The Impacts of Compulsory Crop Insurance in the Brazilian Dairy Sector

by

Glauco R. Carvalho – Researcher at Embrapa. Ph.D. candidate, Department of Agricultural Economics. Texas A&M University.

Rafael Costa – Corresponding author. Consultant, Blue Consultoria Financeira e Estatística, Ph.D. in Agricultural Economics, Texas A&M University. rafaeldfcosta@gmail.com

Selected Paper prepared for presentation at the Southern Agricultural Economics Association's 2015 Annual Meeting, Atlanta, Georgia, January 31-February 3, 2015

The Impacts of Compulsory Crop Insurance in the Brazilian Dairy Sector

Abstract

The dairy sector is an important segment of the Brazilian agribusiness. From the demand side, dairy products are the second most important in terms of household expenditure on food. From the supply side, Brazil is the 4th largest country in milk production with more than 32 billion liters per year. Moreover, nearly 1.3 million of dairy farmers are in operation, most of which characterized as small family farms. The rural credit is the main mechanism in terms of dairy policy. A program called PRONAF was created in 1996 to support small farmers by offering them special financial provisions, such as low interest rates. However, in 2013 the Brazilian Government through Central Bank imposed mandatory farm insurance as a condition to access rural credit. The impact of this policy on the dairy sector is unknown and this paper aims to evaluate such a policy. A structural econometric model of the Brazilian dairy sector is used to quantify the effect of that change on the production, consumption and milk price. The impact will be considered relative to a ten-year baseline scenario ending in 2022. Annual equilibrium prices are solved by minimizing the squared difference between supply and demand for four different markets: cheese, butter, milk powder, and fresh dairy products. Contributions to policy makers, private companies, and future researches are expected.

Keywords: insurance, policy analysis, structural model.

JEL Code: C50, C22, Q18.

Introduction

Studies related to market analysis have played an important role in understanding price dynamics, supply, and demand behavior. Those studies have assisted policy makers and the dairy industry in terms of strategic decisions regarding investments and public policies. In Brazil, the dairy sector is an important segment of the agribusiness. Brazil is the fourth largest producer in the world according to the Food and Agriculture Organization (FAO, 2014), and the whole sector is composed of nearly 1.3 million farmers (IBGE, 2009).

Over the past three decades the Brazilian dairy sector has changed significantly in terms of regulation, management and technology. Until the early 1990s, a price controlling policy by the Brazilian federal government was in place and caused reluctance for investment at the farm level. Overall, the dairy farms are still not very competitive because of low production per cow, small production per farm, inferior milk quality, and high production costs (Rodrigues, 1999). The dairy sector is one of the most complex segments of the agribusiness. At the farm level, the complexity of managing dairy farms is also increasing due to recent policies like biofuel promotion around the world and the impact on feed cost, land price, among others. The dairy farms are sensitive to changes in corn price (and corn-based feed prices) because those inputs account for the majority of grain-based diets in the farm. Trade policies and agricultural policies, such as rural credit, insurance, and price support, also affect the dairy industry, since those policies have direct impacts on net revenue. Therefore, the future of the dairy sector depends also on how these policies are managed over time.

Martins (2004) pointed out that trade and macroeconomics policies have strong impacts on the Brazilian dairy industry. On the other hand, policies to keep food prices at low levels have transferred income from the dairy sector to consumers, causing a disincentive to invest in technology. Other studies concluded that, historically, public policies in Brazil have punished the dairy sector (Calegar (2001), Martins and Vieira (2001), Tupy (2001)).

Agricultural policy in Brazil is primarily conducted by two ministries: the Ministry of Agriculture, Livestock and Food Supply (MAPA) and the Ministry of Agrarian Development (MDA). While MAPA deals with commercial agriculture, MDA deals with small-scale family farms. Overall, Brazil's agricultural policy can be described by three main mechanisms: minimum price guarantees, rural credit, and agricultural insurance.

The rural credit is the most commonly practiced, and it consists of providing financial support with subsidized interest. Financial support goes to both commercial farms and small-scale family farms. For the commercial farms, the National Rural Credit System (SNCR) provides funding to commercialization, cash flow, and investment. In 2012, commercial dairy farms received about US$1.54 billion. For small family farms, a program called PRONAF was built to manage the offers of credit and other agricultural policies. This program, which was created in 1996, was designed to support small farmers by offering them special financial

provisions, such as low interest rates. In 2012, about US$1.64 billion was applied to the dairy sector through PRONAF, with interest rate varying from 0.7% to 2.5% a year, according to data from SNCR. However, in 2013 the Brazilian Government through its Central Bank imposed mandatory farm insurance as a condition to access rural credit. The impact of this policy on the dairy sector is unknown and this paper aims to evaluate such a policy.

An econometric model that attempts to replicate the dairy sector in Brazil, and capture important decision points, is developed and discussed in this study. Understanding how milk flows from raw materials to the final products, and how the supply curve responds to price and cost changes, provide insights of impacts for future dairy policies. A system of equations is built to simulate how well the entire system represents the sector over a historical period. As for specific interest, the research evaluates impacts of mandatory farm insurance policy on the dairy sector. A brief description of the data used for developing the econometric model is followed. A background of the research interest is also included in this section. A methodology section describes how the proposed analysis was performed. Results section depicts the impacts of the analyzed research question. Lastly, a conclusion section finishes the study.

Data and Background

Collecting Brazilian data to build the model was challenging. Different sources were combined due to a strong limitation in organized and complete datasets. Annual data from 1980 to 2012 were used to estimate the model and the policies were analyzed relative to a 10-year baseline scenario ending in 2022.

As for the number of dairy cow and total milk production, data from Organisation for Economic Co-operation and Development (OECD)-FAO and the Bureau of Statistic of Brazil, namely Brazilian Institute of Geography and Statistics (IBGE) were used. Retail price index for dairy products is also published by IBGE. Data about supply and demand of dairy products (cheese, butter, milk powder and fresh dairy), on the other hand, was offered only by OECD-FAO.

In terms of raw milk prices, corn, and soybean prices the *Fundação Getúlio Vargas* (FGV) were the main source. In some cases those series were merged with more recent data provided by the Center for Advanced Studies on Applied Economics (Cepea), and *Instituto de Economia Agrícola* (IEA-SP). Cost of milk production, cost of insurance, and minimum milk prices were given by the National Food Supply Agency (Conab). Macroeconomic data is published by a number of different sources such as IBGE, the Brazilian Central Bank, and the Institute of Applied Economic Research (IPEA).

