Extended Abstract
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Paper/Poster Title	**Price transmission analysis of Irish butter export prices in the world butter market**

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Abstract	***200 words max***
The empirical study seeks to track and improve our understanding of the market price dynamics and international competitor behaviour. Using the Vector Error Correction Model for data from 1970-2019, it tests whether price changes in New Zealand (NZ) and the Netherlands butter prices, and farm milk prices have a positive or negative impact on Irish butter prices, which helps to provide price transparency. The Irish butter prices were horizontally and vertically cointegrated, and were more responsive to NZ butter prices (positive effect) and farm milk prices (negative effect) in the long-run. In the short-run, the NZ lagged annual price growth rate had a negative effect on Irish annual price growth rate and the Netherlands had a positive impact. Therefore, future policies or pricing strategies that seek to ensure price leadership and risk management for Irish butter prices needs to consider the long-run and short-run effects of international competitor prices and raw material prices identified in this study.	
Keywords	horizontal and vertical price transmission, butter prices, milk prices, Vector Error Correction
JEL Code	e.g. Energy: Demand and Supply Q41 see: www.aeaweb.org/jel/guide/jel.php?class=Q)

Introduction	***100 – 250 words***

In 2019, Ireland exported €1.1 billion worth of butter, making it the 3rd largest exporter of butter in the world after the Netherlands (€1.4 billion) and NZ (€2.2 billion) (OEC, 2019). The dairy exports sector had the highest contribution to the total food and drinks exported by Ireland. Irish butter prices were considered the most volatile in the recent years, making it an interesting sector for this study. Prices reflect competing equilibrating forces in a market setting and provide vital signals for the allocation of resources by economic agents. Traditional indicators of competitiveness generally focus on export growth and market shares, but another important component is price competitiveness (proxy by export price) for homogenous goods like butter which is important for tracking and understanding the market price dynamics and competitor behaviour.

The paper contributes to knowledge on the world butter markets. Thus, it may help stakeholders from the Irish dairy sector to formulate their butter prices and trade expectations more precisely along the value chain, i.e. farm to trade level. It provides an assessment of the degree of integration of Irish butter in the international butter market and the mode of price transmission or co-integrating relationships to ensure competitive price leadership. The flexibility of the Irish butter market to absorb

domestic- and foreign-origin shocks takes paramount importance, especially when the country's policy menu is restricted by participation in world market where the competitor countries, the EU and WTO policies may have an influence on it.

Methodology	***100 – 250 words***

The annual time series data for milk (1975-2019) and butter (1970-2019) prices were collected from Irish Central Statistics Office (CSO) and Food and Agriculture Organization Statistical Databases (FAOSTAT). The selection of countries, i.e. Ireland, Netherlands and New Zealand, was motivated by their significance in the world trade of dairy products. The annual data was more appropriate to show the long-run price adjustments before, during and after the milk quota policy which was introduced in 1984 and officially abolished in 2015.

The estimation strategy for this study can be summarized as follows. The first step was to test whether the individual price series and residuals are stationary and their order of integration using statistical tests and line graphs. The second step was to estimate the long-run relationship and check for the order of integration of the residuals. The third step was to estimate the long-run cointegrating equations based on economic theory, as well as the short-run adjustment terms. The results derived from these relationships feed into variables used to estimate a general Johansen multi-equation Vector Error Correction Model. The fourth step was to estimate the orthogonalized impulse response functions to indicate how a shock or exogenous price impulses to one variable affects the other variables, or to describe the causal effects, while ensuring that the ordering is justified based on economic theory. Lastly, the robustness checks (i.e. for autocorrelation and stability) were performed and a number of reasonable specifications were tried and compared.

Results	***100 – 250 words***

These findings suggested that there was co-integration or long-run economic relationships between prices both horizontally and vertically which implies that prices move closely together in the long-run, although in the short-run they may drift apart due to the quota policy in this case. Therefore, the estimation of the VEC models for price transmissions or causal relationships was warranted.

There was a bidirectional causality relationship that occurred between NZ and Ireland for butter prices, but Irish prices had a positive inelastic impact on NZ prices. This is expected given that NZ is the world leader in butter and it suggests that Ireland is a price taker in the world butter market. The Netherlands prices had a positive short-term shock on Irish butter prices, but their impact slightly declined below zero in the long-run. For vertical price transmission in the long-run, in Ireland, there was a unidirectional causality relationship that occurred from farm milk prices to butter prices and farm milk prices had a negative elastic impact on butter prices, significant at the 5% level, ceteris paribus. Farmers were unlikely to directly benefit from increase in butter prices unless they were part of a cooperative that had shares in the processing companies.

Discussion and Conclusion	***100 – 250 words***

In the long-run, for Ireland to maintain it comparative advantage in the world butter market, it needs to ensure that there is a steady increase in milk that supports it growth ambitions. Processors and policy maker need to watch factors that influence the milk market closely when setting butter prices because they may have an indirect impact on butter prices. During the quota period, Ireland had the highest butter prices or was

most expensive and was limited in terms of being able to increase quantity which means it was not able to expand in existing and new markets as desired. At the same time, NZ was able to significantly increase it quantity exported within the same price range. Ireland was limited to competing through prices and was a price taker in the international butter market. In the short-run, the NZ lagged annual price growth rate had a negative effect on Irish annual price growth rate and the Netherlands had a positive impact. Therefore, future policies or pricing strategies that seek to ensure price leadership and risk management (price resilience) for Irish butter prices need to consider the long-run and short-run effects of international competitor prices and raw material prices identified in this study. Taking into account the nuances that exist at regional level, whereby a one size fits all approach might not best for some countries or sectors. Our empirical findings present an opportunity for improving our conceptual understanding of the dynamic butter market adjustments, especially for Ireland.