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Oleksandr Shepotylo and Volodymyr Vakhitov

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Visiting address: C.J. Hambros plass 2d
Address: P.O. Box 8159 Dep.
NO-0033 Oslo, Norway
Internet: www.nupi.no
E-mail: info@nupi.no
Fax: [+ 47] 22 99 40 50
Tel: [+ 47] 22 99 40 00

Effect of NTM on Productivity of Firms in Food Processing*

Oleksandr Shepotylo† and Volodymyr Vakhitov‡

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Abstract

Over the last two decades import tariffs have declined significantly. Governments around the world increasingly use non-tariff measures as a substitute for the tariff protection. Little is known about their importance for and effect on international trade.

Literature reports a positive effect of reduction in tariffs and services liberalization on productivity of the economy through the firm productivity increase (Pavcnik, 2002; Javorcik, 2004; Amiti and Konings, 2007) and through elimination of low-productive firms and reallocation of resources towards high-productive firms (Melitz, 2003). To the best of our knowledge, no study investigates the effect of the NTMs on an individual firm. To feel this void in the literature, we study the effect of NTMs on firm-level productivity and industry dynamics, focusing on food-processing sector. Since the scope on NTMs is vast and hardly explored, at this stage we focus on the average effect of NTM on productivity of a firm. We investigate the effect on productivity through competition within the same industry (defined at NACE 3 digit level), as well as thorough backward linkages due

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†Kyiv School of Economics, oshepotylo@kse.org.ua

‡Kyiv School of Economics, vakhitov@kse.org.ua

to competition in industries that provide inputs into production process. We use firm-level data for Ukrainian firms in 2001-2006. As NTM variable, we calculated our own firm-level index, based on measures estimated by (Movchan and Shportyuk, 2010)

Our initial results indicate that effects of NTM on productivity of firms is miniscule compared with the effect of traditional protectionist measures such as tariffs for inputs. This result holds for majority of specifications and quite robust to the choice of the NTM measure, using current or lagged values of NTM, or the choice of productivity measure.

Keywords: non-tariff measures, productivity, food industry

JEL: F14, G28, L80

1 Introduction

We study the effect of non-tariff measures (NTM) on productivity of firms in food processing industry. Non-tariff measures (NTMs) have always been important elements of trade policy. Today, they play increasing role in shaping the world trade in absolute and relative terms. Increased public concerns about health and safety issues stimulate governments to regulate quality and safety of goods by means of sanitary and phytosanitary (SPS) measures, product licensing, and technical barriers to trade (TBT). As WTO (2012) points out, there is an upward trend in both SPS and TBT notifications. In particular, 2010 has shown both the maximum number of SPS and TBT notifications. In relative terms, global drive for tariff reduction during the last two decades increased relative importance of NTMs. NTMs come in various forms and address different concerns. Like a double-edged sword, they serve both as protectionist, wellfare-reducing measures and as regulatory, wellfare-increasing corrections of the market failures. Addressing public concerns about health and safety issues, NTMs can be not only trade barriers that raise trade and production costs, but also trade catalysts that may improve quality of imported goods and boost consumer confidence by solving asymmetric information problem.

Mounting empirical evidence shows a positive impact of trade and services deregulation on productivity in the downstream manufacturing industries. Arnold et al. (2011) establish a positive link between TFP of manufacturing firms and liberalization of the services sector by analyzing the impact of liberalization of services on the performance of approximately ten thousand manufacturing firms in the Czech Republic in 1998-2003. Fernandes and Paunov (2011) find that forward linkages from foreign direct investment in services to downstream manufacturing industries lead to increase in firm-level productivity. The studies that find the positive effect of tariff reduction on productivity are even more abundant (Krishna and Mitra, 1998; Pavcnik, 2002; Amiti and Konings, 2007).

The effect of NTMs on trade and productivity has not been studied as extensively. In particular, to best of our knowledge, the effect of NTMs on firm-level productivity has not yet been investigated. This paper fills the gap in the literature. It is especially important to analyze given *apriori* ambiguity of the effect of NTMs on firms' performance. From the demand side, stricter regulations can improve quality and safety of imported inputs and final goods, which may stimulate consumer demand and give companies that use better inputs a comparative advantage. NTMs can also reduce foreign competition with an ambiguous implication for firms' and industry performance. From the supply side, regulations increase trade and production costs, which has a negative effect on firms' performance.

We use measures of NTMs constructed by Movchan and Shportyuk (2010) and combine them with firm-level data for Ukrainian food producers in 2001-2006. We adopt the standard two-stage approach of estimating the effect of a policy change on productivity (Pavcnik, 2002; Javorcik, 2004; Amiti and Konings, 2007; Khandelwal and Topalova, 2011). At the first stage, we estimate the production function using the Olley-Pakes methodology (Olley and Pakes, 1996), controlling for demand shocks as suggested by De Loecker (2011), to extract total factor productivity (TFP) of firms in food processing industry. At the second stage, we regress TFP on the firm-specific index of NTM restrictiveness, controlling for the firm-specific heterogeneity, market structure, and effects of trade and services liberalization.

