Trade Restrictions and Labor Productivity: Evidence from the Georgian Wine Industry[*]

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Abstract

Russia, the Republic of Georgia's largest neighbor and trading partner, started imposing economic sanctions on Georgia beginning in early 2006, by restricting the import of Georgian wine to Russia. I exploit this natural experiment to estimate the effects of the embargo on the Georgian wine industry. I conclude that the trade ban actually increased the productivity of wine producers. Not only did average labor productivity increase during the embargo the entire productivity distribution shifted to the right. The reason Georgian firms became more competitive is that they had to export to relatively more competitive markets in US and Europe. The following two main sources of improvement happened to be important. First, firms decrease their employment and increase wages during the embargo substantially; firms let least productive workers to leave. And second, the cost of intermediate inputs per liter of wine increased dramatically during embargo, which led firms to produce better wine. The embargo positively affected exporters' productivity. But, the most interesting is the fact that embargo did (indirectly) affect domestic producers significantly. This can be explained by the fact that non-exporters were competing with highly productive exporters in the domestic market.

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1. Introduction

International economic sanctions are often adopted by countries or by international organizations as a means of influencing another government's behavior without resorting to military conflict. Historically, economic sanctions, which date back at least to the Megarian decree of Athens in 435 B.C., were used by Napoleon in the Continental System commencing in 1806, by Thomas Jefferson in the Embargo Act of 1807, and by the League of Nations against Italy in 1935(Kaempfer W, Lowenberg A., 2007). Hufbauer et al. (1990) provides very nice survey of economic sanctions, which records 116 cases since 1914. One can observe that the use of economic sanctions by countries as well as international organizations accelerated after the collapse of the Soviet Union in 1990. Economic sanctions might include various trade sanctions, i.e. restrictions on imports from or exports to the target country; investment sanctions, which include restrictions on capital flows to the target. In any case, economic sanctions are supposed to work by creating some kind of problems on the target country, and particularly on its ruling regime, which is then forced to change its policies in order to fulfill the sender's demands and thereby avoid further sanctions damage.

In order to get the idea of what natural experiment took place in Georgia, cradle of wine, where the wine production started some 8000 years ago, let me introduce some preview of the facts. Before 2006 almost 80% of Georgian wine exports were to Russia. For example, in 2004 total export of the firms we have in our data reached around $41 mln. Out of this, only $7 mln was exported in US or Europe, while export in Russia amounted to $30 mln. The situation is very similar in 2005 as well, out of $76 mln total export, $58 mln was to Russia and only $13 mln was exported in US or Europe. Not surprisingly, we have analogous results for wine in liters as well. In 2005 import from Georgia represented 17% (34mln liter) of Russian wine import[1]. Georgia had been exporting in Russia for decades. Therefore, its brands were very well established in the Russian market and faced little competitions. However, due to political tensions on March 15, 2006 Russia banned the import of Georgian wine. On May 5, 2006 the Russian government banned the import of Georgian mineral water and other agricultural products

[1] See http://www.wine-business-international.com/129---en-top_navi-home.html

as well[2]. Starting from that time, Georgian wine producers could no longer export in Russia and therefore the main destination of all of their export has to be European and US markets. For example, in 2010 out of total $31 mln almost $22 mln was exported in Europe and US. Similar pattern remained in all years after 2006. Apparently, these markets are more competitive than of Russian where Georgian brands had been established; so Georgian firms have to be faced tougher competition in European and US markets. New networks were formed in the West gradually but many firms stopped exporting in the short run. The extent of pre-sanctions trade between sanctioner and target is an important factor in determining the ease with which the target can find alternative sources of supply and alternative markets for its goods, and therefore in determining the terms-of-trade effects of the sanctions (Kaempfer & Lowenberg., 2007). This is particularly relevant for this case because as it was mentioned, the Russian market represented most of Georgian wine export's destination.

The questions that I am going to answer in this paper are: What was the effect of the Russian embargo on the Georgian wine industry? Did the labor productivity increase in the wine industry? What mechanism might play role in making firms become more productive? Are exporters more productive than non-exporters in general and was the effect significant both- exporters and non-exporters?

Why is it an interesting piece of topic for economic theory? First, it is important to answer the question: Does more competition increase productivity? My case is relevant for answering this question because as I mentioned before, Georgian wine producers had to compete in more competitive environment after the embargo. Second, what was the driving mechanism, which lead to higher labor productivity? Schmitz (2005) examines these issues on the example of American and Canadian iron ore producers and concludes that labor productivity increased in the iron ore industry once they faced tougher competition from foreigners. The channel there trough which the Canadian firms and US manage to improve the productivity was the following: all they did was they fired many

[2] The same policy was applied against Moldovan wine around the same time. To be more precise, this trade restriction, which continued from 2006 till 2013, was not declared as an embargo by Russian officials. Official reasons were low quality level. Interestingly no other country in the world complained about the quality of Georgian wine or water. Therefore, it is hard to believe that this trade restriction has anything to do with wine quality. Moreover, the ban was lifted few months after the change of government in Georgia which lead me believe that embargo was mainly due to political reasons.

idle workers and each worker was responsible couple of tasks, which would take couple of workers before. As a result employment dropped significantly and apparently productivity per worker increased. It is an attractive explanation for my case as well, because after embargo there was significant decrease in employment indeed. The other interesting question that arises in economic literature is: does an export quota shift firms to higher quality products? We could think of two possible scenarios that might take place. The first in which firms continue selling low quality products with low prices and less profit or serve the domestic market. And the second, firms adopt new markets and better technologies, bearing high fixed cost initially in return for low marginal cost and higher profit later. Feenstra (1988) examines this issue for the case of Japanese car exporters and concludes that Japanese car exporters substantially upgrade cars exporting in the USA after having import quota from USA. This explanation seems relevant for Georgian wine as well because we see price and quality upgrade in the data.

Somewhat related to the questions I ask are considered in Lektzian & Souva (2001). The main topic there is the determinants of the time it takes for nations to return to pre sanctions levels of trade after a sanctions episode ends. The paper examines a data set of 59 of economic sanctions cases occurring between 1954 and 1992. They find strong support for the theoretical hypothesis that democratic political institutions facilitate a return to trade. In contrast, I cover periods before and during embargo. I cannot consider the issue of comparison pre and post periods of embargo because the ban has been lifted recently, few months ago. I consider this question a topic for future research.

