Research Article

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The evolution of the milk sector in Portugal: Implications from the Common Agricultural Policy

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Abstract: The milk sector across the European Union (EU) has experienced several changes, due to the intrinsic characteristics of its respective structures of production. In fact, due to significant increases in production, this sector has suffered dramatic surplus supplies, which have had a relevant impact, namely on the market's management. In this framework, the EU created the milk quota system in the 1980s to control the milk markets and prepare the sector for the subsequent reforms verified by the agricultural policy instruments. However, this system was a temporary measure from the Common Agricultural Policy (CAP) and was removed in 2015, having new and relevant impacts on the sector around Europe and, specifically, in Portugal. In this context, the main objective of this research was to assess the several impacts from the several reforms of the CAP instruments for the milk sector within the Portuguese context. For this, a literature survey from the Web of Science (Core Collection) was carried out searching for the topics “milk” and “Common Agricultural Policy.” From this search, 57 documents (only articles were considered, excluding, for example, proceedings papers) were obtained. To complement this literature review, several data from the Eurostat and from the Portuguese agricultural market information system were considered and explored through econometric approaches. The main insights obtained show that the milk sector is a controversial topic, which continues to need special policy attention, namely to avoid asymmetries across the several EU member-states.

Keywords: European Union, milk quota system, literature review, econometric approaches

Jel Codes: C20, Q10

1 Introduction

In consequence of the CAP instruments for the several sectors, including, for dairy activities, namely through guaranteed prices and export subsidies, milk production in the European Union (EU) (before 1992 European Economic Community) increased significantly creating surplus supplies and causing difficulties in the dairy markets. To avoid any dramatic impact on the markets, the EU introduced the milk quota system in 1984, where limits in production were defined by punishing farmers who exceeded those maximum limits with a levy (Eurostat 2018).

In the CAP “Health check” framework, from 2009, the EU prepared for the end of the milk quota system in 2015, from a perspective of market protection reduction and affording the farmers and the respective institutions more responsibility towards managing the markets and taking advantage of the international market potential (Eurostat 2018). However, because of the sector's characteristics and organization across the European countries, several problems are expected, namely, with new overproduction contexts and with consequent reductions in dairy market prices (Marshall 2015).

In any case, the milk quota system is a controversial issue, namely with its impacts across the several farm domains, including efficiency (Areal et al. 2012) and scale economy fields (Corbett 1992). In turn, the potential to take advantage of new opportunities arising from the abolishment of the quota system seems to be greater in larger rather than in smaller farms, calling again, for policy interventions (Groeneveld et al. 2016).

For Portugal, in 2016, the context described by the Statistics Portugal (INE 2016) is of self-sufficiency for

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milk and butter and insufficient production for the national consumption of yogurt and cheese. On the other hand, the increases in milk production capacity were accompanied with decreases in rations between milk production prices and the respective compound food costs.

This new context without milk quotas has several impacts, namely on the farms, around the EU and specifically in Portugal. In turn, a quick survey on the Web of Science shows that there is not much research on these topics for the Portuguese reality, highlighting the pertinence of this study. In this framework, the main objective of the study presented here is to contribute to bring new insights into the impacts from the abolishment of the EU milk quota system in 2015 within the Portuguese context. For this purpose, a literature survey was performed through the Web of Science Core Collection (2020) scientific platform, where 57 articles for the topics “milk” and “Common Agricultural Policy (CAP)” were obtained and considered as the basis for the literature review. In addition, several pieces of statistical information for the milk markets were considered from the Eurostat (2020) and from the Portuguese agricultural market information system (SIMA 2020) to perform a number of econometric analyses, based on the supply theory, following the procedures proposed by Stata (2020). SIMA is a system of information about the Portuguese agricultural markets performed by the Planning, Policy and General Administration Office of the Ministry of Agriculture.

2 Literature review

The literature review was carried out to highlight the several impacts from the CAP reforms in the milk sector. The main reforms of the CAP are presented as follows (Massot 2020):

- 1992, eliminating the system of guaranteed prices and introducing a system of compensatory income support;
- Agenda 2000, strengthening of the 1992 reform;
- 2003, decoupling of financial supports from volumes produced;
- 2009, strengthening of the 2003 reform;
- 2013, more concerns with markets and environment.

