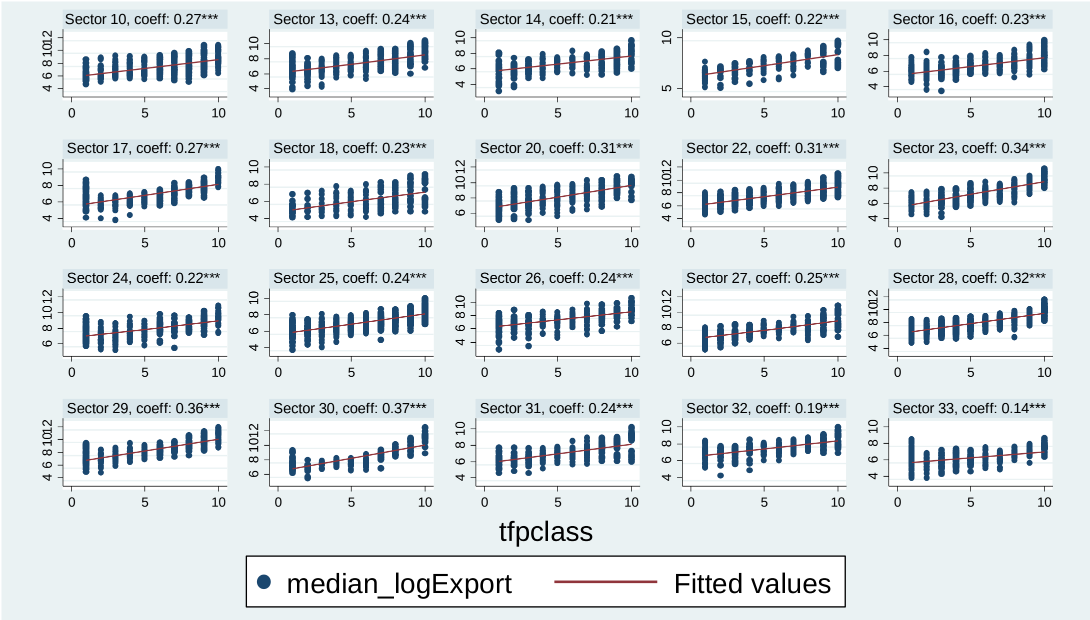
Starting with stylized facts, the data show that both the level and the growth rate of exports are higher in the highest deciles of the productivity distribution. This relation holds at different levels of aggregation, with a positive and significant correlation across countries, sectors, and years (figures 1 and 2), at both the country and sector levels.

The potential role of the higher moments of the productivity distribution is explored by examining the correlation between export competitiveness and a set of dispersion measures: the skewness index, the Pearson's coefficient, and the ratios between percentiles (p80/p20, p90/p10). Evidence on these correlations is provided based on a two-step procedure.

In the first step, an index of export competitiveness is computed using a gravity equation approach: a two-stage estimation procedure uses an equation for selection into trade partners in the first stage and a trade flow equation in the second (Helpman, Melitz, and Rubinstein 2008; see appendix A for details on the procedure). As expected, the highest values correspond to Europe's largest and most central countries: Germany, France, and Italy (Table 1).

[1] See appendix A for the list of countries and their time coverage.

**Figure 2**
**Correlation between median export levels and median total factor productivity decile in selected sectors**




*Note*: The figure presents the relationship between the logarithm of export of the median firm and the total factor producivity decile of each country-year combination, by sector. The distribution of exports is computed over the population of firms in the given country-year combination. Each point is a country-year observation. The numbers identifying the sectors follow the NACE Rev.2 sector classification.

*Source*: Authors' calculations based on CompNet data.