Our results suggest that effects of NTM on productivity of firms is miniscule compared with the effect of traditional protectionist measures such as tariffs for inputs. This result holds for majority of specifications and quite robust to the choice of the NTM measure, using current or lagged values of NTM, or the choice of productivity measure.

The structure of the rest of the paper is as follows. Next section discusses NTM. Section 3 presents the data. Section 4 describes the methodology and provides results of TFP estimation. Section 5 presents results. Section 6 concludes.

2 Core NTM measures

WTO (2012) summarizes the key facts and findings on the effects of NTMs on trade. It is large economically and significant statistically. NTMs are often far more trade-restrictive than import tariffs. Looi Kee et al. (2009) find that the simple average ad-valorem equivalent of NTMs was 12 percent in 2003 for all product lines and 45 percent for product lines affected by NTMs. For 55 percent of lines affected by NTMs, the ad-valorem equivalent of the NTM is higher than the import tariff. Importantly, NTMs have ambiguous effect on trade – a negative effect due to increased cost of production and positive effect due to higher consumer confidence about quality and safety of a product. Empirically, NTMs have positive effect on trade in more technologically advanced sectors and negative effect in agriculture. On average, cutting the ad-valorem equivalent of NTMs by half (from 12 to 6 percent) would increase trade by 2 to 3 percent (Hoekman and Nicita, 2011).

To best of our knowledge, no firm-level effect of NTMs has been analyzed. We consider the effect of NTMs on productivity of food producers in Ukraine in 2001-2006. We use core NTMs and licensing measures computed by Movchan and Shportyuk (2010). Core NTMs are intentionally trade-restrictive measures (in contrast to measures that can be adopted for health and safety reasons, such as sanitary standards). Core NTMs include price and quantity controls. Movchan and Shportyuk (2010) used four NTM measures:

- Licensing (an importer must obtain import license; mostly applied to alcohol and tobacco products, some ozone-destroying products and insecticides).

- Import quotas (the most famous – sugar quotas);
- Minimum customs value (introduced in 1997 and abandoned since 2000);
- Weapon imports control (mostly applied to goods produced by chemical industry and machine-building). Since 2002 this type of control is applied to 2.3% of tariff lines.

Table 3.7 of Movchan and Shportyuk (2010) gives an overview of the NTM measures that we use, while Table 3.4 provides the summary statistics of import licensing in Ukraine in 1996-2006. Food processing, petroleum refineries, and chemicals, rubber, and plastic were the industries where core NTMs were applied the most.

3 Data

The data for the project come from statistical statements every commercial firm has to submit annually to the State Department of Statistics of Ukraine. We have chosen 2001-2006 period due to the data constraints and consistency of statistical statements across years. We used these statements as our main data source for estimation of the production function coefficients and TFP recovery. For the output measure, our dependent variable, we used total revenue net of indirect taxes, which is available from the Financial Results statement. The measure has been deflated with two-digit sector inflation indices provided by Statistics Department. The Balance Sheet statement was a source of the tangible assets data (which is used as the capital measure). The Financial Results statement also provides a measure of material costs. The Enterprise Performance statement contains data on tangible investments which are used as instruments in Olley-Pakes estimation procedure. Employment also comes from the same statement. The labor measure is calculated as the averaged number of enlisted employees in a year, which is a rough estimate of the full-time equivalent. Using this, we also used the logarithm of labor productivity (calculated as Value Added, which was simply output less material costs per full-time employee) as another measure of productivity. Measures of capital, material costs and investments have been deflated with CPI inflation index provided by Statistics Department. The main data set has been combined with the Customs Office data to retract importer or exporter status of the firm.

	2001	2002	2003	2004	2005	2006	Total
Initial sample size	6,230	6,201	6,064	5,727	5,440	5,451	35,113
Firms with recovered TFP	5,992	5,978	5,837	5,535	5,254	5,135	33,731
Firms with NTM index	2,677	2,570	2,440	2,459	2,487	2,115	14,748
Final sample	2,654	2,542	2,428	2,446	2,472	2,096	**14,638**

Table 1: Sample Composition

The data have been combined with statistical forms from the State Property Fund and Foreign Investment statements, which helped us create a share of foreign ownership. Also, the registry files accompanying the statements provide a set of codes of territorial and industrial classifications for each firm, organizational form, property type, etc., which let us construct industry and region fixed effects and run the analysis for various sub-samples.