The social, cultural, economic and environmental frameworks across the EU countries and regions present several and strong differences (Lehtonen and Niemi 2018), which become more apparent when it is necessary

to implement common policy measures (Boysen et al. 2016). The same happens across agricultural sectors (Foltyn et al. 2009). Sometimes, the local structures and dynamics conflict with the policy instruments (Orea et al. 2015). In addition, in these contexts there are specific realities such as those from, for example, Cyprus, which need to import a large part of its demand requirements (Pattichis 1999).

These distinct EU realities condition the stakeholders’ awareness and the respective compliance with the designated strategies, showing, for example, the importance of the stakeholders (Marques, et al. 2019) and their involvement in several stages of the food chain (Giacomarra et al. 2019). These dimensions have a special relevance in some agricultural sectors, as with milk production, and in some countries which have adhered to the EU more recently in a post-communist context (Bachev and Nanseki 2008), such as, for instance, the Central European framework (Erjavec et al. 1998).

The several CAP reforms, such as that from 2003, with, namely, the decoupling of direct payments and environmental objectives (Burrell 2004), had direct and indirect impacts on farms (Cacchiarelli et al. 2016) and upstream and downstream sectors (Delattre et al. 2005), promoting, for example, increases in the scale economies of some milk farms in order to reduce costs and compensate for decreases in the respective incomes (Bahrs 2003).

This is a consequence of the reductions of prices in the milk markets (Chatellier and Jacquerie 2004) and the conditions available for quota trade (Kleinhanss and Huttel 2004). The single payments introduced, may bring, however, new opportunities for farming management (Kirner 2004). In any case, there are many concerns about these scenarios (Pitschmann 2004) across the EU member-states.

Nevertheless, the earlier CAP reform of 1992, with the partial decoupling of direct payments, seemed to have more favourable impacts upon the milk trade and activities across the EU member-states (Baltas 1997). Some of these CAP reforms, specifically that from 1992, also occurred, due to international pressures on the EU to reduce the agricultural market protection (Basler 1995). The changes implemented by these reforms required technical and institutional adjustments (Berentsen et al. 1996), where the cooperatives may have a relevant contribution (Fiore et al. 2020), but there also were opportunities to explore new potential (Castel et al. 2010).

Namely after the CAP reform of 1999, the EU perspective was a general institutional price reduction

and quota system abolishment in the context of the milk Common Market Organization (Chatellier 2002). In general, the negative impacts from these reforms on the income of milk farms were expected to be lower than in other agricultural sectors (Colson and Chatellier 1999), as, for instance, crops and cattle (Philippidis and Hubbard 2003). The abolishment of the milk quota system is seen, in some circumstances, as an opportunity to reduce the inefficiencies created by its introduction in the 1980s (Colman 2000), depending on the demand behaviour and dairy industry dynamics (Lelyon et al. 2012).

The dimension of these inefficiencies depended on the management of the local quota system, namely on the conditions for quota trade between farmers (Kersting et al. 2016). These reductions in inefficiencies with the demise of the quota system are possible with increases in the scale economies and respective productivities (McDonald et al. 2014), in some cases, achieved, or not, in a way compatible with the guidelines for a sustainable development (Ramsden et al. 1999). Nevertheless, the milk quota system's end is seen with reserve in some contexts, such as the Slovak one (Rumanovska 2016) and as a promoter of increases in milk production and decreases in prices around the EU (Salou et al. 2017). This deserves special attention, considering the importance of the milk sector within some countries such as Croatia (Zrakić et al. 2015).

CAP reforms, World Trade Organization (WTO) negotiations and the quota system, were the main drivers of the milk sector in the EU (Doluschitz 1992), as well as, the successive EU enlargements (Fuller et al. 1999) and continuous adjustments (Kola et al. 1992), or even EU institutional reforms (Greer and Hind 2012). The several enlargements were, of course, challenges for the EU and for the adherent countries (Kvapilík and Strelec 2003). The international conjuncture and the WTO negotiations have, indeed had, a relevant impact on the design of CAP measures (Swinbank 2005), over the last decades (Willer 1993).

