



**Department of Economics and Finance**

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**Cow Backed Securities – A structured  
finance proposal**

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# **Cow Backed Securities – A structured finance proposal**

*(Valerio Piro)*

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# Introduction

The aim of the present study is to investigate the chance to extend the practice of securitization beyond its standard application, taking into account the securitization of livestock. It will be proposed, how and to what extent, the unconventional collateral arising from the cow production' financial value, e.g. milk sales revenues, could expand credit facilities to the farming sector and originate an investment product suitable for diversification purposes. Chapter one will disclose the theoretical foundation of securitization, synthetic securitization and structured finance, as well as an historical analysis pointing out the evolution and performance of various structured products during the past two decades. Concluding the chapter, it will be explored the current EU securitization legal framework response in the financial crisis aftermath. In chapter two will be presented the Cow Backed Securities proposal and analysed the recent development in the milk market, along, will be pointed out some of the gains such product could bring to both sell and buy side. It will be performed a primary estimation upon the correlation between financial markets and the underlying asset market to discover potential diversification synergies. Chapter 3 will focus on setting up some of the building block to ease the way for future contracting and advisory. It will be illustrated the financial valuation of the collateral and investigated the risk associated with the product catering some first appraisals. The last section will disclose some of the challenges left on the table.

# Chapter 1 – The Securitization

## 1.1 The Securitization

Securitization is a financial instrument that allows the transformation of illiquid assets into marketable securities<sup>1</sup>. In theory, any asset producing a cash flow is eligible for securitization purposes<sup>2</sup>. Indeed, throughout the year the structured finance sector experienced a rapid growth, more and more assets have been securitized to compel with the articulated demand of the credit sector. Trying to explain this process as simple as possible, it is provided the following example:

Bank A, the Originator, is willing to raise money and owns in its balance sheet a lot of loans. One day it decides to sell some of these assets, in doing so Bank A realizes that it is very convenient for it to sell a pool of loans through securitization instead just a few at time to other willing to bear the risk associated with the loans.

A Special Purpose Vehicle (SPV) or Special Investment Vehicle (SIV) it is created ad hoc to ease the transaction and originate the new securities that will be sold in the market. The SPV buys the pool of assets from Bank A in exchange of cash that are transferred to Bank A, a true sale occurred. Now, the SPV owns the pool of loans that before where belonging to Bank A. To pursue the transaction, the SPV must raise the cash somewhere, the SPV can ask to its shareholders the money needed or can issue debt. If the SPV issue bonds to finance the acquisition, those bonds originated became a financial marketable asset and now get the name of Asset Backed Securities (ABS). The ABS just created are a claim on the assets contained in the SPV, with the added feature that now are tradable among financial market participants easily than the initial basket of loans. This type of

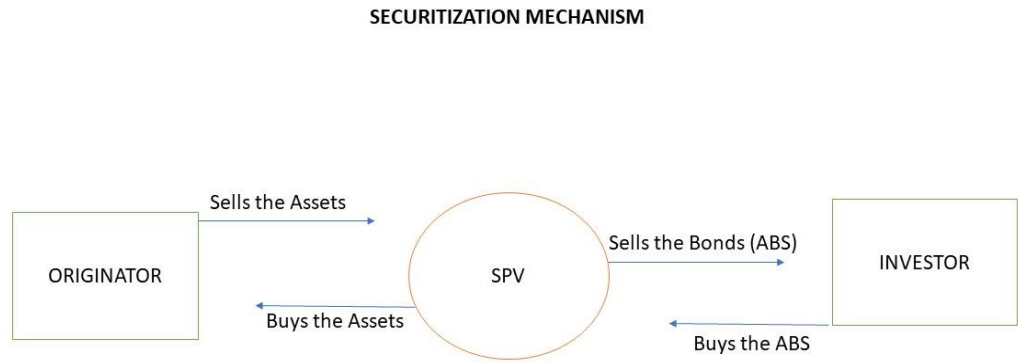
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<sup>1</sup> Caselli, S. & Gatti, S. (2005). “Structured Finance Techniques, Products and Markets”.

<sup>2</sup> Caselli, S. & Gatti, S. (2005). “Structured Finance Techniques, Products and Markets”.

securitization is named *pass-through*<sup>3</sup> because nothing has been done to enhance the credit rating of the assets pool.