	2001	2002	2003	2004	2005	2006	Total
Meat and fish products (NACE 151, 152)	325	317	328	341	368	342	2021
Fruit and vegetables (NACE 153)	187	162	145	153	136	120	903
Vegetable and animal oils and fats (NACE 154)	60	62	63	78	85	81	429
Dairy products (NACE 155)	464	428	398	382	369	337	2378
Grain mill products, starch products (NACE 156)	226	219	212	215	228	176	1276
Prepared animal feeds (NACE 157)	94	87	75	74	76	69	475
Other food products (NACE 158)	894	870	802	798	806	630	4800
Beverages (NACE 159)	404	397	405	405	404	341	2356

Table 2: Final Sample Composition by KVED / NACE-3 industries

Two more control variables, input tariff and index of services liberalization, we took from the data set accompanying Shepotylo and Vakhitov (2015). For construction of the firm-level NTM index, we used firms' report on annual use of inputs from various industries. Between 2001 and 2004, the report was included into the Enterprise Performance statement, and since 2005 it was collected as a separate statement. Only large firms (with over 50 employees in full-time equivalent or substantial annual sales) have to file this report. The reports provide detailed data on annual input expenditures from 22 manufacturing and

15 service sub-sectors. The expenditures have also been inflated with CPI. Another component of the index comes from Movchan and Shportyuk (2010) who estimated core NTM intensity index (NTM_{core}) for 17 two-digit industries. Our final index is the average of the index estimated by by Movchan and Shportyuk (2010) weighted by inputs use intensity in each corresponding sector: for larger firms we have the data on the use of inputs from various sectors. As an alternative measure of NTM we used import licensing as the share of the tariff lines (NTM_{lic})

Measures of NTM, services liberalization and input tariffs have been normalized for the ease of interpretation. All firms with zero output, employment or capital share were eliminated from the sample. The sample composition is presented in Table 1, whereas Table 2 delves into detail on composition of individual three-digit sectors. Descriptive statistics for the estimation sample is shown in Table 3.

Variable	Mean	Standard Deviation
$\ln(TFP_{it})$ $\ln(TFP_{it})$	0.98	1.57
Y_{it} , thsd. UAH 2001	17617.15	59641.8
K_{it} , thsd. UAH 2001	4831.72	15231.59
L_{it} , employment	190.72	284.76
M_{it} , thsd. UAH 2001	9819.61	31873.01
I_{it} , thsd. UAH 2001	1733.4	8375.86
NTM index$_{it}$ (core)	1.38	0.99
NTM index$_{it}$ (license)	5.61	4.19
Share of exporters$_{it}$, 1 if Yes	0.25	0.43
Share of importers$_{it}$, 1 if Yes	0.2	0.4

Note: Descriptive statistics is based on 14,638 observations from the estimation sample.

Table 3: Descriptive statistics

4 Methodology

The empirical strategy is based on the two-stage procedure. First, the TFP measure is identified from a production function estimation procedure. Then, the TFP estimate is regressed on our firm-level measure of NTM intensity.

Estimation of production function

The total factor productivity is estimated separately for each 3-digit KVED / NACE group within the food processing industry subsection (KVED / NACE code "DA"). The standard methodology in the recent literature on TFP estimation for the firm-level data usually follows Olley and Pakes (1996) or Levinsohn and Petrin (2003). We have chosen the former approach and amended it with controls for sub-industry-specific demand and price shocks as suggested by De Loecker (2011). Usually only total revenue data are available as the output measure, while prices are not available. Since the variation in the total revenue may result both variations in physical quantities and differences in mark-ups across firms within the same industry, as well as unobserved price shocks, this may cause "an omitted price variable" bias to the production function coefficients which may further affect estimates of non-tariff measures. De Loecker (2011) introduced a richer constant elasticity of substitution (CES) demand system, which allows uncover markup estimates along with estimates for productivity. This goal is achieved by exploiting variation in the aggregated output within a sub-industry class (4-digit KVED / NACE classification) at time t and by controlling for sub-industry and time fixed effects. Under the demand system, unobserved prices are recovered by the variation in inputs and by aggregate demand and assume away intra-industry differences in technology . If this assumption fails, we still are able to estimate the impact non-tariff measures on productivity because our identification strategy relies on within firm variation in services intensity, whereas time invariant differences in technology are not important.

We start with a production function of a single-product firm i at time t :

$$Y_{it} = L_{it}^{\alpha_l} K_{it}^{\alpha_k} M_{it}^{\alpha_m} \exp(\tilde{\omega}_{it} + \tilde{u}_{it}), \tag{1}$$

where Y_{it} units of output are produced using L_{it} units of labor, K_{it} units of capital, and M_{it} units of material and services inputs. $\tilde{\omega}_{it}$ is firm-specific productivity, unobservable by an econometrician, but known to the firm before it chooses a variable input L_{it}. $\tilde{u}_{it}$ is an idiosyncratic shock to production that also captures measurement error introduced due to unobservable input and output prices.