In the second step, the index of competitiveness is used in its logarithmic transformation, as a dependent variable, to test the roles of the mean and the dispersion of the productivity distribution in the presence of a large set of control variables (market size, wage levels, and fixed effects by country, sector, and year). Three alternative dispersion indexes are used: the p90/p10 ratio, the skewness index, and the asymmetry index (Pearson's second skewness coefficient).[2] The coefficients of productivity dispersion are retrieved through the following regression equation:

$$(1)\ Export.Competitiveness_{i,s,t} = \alpha_0 + \alpha_1 LogTFP(Median)_{i,s,t-1} + \alpha_2 LogTFP(Mean)_{i,s,t-1} + [\alpha_3 TFP(\frac{p90}{p10})_{i,s,t-1}] + \alpha_4 Log\ LaborCost_{i,s,t-1} + \alpha_5 Log\ Firms_{i,s,t-1} + \alpha_6 Disp_{i,s,t-1} + C_i + S_s + T_t + u_{i,s,t}$$

where $Disp_{i,s,t-1}$ is one of the two dispersion indexes other than p90/p10, and $C_i, S_s,\ and\ T_t$ are country, sector, and year fixed effects, respectively. (The third section discusses the term $[\alpha_2 TFP(\frac{p90}{p10})_{i,s,t-1}]$.)

[2] Asymmetry is defined as $Pears._{i,s,t} = \frac{mean_{i,s,t} - median_{i,s,t}}{st.dev._{i,s,t}}$.

**Table 1**
**Export competitiveness of selected countries**

| Country | Mean | Standard deviation |
|---|---|---|
| Austria | 3.55 | 2.53 |
| Belgium | 4.27 | 2.42 |
| Croatia | 0.49 | 2.75 |
| Estonia | 0.94 | 2.84 |
| Finland | 2.95 | 2.74 |
| France | 5.14 | 2.39 |
| Germany | 5.93 | 2.50 |
| Hungary | 2.41 | 2.60 |
| Italy | 5.35 | 2.37 |
| Lithuania | 1.11 | 2.85 |
| Poland | 3.30 | 2.73 |
| Portugal | 2.88 | 2.71 |
| Romania | 2.02 | 2.81 |
| Slovakia | 1.81 | 2.63 |
| Slovenia | 1.35 | 2.62 |
| Spain | 4.59 | 2.46 |
| | | |
| Average for all countries in sample | 3.05 | 3.02 |

*Note*: Figures represent the logarithm of export competitiveness fixed effects, estimated in a two-step procedure following Helpman, Melitz, and Rubinstein (2008). The analysis covers a sample of bilateral export flows from OECD countries to destination countries for several manufacturing sectors from 2001 to 2012. Both CompNet and other countries are included.

*Source*: Authors' calculations based on CompNet and OECD data.

Table 2 reports the regression results. The productivity dispersion as measured by p90/p10 index is always significant in explaining export performance.

**Table 2**
**Effect of different moments of the total factor productivity distribution on export competitiveness**

| Variable | (1) Export $Comp_t$ | (2) Export $Comp_t$ | (3) Export $Comp_t$ | (4) Export $Comp_t$ | (5) Export $Comp_t$ | (6) Export $Comp_t$ |
|---|---|---|---|---|---|---|
| logTFP(Median) $_{t-1}$ | 0.028*** | 0.022** | 0.027*** | | | |
| | (0.009) | (0.009) | (0.009) | | | |
| logTFP(Mean) $_{t-1}$ | | | | 0.028*** | 0.023** | 0.027*** |
| | | | | (0.009) | (0.009) | (0.010) |
| logTFP(p90/p10) $_{t-1}$ | 0.073*** | 0.081*** | 0.086*** | 0.072*** | 0.08*** | 0.084*** |
| | (0.018) | (0.018) | (0.018) | (0.018) | (0.018) | (0.018) |
| Asymm $_{t-1}$ | | 0.042 | | | 0.04 | |
| | | (0.041) | | | (0.041) | |
| Skewness $_{t-1}$ | | | 0.051** | | | 0.052** |
| | | | (0.025) | | | (0.025) |
| Log Firms $_{t-1}$ | 0.492*** | 0.53*** | 0.521*** | 0.492*** | 0.53*** | 0.52*** |
| | (0.049) | (0.042) | (0.042) | (0.049) | (0.042) | (0.042) |
| Log Labor Cost $_{t-1}$ | 0.65*** | 0.662*** | 0.672*** | 0.649*** | 0.661*** | 0.669*** |
| | (0.052) | (0.054) | (0.055) | (0.052) | (0.055) | (0.055) |
| Constant | –3.2*** | –3.559*** | –3.691*** | –3.191*** | –3.556*** | –3.668*** |
| | (0.618) | (0.596) | (0.598) | (0.618) | (0.596) | (0.599) |
| Observations | 1,685 | 1,629 | 1,644 | 1,685 | 1,629 | 1,643 |
| *R*-squared | 0.97 | 0.97 | 0.97 | 0.97 | 0.97 | 0.97 |

*Note:* Country, year, and sector fixed effects are included. Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

*Source*: Authors' calculations based on CompNet data.

