Non-Compliance with Product Standards in an International Duopoly

Laura Birg*          Jan S. Voßwinkel**

April 2018

Abstract

This paper studies the incentives for non-compliant behavior of firms in a two-country duopoly with vertical product differentiation. Both firms have an incentive for non-compliant behavior, while both firms would prefer that the other firm is compliant. The incentive for non-compliance is higher for the high-quality firm than for the low-quality firm. Non-compliant behavior of one firm lowers the incentive for non-compliance by the other firm. A welfare-maximizing government may lack incentives to enforce compliant behavior of the domestic firm.

JEL Classification: F18, K42, L13, Q50 Keywords: product standard, non-compliance, market surveillance, enforcement, trade

Introduction

In the European Union and other OECD countries, firms have to comply with many business process requirements. These include (among others) minimum wages, workers’ rights, tax provisions or environmental regulations. While consumers would generally prefer compliance with these requirements, they are often unable

*Department of Economics, University of Göttingen, Platz der Göttinger Sieben 3, 37073 Göttingen, Germany, laura.birg@wiwi.uni-goettingen.de.
**Department of Economics, NGU Nürtingen-Geislingen University, Neckarsteige 6-10, 72622 Nürtingen, Germany, jan.vosswinkel@hfwu.de.
to observe them. Non-compliance is also not automatically perceived by them as a reduction in the quality of products. For example, there are many reports of tax evasion or violations of employees’ rights by companies, whereby the perception of their products by consumers does not change. One of the most prominent recent examples of non-compliant behavior is Volkswagen’s dieselgate. It turned out recently that the German car manufacturer Volkswagen used a software to create the (wrong) impression that its cars complied with US emission standards for some pollutants. While this caused harm for the environment, the quality of the cars in the eyes of consumers was not lowered by non-compliance. Interestingly, the US-EPA was the first public authority that detected Volkswagen’s deceptive behavior, while the German authorities have remained silent for a long time.

This example is instructive because it suggests that governments may have higher incentives to enforce the rules against foreign companies than against domestic ones. Non-compliant behavior is not a rare exception in some small markets, but a global phenomenon. Non-compliance is a phenomenon that occurs in all economies and is of considerable economic importance, for example in the form of tax-evasion and moonlighting (Medina & Schneider, 2017).

Non-compliance with applicable rules has been investigated in the literature under various aspects of content and methodology. The basis for the economic analysis of rational rule violations is Becker (1968), who examines in particular conditions for optimal probabilities of detection and optimal penalties.

The literature on the impact of environmental policy instruments has dealt in detail with the phenomenon of non-compliance with regulations such as environmental standards or emission trading systems and similar instruments (see Heyes, 2000). The focus is thereby in each case on the effect of a certain instrument, taking into account behavior that is not completely compliant with the rules. Thus, the effects of non-compliant behavior on environmental standards have been investigated at an early stage, with different emphasis on the severity of a standard and measures to enforce it (e.g., Downing & Watson, 1974; Kambhu, 1989; Keeler, 1995; or Arguedas, 2008 and 2013). Emissions trading schemes in the event of imperfect enforcement are analyzed by Malik (1990), Stranlund & Chavez (2000) and Montero (2002). Bachmann et al. (2017) show that the non-compliant behavior of Volkswagen has triggered a negative external effect on other German car
manufacturers.

In markets, the intensity of competition can have a decisive influence on the decision to non-compliant behavior. Intensive competition can increase the pressure for success on companies and thus the incentives to violate rules (Branco & Villas-Boas, 2015; Baumann & Friehle, 2016). The market form and the intensity of competition are therefore decisive determinants for the occurrence of rule violations and must be taken into account in the conception of a strategy for detecting and preventing rule violations.

Against this background, we investigate incentives for firms in a two-country duopoly with vertical product differentiation to comply with production standards and incentives for governments to enforce compliance. The rest of the paper is organized as follows: In the next section, the model is presented. Section 3 presents results for compliant and non-compliant firm behavior. Section 4 discusses enforcement incentives for governments. Section 5 concludes.

1 The Model

Consider a duopolistic market with vertical product differentiation where products are sold in two countries \( j = H, F \). In each of the countries, one firm \( i = H, L \) is located, with firm \( H \) in country \( H \) and firm \( L \) in country \( F \). Each firm sells one product in both markets. Products differ in quality \( i \). Assume without loss of generality \( s_H > s_L \). This quality ranking applies to both markets. If a firm located in country \( j \) exports a product to country \(-j\), it incurs trade cost \( t \). Identical cost of quality \( c \) for both firms is linear in quantity \( q \) and convex in quality \( s \):

\[
c = \frac{1}{2} s_i q_i.
\]

Constant marginal cost \( c \) apply if a firm complies with all legal requirements of production. If firms do not comply, marginal cost decrease to \( \gamma < c \).

Governments in \( j \) detect non-compliant behavior by firms with the probability \( \phi \). If a non-compliant firm is detected, it has to pay a per unit fine \( f \) plus a lump sum fine \( F \). Compliant firms never have to pay a fine.