In any case, milk markets have several specificities that deserve special attention from the diverse stakeholders, including policymakers, where the cyclical behaviour (Bergmann et al. 2015) and volatility (Bisson and Diner 2017) are relevant dimensions that should be taken into account by farmers and policy designers. Of course, the changes in agricultural policy instruments have, also had, implications in the milk markets (Borawski et al. 2020). The CAP rural development policy seems to be an example of positive impacts on the dairy sector (Pavic et al. 2020).

The real impact from the abolishment of milk quotas on prices is not consensual between the several stakeholders, some are more pessimistic (Huan-Niemi et al. 2017) than others, but all seem to agree that the changes in this policy measure have had consequences in the milk markets (Bouamra-Mechemache et al. 2008). Milk prices are, in some circumstances, among other factors, a driver of the land-use framework (Reis and Rodrigues 2017).

Another aspect concerns a milk farm's structure and its vulnerability to climate and economic changes in the EU, considering the perspectives of global warming and the economic crisis. In these cases, the conversion to organic farming practices seems to have reduced the vulnerability of these farms (Bouttes et al. 2019). On the other hand, this could provide an interesting approach towards reducing the impact from milk production on greenhouse gas emissions which are, in fact, relevant, from the enteric fermentation to the energy consumed (Casey and Holden 2005). Organic farming may be, indeed, one, among many, solutions towards mitigating the negative environmental impacts from farms' activities (Casey and Holden 2006).

As referred to before, environmental sustainability has been one of the main objectives considered within the last CAP reforms, through the agri-environmental measures (Herbut and Walczak 2008) or the "greening instrument" (Gaudino et al. 2018), for example. Nonetheless, in some EU farms the benefits for the environment and socioeconomic contexts seem modest (Cortignani and Dono 2018). In these frameworks, the farmers' attitudes and perceptions concerning sustainability are determinant for an effective compliance with any new strategy for a sustainable development (Creemers et al. 2019). Sometimes, some of the environmental dimensions are seen by farmers as something out of its responsibility and the associated bureaucracy is looked upon as one more difficulty to deal with (Macgregor and Warren 2006).

Innovation is another dimension that should be considered and assessed in order to deal with contexts of change (Feyereisen and Melard 2014), as well as, quality certification (Hauwuy et al. 2006), biotechnology (Nagel 1991), farm multifunctionality (Nikolova and Linkova 2011) and the discovery of strategic plans of adjustment (Santaolalla Montoya 2015). Innovation is, indeed, the buzzword for dealing with the several challenges that will arrive in the near future across the diverse socioeconomic dimensions. The multifunctionality of farms and the diversification of activities inside farms may bring interesting contributions to these realities, namely

to mitigate the losses in the farmers' income within a context of sustainability. It is important, also, to change the agricultural paradigms and bring more technology and new ways of thinking, where vocational training and entrepreneurship play a relevant role. In fact, entrepreneurship and innovation are relevant dimensions for agricultural development (Vrontis et al. 2019).

3 Data analysis

In this section, the monthly statistical information available, over the period 2005–2019, in the Portuguese agricultural market information system (SIMA 2020) will be outlined for milk prices in production (euro/kg), average fat content (%) and protein content, also, in percentage (Figures 1, 2–4). These figures were obtained through the Stata (2020) software.

Figure 1 shows that milk prices in Portugal Mainland, for milk purchased from individual producers, seem to have a cyclical behaviour; however, these tendencies appear to have changed after 2015. In any

case, there is a global tendency for milk prices to decrease over the period considered, as well as, the average fat content and protein content.

It is important to note that there is, in general, a slightly greater positive correlation between the milk prices and the percentage of protein content in the Portuguese Mainland and among the milk prices and the percentage of average fat content in the Azores.

In turn, Figure 2, for average monthly characteristics (2005–2019) in Portugal Mainland for milk purchased from reception stations and collective milking rooms, confirms what seems to be a cyclical behaviour for milk prices; however, here it appears that there is an increased tendency, over the period considered, for both the prices and milk characteristics. On average, the milk purchased from individual producers is 6 cents more than the milk purchased from reception stations and collective milking rooms in Portugal's Mainland.