**Table 1.1 - The Securitization Mechanism**



*Source: Author*

Structured finance techniques can be applied to spread the default risk of the new securities. The process consists in originating ABS tranches with different seniority: “*to manufacture a range of securities with different cash flow risks, structured finance issues a capital structure of prioritized claims, known as tranches, against the underlying collateral pool.*”<sup>4</sup>

An example is provided below.

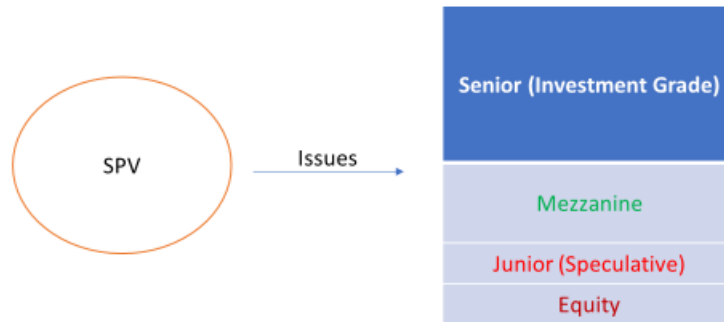
**Table 1.2 Tranches Structure**

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<sup>3</sup> Coval, J.D., Jurek, J. & Stafford E. (2008). “The Economics of Structured Finance”, Harvard Business Review.

<sup>4</sup> Coval, J.D., Jurek, J. & Stafford E. (2008). “The Economics of Structured Finance”, Harvard Business Review.

## TRANCHES STRUCTURE



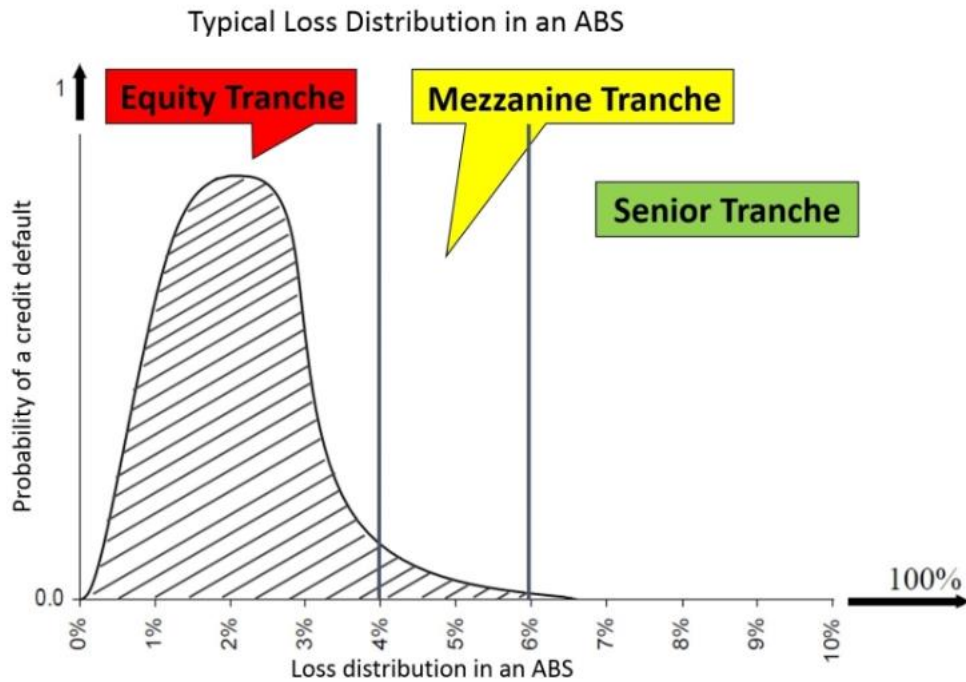
*Source: Author*

Every tranche is associated with a different default risk, a basic tranches structure implies a Senior, Mezzanine and Junior tranche subject to cash flows risks according to a waterfall structure<sup>5</sup>; the diverse deal's structuring may push the tranches structure further, defining several incomes and risk levels. Thus, losses on tranches in this setup follow a probability distribution as it is shown in the next table. Such probability distributions are very sensitive to risk factors adopted in the estimation, so the purpose of the next graph, retrieved online, is to show the decreasing probability of default moving towards senior tranches which verify the structured finance assumptions on tranching.

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<sup>5</sup> Fabozzi, F.J., Kothari, V. (2008). "Introduction to Securitization", Wiley.