Consumers are heterogeneous with respect to quality. Consumers’ marginal willingness to pay for quality \( \theta_j \) is uniformly distributed on the interval \([a, b]\), with \( b = a + 1 \) in \( H \) and \([\alpha, \beta]\), with \( \beta = \alpha + 1 \) in \( F \). Each consumer buys at most one unit of the most preferred good. The utility of not purchasing a good is zero. A
consumer who buys one unit of the good obtains a net utility of \( U = \theta_j s_i - p_i \). The marginal consumer in each country, who is indifferent between both products is characterized by \( \theta_j^* = \frac{p_H - p_L}{s_H - s_L} \). Therefore demand for products \( i \) in both countries \( j \) is \( q_H = b - \theta_j^* \), \( q_L = \theta_j^* - a.U = \theta s_i - p_i, i = H, L. \)

Consider the following timing after the governments have decided on the detection probability \( \phi \) and the fines \( f \) and \( F \): In the first stage, firms decide whether to comply or not. In the second stage, firms choose quality levels. In the third stage, firms compete in prices. We solve the game by backward induction.

2 Results

2.1 Compliance of both firms

In this section we present the results for market \( H \). As markets only differ in market size, the results are qualitatively similar for market \( F \). Consider that both firms comply with the standard. Profits of both firms are \( \pi^{C,C}_H = (p_H - c - \frac{1}{2}s_H^2) q_H \), and \( \pi^{C,C}_L = (p_L - c - \frac{1}{2}s_L^2 - t) q_L \), respectively. The equilibrium quality levels are

\[
s^{C,C}_H = \frac{12b - 8t + 3}{12}, s^{C,C}_L = \frac{12b - 8t - 15}{12}.
\]

Both quality levels increase in the maximum willingness to pay for quality \( b \) and decrease in trade cost \( t \).

Equilibrium profits are

\[
\pi^{C,C}_H = \frac{(8t + 9)^2}{216}, \pi^{C,C}_L = \frac{(8t - 9)^2}{216}.
\]

Profits of both firms are independent of \( b \) and increase in trade cost \( t \). The profit of the high-quality firm \( H \) exceeds the profit of the low-quality firm \( L \).

2.2 Non-compliance of the high-quality firm

If firm \( H \) does not comply with production requirements, it has lower production cost \( \gamma < c \). If firm \( L \) complies with the requirements, profits are \( \pi^{NC,C}_H = (p_H - \gamma - \frac{1}{2}s_H^2 - \phi f) q_H - \phi F \) and \( \pi^{NC,C}_L = (p_L - c - \frac{1}{2}s_L^2) q_L \), respectively.
Equilibrium quality levels are

\[ s_{NC,C}^H = \frac{3 (4b + 1) - 8 (c - \gamma) - 8t + 8f \phi}{12}, \quad s_{NC,C}^L = \frac{3 (4b - 5) - 8 (c - \gamma) - 8t + 8f \phi}{12}. \]  

Both quality levels of both firms increase in the detection probability \( \phi \) and the per unit fine \( f \).

The quality difference for the high-quality firm compared to compliance of both firms is

\[ s_{NC,C}^H - s_{C,C}^H = \frac{2}{3} (c - \gamma) - \frac{2}{3} f \phi. \]  

The first term reflects the competitive advantage the noncompliant firm has because of its lower cost. The second term reflects the additional cost of non-compliance. If the government calibrated its instruments to \( f \phi = (c - \gamma) \), quality levels would be the same under compliance and non-compliance. Results are symmetrical for the compliant firm, as \( s_{NC,C}^L - s_{C,C}^L = -\frac{2}{3} (c - \gamma) + \frac{2}{3} f \phi \).

Equilibrium profits are

\[ \pi_{NC,C}^H = \frac{(9 + 8 (c + t - \gamma) - 8 f \phi)^2}{216} - \phi F, \quad \pi_{NC,C}^L = \frac{(9 - 8 (c + t - \gamma) + 8 f \phi)^2}{216}. \]  

For the non-compliant (compliant) firm, profit increases (decreases) in the cost difference \( c - \gamma \); it decreases (increases) in the per unit fine \( f \) and the detection probability \( \phi \).

### 2.3 Non-compliance of the low-quality firm

If the high-quality firm \( H \) is compliant while the low-quality is not, profits are given as \( \pi_{H}^{C,NC} = (p_H - c - \frac{1}{2} s_{2,H}^2) q_H \) and \( \pi_{L}^{C,NC} = (p_L - \gamma - \frac{1}{2} s_{2,L}^2 - \phi f) q_L - \phi F \).

Equilibrium quality levels are

\[ s_{C,NC}^H = \frac{3 (4b + 1) + 8 (c - \gamma) - 8t - 8f \phi}{12}, \quad s_{C,NC}^L = \frac{3 (4b - 5) + 8 (c - \gamma) - 8t - 8f \phi}{12}. \]  

Quality levels of both firms decrease in the detection probability \( \phi \) and the per unit fine \( f \). This result shows an asymmetry of the effect of the instruments a government may apply to limit non-compliance: while both quality levels increase...
in the detection probability $\phi$ and the per unit fine $f$ when the high-quality firm is non-compliant, they decrease if the low-quality firm is non-compliant. The difference of quality levels is symmetrical to the case discussed in the subsection above.

