Import competition and allocative efficiency*

Viktor Slavtchev

Halle Institute for Economic Research (IWH)

viktor.slavtchev@iwh-halle.de

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1. Introduction

This paper analyzes empirically whether import competition improves allocative efficiency. Generally, when an economy opens to international trade, competition stiffens and pushes firms out of their 'comfort zone' or even threatens their existence. In order to escape this threat and/or survive, firms try to increase efficiency. Overall, theory would predict that increasing import competition will c.p. force firms to employ the resources that are available to them according to their marginal returns. Firms that employ too much of a production factor and face marginal cost larger than the marginal return are supposed to reduce the use of that factor. The resources set free can then be deployed by other firms that are efficient enough to sustain the international competition but where the marginal return of production factors are larger than the marginal cost. This will which will increase the efficiency of using resources and aggregate welfare gains.

We focus on labor, which is also of particular interest for policy. We use the measure of allocative (in-)efficiency originally developed in Petrin and Sivadasan (2013). This measure is based on the notion that the difference in the value of the marginal product of an input and its marginal cost equals to the change in output that would occur if that input's use changed by one unit. We use data from CompNet that cover 22 NACE 2-digits manufacturing industries in 13 European countries from 2003-2016 to calculate the abovementioned difference with respect to labor for each firm and then aggregate at the industry level. Then we apply IV-2SLS regression techniques to assess the causal impact of import competition on allocative efficiency. We find that higher level of import competition is associated with a lower level of inefficiency.

This paper complements a number of previous studies. For instance, empirical research so far has more or less directly documented positive productivity effects from import competition (Braeuer et al. 2019; Dhyne et al. 2017; Bloom et al. 2016; Campbel and Mau 2019; Pavcnik 2002; Trefler 2004; Bernard et al. 2006; Amiti and Konings 2007; Topalova and Khandelwal 2011; De Loecker 2011; Shu and Steinwender 2019; MacDonald 1994). However, this research is largely silent of the particular source of productivity gains. In our case, increase of efficiency is driven by both, decline of initially relatively large and inefficiently operating firms and growth of efficient but initially to small firms. Our results closely relate to Melitz (2003). According to this framework it is the efficient reallocation of factors of production from less to more productive firms that raises average productivity—at higher level of aggregation (e.g., industry or whole economy). Unproductive firms that are unable to adjust and increase efficiency decline or even exit. Relatively productive firms continue to operate. With no frictions, positive welfare effects can be obtained if these firms could make use of the resources set free by other uncompetitive firms. Bernard et al. (2003, 2007) show how this process of reallocation of resources and creative destruction can strengthen comparative advantages in the aggregate. In our case it could be both inter-firm dynamics (reallocation between firms) as well as intra-firm dynamics (decline/growth of un/productive firms).

The remainder of this paper is organized as follows. Section 2 introduces the data and describes the measurement of allocative efficiency and import competition. Section 3 outlines how

we assess the impact of import competition on allocative efficiency and present the results. Section 4 summarizes and concludes.

2. Data and measurement

2.1. Allocative efficiency

The measure of allocative efficiency comes from the publically available CompNet data (www.comp-net.org) (cf. next Section 3 for measurement details). CompNet uses data on individual non-financial private sector firms to calculate a number of measures at the NACE 2-digits industry level across European countries from the period 2003-2016. In this paper, we focus on only manufacturing industries that are arguably strong exposed to international competition (relative to services). We use data from the following countries: Belgium (BE), Croatia (HR), Denmark (DK), Finland (FI), France (FR), Italy (IT), Lithuania (LT), Portugal (PT), Romania (RO), Slovenia (SI), Spain (ES) and Sweden (SE). The NACE 2-digit manufacturing industries included are: Food (10), Beverages (11), Textiles (13), Wearing Apparel (14), Leather (15), Wood, Cork, Straw etc. (16), Paper (17), Printing and other Media (18), Chemical Products (20), Pharma (21), Rubber and Plastic (23), Non-metallic Minerals (23), Basic metals (24), Fabricated metals products (25), Computer and Electronic Equipment (26), Electrical Equipment (27), Machinery and Equipment (28), Motor vehicles and Transportation (29), Other Transport Equipment (30), Furniture (31), Other Manufacturing (32), Repair and Installation of Machinery (33).