### Interaction between Productivity Dispersion and Allocative Efficiency

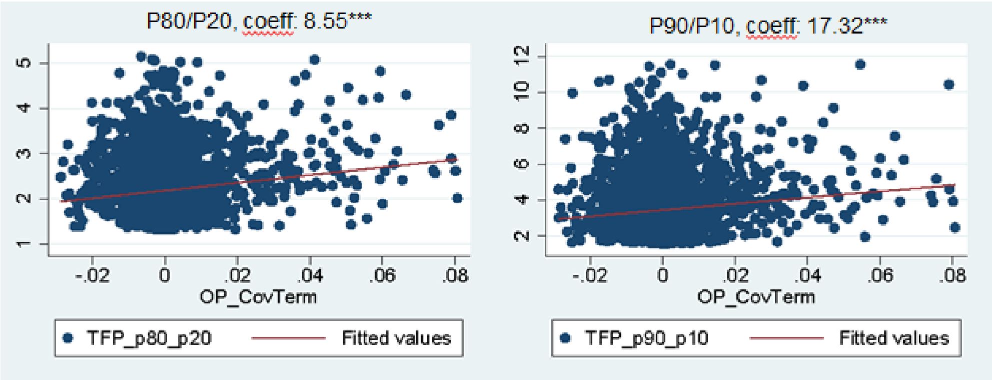
Having established that productivity dispersion matters, it is time to look at its drivers, including their interaction with allocative efficiency. One can conjecture a variety of drivers of the asymmetry of the distribution, including the following:

- Innovation can push the frontier of productivity outward, stretching the right tail of the distribution as innovators increase the distance between them and other firms. The rate at which other firms are able to follow the innovators defines the skewness of productivity. If technological change is able to spread out in the economy, skewness may not increase dramatically; if technology remains limited to a restricted share of firms, skewness will increase, as the rest of the distribution will lag behind.
- Labor market institutions (e.g. bargaining mechanisms, workers unions, etc…) play a role in determining the efficiency of the allocation of laborers among firms. If these institutions are effective, they will channel workers toward more productive firms, which will increase in size, thickening the right tail of the distribution.

- Financial markets can help increase allocative efficiency by awarding resources to the most productive firms.
- Insolvency laws are among the factors that operate on the selection side of firms' demography. The extent to which distressed or unproductive firms are allowed to stay on the market can have important effects on aggregate productivity figures. Allowing distressed or unproductive firms to stay in the market (e.g., by subsidizing them) may indeed increases the misallocation of resources and reduces export competitiveness.

What matters for aggregate productivity growth is whether resources are efficiently reallocated toward the most productive segment of the economy. We first define *allocative efficiency* according to the method of Olley and Pakes (1996), by computing the extent to which firms with higher productivity have a larger market share (the so-called OP gap, computed as the covariance of the change in productivity and firm size with respect to the mean).[3]

**Figure 3**
**Correlation between productivity asymmetry and allocative efficiency**




*Note:* Each point is a sector-year observation.

*Source*: Authors' calculations based on CompNet data.

We regress the two main indexes used to proxy productivity dispersion (P80/P20 and P90/P10; figure 3) on the OP gap. The correlation between these variables is robust and positive after controlling for country and year fixed effects (table 3). This finding suggests a crucial role for reallocation policies, which can increase growth not only by affecting aggregate productivity but also by strengthening the export channel.

[3] The OP gap is defined as $\sum_i^N (s_{it} - \widehat{s_t})(\varphi_{it} - \widehat{\varphi_t})$, where $s_{it}$ represents the single firm's market share, s.t. $s_{it} \in (0,1)$, $\sum_i^N s_{it}=1$, $\varphi_{it}$ is the single firm's level of productivity, $\widehat{s_t} = \frac{1}{N}\sum_i^N s_{it}$ is the mean market share, and $\widehat{\varphi_t} = \frac{1}{N}\sum_i^N \varphi_{it}$ is the unweighted mean productivity.