Following De Loecker (2011), we estimate

$$r_{it} = \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \beta_y y_{gt} + \omega_{it} + \xi_{it} + u_{it}, \tag{2}$$

where $r_{it} = \ln(R_{it}/P_{st})$ is log of revenue deflated by corresponding industry (2 digit NACE) price deflator, which is provided by the national statistics office, and other lower-case letters represent upper-case variables in the log form. $\beta_f = \frac{\sigma_s+1}{\sigma_s}\alpha_f$, where $f = \{l, k, m\}$. The elasticity of substitution in sub-industry s can be retrieved as $\sigma_s = -1/\beta_s$. Finally, $\omega_{it} = \frac{\sigma_s+1}{\sigma_s}\tilde{\omega}_{it}$, $\xi_{it} = -\frac{1}{\sigma_s}\tilde{\xi}_{it}$, and $u_{it} = \frac{\sigma_s+1}{\sigma_s}\tilde{u}_{it}$ are error terms. This procedure allows us estimating parameters of production function consistently, without having information on firm-specific prices. Here we rely only on the assumption that the demand function is of CES form, which is common in the literature.

We estimate (2) by the Olley-Pakes methodology separately for eight 3-digit industry groups. Capital and materials are deflated by a production price index, which introduces a measurement error. Under the assumption of competitive input markets, it does not introduce a bias in our estimation of production function parameters, since all firms have the same access to the same inputs. Instead of using overall industry output, we use more disaggregated sub-industry $g \in s$ output (NACE 4 digit), y_{gt}, to add more variability to estimation of σ_s. It is valid since we assume constant elasticity of substitution within an industry group. The point estimates of the coefficients of the production function are presented in Table 4. As described in Shepotylo and Vakhitov (2015), total factor productivity net of price and demand effects is recovered as

$$\ln(TFP_{it}) = (r_{it} - \beta_l l_{it} - \beta_k k_{it} - \beta_m m_{it} - \beta_y y_{gt})\frac{\sigma_s}{\sigma_s + 1}. \tag{3}$$

The TFP measure estimated in (3) may still potentially suffer from several shortcomings. First, deflators for inputs are not available at the level of separate industries or regions, thus economy-wide inflation indices were used instead. If the assumption about competitiveness of input markets fails, this may cause bias in the factor elasticities estimates. Second, it is impossible to account for idiosyncratic demand shocks which translates into variability of firms' markups. Third, effect of non-tariff measures on revenues is ambiguous. On the one hand, introduction of NTM may lead to an increase in the quality of imported goods. On the other hand, overprotectionism of the local markets nay have adverse affect on the quality of the domestic goods. with a simultaneous decrease in the market size. Depending on the market structure, these effects may or may not be fully internalized by the price and, consequently, affect the revenue of the firm. At the same time, NTM may cause exits of less productive firms and thus lead to shrinkage of the product variety. As a result, there is "observational equivalence" dilemma: when one observes an increase in the revenue of the firm it is hard to tell was it due to a productivity increase or diminishing the market size. Hopefully, firm-level fixed effects and controls for within-subindustry demand minimize the influence of the idiosyncratic component in the TFP estimates.

Industry	$\ln(K)$	$\ln(L)$	$\ln(M)$	$\ln(Y_{NACE4})$	N	χ^2
NACE-151,152 (Meat and fish products)	0.074**	0.314***	0.652***	-0.114	4013	11292.6
	(0.028)	(0.028)	(0.019)	(0.066)		
NACE-153 (Fruits and vegetables)	0.045	0.321***	0.619***	-0.086	1416	2941
	(0.045)	(0.061)	(0.048)	(0.084)		
NACE154 (Vegetable, animal oils, fats)	-0.004	0.153**	0.672***	0.202	1019	900.6
	(0.073)	(0.059)	(0.034)	(0.121)		
NACE155 (Dairy products)	0.081*	0.315***	0.601***	0.0434	3172	3267.5
	(0.038)	(0.043)	(0.037)	(0.193)		
NACE156 (Grain mill and starch products)	0.082	0.259***	0.658***	0.114	2632	4963.7
	(0.042)	(0.027)	(0.019)	(0.137)		
NACE157 (prepared animal feeds)	-0.023	0.170**	0.713***	0.022	783	1860.7
	(0.060)	(0.065)	(0.031)	(0.353)		
NACE158 (Other food products)	0.053*	0.343***	0.581***	0.030	8053	8376.3
	(0.023)	(0.026)	(0.023)	(0.052)		
NACE159 (Beverages)	0.032	0.302***	0.697***	0.178*	3823	5413.5
	(0.033)	(0.038)	(0.025)	(0.072)		

Notes: * p<0.05, ** p<0.01, *** p<0.001. Bootstrap standard errors are presented in parentheses. Table reports point estimates of revenue function parameters, β for Ukrainian firms in food processing in 2001-2009. Each row in the table represents Olley-Pakes estimation of production function for each industry, defined according to three-digit NACE classification. Each estimation is performed with year and sub-industry dummies, which are not reported for brevity.