The total milk supply is estimated on a state-by-state basis and considers the top six states in the Brazilian milk production. Dairy farms in Brazil are very heterogeneous in terms of size, management, and use of technology. There are a mix of farms with professional management and good technical and financial control, contrasting with other farms where the cost of milk

production is still unknown. On average, the three states located in the southern Brazil (*Paraná*, *Santa Catarina*, and *Rio Grande do Sul*) have a more homogeneous production system and better management tools. The production of these is also growing relatively faster than in the other regions.

Figure 1 presents the spatial distribution of milk production in Brazil. Basically, dairy farms are located throughout the country. The top six states, highlighted in the map, represented 76.5% of the total milk production in 1980. In 2012, the same states accounted for 77% of the total production. Therefore, the top six states kept the same share of the total milk production despite the weak performance of *São Paulo*, where the share of the total production decreased from 16% to 5% in the same comparison. As cited by Novo, et al. (2010), the expansion of sugar cane acreages played an important role in explaining the reduction in milk production in *São Paulo*.

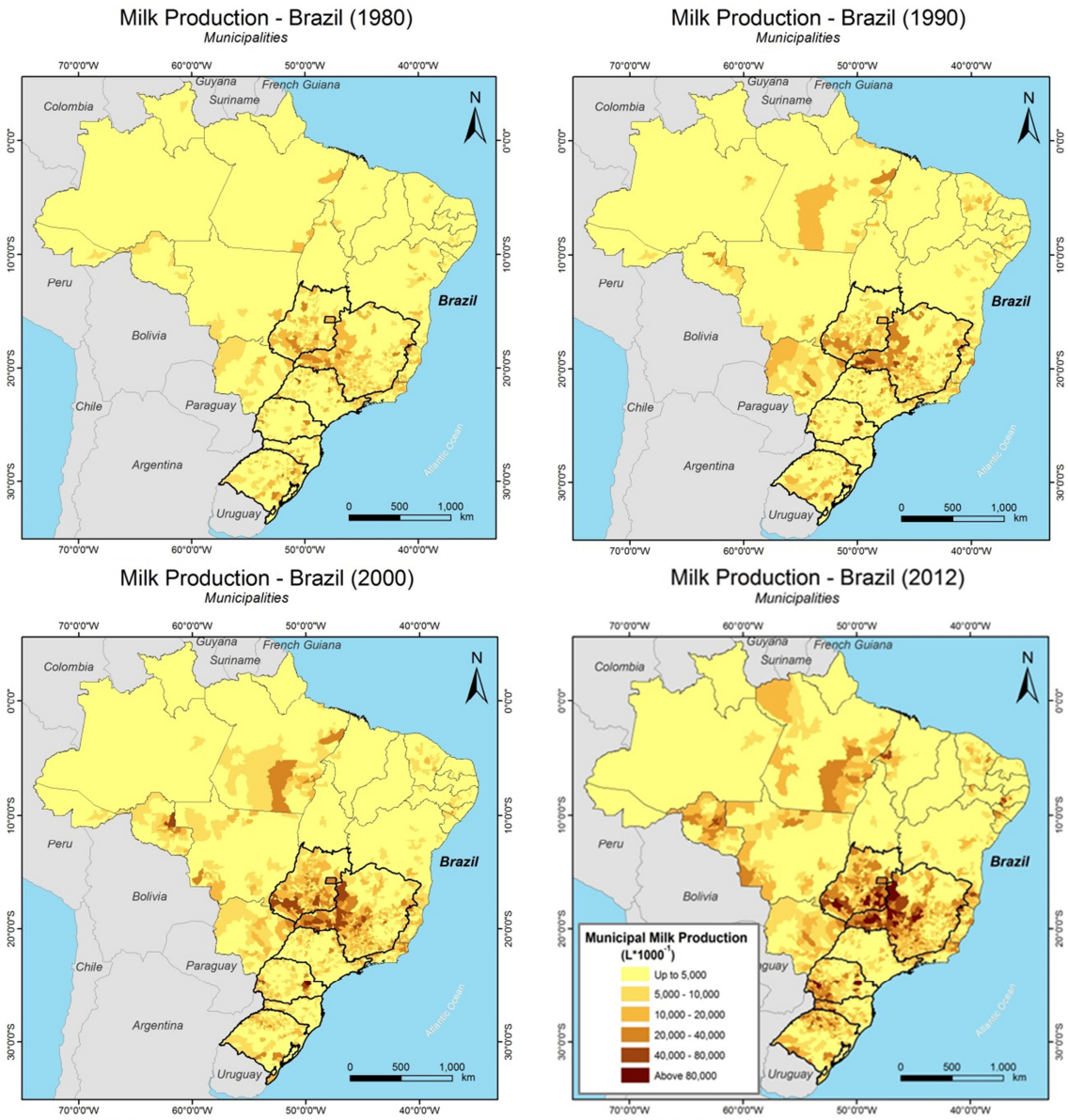

Figure 1. Milk Production in Brazil: 1980 to 2012.

Agricultural risk management policy in Brazil is composed of three main programs: the Farming Activity Guarantee Program (PROAGRO), the Harvest Guarantee (Garantia Safra), and the Crop Insurance Premium Subsidy Program (PSR). The PROAGRO and the PSR are administered by the Ministry of Agriculture (MAPA) while the Harvest Guarantee program is under the Ministry of Rural Development (MDA). The PROAGRO is the most important agricultural risk program in terms of participation since it is tied to subsidized operating costs loans (PRONAF and PRONAMP[1]). In turn, in the last eleven crop years, almost half of the

[1] National Program of Support to the Average Size Producer (PRONAMP) is the program that manages credit offers for average and large scale producers.

producers who were awarded subsidized agricultural loans participated in the PROAGRO program (GESER, 2014).

PROAGRO was created in 1973 and works as a subsidized crop insurance program for the producers who were eligible to be part of either the PRONAF or PRONAMP loan programs. The main goal of PROAGRO is to exempt the farmer of paying its subsidized loan obligations in cases of adverse climate conditions. It also indemnifies the producer by transferring funds in the event of financial losses caused by catastrophic weather events. To participate in this program, the producer has to pay an additional rate to its loan rate and conduct his farming operations based on the government's Agricultural and Climate Risk Zoning (ZARC)[2]. In 2004, an extension to the PROAGRO (PROAGRO Mais) was created. This extension was intended to assist producers who were awarded loans from the PRONAF program. The structure of this extension is very similar to the traditional PROAGRO. The major difference between these two programs is that for producers to be awarded PRONAF loans they must adhere to the PROAGRO program (via the PROAGRO Mais). For the average to large producers (or for the PRONAMP participants), the purchase of PROAGRO or any type of crop insurance was facultative.