**Table 3**
**Coefficients on productivity asymmetry and allocative efficiency**

| | P80/P20 | P80/P20 | P90/P10 | P90/P10 |
|---|---|---|---|---|
| OP | 8.5*** | 3.58*** | 17.32*** | 4.18* |
| Constant | Yes | Yes | Yes | Yes |
| Country fixed effects | No | Yes | No | Yes |
| Year fixed effects | No | Yes | No | Yes |

*Source*: Authors' calculations based on CompNet data.

These results add a new perspective to the question about the effects of the slowdown in productivity on exports. If the productivity path becomes slower for the average firm but does not change for the right tail of the distribution, an increase in allocative efficiency may reinforce aggregate exports, regardless of the productivity of the average firm. This feature cannot be understood without going beyond the standard use of average variables (i.e., exploiting all the information of a micro-based dataset).

## Assessing Export Prospects Based on Productivity, Its Dispersion, and Allocative Efficiency

Average productivity is positively correlated with trade, but one also needs to incorporate information on the shape of the underlying productivity distributions to fully understand the dynamics of exports. The intuition is that behind the same average productivity there may be distributions with very different shapes: indeed, for a given level of average productivity, the share of exporters will be larger the greater the skewness (or dispersion) of the productivity distribution. Skewness depends on the structure of firms within the sector or country. If a large share of firms are large and highly productive (so that the productivity distribution of the economy is characterized by a long and thick right tail), more firms will be able to position themselves above the productivity cut-off that allows them to export, increasing exports. In contrast, in an economy in which productivity is normally distributed, the effects of higher average productivity on exports would be more muted.

This section applies this approach to exports. It explores the extent to which productivity dispersion mediates the effect of a change in median productivity on exports. When median productivity slows, the implications for trade will depend strongly on the productivity dispersion: Exports could decrease in the presence of lower productivity dispersion and increase if dispersion is sufficiently greater.

This section also examines the potential role of allocative efficiency in influencing such mediation effect, shedding light on the potential gains from increased allocative efficiency on export competitiveness. It identifies the main channels of interaction between the median and the dispersion of the relevant productivity distribution and uses them to project exports.

The choice of the terms representing different moments of the productivity distribution is not as straightforward as one might think. Indeed, it can lead to biases driven by spurious or trivial relations. We argue that the first moment should be represented by median total factor productivity (TFP), because it is more stable than mean TFP and not necessarily affected by changes in outliers. Skewness cannot be used as a dependent variable, because its formula contains the mean (which enters with a negative sign) and by construction will therefore always display a negative correlation with average TFP. By the same line of reasoning, the asymmetry index (or Pearson coefficient) is constructed using the difference between the mean and the median over the standard deviation and is therefore equally unusable. All this considered, the rest of the analysis therefore uses the p90/p10 and p80/p20 ratios, which are not susceptible to these biases, to represent skewness and asymmetry.

The econometric strategy is as follows:

- We estimate the relation between productivity dispersion and median productivity.
- We augment this relationship by adding the OP gap (a proxy for allocative efficiency), to determine whether it modifies the impact of median productivity on dispersion.
- We use the estimated parameters to construct fitted values for the p90/p10 term in equation 7.1, in order to understand the implications of different productivity growth scenarios for export competitiveness.

***Stylized Facts***

The data in the sample reveal heterogeneity across countries in the change in median and average TFP between 2006 and 2013 (figure 4). This heterogeneity reflects a wide array of factors—from labor market to competition policy, from openness toward foreign competition to the presence of multinationals—which affect the spectrum of firms in existence and their contribution to overall productivity growth. As expected, average productivity is much more variable than median productivity, as it is mechanically influenced by the other moments of the distribution. As a consequence, the median is chosen as the most suitable variable for detecting a nontrivial relation between central moments of productivity and its dispersion.