As far as comparison between exporters' and non-exporters' productivity is concerned, various authors tested the hypothesis, that exporting firms have higher productivity than non-exporters, using firm level data from different countries. For example, for the United States Bernard and Jensen (1995, 1998a, 1998b, 1999a, 1999b) have shown that this fact holds for industrial firms. Several other empirical works for other countries has been done by Bernard and Wagner (1997) and Wagner (2002) for the case of Germany; Aw et al. (1998) for the case of Taiwan and Korea; Clerides et al. (1998) for the case of Colombia, Mexico and Morocco; Girma et al. (2003, 2004) for the case of the U.K. These studies focus only on the average firm and make conclusions on exporters performance in aggregate form. In other words, using an OLS estimation procedure gives a general idea

of the comparison between exporters and non-exporters. However, it does not give us information about firms in different quantiles of the distribution. Yasar et al (2003) is exception in this regard which presents a quantile regression estimation. They use Turkish data where there are many small firms and the overall over-performance of exporters might be misleading. However, they conclude that "the productivity effect of exporting is present at all points along the conditional output distribution, and this effect increases as one moves from the lower tail to the upper tail of the distribution. Exporting firms that continuously exported throughout the time-period have more pronounced productivity effects compared to firms in other categories (i.e. new exporting firms, exporting firms that exit, and exporting firms that switch exporting practices)." I use similar but somewhat different approach. I provide empirical analysis based on novel data on the wine industry in Georgia. In addition to OLS estimation procedure first I compare the distributions of productivities of exporters and non-exporters, and establish first order stochastic dominance of the former, using a Kolmogorov-Smirnov test (Kolmogorov, 1933; Smirnov 1939)[3]. Next, I investigate the effect of the embargo on the distribution of the exporters and non-exporters. Intuitively embargo had direct impact on exporters and their productivity should be affected. However, domestic producers might be affected as well. That is because the non-exporters had to become more efficient as well because they had to compete exporters in the domestic, Georgian market. So the how would their productivity change relative to exporters is not clear. Though as we will see below, exporters' dominance over the non-exporters holds in both-pre embargo and embargo periods.

The remaining part of the paper is organized in a following way: section 2 provides the theoretical background and estimation strategies. Section 3 describes data, which is novel and has not been used in the economic literature. Section 4 provides empirical results in which I find evidence of the labor productivity increase during the embargo. Section 5 presents various robustness checks and shows that similar results hold for example in the case of defining labor productivity using value added per worker. Section 6 concludes and offers suggestions for future research.

[3] Note that this approach was used by Delgado et al(2002) for Spanish manufacturing firms.

2. Theory and Estimation Strategies

2.1 The effect of embargo on the labor productivity

In order to gauge the effect of embargo on the labor productivity in the Georgian wine industry I use several characteristics of the firms. Measurement of labor productivity is very important for my paper and I use all my available data to provide various kinds of measures. In the main specification I use labor productivity defined as (natural logarithm of) the revenue per worker. Second most natural measurement I could use is quantity produced per worker. However, the former has the advantage of having affected by the price and thus capture some effect of change in quality which is very relevant for the case discussed here. The third interesting measure of labor productivity would be the value added per worker. My hypothesis that increasing labor productivity is partially explained by increasing the quality of wine leads me to use the first measure in the main specifications. In this regard third measure is also similar and I provide the results for it in the section, which checks the robustness of my results. The regression specification in which quantity per worker is used provides some more evidence that firms switched to producing higher quality (or upgraded) wine production than higher quantity[4]. In order to strengthen the idea of the upgraded wine production I provide the regression specification results in which the explanatory variable, cost of inputs (intermediate goods) per liter of wine turns out to be highly significant.

As far as measuring the explanatory variables is concerned, having logarithm of employment in the main regression specification can be justified by the fact that it matters how much in percentage terms firms decrease their employment not in absolute terms. For example, firing one least efficient worker would affect more the firm having around ten workers than the one, which has around hundred of workers. For controlling the size of firm I use various measures, not only its number of employees but also total cost, labor cost and cost of intermediate goods. I could have just used employment for capturing size effect. In the end these kinds of cost measures are positively correlated with employment; say, everything else equal, more workers need more compensation. However, measuring firms' size with various kinds of costs gives me bit more insight.

[4] By this I mean that firms choose to produce wine selling on higher price on the market.

For instance, positive coefficient of cost on intermediate good would indicate that firms investing more in the input goods is associated with higher productivity. I use the logarithm of costs in the main specification because of the same argument as in case of employment. I am considering the specifications without logarithm in the section 5 as the robustness checks of the main results. Including time trend in our regression is very natural to avoid the spurious regression. For example Holman, Joyeux and Kask (2008) estimate that labor productivity growth amounted 3% annually in the United States during 2000-2005[5]. So, if I run the regression without time trend in it I might end up with unusually high effect of shock, the result, which of course suffers from, omitted variable bias. To control for unobserved firm heterogeneity I use the regression specification with firm fixed effect. And of course, to have more reliable standard errors I used robust standard errors.

Looking at my data it is very easy to observe that during the embargo the increase in productivity amounted around 43% after controlling for 8% annual increase. The effect of the shock is clear, however my main interest is to find the channel through which embargo might lead the labor productivity to increase. The mechanism I have in mind comes from empirical evidence and private interviews with the representatives of the Georgian wine sector. The average firm decreased the employment by 27% during the embargo period compared to the period of 2000-2005 years. This would of course push the productivity upwards in case the fired workers were the least productive. Moreover, this is consistent with the main idea of Schmitz (2005) mentioned above. According to the author Great Lakes iron ore producers had faced no competition from foreign iron ore in the Great Lakes steel market for a century till 1970s. In the early 1980s, as a result of developments in the world steel market, Brazilian producers were offering to deliver iron ore to Chicago at prices substantially below prices of local iron ore. In response to the crisis, these industries dramatically increased productivity.[6] Labor productivity doubled in a few years (whereas it had changed little in the preceding decade). He shows that most of the productivity gains were due to changes in work practices. Work practice changes reduced overstaffing and hence increased labor productivity. That is exactly

[5] Holman, Joyeux and Kask (2008) measures labor productivity as output per hour

[6] Schmitz(2005)

what I observe in Georgian data. Reduced overstaffing did indeed increase labor productivity.