However, in June 2013, the Central Bank of Brazil, implemented a new resolution (Resolução 4235) that required all recipients of government subsidized agricultural loans to purchase crop insurance either by participating in the PROAGRO or by buying private crop insurance. This resolution was intended to take full effect starting in July 2014. However, there has been many criticism by local crop insurance industry experts with respect to the lack of infrastructure to fulfill this new demand. An increase in demand for both PROAGRO and private crop insurance products is expected. If the resolution is indeed implemented, the number of PROAGRO participants is expected to increase by 40% in 2014, according to industry projections (GESER, 2014).

The impacts of this compulsory crop insurance is expected to affect the Brazilian agribusiness as a whole. One of the industries that will be impacted is the dairy sector. Currently there are no private insurance products for the dairy sector therefore the only option for the dairy producers will be the PROAGRO program. Thus, for those dairy producers who have subsidized loans, a direct increase in the dairy farmer's operating costs is expected. The magnitude of this increase is expected to be about 1.2% of the total production cost which is equivalent to the premium rate that producer will have to pay to the government (BACEN, 2007). Another impact caused by this resolution is the increase in operating costs for the dairy production feed costs: corn and soybeans. The increase in total production cost for corn and soybeans are expected to be 2.9% for each. Such increase represents the premium rate to be paid by corn and soybean producers by being obligated to participate in the PROAGRO. It is important to mention that not

[2] ZARC is an instrument developed by the Brazilian government with support from the Brazilian Company of Agricultural Research (EMBRAPA) to guide producers with respect to planting decisions such as: planting period, soil type, and seed type. Currently, it comprises of 40 crops and is present in 24 states (MAPA, 2014).

all producers (dairy, corn, and soybean) have subsidized agricultural loans. The soybean and corn planted areas which had subsidized operating cost loans (both PRONAF and PRONAMP programs) were equal to 12.1 and 5.8 million hectares, respectively; this represents 44% and 37% of the soybean and corn total planted area. Hence, the overall impact of the mandatory PROAGRO on the dairy sector may be smaller than the 2.9% increase in premium payment. However, for simplicity, it is assumed that the overall impact expected will be represented by the increase in premium rates (i.e. 1.2% for dairy and 2.9% for both soybean and corn).

Based on the previous discussion, this study investigates the impacts of the compulsory PROAGRO insurance by evaluating three different scenarios. The first scenario implements a positive 1.2% direct shock to the production costs of the dairy industry in Brazil. Scenario 2 analyzes an indirect shock to the dairy industry by increasing the feed cost by the amount of the increase in the PROAGRO premium 2.9%. Lastly, scenario 3 combines both scenario 1 and 2.

Method

The entire model consists of a partial equilibrium approach to estimate structural supply and demand functions for the Brazilian dairy sector to replicate the actual sector. The equations are estimated using least squares criterion following the classical multiple linear regression model as described in Greene (2008). For each equation that contains the lagged dependent variable, the Breusch-Godfrey Lagrange multiplier test was run to test for the presence of serial correlation. This procedure was applied because Greene (2008) shows that in the presence of serial correlation, all coefficients on the right hand side are inconsistent.

As for the other equations, without lagged dependent variables, the coefficient estimates are consistent but not efficient. Nevertheless, in some equations where inference was important the first order serial correlation problem was fixed using the Prais-Winsten estimator described in Prais and Winsten (1954) and Greene (2008). Information criteria, such as Schwarz loss (Schwarz, 1978) and Akaike information criterion (Enders, 2003) were used for selection between different specifications.

As for the empirical model, the milk production is a result of production per cow, multiplied by the number of dairy cows in each year (Figure 2). The equations used to estimate the number of dairy cows are expressed as a function of dairy cows lagged one year, deflated net revenue lagged one year, and exogenous variables. Following Greene (2008), a Breusch-Godfrey Lagrange multiplier test was run to check for the presence of serial correlation. Milk production per cow depends upon time trend, and costs deflated net revenue. The time trend variable represents the effects of technology over time. The net revenue variable, on the other hand, considers the effect of relative profitability of producing milk. The total milk production is determined by the number of dairy cows on the farm and the production per cow. The total supply of milk is an aggregation of each region and represents the entire country.

The structural model incorporated the mandatory insurance cost to the total cost that is part of the net revenue indicator. Therefore, the insurance cost is impacting the estimated number of dairy cows and production per cow. These two variables are used to calculate the total milk production. As for dairy products, the total raw milk supply flows to different products and the total supply of each product is defined as the sum of production, imports, and beginning stocks. On the other hand, the total demand is calculated by total consumption, exports, and ending stocks. For both the supply and the demand side of the model, international trade is mostly marginal in the Brazilian dairy sector. Brazil is historically a net importer country, and trade is still not consolidated in the dairy industry.