**Table 1.3 - Typical Loss Distribution in an ABS**



*Source: Krahnen, J. P. (2014). "Asset Backed Securites need to be better regulated." Center for Financial Studies*

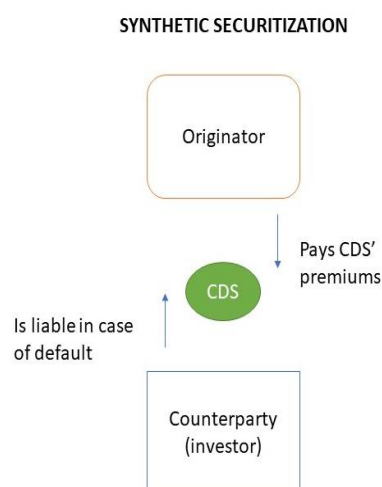
Following the precedent assumptions, from the graph we can see how the loss distribution is skewed toward the equity capital of the SPV, here denominated "Equity Tranche" and the Junior level tranches. Hence, if a credit default occurs and it is only partial, the first capital at risk is the Equity one, then the junior tranches will absorb the default in excess and so on going toward the senior tranches (waterfall structure). Following this reasoning, more senior tranches have lower returns associated with low risks and may be assigned rating as high as investment grade (AAA to BBB-), while junior tranches show higher returns but also higher risks, usually below investment grade.

## **1.2 Synthetic Securitization**

Digging deeper in the securitization world we can find also the Synthetic Securitization, a credit risk tool developed alongside the “standard” securitization process discussed before.

Synthetic securitization allows the originator who owns in its balance sheet a portfolio of assets, for explanatory purposes let define this portfolio as a loan portfolio, to hedge the credit risk associated with the portfolio using credit derivatives such as the Credit Default Swap (CDS). A CDS is a derivative contract involving 2 parties, a buyer and an investor, similar to an insurance contract: the buyer of the derivative pays premiums over time to the investor who is bearing the risk of the default of the asset in the portfolio, the latter is liable should a credit default occurs. This way the holder of the loan portfolio can hedge the credit risk of the portfolio paying the CDS’ premiums<sup>6</sup>. The process is described in the table below.

**Table 1.4 - Synthetic Securitization**



*Source: Author*

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<sup>6</sup> Kaya, O. (2017). “Synthetic securitisation Making a silent comeback”, Deutsche Bank.

In its simplest form Synthetic Securitization differs from Securitization for two main reasons: first, it is a transaction which does not generate any funding for the originator, indeed, there is no true sale of assets, so the portfolio remains in the originator's balance sheet. Lastly, there is no need for a special purpose vehicle (SPV) to participate in the transaction, but it is necessary that a counterparty is willing to bear the risk of the portfolio and enters into the contract.

Synthetic Securitization proved itself to be a powerful tool for hedging purposes and risk exposure management considering mandatory capital requirements to which Financial Institutions are subject and a speculative tool in the wake of the Great Financial Crisis.

### **1.3 The Securitization Market**

The players active in this secondary market are banks, insurance companies, money market funds, pension funds, mutual funds, hedge funds etc... Such wide plateau of participants could be achieved thanks to the broad array of structured products available, giving investors the choice to buy tranches suited to their risk and return preferences.

Hence, Securitization along with Structured Finance techniques give investors the ability to negotiate within capital markets assets that otherwise were illiquid, on one hand, it expands credit facilities not available before and, on the other, it allows investors to diversify their investment portfolios with assets unavailable at inception because too costly and risky to handle. Such instruments could generate gains among the business community in terms of lower funding costs and diversification possibilities<sup>7</sup>.

Those financial innovations are often deemed to be at the core of the financial crisis withstood in 2008, more about the role played in the crisis by Securitized and Structured products will be presented later.