The story would end up here; however, it does not seem too much of the change to fully explain the abovementioned big increase in the productivity. We will see below that corresponding regression specification results in significant effect of employment but still attaches quite a bit of effect to the shock. The second factor that might have affected the productivity is the input cost per liter of wine. It is clear that if the better inputs (grapes, sugar etc.) are used workers are going to produce better (higher quality) wine and thus generate higher revenue. Again, what I see in the data and in personal interviews the firms pay more attention to inputs and increased the input cost per liter of wine significantly. Moreover, the regression specification below indicates that input cost per liter is highly significant and what is the most important is that shock becomes insignificant. So, these two changes in the firms' business strategy accounted most of the effect of shock on Georgian wine industry.

Therefore, I am left with two main sources of increased productivity, decreased employment and better inputs. In order to provide further evidence of the mechanism through which firms became more productive I would ideally have more detailed data about composition of the labor force of firms, for example skilled compared to unskilled workers. If say, the composition changed in favor of more skilled workers that would indicate that firms fire least efficient workers and leave/hire most productive workers. Unfortunately, I don't have this data and can only rely on the cost structure of the firm to present some evidence supporting my hypothesis.

2.2 Extensive versus Intensive margin

After I establish the positive impact of embargo on labor productivity I perform several tests to find out whether abovementioned increase in labor productivity is because less productive firms exit (extensive margin) or because surviving firms increase productivity (intensive margin). If there were selection and only the highest productive firms survive the embargo then their increase in input cost would be positively correlated with the productivity but this might not be generally true. So, checking it is very important as the selection might make my result biased. For the first hypothesis, I take all the firms

operating in 2005 and I look at the difference in the 2005 -year productivities of the firms who never produced during embargo and ones, which continued production during embargo.[7]

Next, to test whether the surviving firms increase productivity during embargo, I just run the simple regression for year 2005 and 2006, for the firms, which were active during both, before 2005 and during embargo years. The main variable is shock, which is, equal to 1 if year during embargo, otherwise it is zero. Coefficient of the shock in this specification gives the average increase in productivity of the survival firms during embargo.

2.3 Non-Parametric Approach

After I establish positive effects of embargo on the labor productivity of "average firm" I am interested in looking at the whole distribution of labor productivities before and during embargo. This way I will be able to see how the industry as a whole was developing before embargo compared to during embargo. I construct empirical distributions and graph them for the whole sample before and during the embargo. One can see on Figure 1(a,b,c) that distribution of labor productivity during embargo dominates the productivity distribution before embargo. However, how significant is the dominance is the question of the empirical test, which I present here. I am going to use Kolmogorov-Smirnov test. Following Kolmogorov(1933) and Smirnov(1939) I am interested in testing whether distribution F first order stochastically dominates G or not. By this I mean $F(z) \leq G(z)$ uniformly in $z \in R$, with strict inequality for some z. Formally I am interested in justifying the following:

H_0 can not be rejected against H_1 in one sided test

$$H_0: F(z) - G(z) = 0 \; for \; all \; z \in R \;\; vs. \;\; H_1: F(z) - G(z) > 0 \; for \; some \; z \in R$$

The Kolmogorov-Smirnov testing procedure goes in a following way: take independent random sample of z-s from both distribution, say, $Z_1, Z_2, \dots, Z_n$ from distributon F and $Z_{n+1}, Z_{n+2}, \dots, Z_{n+m}$from distribution G. The Kolmogorov-Smirnov statistic for this tests

[7] In the main specification I define survivor as the one who produced at least once during embargo. I do specifications with other variations of definition of survivor, quitter and market enterer in the section which checks the robustness of my results

are then calculated as $KS_N = \sqrt{\frac{n \cdot m}{N}} \max_{1 \le i \le N} \{T_N(Z_i)\}$ respectively, where $T_N(Z_i) = F_n(Z_i) - G_n(Z_i)$ and $N = n + m$. F_n and G_n represent the empirical distribution functions for F and G,

$F_n(z) = \frac{1}{n} \sum_{i=1}^{n} 1\{Z_i \le \text{z}\}$ and $G_n(z) = \frac{1}{n} \sum_{i=n+1}^{N} 1\{Z_i \le \text{z}\}$, respectively. The limiting distributions of these test statistics under corresponding H_0's are derived by Kolmogorov and Smirnov and are the following: $\lim_{N \to \infty} P(KS_N > z) = \exp(-2z^2)$.

However, from what was mentioned before, I would have independence problem if I used whole sample at once. Indeed, having the same firms in the sample over the years invalidates our sample for direct testing. One way to handle this problem is to compare distributions year by year (Delgado et al 2002). I differentiate between survivors, firms who exit the market and firms who enter the market during embargo. For simplicity, I take year 2005 as a baseline for comparison, as it is the last year before the embargo. First, I compare the productivity distribution of the surviving firms in 2006 to their distribution in 2005. Then I do the same for the remaining years starting from 2007 onwards and compare them to 2005 distribution. This will give me information about productivity increase in the firms that operated before and during embargo.

The percentile-percentile (p-p) plot in Figure 1(f,g,h) gives a visualization of the test result A p-p plot is a two-dimension probability plot for assessing how closely two data sets agree. This is done by plotting two cumulative distribution functions against each other. Thus, for input z the output is the pair of numbers giving the percentages that the distributions have below z: $\big(F_1(z), F_2(z)\big) = (P_1(Z_1 \le z), P_2(Z_2 \le z))$

The diagonal in the p-p plot is the comparison base that shows when the percentages of the two cumulative distribution functions are the same: $P_1(Z_1 \le z) = P_2(Z_2 \le z)$. The closer the p-p line is to the diagonal line, the more certain we are whether the two samples have the same underlying distribution.

2.4 Exporters vs non-Exporters

One of the questions I am trying to answer in the paper is whether both exporters and

non-exporting firms were affected by the embargo. In order to answer these questions first I am going to check whether exporters were more productive than non-exporters over the entire period of time.