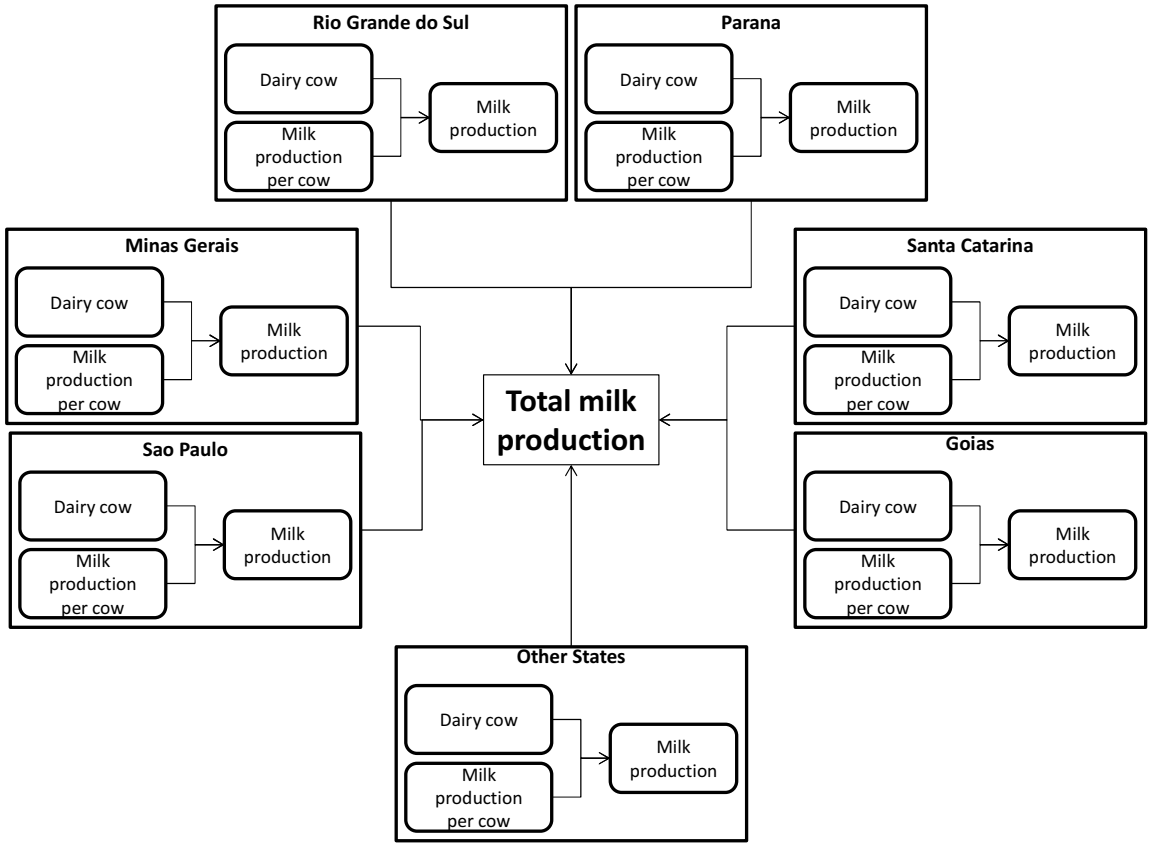

Figure 2 - Milk Production Estimation on a State Basis
Note: Adapted from Brown (1994).

To complete the structural procedure, a non-linear optimization method is used for the partial equilibrium model, which solved for four different dairy markets: butter, cheese, milk powder, and fresh products. The objective of each market is to minimize the squared difference of the excess supply in a given year as described in equation 1.

$$Obj.function = Min\ \Sigma_k\ (supply_k - demand_k)^2 \qquad 1$$

where, k = butter, cheese, milk powder, fresh products.

The method is dynamic and recursive where each endogenous variable is explicitly followed over time. The entire model is solved sequentially, one period at a time, for the 10-year forecast. The model is exercised by running different scenarios with the baseline as the reference scenario. The baseline considers the *status quo* of the exogenous variables and current policies. The mandatory insurance represents about 1.2% of the total cost if only the direct cost of the policy on dairy farm is considered. However, an indirect effect is expected in feed cost since the mandatory insurance may affect corn and soybean costs as well. Therefore, alternative scenarios are used to contrast with the existing conditions and consider the direct and indirect effect of the mandatory insurance policy.

Results

The total milk production in Brazil is presented in Table 1. The baseline forecast is in between the scenarios developed by both OECD/FAO (2013) and the Brazilian Ministry of Agriculture (MAPA, 2013). It is worth mentioning that in our baseline scenario the world's economy is assumed to perform somewhat worse in the next ten years compared to the last decade. For that reason, the overall growth rate is lower than that of the previous period. The production per cow is expected to grow a little faster than before, but it is still very low, with annual production smaller than 2,000 kg/cow by 2022. An expected lower number of dairy farms and greater competition with alternative agricultural activities may cause management improvement for the coming years, inducing better use of technologies.

Table 1. Total Milk Production in Brazil: 1,000 ton

2012	**2022 (forecast)**		
	Baseline	*OECD-FAO (1)*	*MAPA (2)*
33,055	41,649	38,839	44,514

Note: (1) OECD-FAO outlook 2013-2022; (2) MAPA: Brazilian Ministry of Agriculture.

Conceptual evaluation

Figure 3 represents a negative shock in the milk supply at farm level due to cost rising. Such a policy would shift the supply curve to the left reaching the new price/quantity equilibrium at P'_F and Q'_F as represented in Figure 3. The total milk production is now represented by S' and the wholesale and retail prices by P'_W and P'_R, respectively. Therefore, an increase in the cost of milk production would lead to a lower supply and higher prices in the entire supply chain.

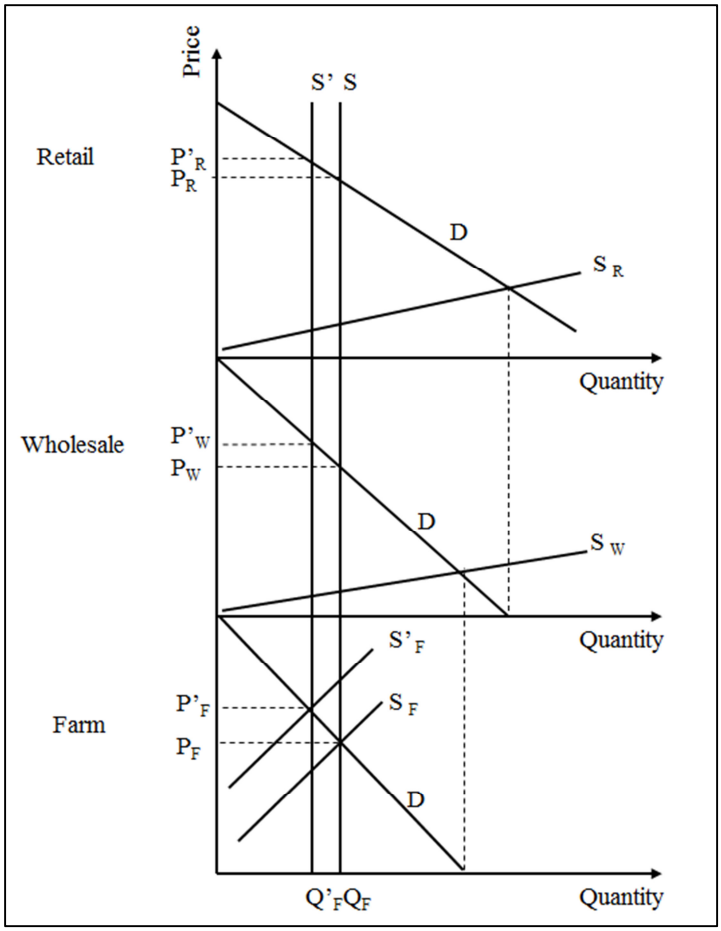

Figure 3. Negative Supply Shock on the Dairy Chain

Empirical evaluation

The first scenario to be analyzed was a 1.2% increase in the production costs of the dairy industry in Brazil due to the mandatory crop insurance resolution. The second scenario analyzed is a 2.9% increase in the dairy industry feed cost. Scenario 3 is a combination of scenarios 1 and 2.