Table 4: Estimates of Production Function Coefficients

Estimating the NTM measure

Out primary variable of interest, the measure of NTM effect, is the firm-specific index of NTM intensity. The index was computed similar as follows:

$$NTM_{it}^{s} = \sum_{j} a_{it}^{j} \times ind_{t}^{j} \tag{4}$$

where a_{it}^{j} is the share of input sourced from other sectors affected by non-tariff regulations j in the total input for a firm i at time t, and ind_{t}^{j} is the value of NTM-equivalent tariff barrier as calculated in Movchan and Shportyuk (2010). We used inputs from all manufacturing industries, for which Movchan and Shportyuk (2010) calculated two ($s = 1, 2$) equivalents, "core" and "license". As a result, we have obtained "NTM-core" and "NTM-license" measures. The Table 5 presents dynamics of both measures. As one can see, the average NTM load tends to fall over time for both measures. There is variation between industries also, as shown at Fig. 1. The lowest NTM measures are found in "Grain mill and starch products" (NACE - 156), whereas the highest NTMs are observed in "Beverages" (NACE - 159). Also, in the industry-wise view, NTMs appear to increase in 2005 and then fall almost to the previous level in 2006, which suggests both intertemporal and inter-industry variation in this variable.

Estimation equation

The full estimated regression takes the following parametric form

$$\begin{aligned} ln(Productivity_{it}) = \gamma_0 + NTM_{it}\gamma_1 + exporter_{it}\gamma_2 + importer_{it}\gamma_4 + input\,tariff_{it}\gamma_5 \\ + importer_{it} \times input\,tariff_{it}\gamma_6 + ServiceLiberalizationIndex_{it} \\ + T_t\mu + I_s\lambda + \epsilon_{it} \end{aligned} \tag{5}$$

where $Productivity_{it}$ is firm $i's$ measure of productivity at time t computed according to equation (3) or as labor productivity. The main variable of interest, NTM_{it} is the "core" or "license"- equivalent of non-tariff barriers measure for each firm i at time t. Both current and lagged specification of the NTM measures have been estimated. T_t represents time fixed effect, whereas I_s represents 3-digit industry fixed effects.

Year	NTM Core	NTM Licence
2001	1.432	5.505
2002	1.387	5.277
2003	1.332	5.278
2004	1.305	5.003
2005	1.359	5.245
2006	1.337	7.153

Table 5: Dynamics of NTM measures

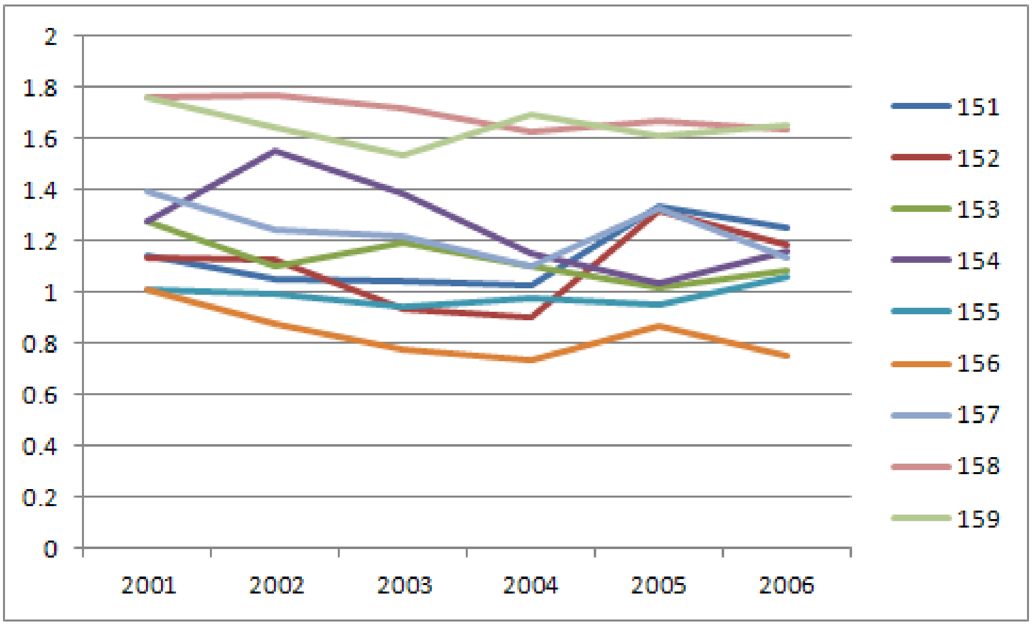

Figure 1: Dynamics of NTM-core measure by 3-digit industries

5 Results

We have estimated (5) for two measures of NTM: the one based on core measure (NTM_{core}), and the one based on import licensing (NTM_{lic}). For productivity, we used Total Factor Productivity estimated according to 3 and labor productivity. We estimated 5 with a standard OLS and with OLS with fixed effects. Finally, we used specifications with current and lagged values of NTM.

Preferred specification

Estimation results of the preferred specification for TFP as the measure of productivity are presented in Table 6. Results for same specification, but with lagged values of non-tariff barriers are shown in Table 7.