First, I run the OLS regression, which includes the dummy variable indicating whether particular firm was exporting at any, given time period. The coefficient of the dummy variable indicates how much on average the exporters are more productive than non-exporters. The obvious candidate for this productivity dominance is the selection effect. By this I mean that, perhaps the most productive firms enter export market and others serve domestic market. In this case we should have the productivity dominance of future exporters even before they start exporting. For this I choose all the firms, which did not export from t-3 to t-1 year and compare the productivity difference between the firms that exported in t, and the ones, which did not.

With the OLS estimation procedure we got the overall dominance of exporters over the entire period of time, 2000-2011 years. Then, I provide stronger version of the exporters' dominance by comparing the productivity distribution of exporters and non-exporters. I construct the empirical distributions of the exporters and non-exporters productivities before and after the embargo. The empirical distribution for the whole sample is presented on the Figure 1. The dominance is clear but now I need to show how significant it is. For this reason I use the Kolmogorov-Smirnov non-parametric test. As it was mentioned above to establish the stochastic dominance of exporters' productivity distribution I need to compare them year-by-year.

3. Data Description

The main part of my data is coming from National Statistics Office of Georgia. I can divide this data into two parts: aggregate level and firm level data. Aggregate data is available on www.geostat.ge , while the firm level data is novel and was processed on our special request for this research. There are interesting patterns if we look at aggregate data. The sharp decrease in the volume of exported wine is clear in the second quarter of 2006, from around 12 mln liters in the last quarter of 2005 to 1.5 mln liters in the second quarter of 2006 (see Figure 2(a)). Moreover, if we look at the dollar value of exported wine it has a similar sharp decline at that point of time, from $25 mln to $5 mln. But, what is promising is the price per bottle of wine, which experienced around a 50% increase from $2 to $3 per bottle. I think that there might be simple explanation for it: the immediate increase in the average price is because the price of wine exported in Europe was higher than it was for Russia. So a selection effect might play role.

Before I go to results of the econometric estimations lets look at one more industry badly affected by the Russian embargo. It is the mineral water industry. I can see from Figure 2(d) that exporting mineral water dropped from 35 mln liters in 2006 first quarter to 5 mln liters in 2006 second quarter. Analogously, the dollar value of total export of mineral water declined from $12 mln to $2 mln. However, as in the case of wine the price of liter water increased from 30 cent to 45 cent. Moreover, the dynamic is more promising for mineral water industry as the volume is increasing steadily and reached 28.6 mln liters in second quarter of 2012 as opposed to 35 mln before the embargo. The value increase is more dramatic from $12 mln to $18 mln in the second quarter of 2012. Moreover, price per liter reached 65 cent per liter. So the overall effect is that in both industries the price increased significantly, volume and value is increasing steadily after the initial sharp decrease.

The aggregate facts suggest that there might be improvement in quality and labor productivity in wine industry. I am going to look at this in more detail by examining firm level data, which was provided by National Statistics Office of Georgia. This is annual survey of firms, which interviews random draw of firms, new draw each year. That is

why I have unbalanced panel data of about 190 firms across time period of 2000-2011[8]. It might seem to be a very small data set but actually if I calculate the share of these firms' export of wine in total wine export from Georgia I get that they represent around 75-80 % of Georgian wine exporters. So, studying their behavior will give us the big picture of the wine industry in Georgia. Our data include firms' export and also their economic indicators such as, employment, revenue, labor cost, total cost, intermediate good cost, value added and profit[9].

4. Estimation Results

4.1 The Effects of the Embargo on Labor Productivity

First, let us see the effect of shock on labor productivity. I run the following regression with firms fixed effect:

$$lnLP_{i,t} = \alpha + \beta * Shock_t + \gamma * lnEmp_{i,t} + \delta * lnTcost_{i,t} + \mu * lnIntcost_{i,t} + \tau * year_t + \alpha_i + \epsilon_{i,t}$$

Where *Shock* refers to dummy variable, which equals to 1 for the years of embargo; otherwise it is zero. It is of course time fixed variable and does not vary across firms. *lnEmp*, *lnTcost* and *lnIntcost* are natural logarithms of the firms' employment, total cost and intermediate good's cost respectively. In order to account for the yearly trend in the labor productivity I have variable *year* in the regression specification. To control for unobserved firm heterogeneity I use the regression specification with firm fixed effect, α_i. The results are reported in the first column of Table 2 where we report robust standard errors. One can see that decreasing in employment is associated with increase in labor productivity. 1% decrease in employment would correspond to 0.9% increase in productivity. Moreover, the all the variables controlling for cost are significant. The variable of the main interest in this specification is *shock*. On average, firms were 23%

[8] In order to have everything measured in the similar way, I converted all the values in the US dollars. To eliminate the results dependent on the exchange rate, I include it in the main regressions in the section which checks robustness of the results. It did not change main results indeed.

[9] I made data cleaning very carefully and try to eliminate the firms, which had very unrealistic characteristics, e.g. reporting employment below three and having revenue of millions, having negative revenue or cost and so on.

more productive after controlling for costs, employment and yearly trend. Moreover, the effect is significant on 5% significance level. So, we still need to account for other variable, which might be affecting productivity increase after the embargo. Theoretical section above suggests that higher input cost per liter of wine would imply the higher quality of wine and therefore higher revenue for firms. Which would increase the labor productivity because of our choice of measuring it. Indeed, after controlling the input cost per liter of wine the effect of embargo became highly insignificant. So, the two main effects through which embargo affected the labor productivity were decreased employment and increased input cost. So, finally our main specification is :

$$lnLP_{i,t} = \alpha + \beta * lnInpcostpl_t + \gamma * lnEmp_{i,t} + \delta * lnTcost_{i,t} + \mu * lnIntcost_{it} + \tau * year_t + \alpha_i + \epsilon_{i,t}$$

Where, the additional variable *lnInpcostpl* is natural logarithm of the input cost per liter of wine. One can see that input costs and employment are highly significant. Specifically, increase in input cost per liter is associated with 0.1 % increase in productivity. This might be the small effect. However, I estimate the increase in input cost per liter after the embargo and it turned out to be 145% on average. Therefore only this would account for 14.5% increase in labor productivity. The effect of employment is bigger, 1% decrease in employment is associated with 0.76% increase in productivity. I estimate the increase in input cost per liter after the embargo and it turned out to be 27.9% on average. So, this would imply increase in labor productivity by 21.4%. As it was mentioned above the increase in productivity after the shock was around 43%, so employment and input costs explain most of its effect. The inclusion of *year* was indeed important because the estimated effect is around 2.6 % per year and this effect is significant on 5% significance level.

