



# Policy Brief

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## When agricultural standards differ across countries, they have consequences for trade and product prices

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### Key messages

- The Covid19 pandemic is a timely reminder that the consequences of food safety risks are borderless. Yet approaches to tackle food safety issues are still national in scope.
- For example, maximum residues limits (MRLs) set to regulate chemical use in agricultural production differ substantially across countries.
- This regulatory heterogeneity decreases agricultural trade flows, leads to higher product prices but has no effects on product quality upgrading.
- Price increases induced by MRL related trade policy are driven more by compliance costs and less by quality-upgrading

### Introduction

In agriculture, the use of chemicals – such as pesticides, herbicides and synthetic fertilizers – is important to protect crops and enhance yields. However, like all other chemicals, extended periods of exposure can cause severe health risks to both farmers and consumers. Chemicals also contribute to pollution, biodiversity losses and can harm non-target plants, insects and birds. As a result, many governments and the Codex Alimentarius Commission – i.e., a Joint FAO/WHO food standards program established to protect consumer health and promote fair practices in food trade – have established maximum residue limits (MRLs) to regulate chemical use. MRLs are the highest level of pesticide residue that is legally tolerated in or on food or feed when farmers apply chemicals. MRLs are also crucial in ongoing debates on the environmental sustainability of the food system.

However, MRLs diverge substantially across countries, and often, they differ even from the Codex (Table 1). The level of residues in a food crop determines its quality in terms of pesticide contamination. Lower limits imply stricter standards and higher quality requirements. In 2014, the EU and the US set MRLs of 0.01 and 10 part-per-million (ppm) respectively on *Carbaryl* use in citrus production, whereas

China had no established limits. The Codex limit established for the same chemical-product pair was 15ppm. Since public standards must be based on science and should not discriminate against imports, the reasons for these differences are not always clear. It is even more difficult to know if these country-specific standards reflect genuine product quality concerns or are disguised protectionist measures. That is also because both motives can be combined in a single measure. Yet, this regulatory heterogeneity has policy implications. First, take the case of farmers who produce according to good agricultural practices (GAP) approved for their domestic market – whether that is a national standard or the Codex. This condition does not grant their fully GAP-compliant products market access to other countries that may have different MRLs. In the end, farmers may need to adjust their production techniques to their final product destinations or adopt the strictest country-specific standard as the *de facto* standard. Either way, this increases the production cost of the farmer. Second, as a public standard, MRLs are mandatory regulations that condition market access. Hence, non-compliance with MRL regulations can lead to export rejections or even complete bans.

Table 1: Comparing MRLs on selected products in 2014

| Chemical     | Crop   | EU   | US  | China | Codex |
|--------------|--------|------|-----|-------|-------|
| Carbaryl     | Citrus | 0.01 | 10  | -     | 15    |
| Methidathion | Citrus | 0.02 | 5   | 2     | 5     |
| Captan       | Apple  | 3    | 25  | 1     | 15    |
| Acetamiprid  | Apple  | 0.80 | 1   | 0.8   | 0.8   |
| Chlorpyrifos | Wheat  | 0.05 | 0.5 | 0.5   | 0.5   |

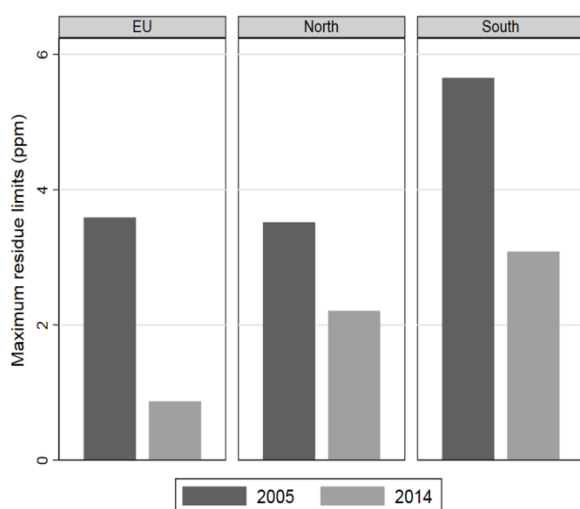
Source: Fiankor et al (2021) based on Homologa data

This policy brief discusses if and to what extent these observed differences in MRLs across countries influence trade flows, product prices and quality upgrading. Using bilateral trade data from 2005 to 2014 for 145 agri-food products and 59 countries, we argue that these differences are bad for trade. We will also show that they increase product prices, but have no product quality upgrading effects.