We use the measure of allocative efficiency proposed by Petrin and Sivadasan (2013), which is based on unrealized increases in aggregate productivity. The intuition behind the approach is that, under perfect competition, an input's value of marginal return should equate its marginal cost. A wedge (or gap) between marginal return and marginal cost is a signal that firms using either too much or too little of a given factor, which hurts aggregate output if the resources get reallocated to more productive firms. The authors show that the difference (or the gap between) in the value of the marginal product of an input and its marginal cost at any firm is exactly equal to the change in that firms output that would occur if that firm changed that input's use by one unit.

In what follows we focus on labor because information on the cost of labor is more often available. However, as shown by Petrin and Sivadasan (2013), this approach can be applied to any input. The marginal product of labor at firm *i* in industry *j* in country *c* at time *t* is given as the marginal increment in output per unit change in labor:

$$\frac{\partial Q_{ijct}}{\partial L_{ijct}} = \beta^l \; e^{v_{ijct}} L_{ijct}^{\beta^l - 1} K_{ijct}^{\beta^k} = \beta^l \; \frac{Q_{ijct}}{L_{ijct}}$$

where $v_{ijct} = \omega_{ijct} + \varepsilon_{ijct}$. Once the marginal product is recovered from a production function estimation, the value of the marginal product of labor can be obtained by just multiplying the marginal product by the firm level output price:

$$VMP_{ijct}^{l} = P_{ijct}(\beta^l \; \frac{Q_{ijct}}{L_{ijct}}).$$

Since output prices at firm level are generally not available, we use industry price index, $P_{ijct}=P_{jct}$. Industry prices might introduce measurement error (Foster et al. 2008). However, as pointed by Petrin and Sivadasan (2013), the marginal products of inputs will still be consistent if the deviation of the firm level price from the industry price is not systematically correlated with the input levels. Under this assumption, the gap at the firm level is:

$$G^l_{ijct} = |VMP^l_{ijct} - w_{ijct}|,$$

where w_{ijct} represents the wage of the marginal worker in firm *i*. For the empirical analysis, we follow Petrin and Sivadasan (2013) and use the average firm wage. With this in mind, G^l_{ijct} indicates the increase in output if labor gets allocated optimally; the social optimum is reached when all gaps are equal to zero, $G^l_{ijct} = 0$.

For the empirical analysis (because import competition is measured at the industry level), we sum the gaps over firms in a given industry:

$$G^l_{jct} = \sum_i G^l_{ijct}.$$

The gap at industry level might arise not only because of irrational firms, but also due various (labor market) frictions external to the firms.

The computation of the gap is based on an OLS estimation of industry-country-specific Cobb-Douglas production functions (i.e. the estimation of $\beta^l = \beta^l_{jc}$). Alternative production function specifications (e.g., translog) as well as more sophisticated estimation approaches (e.g. Levinson and Petrin 2003; Wooldridge 2009) lead to very similar results.

2.2. Import competition

To measure the strength of import competition in different NACE 2-digit manufacturing industries, we use data from the United Nations Comtrade database that contains information on the trade value between any two countries (UN Statistics Division 2009). In particular, we calculate industry-specific import competition strength as

$$\boldsymbol{IC_{jct}} = \left(\frac{\boldsymbol{M_{jct}}}{\boldsymbol{M_{jct}} + \boldsymbol{Q_{jct}}}\right) * \mathbf{100},$$

where M_{jct} is the value of the total imports and Q_{jct} is the total value of domestic production by industry *j* in country *c* in year *t*.[1]

3. Assessing the effect of import competition on allocative efficiency

[1] Similar, to previous research, this measure does not take into account that some of the imports might be intermediate inputs to firms in an industry (for discussion see Braeuer et al 2019).