As it was mentioned in the theory section it is important to check whether the increase in productivity is due to extensive of intensive margin. My regression results show that on average the quitters (just after when the shock) were 33.2% less productive than ones who survived, however the effect is insignificant! In other words our result of higher productivity during embargo can not be explained by the fact that the least productive firms quit and the most efficient ones remain in the market. Moreover, my estimates indicate that the increase in productivity in survivor firms was 37.6%, after controlling

for 9.2% yearly increase. This change in productivity is both statistically and economically significant. So, the overall increase in productivity during embargo is consistent with hypothesis of intensive margin and not with extensive margin.

After I establish the positive impact of embargo on the labor productivity using regression techniques, I am interested how the distribution of productivities was affected during embargo. The regression results suggest that we might have productivity distribution shifted to the right, meaning that during embargo the distribution stochastically dominates one before the embargo. I construct the empirical distribution of the productivities before and during embargo and Figure 1 presents the results. One can see the dominance clearly. Moreover if we look at p-p plots we see that the curve is not very close to 45 degree line, which suggests that the distributions should not be the same. However, it needs to be tested using proper statistical took, Kolmogorov-Smirnov test. Again, I compare the productivity distributions year by year. The corresponding p-values for K-S test are reported in Table 5.The null hypothesis of the same distribution in 2005 and years during embargo is rejected in all years 2006 onwards.

4.2 The Effects of the Embargo on Exporters and non-Exporters

To estimate whether the effect of shock was the same for exporter and non-exporters first it is interesting to see whether exporters were more productive than non-exporters. The average labor productivity of exporters is 2.94 compared to 0.71 of non-exporters. Now, let's look at the productivity distributions of exporters' and non-exporters'. One can see on Figure 1(d) that the dominance of exporters' productivity is obvious. However, this is unconditional productivity difference. More interesting for us is to see if there is *ceteris paribus* productivity differential between exporters and non-exporters. I run the above-mentioned regression but now include dummy variable *exporter*, which is equal 1 if the firm was exporting at particular point of time; otherwise it is zero. Moreover, to control for year-fixed effects I included dummy variables $\lambda_t$for each year 2001 onwards[10]. So I run the following regression:

[10] Dummy for year 2000 is excluded to avoid collinearity

$$lnLP_{i,t} = \alpha + \beta * lnInpcostpl_t + \gamma * lnEmp_{i,t} + \delta * lnTcost_{i,t} + \mu * lnIntcost_{it} + \rho * exporter_{it} + \lambda_t + \alpha_i + \epsilon_{i,t}$$

Where λ_t is year fixed effect. The estimated coefficient on *exporter* gives me the over performance of exporters compared to non-exporters, which is 35.9% and the effect is statistically significant. (See Table 4)

The obvious candidate is selection effect. So, if the exporters became ones, which are most productive, they should be more productive even before they start exporting. Consistent with Wagner (2007) I run the regression:

$$lnLP_{i,t-3} = \alpha + \beta * lnInpcostpl_{i,t-3} + \gamma * lnEmp_{i,t-3} + \delta * lnTcost_{i,t-3} + \mu * lnIntcost_{i,t-3} + \rho * exporter_{it} + \lambda_{t-3} + \epsilon_{i,t}$$

I got that the future exporters were not more productive than non-exporters. Actually, they were 1.5% less productive but the effect is highly insignificant (P-value 0.88). So, the selection effect should not have played much role here.

To see the differential effect of embargo on exporters and non-exporters I run the regression abovementioned regression with an additional variable, which is product of *shock* and *exporter*. So the coefficient of this variable tells us what was the change in the exporters' productivity dominance over the non-exporters'. As we can see from the Table 4 average exporters' dominance was 4.4% less during embargo, but this differential effect is highly insignificant (P-value 0.78). So the embargo must have had similar effects on the both set of firms.

As most of the firms were switching back and forth between exporting and non-exporting it is not very clear how to define the effect of shock on exporter and non-exporters. So, instead of focusing on particular firms here I focus on the distribution of exporters' and non-exporter's productivity as a group. For graphical illustration Figure1(a,b,c) presents these distributions before and after the embargo. One can see that, both-exporters' and non-exporters' productivity distribution shifted to the right. Moreover p-p plots suggests that the distributions should not be the same. However, as it was mentioned before given we have repeated firms over the years, we need to implement Kolmogorov-Smirnov test separately for each pair of years. For illustration I compare the distributions for each year of embargo to the distribution of 2005 year (both, for exporters and non-exporters).

Results in Table 5 show that dominance is indeed the case for both categories of firms. Most of the P-values are less than 5% except one case when the P-value is still less than 10%.

5. Robustness Checks

In this section I check the robustness of the main results obtained above by using different measure of productivity ; using specification without logarithm and by including exchange rate as additional control.

First, as it was mentioned above there are various ways I can define labor productivity and let us now see how the main results change if instead of sales per worker I use value added per worker. Here, I calculate workers' value added as sales less cost on intermediate inputs divided by the number of employees. As we can see from the third column of Table 6 the employment and input cost per liter of wine remains to be significant factor of productivity increase during embargo. Moreover, the magnitudes are close to the ones I had before for the main specification.

I have used logarithms of all the variables in the main specifications except the dummies. However, if I allow having log-linear relationship the results do not change much. The magnitudes change of course. We can see from second column of Table 7 that qualitative results and main conclusions above still hold for these specifications as well.

Lastly, to eliminate the possibility that increase in the productivity, defined as in the main specification-sales per worker, might be due to simply strengthening of Georgian currency during embargo, I include exchange rate in the main specification above. One can see from Table 8 that the effect of change in exchange rate is insignificant and the estimates above remain almost unchanged. Indeed, the exchange did not fluctuate too much over 2000-2011 to "cause" the labor productivity increase.

6. Conclusion

This paper contributes to the literature of international economics in two ways. First, I empirically gauge the effect of Russian sanctions on the labor productivity in Georgian wine industry. Second, I contribute to the growing literature related to the productivity difference between exporters and non-exporters. Moreover, I show that the embargo had

similar effect on exporters and non-exporters. This paper uses novel, firm level data set on Georgian wine industry to quantify the effects of sanctions on labor productivity.