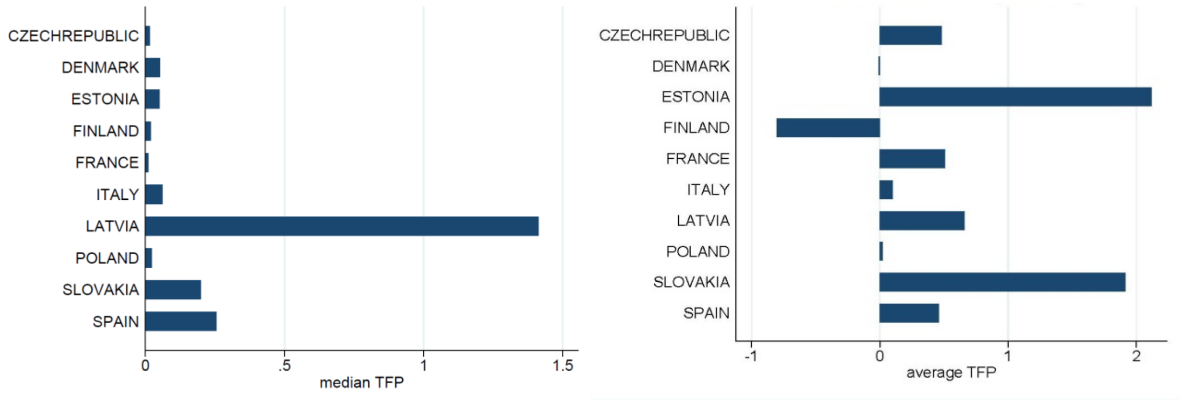
Figure 5 presents a scatter plot showing the correlation between lagged median productivity and productivity dispersion (in the form of changes in p90/p10 and p80/p20 ratios). Each observation represents a sector-country-year combination. The results reveal a very small but strongly significant positive relationship. This measure is very raw, however; additional tests are needed.

***Results of Initial Tests***

We used ordinary least squares (OLS) regression to test the relation between productivity growth and its dispersion. The dependent variable is the productivity dispersion, defined by either the p90/p10 or the p80/p20 ratio of the TFP distribution. The main independent variable of interest is median TFP (because the median is more stable and less sensitive to variations at the extremes of the distribution).

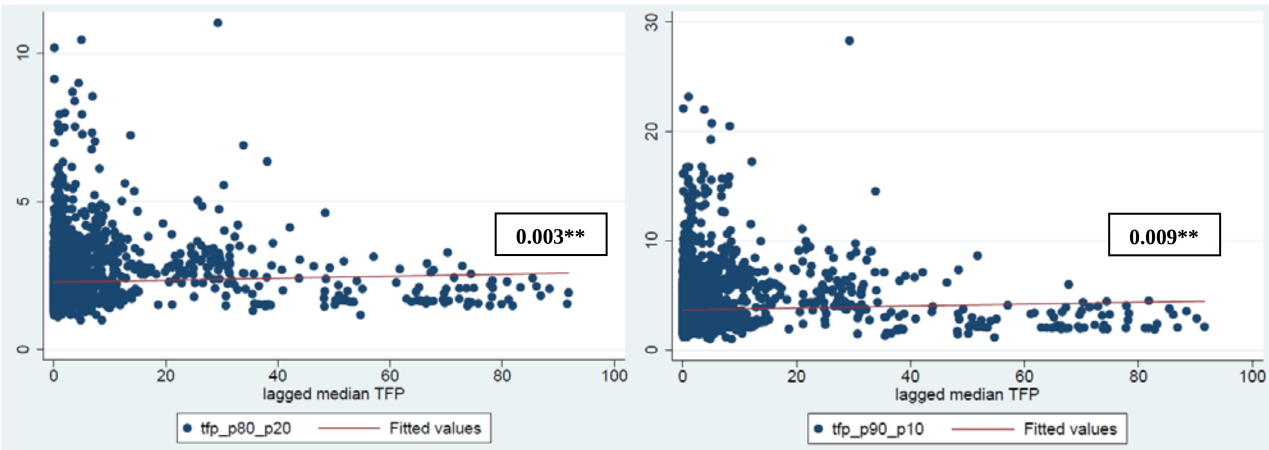
**Figure 4**
**Absolute difference between mean and median total factor productivity between 2006 and 2013 in selected countries**

a. **Median TFP** **b. Average TFP**




*Source*: Authors' calculations based on CompNet data.

**Figure 5**
**Correlation between lagged median total factor productivity and productivity dispersion indexes**




*Note*: Each point is a country-sector-year observation.

*Source*: Authors' calculations based on CompNet data.