The origin of the Securitization is dated back in 1970, when, in the United States the first government-guaranteed residential mortgage has been securitized by the Government National Mortgage Association. During the 1980s in the United States a market for Asset

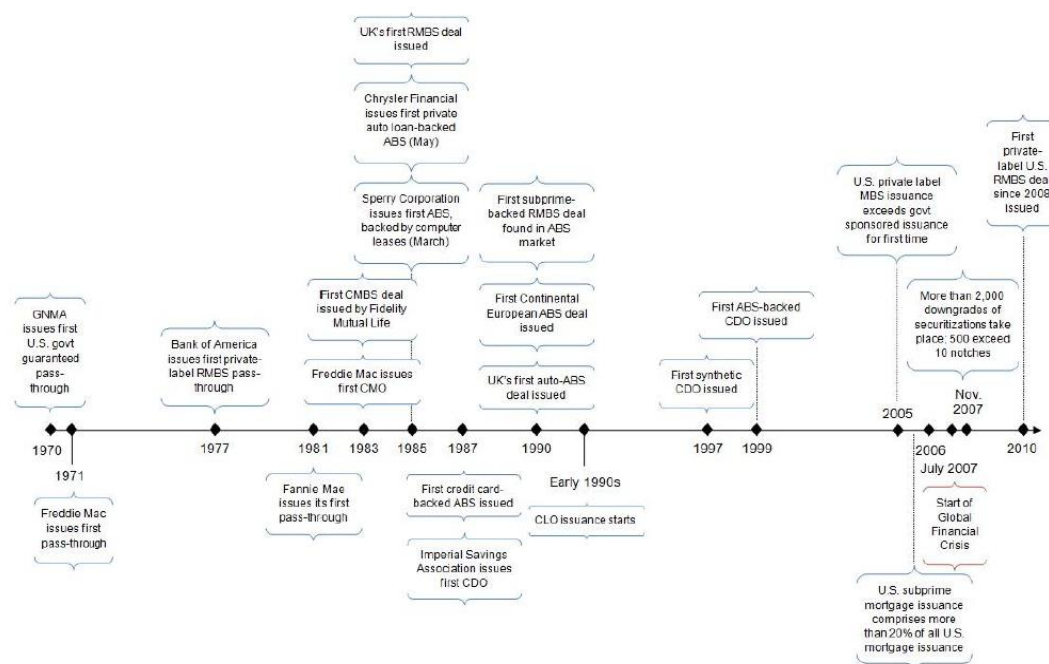
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<sup>7</sup> Segoviano, M., et al (2013). "Securitization: Lessons Learned and the Road Ahead", IMF.

Backed Securities (ABS) started to flourish sided by the development of Residential Mortgage Backed Securities (RMBS) issuance in the United Kingdom. Over the course of the 1990s the innovation spreads from the US across Continental Europe and UK in form of ABS and Mortgage Backed Securities. *“By the turn of the century, the issuance of U.S. private-label securitizations stood at US\$1 trillion, around five times that of Europe”* IMF (2013).

In the graph below, it is presented a timeline with major developments in the global Securitization market.

**Table 1.5 – Securitization History Timeline**



Source: IMF (2013)

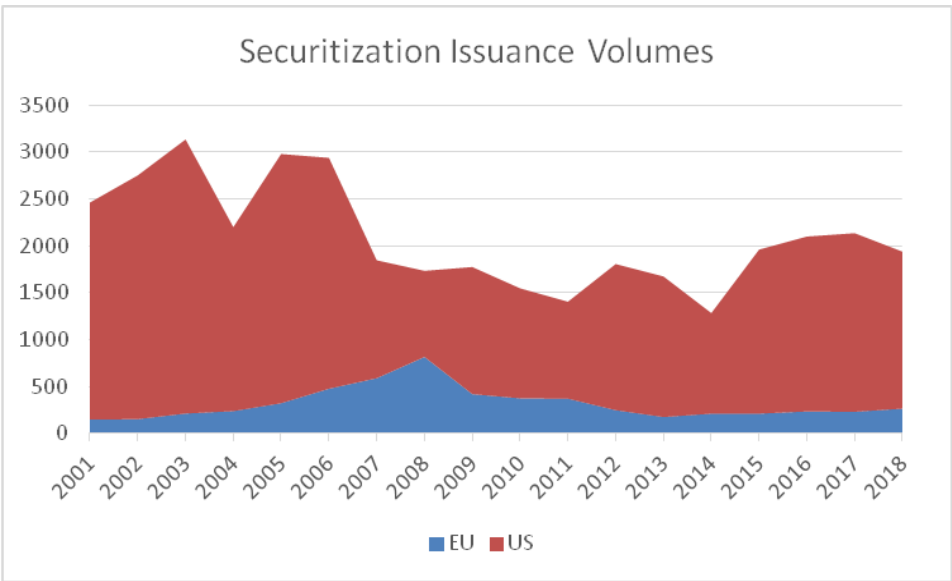
Globally, in the period spanning from 2000 to 2007, the Collateralized Debt Obligation (CDO, ABSs pooled together) issuance experienced a steady growth and largely overcome other structured products until reached its peak of US\$1 trillion at the end of 2007. During the same period in the U.S., the increase in CDO securities issuance has

been accompanied by the subprime mortgage market expansion that experienced a robust six-fold growth of issuance volumes reaching US\$600 billion per annum.