The standard trade agreement theories predict that reducing tariffs and opening economy can be beneficial for many industries and in particular it is associated with increase in labor productivity. However, our analysis shows that export bans and restrictions might actually give us similar effects. By this I mean that export barriers were exactly the driving force to open Georgian economy for very competitive European and US markets. I find that labor productivity and good's quality (measured by price of the good and intermediate goods) increased significantly during 2006-2013 Russian embargo.

In the second part of the paper, I established the exporters' productivity dominance over the non-exporter's productivity. The dominance is derived in two conceptually different ways. First, using least square estimates allow me to document exporters dominance for average firms. In other words, the entire set of exporters performs better than the group of non-exporters. It is clear that it leaves room for having different situation on different quantiles of productivity. Our second, non-parametric approach tackles this problem exactly. I establish that the distribution of productivities for exporters dominates productivity distribution of non-exporters. The dominance is not homogenous, meaning that the over-performance of exporters is larger in lower part of the productivity distribution. Moreover, the exporters' dominance did not change much after the embargo. I got pretty strong support for selection hypothesis in my data.

Just recently, in summer of 2013 Russian Government has allowed Georgian wine producers to export in Russia. The embargo is officially over. For future research it would be interesting to analyze of what will be the effects of embargo lift on Georgian wine industry. Furthermore, as it was discussed earlier in the data section analogous restrictions were applied against mineral water and agriculture industries. The similar aggregate data suggests that there might be similar productivity improvement in those industries as well. Studying those cases will be useful for testing economic theories and in particular the ideas developed in this paper.

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Appendix

Table 1. The Effect of Shock on Labor Productivity and Employment

	Labor Productivity		Employment
	Whole Sample	Survivors	
Shock	0.435**	0.376**	-0.279***
	(0.170)	(0.179)	(0.092)
Year	0.082***	0.093***	0.014
	(0.027)	(0.030)	(0.015)
Number of Obs.	718	378	730

Notes:* p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors are in parentheses and are robust standard errors. The first column reports the results of the OLS regression with firm fixed effects for the whole sample of 718 observations. While, the second column is the same regression for the survivors. Survivor here is defined as firms exporting at least once in both periods: before and and once during embargo. The third column indicates the drop in employment due to shock.

Table 2. Main Results: the effect of shock on labor productivity

	(1)	(2)	(3)
Shock	0.230**	-	0.035
	(0.108)	-	(0.088)
Year	0.009	-	0.024*
	(0.014)	-	(0.014)
Employment	-0.920***	-1.313***	-0.761***
	(0.061)	(0.139)	(0.063)
Total Cost	0.723***	0.902***	0.616***
	(0.052)	(0.139)	(0.044)
Intermediate Cost	0.209***	0.199	0.210***
	(0.033)	(0.164)	(0.027)
Intermediate Cost (per liter)	-	0.198	0.102***
	-	(0.120)	(0.025)
Quit	-	-0.332	-
	-	(0.207)	-
Firm Fixed Effect	Yes	No	Yes
Number of Obs.	685	49	566

Notes: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors are in parentheses and are robust standard errors. Labor productivity is defined as sales per worker. The dependent variable is natural logarithm of labor productivity. The explanatory variables : *Employment* , *Total cost* , *Intermediate cost and Intermediate cost per liter* are all in logarithms. First column represents the results of the OLS regression with firm fixed effects. The coefficient of the *Shock* indicates the average increase in productivity during the embargo. Second column reports the results of the regression which is used to check whether there were selection effect in firms-least productive firms exit the market or not. The regression is run for year 2005 and compares the productivities of the firms which never operated after 2005 and firms which survived the embargo. The third column is the result of the main specification where intermediate input cost and employment is included as explanatory variables.

Table 3. Summary Statistics of Labor Productivity

	Labor Productivity	
	Mean	Number of Obs.
Non Exporters	0.713	278
Exporters	2.942	440

Table 4. Regression results: Exporters versus Non-exporters

	(1)	(2)	(3)
Shock*Exporter	-	-0.044	-
	-	(0.164)	-
Exporter	0.359***	0.369***	-0.016
	(0.091)	(0.095)	(0.109)
Intermediate Cost (per liter)	0.085***	0.085***	0.073***
	(0.023)	(0.023)	(0.027)
Employment	-0.760***	-0.758***	-0.858***
	(0.059)	(0.060)	(0.096)
Total Cost	0.597***	0.596***	0.672***
	(0.043)	(0.044)	(0.069)
Intermediate Cost	0.194***	0.194***	0.191***
	(0.024)	(0.024)	(0.045)
Firm Fixed Effect	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes
Number of Obs.	566	566	230

Notes: The regression results in panel (1), (2) and (3) correspond to the various tests. The results in the panel (1) are used to see whether exporters are more productive than non-exporters. The results in panel (3) are used to test whether there were ex-ante productivity difference in future exporters and non-exporters. In other words it tests whether there was selection when entering the export market or not. The results in the panel (2) are used to see whether embargo has differential effect on exporters compare to non-exporters.

Table 5. Results of the Kolmogorov-Smirnov Test

Year	Number of Firms	Statistics
2006	35	0.365***
2007	24	0.279**
2008	27	0.521***
2009	35	0.436***
2010	31	0.356***
2011	32	0.525***

Notes: * p < 0.1, ** p < 0.05, *** p < 0.01. For comparing the productivity distributions of exporters and non-exporters Kolmogorov-Smirnov statistics is used. P-Values are based on the limiting distribution: $\lim_{N\to\infty} P(KS_N > z) = \exp(-2z^2)$. The comparisons are made between firms existing in years 2006 onwards to firms existing in 2005, when the number of firms was 113.