The specification is as follows:

(2) $Y_{ist} = \alpha_1 + S_s + C_i + T_t + \beta_1 X_{ist-1} + \epsilon_{ist}$

where $Y_{ist}$ is one of the two dispersion indexes in country *i*, year *t*, and sector *s*. All regressions include a constant; sector, year, and country fixed effects; and heteroskedasticity-robust standard errors. The term $X_{ist-1}$ stands for lagged median TFP, the main explanatory variable of interest, in country *i*, year *t*, and sector *s*.

**Table 4**
**Effect of lagged median total factor productivity and productivity dispersion indexes**

| | **(1)** | **(2)** |
|---|---|---|
| **Variable** | **TFP_p80_p20** | **TFP_p90_p10** |
| $\log TFP(Median)_{t-1}$ | 0.027*** | 0.075*** |
| | (0.004) | (0.010) |
| Country fixed effects | Yes | Yes |
| Sector fixed effects | Yes | Yes |
| Year fixed effects | Yes | Yes |
| Constant | 2.226*** | 3.302*** |
| | (0.087) | (0.169) |
| Observations | 4,905 | 4,907 |
| $R$-squared | 0.53 | 0.53 |

*Note*: Heteroskedasticity-robust standard errors are in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

*Source*: Authors' calculations based on CompNet data.

Median lagged TFP is positively and significantly related to the two dispersion indexes (table 4). The results are robust to alternative time periods. In particular, they remain broadly unchanged when adding a dummy for the 2008 financial crisis—possibly because productivity trends vary slowly and the sample does not go far back enough or include enough countries to capture consistent variations.

Table 4 provides initial insight into how TFP growth affects the dispersion of the productivity distribution, suggesting that such growth is higher for the right tail than for the left tail. This finding does not yet provide a satisfactory explanation of the heterogeneity shown in the figures above, however, as it establishes only the existence of an average correlation. The temporal dimension does not seem to be sufficient to explain such heterogeneity, as the coefficient of median productivity does not change with the sample period used. We need to find other variables to motivate such heterogeneity.

**Table 5**
**Contribution of allocative efficiency to the effect of median total factor productivity on productivity dispersion**

| Variable | (1) TFP_p80_p20 | (2) TFP_p80_p20 | (3) TFP_p90_p10 | (4) TFP_p90_p10 |
|---|---|---|---|---|
| High allocative efficiency | 0.029 | 0.033 | 0.083 | 0.096 |
| dummy $_t$ | (0.023) | (0.024) | (0.062) | (0.062) |
| logTFP(Median)$_{t-1}$ | 0.027*** | 0.022*** | 0.075*** | 0.059*** |
| | (0.004) | (0.004) | (0.009) | (0.009) |
| Interaction | | 0.02** | | 0.08*** |
| | | (0.009) | | (0.002) |
| Constant | 2.224*** | 2.222*** | 3.3*** | 3.288*** |
| | (0.087) | (0.087) | (0.169) | (0.171) |
| Observations | 4,905 | 4,905 | 4,907 | 4,907 |
| R-squared | 0.53 | 0.53 | 0.53 | 0.53 |

*Note*: Country, year, and sector fixed effects are included. Robust standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

*Source*: Authors' calculations based on CompNet data.

### *Adding Allocative Efficiency*

In order to further explore the nexus between average productivity and its dispersion, we introduce allocative efficiency, which we measure by computing the extent to which labor is located in the most productive firms using the OP gap. Given the institutional framework in a given country or sector, reallocation of labor from less productive to more productive sectors may increase productivity dispersion, given the same variation in median productivity.

To incorporate this new variable in the regression framework, we modify equation 2 as follows:

(3) $Y_{ist} = \alpha_1 + S_s + C_i + T_t + \beta_1 X_{ist-1} + \beta_2 D_{ist} + \beta_3 D_{ist} * X_{ist-1} + \epsilon_{ist}$.

This equation adds the dummy variable $D_{ist}$, which takes the value 1 if the observation presents an OP covariance term that is equal to or greater than the 90th percentile of the overall distribution. The dummy is added in order to identify that part of the sample characterized by high allocative efficiency. We also add an interaction term between this allocative efficiency dummy and median productivity growth, $X_{ist-1}$. The coefficient estimate $\beta_3$ gives an idea of whether allocative efficiency can explain heterogeneity in the relation between TFP growth and dispersion (table 5).