## Increasing relevance of MRLs

MRLs are continuous measures of relative stringency that can be ranked on a vertical scale. For instance, if two countries the US and the EU set limits of 3 and 25 ppm respectively on a Captan use in apple production (Table 1), then it is clear that for this product-pesticide pair, standards in the EU are stricter than in the US. As a result, MRLs have a notion of strictness (quality) that allows cross-country comparisons. While it is clear from Table 1 that stringency levels differ across countries, it is also worth pointing out that they also differ across North-south divides. Developed countries in the North have very stringent standards, compared to their developing country counterparts in the South. Generally, developed countries are standard-makers and developing countries are standard-takers. The EU especially has very strict limits. MRLs have also become stricter over time with established limits laxer in 2005 than in 2014 (Figure 1).

Fig 1: Average MRLs by importing country groups



Source: Fiankor et al. (2021) based on Homologa data

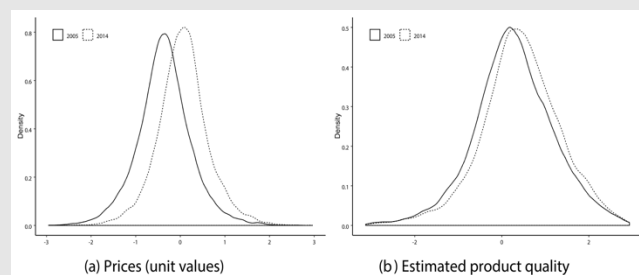
## Box 1: Measuring product quality from trade data

How can we measure unobservable ‘product quality’? A standard approach is to use product prices (measured as unit values) to proxy quality, i.e., higher priced products are deemed to be of higher quality. Bilateral trade data for all commodities record the nominal value of imports in US dollars, as well as the quantity in tonnes from a given exporter. Taking the ratio of trade values and trade quantities, we get unit values. However, prices may not proxy quality precisely if they reflect production costs, exchange rate differences or market power.

Our approach follows Khandelwal et al. (2013) and recovers quality directly from observed trade data. The intuition behind the approach is that conditional on prices, varieties with higher market shares are of higher quality. For example, if bananas from two countries sell at the same price, the country that offers a higher quality faces a higher demand from the importing country. After estimating quality, we get quality-adjusted prices – i.e., the difference in product prices for the same level of quality – as observed prices minus estimated quality.

For exploratory analysis, we plot the densities of our quality estimates and unit values for the years 2005 and 2014. The results in Fig. 2 reveal that both average quality and prices increases over the period. However, compared with prices average quality did not change by much. The extent to which these changes are driven by cross-country difference in MRL-related policies is the goal of this policy brief.

Fig 2: Distribution of prices and estimated product quality



## Key findings

**Trade effects:** Cross-country differences in MRLs are trade-restrictive. A stricter importing country residue limit equivalent to an increase in bilateral MRL differences across country-pairs by 0.1 units at the mean—which is an increase of about 9%—reduces observed trade flows in 1000 USD by 0.82%, on average (Column 1 of Table 2). Differences in MRLs also reduce the number of varieties available to consumers in the importing country, and reduce the market shares for exporters in the importing country market, but increases market exit rates. What the results show is that stringent importing country standards —by raising fixed and variable trade costs—induce a selection effect that discriminates against non-compliant

exporting countries. Countries that cannot meet the strict standards exit the importing country market.