A 1.2% increase in dairy production costs due to the mandatory crop insurance resolution has the expected impacts on the Brazilian dairy industry. As depicted in Figure 3 and shown in Table 2, the baseline forecast milk production estimated in all scenarios decreases when compared to the baseline forecast without the implementation of the mandatory crop insurance resolution. The largest reduction in milk production was found in scenario 3 where the milk production decreased from 41,649 to 41,577 thousand tons. Although there were reductions in milk production, the relative change was very insignificant – the largest reduction was equal to -0.17%. Interesting to note that scenario 2 underwent the least decrease in milk production. This was somewhat expected since the increase in feed cost is an indirect shock (i.e. feed cost is a function of corn and soybean).

Table 2. Estimated Changes in the Baseline Forecast of the Brazilian Milk Production, Number of Dairy Cows, Milk Price, and Feed Cost due to the Mandatory Crop Insurance Resolution

Variable	2022						
	Baseline	**Scenario 1**		**Scenario 2**		**Scenario 3**	
	Quantity	*Quantity*	*% Change*	*Quantity*	*% Change*	*Quantity*	*% Change*
Total milk production (1,000 tons)	41,649.00	41,608.57	-0.10%	41,617.90	-0.07%	41,577.11	-0.17%
Number of dairy cows (1,000 heads)	26,737.49	26,723.65	-0.05%	26,726.40	-0.04%	26,712.42	-0.09%
Milk price (R$/kg milk)	0.908	0.911	0.37%	0.911	0.28%	0.914	0.65%
Feed Cost (R$/kg milk)	0.216	0.216	0.00%	0.222	2.90%	0.222	2.90%

Note: Scenario 1 is a 1.2% increase in the production costs of the dairy farms in Brazil due to the mandatory crop insurance resolution. Scenario 2 is a 2.9% increase in the feed cost of dairy farms due to the mandatory crop insurance resolution. Scenario 3 is a combination of scenarios 1 and 2.

Similar changes took place in the baseline forecast for number of dairy cows. In all scenarios, the number of animals underwent a decrease with Scenario 3 having the largest drop. Such changes can be explained due to the increase in feed costs – more expensive to feed the dairy herd. The Brazilian milk price variable was also evaluated. In contrast to the production and the number of cows, the milk price increased as expected. The price increase ranged from R$0.03/kg for scenario 1 and 2 to R$0.06/kg for scenario 3. The largest relative change in the milk price variable occurred in scenario 3 where the forecast milk price increased by 0.65%. This increase was also expected since farm operating costs rose due to the mandatory expenses in crop insurance. The forecast for the feed cost increased for scenarios 2 and 3 by the same amount while scenario 1 remained the same. The mandatory crop insurance directly affected the feed costs by increasing the cost of buying corn and soybean. This increase in feed cost was exactly equal to the cost of buying crop insurance (2.9%). In other words, the corn and soybean producers pass the cost of buying insurance to the dairy supply chain. Since scenario 1 shock was at the dairy farm production cost there was no change in feed cost when compared to the base model.

Table 3 shows the estimated changes in the baseline forecast of the consumer price index of dairy products (butter, cheese, milk powder, and fluid milk) due to the mandatory crop insurance resolution. The model results indicate an increase in the consumer price of dairy products. The forecast for the butter price index increased the largest in scenario 3 (up by 0.22%) while scenario 2 underwent the smallest increase (0.09%). Similarly, the forecast for the cheese price index increased the most in scenario 3 (0.63%) and the least in scenario 2 (0.27%). Similar results were found in the baseline forecast for the milk powder price index. The largest increase of all dairy price indices occurred in the fluid milk price index. In Scenario 3, the baseline forecast rose from 102.45 to 103.92, which represented a 1.39% increase. This can be explained by the fact that the fluid milk processing cost is basically composed by the raw milk itself while the others dairy products have a greater share of other ingredients in the production process.

Figure 4 graphs the model estimated milk production from 1980 to 2022. It also compares the base model milk production projection to the scenario-estimated milk production. As previously discussed, the impacts of the mandatory crop insurance in the Brazilian milk production were as expected. In other words, the milk production declined to lower levels due to the increase in cost in all scenarios. However, the decline in milk production was marginal and this is depicted in Figure 4. The base model milk production projection is almost completely overlapped by the scenario-estimated projections for all years. With respect to relative change, this shows that the long run impacts of the compulsory crop insurance will be very small.

Table 3. Estimated Changes in the Baseline Forecast of the Brazilian Butter, Cheese, Milk Powder, and Fluid Milk Consumer Level Prices due to the Mandatory Crop Insurance Resolution

Consumer Price Level (12/ 2012 = 100)	2022						
	Baseline	**Scenario 1**		**Scenario 2**		**Scenario 3**	
	Quantity	*Quantity*	*% Change*	*Quantity*	*% Change*	*Quantity*	*% Change*
Butter price index	93.88	94.00	0.12%	93.97	0.09%	94.09	0.22%
Cheese price index	104.20	104.57	0.35%	104.49	0.27%	104.86	0.63%
Milk powder price index	91.941	92.347	0.44%	92.253	0.34%	92.663	0.79%
Fluid milk price index	102.495	103.297	0.78%	103.112	0.60%	103.922	1.39%

Note: Scenario 1 is a 1.2% increase in the production costs of the dairy industry in Brazil due to the mandatory crop insurance resolution. Scenario 2 is a 2.9% increase in the dairy industry feed cost due to the mandatory crop insurance resolution. Scenario 3 is a combination of scenarios 1 and 2.