Equilibrium profits are

$$\pi_{H,NC} = \frac{(9 - 8(c - \gamma - t) + 8f\phi)^2}{216}, \pi_{L,NC} = \frac{(9 + 8(c - \gamma - t) - 8f\phi)^2}{216} - \phi F$$

(7)

For the non-compliant (compliant) firm, profit increases (decreases) in the cost difference $c - \gamma$; it decreases (increases) in the per unit fine $f$ and the detection probability $\phi$.

### 2.4 Non-compliance of both firms

If both firms do not comply with the production requirements, both firms benefit from lower cost, but both firms share the risk of being detected. Profits for both firms are $\pi_{H,NC} = (p_{H} - \gamma - \frac{1}{2}s_{H}^2 - \phi f) q_{H} - \phi F$ and $\pi_{L,NC} = (p_{L} - \gamma - \frac{1}{2}s_{L}^2 - \phi f) q_{L} - \phi F$. Equilibrium quality levels are

$$s_{H,NC} = \frac{12b - 8t + 3}{12}, s_{L,NC} = \frac{12b - 8t - 15}{12}$$

(8)

Quality levels of both firms are independent of the instruments a government may apply to limit non-compliance. They are identical to the case where both firms comply with all production requirements.

Equilibrium profits are

$$\pi_{H,NC} = \frac{(8t + 9)^2}{216} - \phi F, \pi_{L,NC} = \frac{(8t - 9)^2}{216} - \phi F$$

(9)

Both firms’ profits are identical to the case of compliance by both firms except for the expected lump sum fine. It follows that both firms would prefer the equilibrium, where both firms comply to the symmetric non-compliance equilibrium.
2.5 The incentive for non-compliance

While both firms prefer the symmetric compliance equilibrium to the symmetric non-compliance equilibrium, both firms may have an incentive not to comply if this results in an extra profit. If the other firm is compliant, the extra profit of non-compliance is

\[
\Delta_C^H = \frac{2(c - \gamma - f \phi)(9 + 4(c - \gamma) + 8t - 4f \phi)}{27} - \phi F \\
\Delta_C^L = \frac{2(c - \gamma - f \phi)(9 + 4(c - \gamma) - 8t - 4f \phi)}{27} - \phi F. \tag{10}
\]

The incentive decreases in the instruments a government may apply to limit non-compliance \(f, F, \phi\). The incentive is larger for the high-quality firm that sells products in its home market. Trade cost \(t\) increase (decrease) the incentive for non-compliance of the high-quality (low-quality) firm. If the government would calibrate \(\phi F\) to reduce the incentive of the foreign low-quality firm for non-compliance to zero, the high-quality firm would still have an incentive to non-compliance. But since a compliant firm never has to pay a fine, the government could recalibrate the to also reduce the incentive of the high-quality firm for non-compliance to zero.

If one firm already shows non-compliant behavior, the incentive of the other firm also not to comply is

\[
\Delta_{NC}^H = \frac{2(c - \gamma - f \phi)(9 - 4(c - \gamma) + 8t + 4f \phi)}{27} - \phi F \\
\Delta_{NC}^L = \frac{2(c - \gamma - f \phi)(9 - 4(c - \gamma) - 8t + 4f \phi)}{27} - \phi F. \tag{11}
\]

The incentive for non-compliance is lower for both firms if the other firm already shows non-compliant behavior.

3 Optimal Enforcement

Consider welfare-maximizing governments in both countries. Each government maximizes (local) welfare, given as

\[W_j = CS_j + \pi_j - \phi_j + F + f(q_{jH} + q_{jL}),\]

where \(CS\) is consumer surplus, and \(\phi_j\) is the cost of enforcement. Governments
in $j$ have no interest in decreasing the profit of the firm located in $j$. Therefore, governments will only enforce production requirements, if the firm not located in $j$ is non-compliant.

If non-compliant behavior of a firm results in harmful effects in $j$, incentives for enforcing the standard increase. For instance, non-compliance could result in per-unit emissions of a harmful pollutant (which is not considered to be harmful for consumers, so they do not consider this to be a quality decrease). If these emissions result from consumption, the incentive for the government to enforce compliance would increase. If emissions are production-generated, there may result an incentive for the government located in $j$ to enforce non-compliant behavior of the firm located in $j$.

4 Conclusion

This paper has studied the incentives for non-compliant behavior in a two-country duopoly with vertical product differentiation. Both firms have an incentive for non-compliant behavior, while both firms would prefer that the other firm is compliant. The incentive for non-compliance is higher for the high-quality firm than for the low-quality firm. Non-compliant behavior of one firm lowers the incentive for non-compliance by the other firm. A welfare-maximizing government may lack incentives to enforce compliant behavior of the domestic firm.

If non-compliance results in a cross-border damage, incentives for cooperation of governments could arise. This is left for future research.
References