The effect of one standard deviation change in non-tariff intensity index is associated with very modest change in TFP, and the effect is never statistically significant. Also, the effect is numerically much smaller in the specification with the lagged NTMI values. This suggest that in food processing, all changes in protectionist measures are revealed immediately, due to short production cycles. On the other hand, it is evident that firms engaged in international trade are, on average, more productive (in particular, exporters show between nine and eleven percent gain in productivity). This corresponds with theoretical findings of Melitz (2003): only more productive firms are able to cover the fixed costs associated with expanding into the foreign market. For importers, the effect is also negative, still statistically insignificant. However, the most relevant finding is the effect of non-tariff barriers, which appears to be negative both for the current and the lagged NTM measures in OLS specifications. For importers, the negative magnitude reinforces, as the sign for the cross-effect variable indicates, though it turned insignificant once we control for the firm-level fixed effects, indicating that variation of the effect between the firms is greater than within firms. This finding may suggest an important outcome: the total effect of NTM on productivity of Ukrainian food-processing firms is not significant compared to the effect of direct protectionist measures. Once the firms have to import important inputs, whether equipment or raw materials, they face serious impediments for their productivity from the import tariffs. One standard deviation change in the input tariffs measure may decrease TFP by as much as three percent. A possible compensation for decline in productivity associated with protectionism may come from the services sector liberalization. The result repeats the one obtained in Shepotylo and Vakhitov (2012): if services undergo liberalization, firms using inputs from the services sectors are more productive, on average.

	(1)	(2)	(3)	(4)	(5)	(6)
NTM_{core}	0.0105	0.0176	0.00921	0.0233	0.0209	0.0223
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Exporter	0.269***	0.257***	0.255***	0.109***	0.114***	0.113***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Importer	0.312***	0.269***	0.272***	0.0367	0.0331	0.0342
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Input Tariff	-0.0847***	0.0221	0.0325*	-0.0473***	-0.0197*	-0.0158
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Importer $\times NTM_{core}$	0.0485		0.0457*	-0.009		-0.008
	(0.02)		(0.02)	(0.02)		(0.02)
Importer $\times$ Input Tariff	-0.109***		-0.0698*	-0.0261		-0.0232
	(0.03)		(0.03)	(0.02)		(0.02)
Serv.Lib		0.498***	0.493***		0.196***	0.195***
		(0.05)	(0.05)		(0.04)	(0.04)
Constant	2.441***	2.294***	2.297***	2.610***	2.540***	2.539***
	(0.03)	(0.03)	(0.03)	(0.14)	(0.12)	(0.12)
Firm fixed effects	no	no	no	yes	yes	yes
Industry and year fixed effects	yes	yes	yes	yes	yes	yes
Observations	14638	14638	14638	14638	14638	14638
Adjusted R^2	0.762	0.78	0.781	0.17	0.186	0.186

Notes: *p<0.05, ** p<0.01, ***p<0.001

Robust standard errors clustered at firm-level in parentheses

Table 6: Effect of NTMI on TFP

	(1)	(2)	(3)	(4)	(5)	(6)
$L.NTM_{core}$	-0.0233	-0.00643	-0.0195	0.000536	0.00102	0.00147
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Exporter	0.268***	0.258***	0.253***	0.0937***	0.0975***	0.0974***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Importer	0.293***	0.256***	0.256***	0.00901	0.00509	0.00508
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Input Tariff	-0.0850***	0.0258	0.0371*	-0.0627***	-0.0337**	-0.0320*
	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
Importer $\times L.NTM_{core}$	0.0748**		0.0655**	0.000169		-0.00269
	(0.03)		(0.02)	(0.02)		(0.02)
Importer $\times$ Input Tariff	-0.109***		-0.0744**	-0.0121		-0.00948
	(0.03)		(0.03)	(0.02)		(0.02)
Serv.Lib		0.488***	0.482***		0.189***	0.189***
		(0.05)	(0.05)		(0.04)	(0.04)
Constant	2.548***	2.353***	2.358***	2.544***	2.444***	2.443***
	(0.03)	(0.03)	(0.03)	(0.09)	(0.10)	(0.10)
Firm fixed effects	no	no	no	yes	yes	yes
Industry and year fixed effects	yes	yes	yes	yes	yes	yes
Observations	10476	10476	10476	10476	10476	10476
Adjusted R-squared	0.777	0.794	0.794	0.163	0.18	0.18

Notes: *p<0.05, ** p<0.01, ***p<0.001

Robust standard errors clustered at firm-level in parentheses

Table 7: Effect of lagged NTMI on TFP

Alternative measures of NTM

To make sure that our findings are not driven by a particular NTM measure we tried another one based on import licensing (NTM_{lic}), also estimated by Movchan and Shportyuk (2010). The alternative measure is estimated as the share of the corresponding tariff line. We have weighted the average share by the use intensity of the corresponding inputs. The results are presented in Table 8. The findings mostly confirm the one found for NTMI measure. One standard deviate increase in the NTM_{lic}measure may bring about less than one percent drop in productivity, but the effect turns insignificant once we introduce firm-level fixed effects. Apparently, an increase in the use of inputs affected by non-tariff measures decreases productivity slightly, and more so for importers. The effect of direct application of tariffs for inputs is associated with more tangible TFP decrease. The effect of service sector liberalization is comparable in terms of both magnitude and statistical significance, which suggests that service liberalization is not correlated with NTM measures.