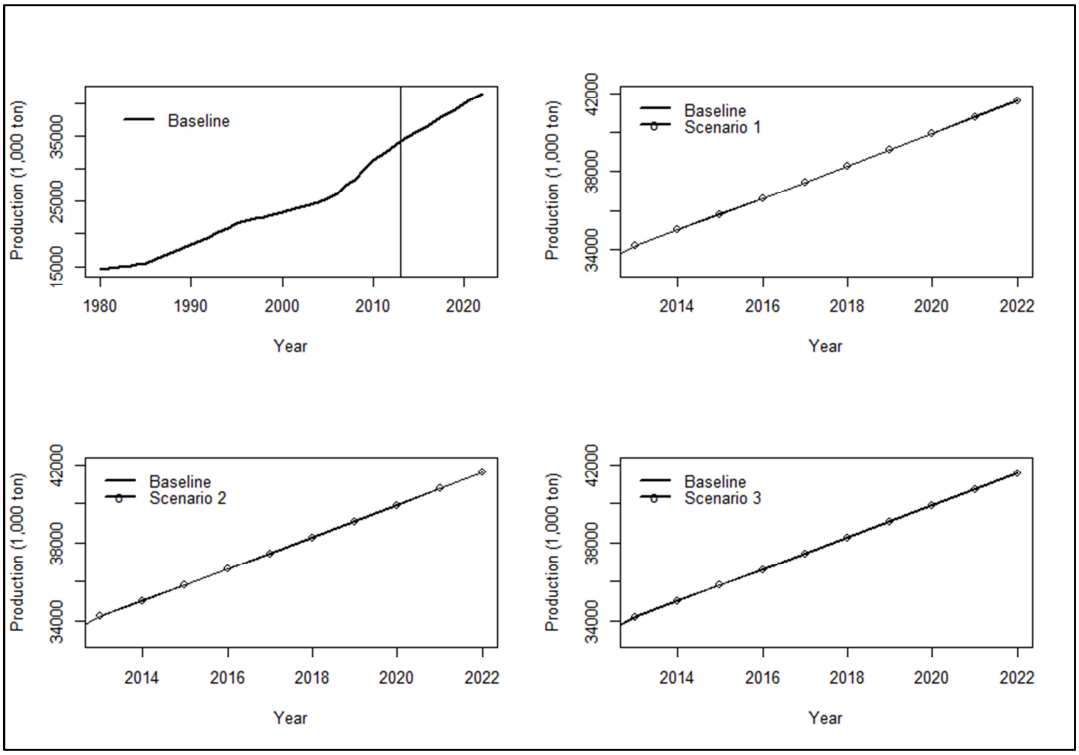

Figure 4. Model-estimated Changes in the Baseline Forecast for Milk Production for Different Scenarios

As for the long run impacts on milk price, the scenario-estimated projections are presented in Figure 5. For most of the years between 2013 and 2022, the milk price projected by the base model is below the projections estimated by all scenarios. The largest difference is found in scenario 3 and takes place in two years: 2017 and 2020. Still, the impacts of the increase in production costs for dairy (either directly or indirectly) are very marginal.

As it can be observed in Figure 6, the effects of the compulsory crop insurance in the feed cost projection are very noticeable. The feed cost baseline projection remains the same, as it was previously discussed. Scenarios 2 and 3 are where the feed cost baseline projection changes when compared to the baseline projection for the base model. The largest increase in feed cost with respect to the base model occurs in 2017 to 2020. By 2022, the feed cost projected by both the base model and scenarios 2 and 3 are almost identical only differing by 2.9%, which is the total increase in feed cost.

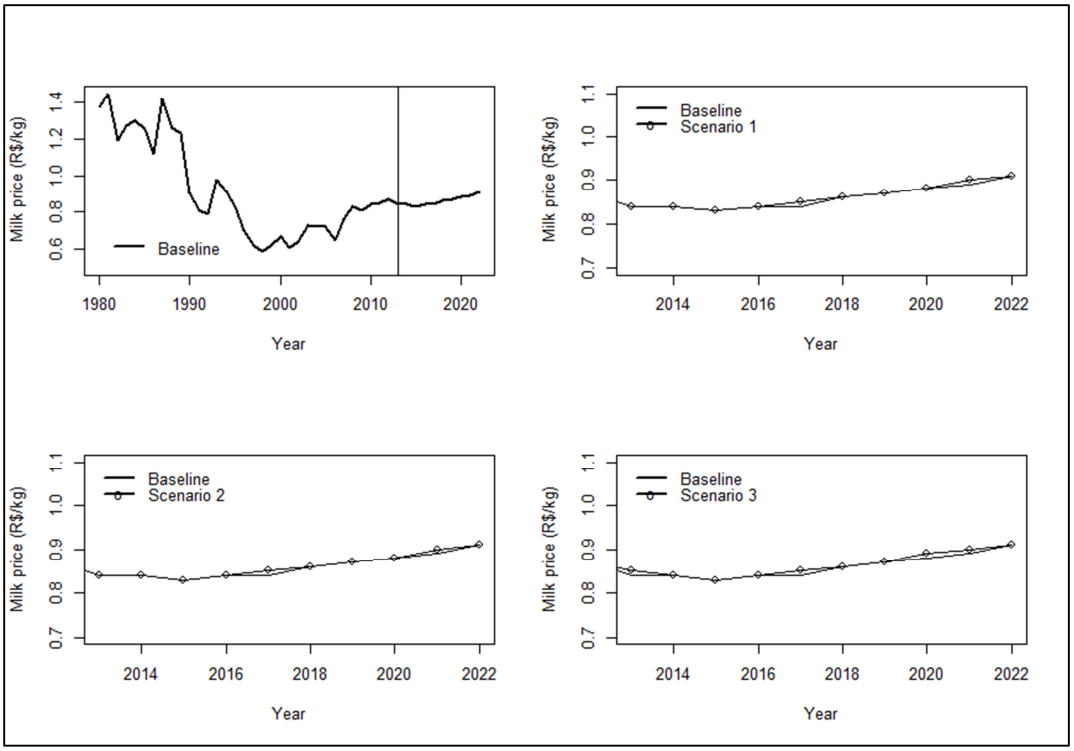

Figure 5. Model-estimated Changes in the Baseline Forecast for Milk Price (Farm Level) for Different Scenarios