Table 2: OLS estimates of the effects of bilateral differences in MRLs ( $MRL_{ijkt}$ ) on trade, prices and quality upgrading

|                 | Trade     | Price    | QA Price | Quality   |
|-----------------|-----------|----------|----------|-----------|
|                 | (1)       | (2)      | (3)      | (4)       |
| $MRL_{ijkt}$    | -0.082*** | 0.027*** | 0.026**  | 0.002     |
|                 | (0.023)   | (0.008)  | (0.012)  | (0.013)   |
| $Tariff_{ijkt}$ | -0.259*** | 0.035*** | 0.113    | -0.078*** |
|                 | (0.014)   | (0.005)  | (0.008)  | (0.008)   |
| <i>N</i>        | 615,483   | 399,526  | 399,526  | 399,526   |

Notes: Robust country-pair-product clustered standard errors in parentheses. \*\*\*, \*\* denote significance at 1%, 5% respectively. Importer-product-time, exporter-product-time, and importer-exporter fixed effects included in all regressions. QA = quality-adjusted.

**Price effects:** Conditional on trading, standards lead to higher product prices (Column 2 of Table 2). This effect is consistent with the distribution in Fig 2. This holds even if we adjust prices for quality (column 3). These findings are indicative of one of two things. (1) The increased production costs of meeting standards stricter than those existing domestically in the exporting country are passed on to consumers in the importing country as higher prices. (2) By reducing trade and inducing non-compliant domestic producers and foreign exporters to exit the product-destination market maintaining the standard, standards reduce competition in the imposing country. Surviving exporters and domestic producers exploit this and charge higher prices.

**Effects on quality:** We can decompose the price effect into quality (column 2) and quality-adjusted price (column 3) components. The quality-adjusted prices are net-quality and so sort out quality embodied in prices. We see that stricter MRLs affect the quality and quality-adjusted prices of imports positively. Consistent with the distributions in Fig 2, the quality effect is, however, very small. This suggests that conditional on trading, export volumes after controlling for prices remain unchanged. The exception is for intra-EU trade where MRLs induce significant increases in quality-upgrading and lower quality-adjusted prices.

Stricter MRLs, unlike higher tariffs, displace both non-compliant domestic and foreign firms. This reduces competition in the imposing market, which successful firms exploit to exert some form of market power to charge higher prices. Thus, the unambiguous increase in product prices induced by MRL related trade policy is driven more by compliance costs and less of quality-upgrading. Overall, our findings are consistent with existing findings (e.g., Asprilla et al 2019) that stricter NTMs in a given market reduce the number of surviving firms, increases their market power, but if anything, only has a small positive effect on import shares.

## Are developing countries worse off?

Many developing countries in the South are tropical and suffer from severe pest and disease pressure. This may necessitate them to use relatively more synthetic chemicals in their production. To the extent to which this is true, the findings we discuss above may hide interesting heterogeneous effects. We explore how our estimates vary across different trade routes. MRLs hinder export flows from developing countries more than it does for exports from developed countries. The price raising effects are pronounced for South-North trade but not exports to the South. This means that compliant exporters from the South enjoy higher quality-adjusted prices in high-value markets in the North.

## Conclusions

How standards affect trade in agri-food products is a subject of intense scrutiny. This policy brief provides the first set of empirical evidence on the quality and quality-adjusted price effects of regulatory heterogeneity in agricultural markets. We show that differences in public MRL regulations are trade-restrictive. However, conditional on trading, they increase product prices and quality-adjusted prices but have a small positive but statistically insignificant effect on estimated product quality.

Since regulatory heterogeneity of MRLs hinder trade and lead to higher food prices but do not induce product quality upgrading, we recommend

- Targeted co-operation among governments in designing standards and technical regulations.
- a move towards regulatory harmonization or mutual recognition agreements is a necessary to dampen these effects.
- the need to ensure that food safety standards are appropriate, transparent, science-based, and do not overly restrict trade. For MRLs, this means that there should be an incentive for all countries to strengthen the Codex and ensure that it has the scientific capacity and resources to develop standards acceptable for all countries.

## Further readings

- Asprilla, A., Berman, N., Cadot, O. and Jaud, M. (2019). Trade policy and market power: firm-level evidence. *International Economic Review* 60: 1647–1673
- Fiankor, D. D. D., Curzi, D., & Olper, A. (2021). Trade, price and quality upgrading effects of agri-food standards. *European Review of Agricultural Economics*, 48(4), 835 – 877.
- Khandelwal, A. K., Schott, P. K. and Wei, S.-J. (2013). Trade liberalization and embedded institutional reform: evidence from Chinese exporters. *American Economic Review* 103: 2169 – 95.

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