Table 6. Regression Results for Value added per Worker as a Measure of Productivity

	(1)	(2)	(3)
Shock	0.354**	0.131	-0.017
	(0.172)	(0.160)	(0.170)
Intermediate Cost (per liter)	-	-	0.064*
	-	-	(0.035)
Employment	-	-0.841***	-0.745***
	-	(0.065)	(0.079)
Total Cost	0.699***	0.864***	0.800***
	(0.062)	(0.058)	(0.062)
Intermediate Cost	-0.001	0.058	0.061*
	(0.040)	(0.038)	(0.034)
Year	0.024	0.017	0.023
	(0.020)	(0.018)	(0.019)
Firm Fixed Effect	Yes	Yes	Yes
Number of Obs.	655	655	550

Notes: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors are in parentheses and are robust standard errors. Value added is defined as sales less cost on intermediate inputs divided by the number of employees. Labor productivity is defined as value added per worker. The dependent variable is natural logarithm of labor productivity. The explanatory variables : *Employment* , *Total cost* , *Intermediate cost and Intermediate cost per liter* are all in logarithms. First column represents the results of the OLS regression with firm fixed effects. The coefficient of the *Shock* indicates the average increase in productivity during the embargo. Second column reports the results of the regression when adding employment as explanatory variable. The third column is the result of the main specification where both intermediate input cost and employment is included as explanatory variables.

Table 7. Regression Results Using Variables in Levels

	(1)	(2)	(3)
Shock	0.380**	-	0.369**
	(0.175)	-	(0.195)
Intermediate Cost (per liter)	-	0.001***	0.001***
	-	(0.000)	(0.000)
Employment	-0.006***	-0.004**	-0.004**
	(0.002)	(0.002)	(0.002)
Total Cost	0.000**	0.000**	0.000**
	(0.000)	(0.000)	(0.000)
Intermediate Cost	0.000	0.000***	0.000*
	(0.000)	(0.000)	(0.000)
Year	0.058**	0.094***	0.058**
	(0.025)	(0.017)	(0.027)
Firm Fixed Effect	Yes	Yes	Yes
Number of Obs.	709	566	566

Notes: : * p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors are in parentheses and are robust standard errors. Labor productivity is sales per worker. The dependent variable is natural logarithm of labor productivity. The explanatory variables : *Employment* , *Total cost* , *Intermediate cost and Intermediate cost*

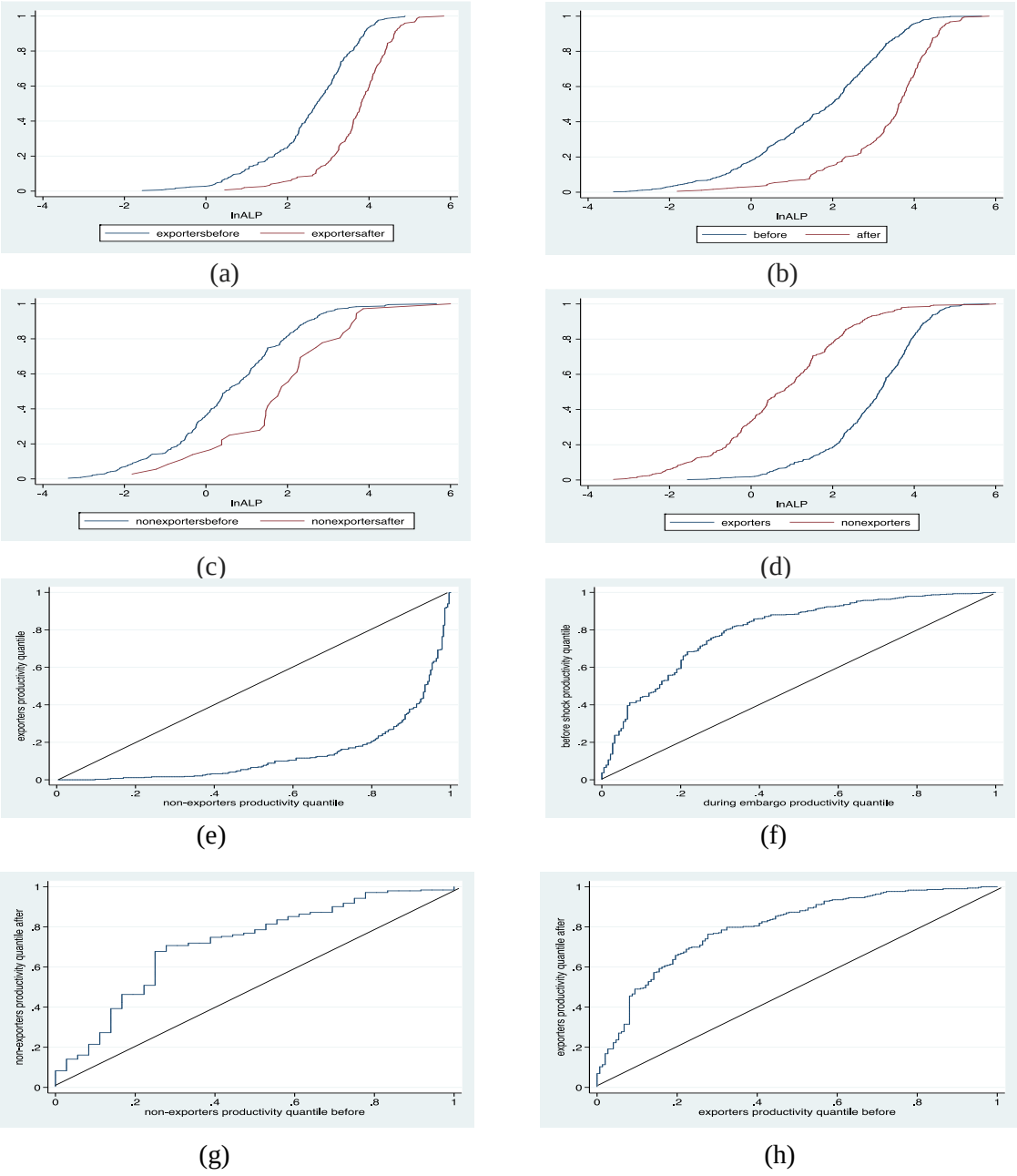
per liter are all in levels. First column represents the results of the OLS regression with firm fixed effects. The coefficient of the *Shock* indicates the average increase in productivity during the embargo. Third column reports the results of the regression when adding intermediate input cost as explanatory variable. The second column is the result of the main specification where shock is excluded from the specification, while both-employment and labor cost are included in the regression.