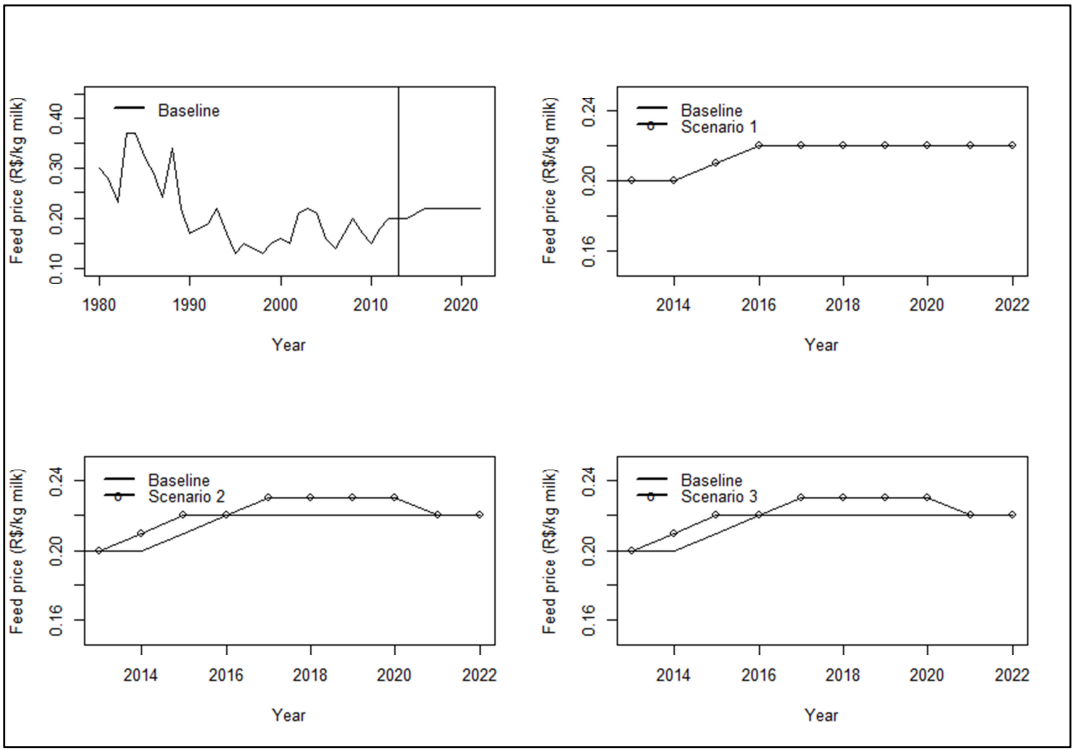

Figure 6. Model-estimated Changes in the Baseline Forecast for Feed Cost for Different Scenarios

Figure 7 below illustrates the impacts of the analyzed policy shock on consumer price of fluid milk. For the first few years, the baseline projection for the original model and the projection for all scenarios almost offset each other. In scenario 3, by 2015, the projection for fluid milk starts to move up indicating that the fluip milk price will increase in the next 10 years. On the other hand, the projections estimated in scenario 1 is almost identical to the base model projections.

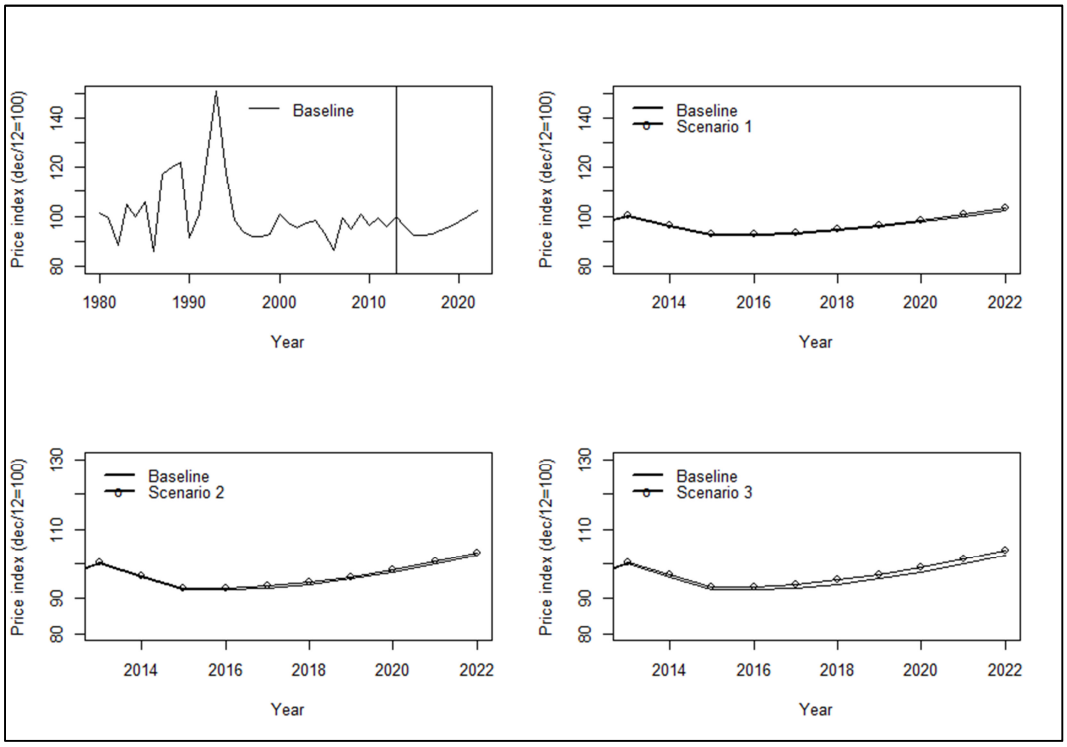

Figure 7. Model-estimated Changes in the Baseline Forecast for Fluid Milk Price Index for Different Scenarios

Conclusion

This paper investigates the potential impacts of compulsory crop insurance in the Brazilian dairy market. Since this crop insurance obligation will be entered in the dairy processes as an operating expense, three scenarios were analyzed to simulate this shock on the milk production, herd size, milk price, feed cost, and consumer dairy prices. Scenario 1 examines a positive 1.2% direct shock to the production costs of the dairy industry. Scenario 2 analyzes an indirect shock to the dairy industry by increasing the feed cost by 2.9%. Lastly, scenario 3 combines both scenario 1 and 2.