The high allocative efficiency dummy does not seem to have a significant effect on productivity dispersion per se, but its interaction with median productivity is striking. The coefficient is positive and statistically significant for both specifications, as is the coefficient of median TFP. These results suggest that the positive relationship between median TFP and dispersion is much stronger in the presence of high allocative efficiency.

The coefficient estimates for the interaction terms show the potential additional effect on productivity dispersion of an intervention designed to increase allocative efficiency from the sample average to the top 10 percent of the sample. Column (3) shows that on average, a unitary increase in median TFP would result in a 0.075 point increase in the p90/p10 ratio. In the high allocative efficiency scenario (column 4), the same variation in median TFP increases the p90/p10 ratio by up to 0.14 points on average (0.059 + 0.8), about doubling its size. This difference is remarkable, with important policy implications, particularly for export dynamics. Depending on allocative efficiency (by country and/or sector), the same rate of productivity growth (increasing or declining) implies a different reaction of productivity dispersion and thus export performance.

### Impact of Alternative Productivity Scenarios on Export Performance

Having provided more clarity on the possible drivers of heterogeneity in the relationship between productivity growth and dispersion, we can put all the elements together to investigate how a change in productivity growth affects export performance. Using the computed coefficients, we construct two scenarios for export performance: a baseline growth scenario, in which median TFP rises by 1.2 percent (the Congressional Budget Office's baseline scenario), and a low-growth scenario, in which it rises by just 0.8 percent.

**Table 6**
**Impact of total factor productivity growth and allocative efficiency on export competitiveness**

| TFP growth\Olley-Pakes covariance term | High allocative efficiency scenario | Baseline allocative efficiency case |
|---|---|---|
| Baseline TFP growth scenario (1.2 percent) | 1.2 percent | 0.5 percent |
| Low TFP growth scenario (0.8 percent) | 0.8 percent | 0.3 percent |

*Note*: Coefficients in percentage point variations. See footnote 8 for derivation of scenarios.

For both scenarios we assume either baseline allocative efficiency (computed using the coefficient of median TFP in column 4 of table 5) or high allocative efficiency (computed using the coefficients of median TFP and the interaction term in column 4 of table 5). We multiply the initial increase in median productivity by these coefficients to assess the impact on the productivity distribution. We then multiply the resulting number by the coefficient of p90/p10 on export competitiveness (from column 1 of table 2) to estimate the effect of the assumed increase in median TFP on exports, as mediated by productivity dispersion and the degree of allocative efficiency. Table 6 summarizes the results.[4]For the baseline allocative

[4] As an illustration, the number in the upper right side is obtained by multiplying the 1.2 percentage point increase by the baseline coefficient of 0.059 (the effect of median TFP on the p90/p10 ratio in absence of allocative efficiency, as from column (4) of table 5) and then by the second stage coefficient 0.073 (the effect of p90/p10 on "export competitiveness," as from column (1) of table 2). Analogously, the effect in the upper left cell (high TFP growth and high allocative efficiency) is obtained by multiplying the increase of productivity of

efficiency case, Table 6 suggests that a slowdown in annual productivity growth from 1.2 percent to 0.8 percent would slow the annual increase in export competitiveness from 0.5 percent to 0.3 percent. It also shows that allocative efficiency can modify this result significantly. For a country that is in the top 10 percent of allocative efficiency (the high allocative efficiency scenario), the impact of slowing productivity growth on exports is more pronounced, on the order of 0.4 percent a year (1.2 percent minus 0.8 percent). A reform that moves a country from the baseline allocative efficiency case to the high scenario would initially have a much larger impact than the productivity slowdown, raising export competitiveness by 0.7 percent (1.2 percent minus 0.5 percent). For a country with average allocative efficiency, an efficiency-enhancing reform could thus offset the impact of slowing productivity growth on export competitiveness for as long as three and a half years.

