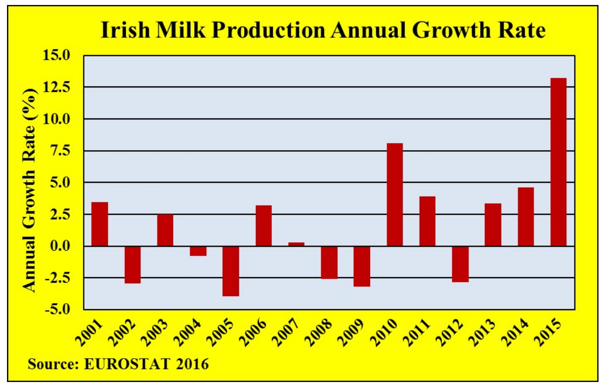
EU Milk Quota Abolishment: Has the Productivity of Irish Dairy Farms Been Impacted?

Motivation: Between1984 and 2015, the European Union (EU) dairy sector has been subject to country specific production quotas. These quotas had as their main objective increasing overall EU dairy farm income. Although these quotas were officially eliminated in March, 2015, their future elimination were made known starting in 2008. Leading up to their elimination, many EU countries experienced increased milk production Läpple et al. (2016). As shown in the figure to the right the 2000-2014, average growth rate of Irish milk production is less than 5%, while in 2015 milk production increased by 13%.



Previous studies have investigated the impacts of potential milk quota elimination on the Irish dairy industry. Gillespie et al. (2015) compared Irish dairy productivity before and after milk quota implementation using 1979-2012 data. They find this policy negatively affected dairy total factor productivity defined as by a Malmquist productivity index by stochastic frontier model. Frick and Sauer (2016) estimated the impacts of market deregulation on German dairy industry productivity via the use of the Wooldridge LP (WLP) proxy approach. The implicit assumption of these previous analyses is that the impacts of production quota elimination are symmetric to the impacts of their imposition. In 2017 we are beginning to obtain farm level data that will eliminate this assumption. Our analysis undertakes such an examination.

The main objective of our analysis is to evaluate the Irish dairy industry total factor productivity pre vs. post quota elimination. The examination of quota productivity impacts is two-fold. In the first stage of our analysis, a novel structural model, developed by Levinsohn and Petrin (2003) and Ackerberg et al. (2015), is adopted to control for endogeneity in estimation of a quality adjusted milk production function. We compare the productivity results under the LP specificaton using the: (i) the traditional OLS approach controlling for fixed effects and (ii) estimation of stochastic frontiers. Under the second approach, we will decompose aggregate Irish dairy industry productivity growth into contributions of farm-level technical efficiency growth vs. potential resource reallocation. Under both approaches we account for milk quality (i.e., component composition) when measuring the amount of milk production.

Empirical Models: *Step 1: Productivity estimation.* A farmer is assumed to produce Q units of milk with five inputs: labor hours (L), capital costs (K), intermediate inputs including materials and energy (M), feed costs (H) and cow numbers (C). Consider a Cobb-Douglas production function: $q_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \beta_h h_{it} + \beta_c c_{it} + \omega_{it} + \epsilon_{it}$, where q_{it} is the log of output and l_{it}, k_{it}, m_{it}, h_{it} and c_{it} are the logs of inputs. $\beta = \{\beta_0, \beta_l, \beta_k, \beta_m, \beta_h, \beta_c\}$ is a vector of parameters to estimate. ϵ_{it} represents idiosyncratic shocks. ω_it denotes productivity shocks that are observed by farmers, but not by the econometrician, which is potentially correlated with input choices. To deal with this endogeneity problem, we adopt the methods of Levinsohn and Petrin (2003) and Ackerberg et al. (2015) to obtain consistent estimation of productivity, ω_{it}.

LP uses the intermediate material demand (m_{it}) as a proxy for productivity, the optimal amount of which is determined by $m_{it} = f_t(k_{it}, c_{it}, \omega_{it})$. Assuming f_t is strictly increasing in ω_{it}, we have $\omega_{it} = f_t^{-1}(k_{it}, c_{it}, \omega_{it})$. Inserting this into the production function and collecting terms, we have: $q_{it} = \beta_l l_{it} + \beta_h h_{it} + \Phi_t(k_{it}, c_{it}, m_{it}) + \epsilon_{it}$. Productivity is assumed to follow the law of motion $\omega_{it} = g_t(\omega_{it-1}) + v_{it}$. v_{it}represents mean zero shocks to the farm's productivity, which is uncorrelated with information set at period $t-1$. GMM method is applied to obtain estimates of β_k, β_c and β_m. To solve the identification problem that a variable input, such as feed and labor, may also be correlated with unobserved productivity, Ackerberg et al. (2015) and Wooldridge (2009) propose to estimate all coefficients in one step with additional moment conditions.

Production functions and corresponding productivity measures (ω_{it}) will also be estimated by using OLS controlling for fixed effects and the Stochastic Frontier Approach (SFA). We will examine the relationship between the three measures of farm-level productivity growth.

Step 2: Aggregate productivity growth decomposition. Aggregate productivity growth is computed via the following: $APG_t = \frac{AP_t - AP_{t-1}}{AP_{t-1}}$, where $AP_t = \sum_i \lambda_{it}\omega_{it}$ is aggregate productivity with ω_{it} represents farm i's productivity in year t and λ_{it} represents sample share of physical milk output. Petrin and Levinsohn (2012) decompose aggregate productivity growth as follows:

$$APG_t = \sum_i \sum_k \bar{D}_{it}(\bar{\varepsilon}_{ikt} - \bar{c}_{ikt})\Delta \ln X_{ikt} - \sum_i \bar{D}_{it}\bar{c}_{iqt}\Delta \ln Quota_{it} + \sum_i \bar{D}_{it}\Delta \ln \omega_{it} \qquad (1)$$

where X_i is a vector of k inputs, D_i is the Domar (1961) weight, ε_{ik} is the elasticity of output with respect to inputs, c_{ik} is farm-specific revenue share for inputs and $Quota_{it}$ is the ratio of quota used to quota assigned to farm i. From equation (1), we can interpret contributions of technical efficiency growth and reallocation of resources as well as the dynamic change after milk quota elimination.

Description of Data: For this analysis, we will use a 2000-2015 unbalanced panel of dairy farms obtained from the Irish National Farm Survey (NFS). The NFS data provides specific information about household production decisions on inputs used and outputs produced, as well as monthly cost and returns from milk production. The panel nature of the data allows us to estimate quality adjusted production functions while control for endogeneity as well as to investigate dynamic changes in factor productivity and resource reallocation across dairy farms. The recently released 2015 edition of the NFS farm survey represents the first available farm-level Irish dairy data after EU milk quota elimination.

Besides influencing factors discussed above in this proposal, elimination of production quota may also affect the Irish dairy industry via changes in the rate of entry or exiting of farms from the industry Kirwan et al. (2012). However, observations from 2015 data provides limited time window for dairy farms to adjust structural change. The 2016 Irish farm survey is expected to be available by May 2017. We hope to include the 2016 data into our analysis should the data be available.

Reference: This reference list associated with this proposal can be found at this URL.