Alternative measures of productivity

Finally, we tried a different measure of productivity. We used labor productivity, which is output less material costs per a full-time employee count. Results for estimating equation 5 follow in Table 9. The results for both NTM measures are similar as those in TFP specifications. Namely, there is no substantial and statistically significant effect of non-tariff measures for food processing firms if firm fixed effects are accounted for. Statistical significance in OLS specifications rather indicates a contemporaneous long-run shift in both OLS and NTM over time, and this trend is removed with the firms fixed effects. Exporting status is associated with 6-7% labor productivity gain, which again confirms findings from the previous subsection. There seems to be a slight difference in the effect of NTM for importers, but the result is not entirely conclusive. The effect of import tariffs for importer's labor productivity remains negative, but loses statistical significance in several specifications.

6 Conclusions

The present study indicates that non-tariff barriers are not critical in Ukrainian food processing. The effects of NTM for productivity of an average firm appears to be insignificant and numerically very small. However, another important result of the work is the strong adverse relationship between productivity and direct protectionists measures of inputs. An increase in input tariffs measures by one standard deviation is associated with three to six percent decrease in productivity. For specifications with Total factor productivity the effect is especially pronounced, which may rather indicated possible measurement issues in labor productivity variable than the lack of this negative correlation. Firms may offset this productivity drop through expanding into the foreign markets. Out analysis suggests that exporters receive up to 12 percent productivity gain. At the same time, importers bear both direct and indirect costs of protectionism through the use of inputs and raw materials. Service sector liberalization which

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
NTM_{lic}	-0.0245*	-0.0127	-0.0162	-0.00542	-0.00127	0.000871						
	(0.010)	(0.009)	(0.010)	(0.011)	(0.010)	(0.011)						
$L.NTM_{lic}$							-0.0361**	-0.0186	-0.0250*	-0.00085	-0.00342	-0.00025
							(0.012)	(0.010)	(0.011)	(0.012)	(0.011)	(0.012)
Exporter	0.262***	0.252***	0.249***	0.108***	0.114***	0.112***	0.266***	0.257***	0.253***	0.0933***	0.0976***	0.0971***
	(0.022)	(0.021)	(0.021)	(0.018)	(0.018)	(0.018)	(0.024)	(0.022)	(0.022)	(0.023)	(0.023)	(0.023)
Importer	0.316***	0.273***	0.276***	0.0366	0.0328	0.034	0.296***	0.259***	0.257***	0.00665	0.00504	0.00318
	(0.024)	(0.021)	(0.022)	(0.020)	(0.019)	(0.020)	(0.023)	(0.022)	(0.022)	(0.021)	(0.020)	(0.020)
Input Tariff	-0.0838***	0.02	0.0324*	-0.0502***	-0.0226*	-0.0189	-0.0810***	0.0267	0.0403**	-0.0626***	-0.0337**	-0.0320*
	(0.016)	(0.012)	(0.013)	(0.011)	(0.009)	(0.010)	(0.018)	(0.014)	(0.015)	(0.014)	(0.012)	(0.013)
Importer $\times NTM_{lic}$	0.0187		0.0169	-0.0131		-0.0121						
	(0.019)		(0.018)	(0.015)		(0.015)						
Importer $\times L.NTM_{lic}$							0.0333		0.0301	-0.0171		-0.0161
							(0.020)		(0.018)	(0.017)		(0.016)
Importer × Input Tariff	-0.123***		-0.0825**	-0.0242		-0.0215	-0.125***		-0.0886**	-0.0129		-0.00989
	(0.033)		(0.028)	(0.017)		(0.017)	(0.034)		(0.029)	(0.018)		(0.018)
Serv.Lib		0.498***	0.493***		0.196***	0.195***		0.486***	0.481***		0.189***	0.189***
		(0.045)	(0.045)		(0.038)	(0.038)		(0.048)	(0.049)		(0.043)	(0.043)
Constant	2.439***	2.292***	2.296***	2.619***	2.546***	2.546***	2.547***	2.352***	2.358***	2.543***	2.441***	2.441***
	(0.03)	(0.03)	(0.03)	(0.14)	(0.12)	(0.12)	-0.0344	-0.0328	-0.0328	-0.0942	-0.103	-0.102
Firm fixed effects	no	no	no	yes	yes	yes	no	no	no	yes	yes	yes
Industry and year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	14638	14638	14638	14638	14638	14638	10476	10476	10476	10476	10476	10476
Adjusted R-squared	0.762	0.78	0.781	0.169	0.185	0.185	0.777	0.794	0.794	0.164	0.18	0.18