The same cyclical trend for milk prices seems to be found for the Azorean context (Figures 3 and 4), for milk purchased from individual producers (producers have a refrigeration tank on the farm; transport is arranged by the factory) and for milk purchased from individual

Figure 1: Average monthly prices and characteristics (2005–2019) in Portugal Mainland for milk purchased from individual producers.

Figure 2: Average monthly prices and characteristics (2005–2019) in Portugal Mainland for milk purchased from reception stations and collective milking rooms.

Figure 3: Average monthly prices and characteristics (2005–2019) in the Azores for milk purchased from individual producers (producers have a refrigeration tank on the farm; transport is arranged by the factory).

Figure 4: Average monthly prices and characteristics (2005–2019) in the Azores for milk purchased from individual producers (producers deliver to reception stations at the factory; transport is charged for by the producer).

producers (producers deliver to reception stations at the factory; transport is charged for by the producer). On average, the milk prices in the Azores are slightly lower than those paid in Portugal's Mainland for milk purchased from individual producers; however, the trends in this region are for milk prices to increase.

Figure 5, also found using information from the Portuguese agricultural market information system (SIMA), for the first four months of 2005–2020, namely to test the influence of the Covid-19 pandemic context on the milk prices from production, reveals that, in general over the period considered, the prices tended to increase at the beginning of the year, which has not happened in 2020. It seems that there was a slight effect from the pandemic on milk prices at the beginning of 2020. However, it is important to confirm in future research if this is, in fact, a structural break or if it is, in practice, a cyclical trend.

The several tendencies described before for prices were accompanied by decreases in the production of cow's milk on farms in the Portuguese Mainland and increases for the Azores. These data were obtained from

the EU statistical database (Eurostat 2020) for the period 2005–2018 (taking into account the availability of statistical information) (Figure 6).

4 Results for time series regressions

Tables 1–3 were obtained following Stata (2020) and Torres-Reyna (n.d.) procedures for time series regressions. The results presented were obtained considering the supply equation from the supply theory as a base considering, for example, the work of Samuelson and Nordhaus (2009), where the supply is function of the market prices. In general, a positive relationship between supply and prices is expected (supply law), but there are exceptions. In these tables, the statistical tests show that there are no problems with unit root or cointegration, but autocorrelation was found. To correct for serial correlation, the Cochrane–Orcutt regression

Figure 5: Average monthly prices for the first four months of 2005–2020 in the Portuguese Mainland and the Azores.

methodology was considered. For the supply the raw cows' milk delivered to dairies (millions kilograms) was considered from the Eurostat (2020) and the average prices (euro/kg) from the SIMA (2020), for the months of the period 2005–2019. The average prices were obtained by calculating the mean between the milk prices practised in Portugal's Mainland and the Azores, considering that the raw cows' milk delivered to dairies is available on the database for the entirety of Portugal.

Tables 1 and 2 reveal that there are negative relationships between the milk supply and the prices

(this is an exception to the supply law), showing that the trends of increases in the milk prices are not followed by proportional increases in production. On the other hand, Table 2 demonstrates that, in fact, the behaviour of the milk markets in Portugal seems to be more cyclical (in line with the findings of, for example, Bergmann et al. 2015) than affected by structural breaks from policy reforms, considering, for instance, the absence of statistical significance for the coefficient of the dummy to capture the effects from the milk quota's abolishment in April 2015. In addition, Table 3 shows that the price

Figure 6: Production of cow's milk on farms for Portugal's Mainland and the Azores.

Table 1: Results for times series regression between the raw cows' milk delivered to dairies (millions kilograms) and the average prices (euro/kg), for the months of the period 2005–2019

Model	Cochrane–Orcutt AR(1) regression, iterated estimates
Constant	225.019* (12.860) [0.000]
Milk average prices	–248.465* (–4.040) [0.000]
Augmented Dickey–Fuller test for unit root	–10.080* [0.000]
EG-ADF test for cointegration	–2.283 [0.177]
Durbin's alternative test for autocorrelation	173.940* [0.000]
Breusch–Godfrey LM test for autocorrelation	89.215* [0.000]

Note: *, statistically significant at least 5%.

elasticity of supply is around -0.5 , showing that it is inelastic and that the producers are not sensitive to price changes in the milk production markets in Portugal. These findings need additional research, but confirming this context means that in a scenario of overproduction and accentuated reductions in the prices, the producers will have great difficulty in adjusting the supply.