## Concluding Remarks

An economy's allocative efficiency conditions affect the nexus between productivity and exports. Using a novel framework, we set up four illustrative alternative scenarios by interacting two alternative productivity growth assumptions (high and low) with two allocative efficiency scenarios (average and high). In all the scenarios, a reduction in productivity growth relative to the baseline reduces export competitiveness, by both shifting the productivity distribution to the left and shrinking the tail of productive firms that tend to export. However, this effect can be offset, for up to eight years, by reforms that take countries from the average to the higher allocative efficiency scenario.

These preliminary calculations show how policies aimed at improving the allocation of resources could modify the relation between productivity growth and export activity. Allocative efficiency plays an important role in explaining the heterogeneity embedded in the evolution of the distribution of productivity and in the relation between median productivity and dispersion, which determines the share of firms that are productive enough to export.

In an environment of slowing productivity growth, policies that raise allocative efficiency are hence important for two reasons. First, they may mitigate the productivity slowdown. Second, even if they do not, they will reduce its impact on export competitiveness, by increasing productivity dispersion (creating a longer and thicker right tail of the distribution). The larger and more competitive group of firms that are able to face global competition would then play a key role in increasing export volumes. Targeted policies to achieve such a goal should be a priority for countries that aim to stimulate export activity and remain competitive in an increasingly globalized economy.

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1.2 percent by 0.14 (the effect of median TFP on p90/p10 in case of high allocative efficiency, that is 0.06 + 0.08 in column (4) of table 5) and then by 0.073 (the effect of p90/p10 on "export competitiveness," as from column (1) of table 2).

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## Appendix A
## Estimating Export Competitiveness Using the Helpman, Melitz, and Rubinstein Methodology

**Table A.1**
**Countries included in the analysis**

| Country | Years covered |
|---|---|
| Belgium | 2001–13 |
| Croatia | 2002–13 |
| Czech Republic | 2002–13 |
| Denmark | 2001–13 |
| Estonia | 2001–13 |
| Finland | 2001–13 |
| France | 2001–13 |
| Italy | 2001–13 |
| Latvia | 2006–13 |
| Poland | 2005–13 |
| Slovakia | 2001–13 |
| Spain | 2001–12 |

The procedure involves two steps, following Helpman, Melitz, and Rubinstein (2008). In the first, we estimate firms' selection into the export market based on the probability that firms meet an implied zero-profit condition. The probability of selection into trade is measured by estimating a linear probit model over a sample of bilateral export flows from OECD countries ($i$) to export countries ($d$) for several manufacturing sectors ($s$) from 2001 to 2012. The sample includes both CompNet and other countries. For each sector, we estimate the following equation:

$$\Pr\left(Export_{i,d,t}\right) = \varphi_{i,d,t} = \Phi\left(\alpha_0 + \alpha_{i,t} + \beta_{d,t} - \gamma D_{i,d} + z_{i,d,t} + \eta_{i,d,t}\right), \qquad (A.1)$$

where $\alpha_{i,t}$ represent origin*year fixed effects; $\beta_{d,t}$ represent destination*year fixed effects; and $D_{i,d}$ is a vector of standard trade cost variables (such as distance, common border, common language, etc). We also include bilateral indicators for regulation costs in the foreign market ($z_{i,d,t}$) and an error term ( $\eta_{i,d,t}$).

We use the estimated probability to create a set of controls to estimate the second-step model using a nonlinear least square estimator. These controls are the inverse Mills ratio and a polynomial expansion of $\hat{\varphi}_{i,d,t}$ of degree three designed to control for sample selection bias and unobserved firm heterogeneity.[5] The resulting equation is

$$Export_{i,d,t} = \beta_0 + \alpha_{i,t} + \beta_{d,t} - \gamma D_{i,d} + invMill_{i,d,t} + \pi(\hat{\varphi}_{i,d,t}) + \varepsilon_{i,d,t} \qquad (A.2)$$

where $\alpha_{i,t}, \beta_{d,t}$, and $\gamma D_{i,d}$ follow the same notation as before; $invMill_{i,d,t}$ is the inverse Mills ratio of $\hat{\varphi}_{i,d,t}$; $\pi(\hat{\varphi}_{i,d,t})$ represents its polynomial expansion; and $\varepsilon_{i,d,t}$ is an error term. The resulting $\alpha_{i,t}$represent what we then define as export competitiveness.

[5]See Helpman, Melitz, and Rubinstein (2008) for details on the model these assumptions are based on.

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