To assess the effect of import competition on allocative efficiency we estimate the following specification:

$$logG^{l}_{jct} = \beta_0 + \beta_1 logIC_{jct} + \mu_j + \vartheta_{ct} + \varepsilon_{jct},$$

where G^{l}_{jct} is the allocative (in)efficiency output gap and IC_{jct} is the measure for import competition in industry *j* in country *c* at time *t*. μ_j are industry fixed effects that are supposed to capture unobserved industry-specific differences, ϑ_{ct} and country-time fixed effects that are supposed to capture unobserved country-time shocks, for instance changes in labor market institutions, which take place typically at country level. Estimation by OLS is appealing, however, there might some threat to this identification. For instance, domestic firms in industry *j* consciously take some measure to escape the threat, for instance by changing their product portfolio. Hence, we follow Autor et al. (2013) who analyze the effects of Chinese imports on local labor markets in the US and apply IV-2SLS strategy. Specifically, we instrument the strength of import competition in industry *j* in country *c*, with the strength of import competition in the same industry *j* in Germany. Under the arguably plausible assumption that the competitiveness of firms in an industry *j* in country *c* is unrelated to that of firms in the same industry but in a third country, this strategy will allow causal inference.

Table 1 reports the results of the IV-2SLS. As predicted by theory, we find that import competition is associated with a decrease in allocative inefficiency, i.e. efficiency gains.

Table 1: Import competition on allocative efficiency

Dep: $logG^{l}_{jct}$	IV-2SLS, 2nd stage
$logIC_{jct}$	-0.0837936
	(0.041662)
Constant	10.00991
	(0.3934443)
N	3,540
R^2	0.8869

Note: Second stage results from IV-2SLS estimation of the effect of import competition, IC_{jct}, on the allocative efficiency in a NACE 2-digits manufacturing industry *j* in country *c* at time *t*, G^{l}_{jct}. The strength of import competition in industry *j* in country *c*, is instrumented with the strength of import competition in the same industry *j* in a third country, Germany. Industry fixed effects and country*time fixed effects are included. Countries: Belgium (BE), Croatia (HR), Denmark (DK), Finland (FI), France (FR), Italy (IT), Lithuania (LT), Portugal (PT), Romania (RO), Slovenia (SI), Spain (ES) and Sweden (SE). NACE 2-digit manufacturing industries: Food (10), Beverages (11), Textiles (13), Wearing Apparel (14), Leather (15), Wood, Cork, Straw etc. (16), Paper (17), Printing and other Media (18), Chemical Products (20), Pharma (21), Rubber and Plastic (23), Non-metallic Minerals (23), Basic metals (24), Fabricated metals products (25), Computer and Electronics (26), Electrical Equipment (27), Machinery and Equipment (28),

Motor vehicles and Transportation (29), Other Transport Equipment (30), Furniture (31), Other Manufacturing (32), repair and Installation of Machinery (33). Robust standard errors.

4. Summary and conclusions

This paper analyzes empirically whether import competition improves allocative efficiency with respect to the production factor labor. We use the measure of allocative (in-)efficiency originally developed in Petrin and Sivadasan (2013). This measure is based on the notion that differences in the value of the marginal product of an input and its marginal cost indicated loss in potential output due inefficient allocation. We use data on 22 NACE 2-digit manufacturing industries from 13 European countries. We apply IV-2SLS econometric techniques to assess the effect of import competition on allocative (in)efficiency and find that stronger import competition is associated with lower inefficiency. A general interpretation of this results is that import competition has disciplining effects on the domestic economy, which results in efficiency gains. These disciplining effects could materialize due to both, an improved optimization by firms as well reallocation of resources across firms. The relative importance of either mechanism as well as the role of institutions (or frictions) that determine the functioning of the markets in terms of resource (re-)allocation is fruitful avenue for further research.

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