Notes: *p<0.05, ** p<0.01, ***p<0.001

Robust standard errors clustered at firm-level in parentheses

Table 8: Effect of NTM_{lic}on TFP

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$NTMI$	-0.0183*		0.0107					
	(0.008)		(0.009)					
NTM_{lic}		-0.0264***		0.0129				
		(0.007)		(0.008)				
$L.NTMI$					-0.0376***		-0.00559	
					(0.009)		(0.009)	
$L.NTM_{lic}$						-0.0374***		0.00548
						(0.008)		(0.010)
Exporter	0.214***	0.212***	0.0743***	0.0740***	0.207***	0.207***	0.0668***	0.0666***
	(0.012)	(0.012)	(0.014)	(0.014)	(0.013)	(0.013)	(0.016)	(0.016)
Importer	0.289***	0.289***	0.0363**	0.0366**	0.272***	0.273***	0.015	0.0143
	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)	(0.013)	(0.012)	(0.012)
Input Tariff	0.0487***	0.0552***	0.00315	0.00119	0.0530***	0.0593***	-0.00883	-0.00891
	(0.008)	(0.008)	(0.007)	(0.007)	(0.010)	(0.010)	(0.008)	(0.008)
Importer × Input Tariff	-0.0164	-0.0278*	-0.0104	-0.00726	-0.0317*	-0.0395**	-0.0137	-0.0131
	(0.012)	(0.011)	(0.009)	(0.009)	(0.013)	(0.012)	(0.010)	(0.010)
Importer $\times NTMI$	0.0455***		-0.0173					
	(0.012)		(0.010)					
Importer $\times L.NTMI$					0.0493***		-0.0113	
					(0.013)		(0.011)	
Importer $\times NTM_{lic}$		0.0335**		-0.0254**				
		(0.011)		(0.010)				
Importer $\times L.NTM_{lic}$						0.0506***		-0.0154
						(0.012)		(0.010)
Serv.Lib	0.135***	0.134***	0.0285	0.0291	0.129***	0.127***	0.017	0.0168
	(0.014)	(0.014)	(0.016)	(0.016)	(0.016)	(0.016)	(0.020)	(0.020)
Constant	0.507***	0.506***	0.757***	0.761***	0.631***	0.631***	0.840***	0.847***
	(0.022)	(0.022)	(0.124)	(0.124)	(0.025)	(0.025)	(0.167)	(0.167)
Firm fixed effects	no	no	yes	yes	no	no	yes	yes
Year and Industry fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Observations	13837	13837	13837	13837	10005	10005	10005	10005
Adjusted R-squared	0.224	0.225	0.094	0.094	0.216	0.216	0.094	0.094

Notes: *p<0.05, ** p<0.01, ***p<0.001

Robust standard errors clustered at firm-level in parentheses

Table 9: Effect of NTM_{core} and NTM_{lic}on labor productivity.

took place in Ukraine in the beginning of 2000's had apparently positive impact for productivity. Also, there is not statistically significant effect of foreign ownership. This results is not shown in this work, but additional tables are available from the authors upon request.

The paper has obvious policy implications. First, even after joining the WTO, Ukraine is still able to increase productivity of food processing via decreasing tariffs for imported inputs. On the other hand, there still is a potential of broader use of non-tariff measures. Even though the literature states that non-tariff measures are becoming increasingly popular, our study has found no devastating effect of NTM on productivity. One of possible reasons for such finding is the dual goal of applying NTM. Unlike direct protection of the market with tariffs, NTM are also able to increase competition through the complicated mechanism of quality increase, which drives competition, productivity gain and expansion abroad. Even though further analysis is required, preliminary results suggest that this "creative" facet of NTM is at least as strong as the possible negative influence.

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About the Authors

Volodymyr Vakhitov holds positions of Assistant professor at Kyiv School of Economics in Ukraine and of Senior Economist at the Center for Market Studies and Spatial Economics at Higher School of Economics in Russia. After graduating from the National University of Kyiv Mohyla Academy he obtained a PhD degree in Economics from the University of Kentucky, USA, in 2008. He was awarded with various grants and fellowships from the World Bank, Soros Foundation, and Global Development Network. Dr. Vakhitov's research interests are in agglomeration economies, urban and regional economics, and productivity analysis. Also, Dr. Vakhitov was invited to give lectures in Behavioral Economics both in Ukraine and abroad.

NUPI
Norwegian Institute of International Affairs
C.J. Hambros plass 2D
PO Box 8159 Dep. NO-0033 Oslo, Norway
www.nupi.no | info@nupi.no

Oleksandr Shepotylo is a lecturer in the department of Economics at the University of Bradford, UK. Before that, he worked at Kyiv School of Economics (Ukraine) and Higher School of Economics (Russia). Oleksandr obtained PhD in Economics at the University of Maryland at College Park in 2006. He worked as a consultant at The World Bank's Development Research Group (DECRG) in 2003-2006. His main research interests are international trade, spatial econometrics, and applied industrial organization.