The results of our analysis indicate that milk production will decrease over time as well as the number of dairy cows. On the other hand, both milk price and feed cost will increase in the long run. However, these changes in the long run are predicted to be relatively small. For example, the largest decline in milk production is 0.09%, which occurs in scenario 3. This

represents a drop of 72 thousand tons of milk. In relative terms, this amount is very small when compared to the total milk production for the country (the baseline model forecast for 2022 is 41,649 thousand tons). Similar case occurs when analyzing milk prices. The baseline model forecast for 2022 milk price is modeled to go up by 0.65% - from R$0.908/kg in the baseline model to a scenario 3 estimate of R$0.914/kg. As for the consumer price, the 2022 forecast suggested an increase in all dairy products, with emphasis to the fluid milk.

As observed from the above analysis, the dairy farms in Brazil are not very responsive to changes in exogenous variables. The milk production suffers only marginal changes compared to the baseline scenario. A possible reason is because farm management in Brazil is not homogenous even between neighboring areas. In addition, many farmers don't know their production cost, which may cause very slow adjustments in the production systems.

References

Brown, D.S. 1994. "A Structural Approach to Modeling the US Livestock and Dairy Industries: With Emphasis on the Dynamics Within the System." University of Missouri-Columbia.

BACEN, 2007. Resolução Número 3478, Central Bank of Brazil. Available at: http://www.bcb.gov.br/pre/normativos/busca/normativo.asp?tipo=Res&ano=2007&numero=3478

Calegar, G. 2001. "Competitividade dos produtos lácteos no Estado de Goiás." *VIEIRA, RCT; TEIXEIRA FILHO, AR; OLIVEIRA, AJ Cadeias Produtivas no Brasil. Análise da Competitividade. Brasília: Embrapa Comunicação para transferência de Tecnologia*:207-229.

Enders, W. 2003. *Applied Econometric Time Series*: Wiley.

FAO (2014) "FAOSTAT." In. Rome, Italy, Food and Agriculture Organization of the United Nations (FAO).

Greene, W.H. 2008. *Econometric Analysis*: Pearson/Prentice Hall.

GESER, 2014. *A Compulsoriedade do PROAGRO ou Seguro Rural nas Operações de Crédito Agrícola no Brasil*, Boletim do Seguro Rural. Available at: http://www.esalq.usp.br/geser/

IBGE. 2009. *Censo Agropecuário 2006: Brasil, Grandes Regiões e Unidades da Federação.* Rio de Janeiro: Ministério do Planejamento, Orçamento e Gestão. Instituto Brasileiro de Geografia e Estatística (IBGE).

MAPA. 2013. *Agricultural Outlook: 2012/2013 - 2022/2023.* Brasília: Ministério da Agricultura, Pecuária e Abastecimento/Assessoria de Gestão Estratégica.

MAPA. 2014. Zoneamento Agrícola de Risco Climático. Brasília: Ministério da Agricultura, Pecuária e Abastecimento/Assessoria de Gestão Estratégica.Martins, P.C. 2004. *Políticas públicas e mercados deprimem o resultado do sistema agroindustrial do leite*: Embrapa Gado de Leite.

Martins, P.d.C., and R.C.M.T. Vieira. 2001. "Efeitos de políticas públicas sobre a cadeia produtiva de leite em pó." *Cadeias produtivas no Brasil: Análise da competitividade. Brasília: Embrapa/Secretaria de Administração Estratégica*:239-272.

Novo, A., K. Jansen, M. Slingerland, and K. Giller. 2010. "Biofuel, dairy production and beef in Brazil: competing claims on land use in São Paulo state." *The Journal of Peasant Studies* 37:769-792.

OECD/FAO. 2013. *OECD-FAO Agricultural Outlook 2013-2022.* OECD Publishing and FAO: http://dx.doi.org/10.1787/agr_outlook-2013-en.

Prais, S., and C. Winsten. "Trend estimators and serial correlation. Cowles CommissionDiscussion Paper No. 383. Chicago, IL." PraisCowles Commission Discussion Paper.

Rodrigues, G.V. (1999) "Estruturação e desafios do setor de produção de leite." In M.C.D. Castro, and P.C. Martins eds. *Organização da produção primária: um desafio para a indústria de laticínios.* . Juiz de Fora, Epamig/ILCT, pp. 36-40.

Schwarz, G. 1978. "Estimating the Dimension of a Model." *The Annals of Statistics* 6:461-464.

Tupy, O. (2001) "Impacto de tecnologias de produção na lucratividade privada e econômica do segmento de leite pasteurizado tipo B no estado de São Paulo." In R.C.M.T. Vieira,A.R. Teixeira Filho,A.J. Oliveira, and M.R. Lopes eds. *Cadeias produtivas no Brasil: análise da competitividade.* Brasília, Embrapa/Fundação Getúlio Vargas-RJ, pp. 272-285.

Title: The Impacts of Compulsory Crop Insurance in the Brazilian Dairy Sector

Authors: Carvalho, Glauco Rodrigues
Costa, Rafael

Authors (Email): Carvalho, Glauco R. (glauco.carvalho01@gmail.com)
Costa, Rafael (rafaeldfcosta@gmail.com)

Keywords: insurance
policy analysis
structural model

JEL Codes: C50
C22
Q18

Issue Date: 2015-01-16T03:00:30Z

Abstract: The dairy sector is an important segment of the Brazilian agribusiness. From the demand side, dairy products are the second most important in terms of household expenditure on food. From the supply side, Brazil is the 4th largest country in milk production with more than 32 billion liters per year. Moreover, nearly 1.3 million of dairy farmers are in operation, most of which characterized as small family farms. The rural credit is the main mechanism in terms of dairy policy. A program called PRONAF was created in 1996 to support small farmers by offering them special financial provisions, such as low interest rates. However, in 2013 the Brazilian Government through Central Bank imposed mandatory farm insurance as a condition to access rural credit. The impact of this policy on the dairy sector is unknown and this paper aims to evaluate such a policy. A structural econometric model of the Brazilian dairy sector is used to quantify the effect of that change on the production, consumption and milk price. The impact will be considered relative to a ten-year baseline scenario ending in 2022. Annual equilibrium prices are solved by minimizing the squared difference between supply and demand for four different markets: cheese, butter, milk powder, and fresh dairy products. Contributions to policy makers, private companies, and future researches are expected.

URI: http://purl.umn.edu/196871

Institution/Association: Southern Agricultural Economics Association>2015 Annual Meeting, January 31-February 3, 2015, Atlanta, Georgia

Total Pages: 19

Collections: 2015 Annual Meeting, January 31-February 3, 2015, Atlanta, Georgia