Table 8. The main results with exchange rate in the regression

	(1)	(2)	(3)
Shock	-	0.020	0.206**
	-	(0.082)	(0.103)
Intermediate Cost (per liter)	0.103***	0.102***	-
	(0.025)	(0.025)	-
Employment	-0.764***	-0.763***	-0.924***
	(0.065)	(0.065)	(0.063)
Total Cost	0.613***	0.614***	0.719***
	(0.043)	(0.044)	(0.053)
Intermediate Cost	0.211***	0.210***	0.209***
	(0.027)	(0.027)	(0.033)
Exchange Rate	-0.092	-0.080	-0.160
	(0.192)	(0.186)	(0.201)
Year	0.023	0.021	0.004
	(0.015)	(0.016)	(0.017)
Firm Fixed Effect	Yes	Yes	Yes
Number of Obs.	566	566	685

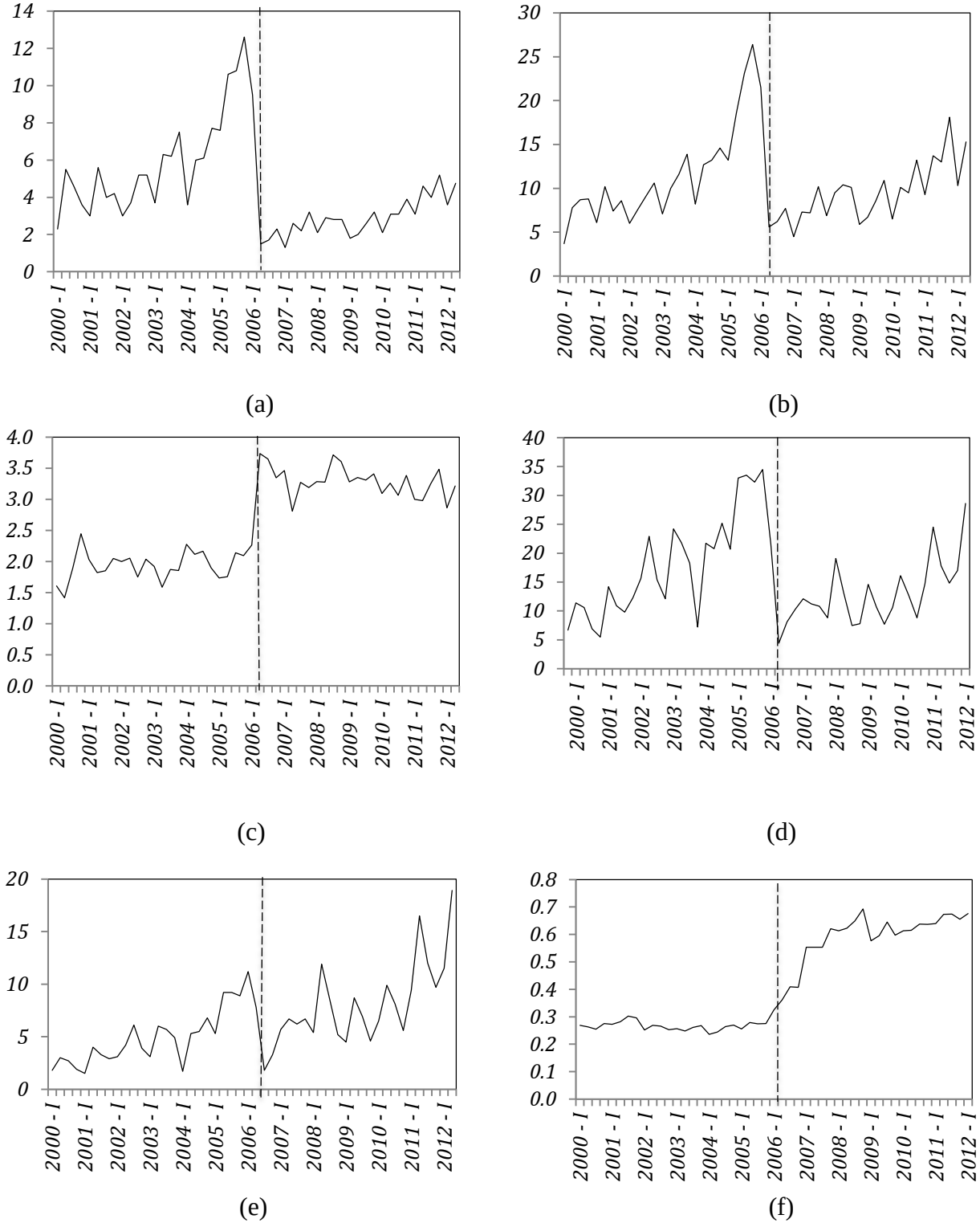
Notes: * p < 0.1, ** p < 0.05, *** p < 0.01. Standard errors are in parentheses and are robust standard errors. Labor productivity is defined as sales per worker. The dependent variable is natural logarithm of labor productivity. The explanatory variables : *Employment* , *Total cost* , *Intermediate cost and Intermediate cost per liter* are all in logarithms. Third column represents the results of the OLS regression with firm fixed effects. The coefficient of the *Shock* indicates the average increase in productivity during the embargo. Second column reports the results of the regression, which includes intermediate input cost as an additional explanatory variable. The third column is the result of the main specification where intermediate input cost and employment are included as explanatory variables. The *Exchange Rate* is the average of the monthly exchange rates between US dollar and Georgian Lari.

Figure 1. Empirical Distributions of Productivity and Corresponding P-P Plots



Notes: The blue curve in the panels (a)-(c) represents the cumulative distribution function before the embargo of exporters, all firms and non-exporters respectively; while the red line represents the cumulative distribution function during the embargo. In panel (d) the cumulative distribution functions of exporters and non-exporters are presented throughout the entire period of time 2000-2011. The panels (e)-(h) represents the same comparison of the productivity distributions but with p-p plot. The blue line is the elative distribution which is defined as $R(r) = G\left(F^{-1}(r)\right), 0 \leq r \leq 1$. The black line is 45-degree line. It represents the case when the two distributions are exactly the same. For example, the curve in panel (e) being below the 45-degree line indicates that productivity distribution of exporters dominates productivity distribution of non-exporters.

Figure 2. Exports and Prices of Georgian Wine and Mineral Water



Notes: Panels (a)-(c) represents the aggregate values of the Georgian wine export in mln liters, Georgian wine export in mln USD and average price of exported Georgian wine. Panels (d)-(f) represents the analogous statistics for mineral water.