These results highlight that the Portuguese milk sector has an inelastic behaviour to the dynamics of the markets and this shows the importance of public interventions to adjust the interrelationships among demand and supply and to avoid sharp falls in market prices. There are, yet, CAP instruments for market interventions, but the framework here presented should be considered by the several stakeholders.

Table 2: Results for times series regression between the raw cows' milk delivered to dairies (millions kilograms) and the average prices (euro/kg), for the months of the period 2005–2019, with a dummy to test the milk quota's abolishment in 2015

Model	Cochrane–Orcutt AR(1) regression, iterated estimates
Constant	224.569* (12.680) [0.000]
Milk average prices	–247.721* (–4.020) [0.000]
Dummy for April of 2015	0.717 (0.150) [0.881]
Augmented Dickey–Fuller test for unit root	–10.080* [0.000]
EG-ADF test for cointegration	–2.415 [0.137]
Durbin's alternative test for autocorrelation	171.490* [0.000]
Breusch–Godfrey LM test for autocorrelation	88.832* [0.000]
VIF	1.01

Note: *, statistically significant at least 5%.

5 Conclusions

The main objective of this research was to assess the impacts from the several CAP reforms in milk production in Portugal, namely the eventual structural breaks from the milk quota system's abolishment in April of 2015. For this purpose, a literature survey from the Web of Science was performed, considering the topics “milk” and “Common Agricultural Policy.” Statistical information relating to the milk prices and characteristics was also analysed, obtained from the Portuguese agricultural

Table 3: Results for times series regression between the raw cows' milk delivered to dairies (kilograms) logarithm and the average prices (euro/kg) logarithm, for the months of the period 2005–2019

Model	Cochrane–Orcutt AR(1) regression, iterated estimates
Constant	18.227* (125.760) [0.000]
Milk average prices logarithm	−0.494* (−4.370) [0.000]
Augmented Dickey–Fuller test for unit root	−10.158* [0.000]
EG-ADF test for cointegration	−2.259 [0.1854]
Durbin's alternative test for autocorrelation	173.152* [0.000]
Breusch–Godfrey LM test for autocorrelation	89.011* [0.000]

Note: *, statistically significant at least 5%.

market information (SIMA), and associated with milk production, found in the Eurostat. These data were, also, explored through time series regression approaches and considering the supply theory as a base.

The literature review shows that, in fact, the several CAP reforms have several direct and indirect impacts upon the dairy sector which, in some cases, seem to be lesser than in other agricultural sectors and that the end of the quota system is a concern in many EU countries and regions. The abolishment of the quota system is seen as a motive for concern due to the potential scenarios of overproduction and consequent reductions in the market prices. However, the several CAP reforms for the milk sector are seen, also, as sources of new opportunities, specifically towards improving technical efficiency and exploring new emergent markets outside the EU. In any case, the price changes in the milk markets seem to be more consequences of volatility and cyclical behaviours rather than being due to structural breaks as implications from the diverse CAP adjustments.

The data analysis appears to confirm these signs of cyclical behaviour for the milk prices in Portugal. However, it seems that there is an average trend for the milk price increases in Portugal and some stabilization for production. In any case, there are relevant differences between the context for the Portuguese Mainland and the Azores. The same happens for the prices practised in different markets associated with the diverse means of delivering the milk from the farms

(directly or through reception stations and collective milking rooms).

Finally, the time series regressions present that there is a negative relationship between the milk supply and the prices in Portugal, showing that the price increases were not accompanied by increases in production. In turn, the end of the quota system in 2015 seems to not have had such a structural impact on milk production in Portugal, confirming the evidence of a cyclical behaviour within the markets. The supply elasticity price is inelastic, revealing that in the context of surplus or dramatic reductions in prices there will be much needed public intervention in order to adjust the markets.

In terms of practical implications, it is suggested that, in this context of the abolition of milk quotas, policymakers should consider the specificities of each reality in the EU in the process of designing policies and create flexible instruments to be adjusted by each member-state. For future studies, a confirmation of the cyclical behaviour of the milk markets in Portugal is recommended, with alternative approaches, as well as an analysis of the impacts from the Covid-19 pandemic using more recent data.

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