As it will be discussed later, such fierce growth experienced in the U.S. Subprime Mortgages Securitization played a central role during the Financial Crisis, however, this cannot be told for every securitized asset classes. Collateralized Loan Obligation (CLO) backed by consumer loans such as credit card, auto, student ones and equipment lease ABS performed very well: in the 1993-2011 period those showed default rates of 0.3% for auto loan, 0.7% for credit card loan, 1.7% for student loans and 5.9% for leases<sup>8</sup>. To better understand market developments in the last decade, a series of graphs and tables are presented thereafter.

**Table 1.6 - Securitization Issuance Volumes**

*Data expressed in €Billion.*



*Source: AFME (2018, 2017, 2016, 2015)*

<sup>8</sup> Segoviano, M., Jones, B., Lindner, P. & Blankenheim J. (2013). "Securitization: Lessons Learned and the Road Ahead", IMF.

In the figure above, it is presented the aggregate issuance volumes both in the U.S. and in Europe from 2001 to 2018. US and European issuance have followed different paths since 2008. After an initial increase in both areas, affected by the crisis the US experienced a steep decline in 2007-2008 and slightly recovered in 2009 thanks to the support of Governments Sponsored Enterprises (GSEs) such as Freddie Mac, Fannie Mae and Ginnie Mae to the Agency MBS market<sup>9</sup>.

By the end of 2009 Securitization volume in the United States experienced a steady decline corroborated by developments of the financial crisis started in 2007, amplified, among all, by the opaque management and distribution of structured products, and a loss of confidence that spread throughout the markets pushing investors to drain liquidity away from complex products toward safer assets.<sup>10</sup> In 2011, the trend inverts and starts to point upward following the US economy expansion withstand in the last decade. In Europe, the decline ends in 2014 when the trend starts to show some positiveness but still far from US, depicting on one hand the European struggling economy but on the other a less volatile environment. The forefront position of the US in such markets is by no means clear and it is marked in 2017 when the US issuance reached 10 times the European one. Set the reference environment for Western Economies, the next graphs will highlight the collateral assets on which Securitization activity has focused.

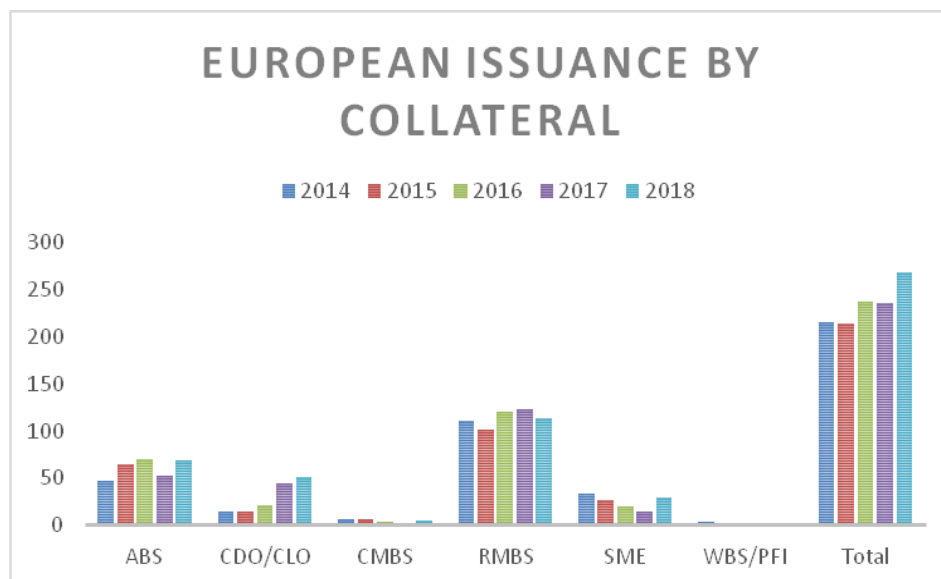
### **Table 1.7 European Issuance by Collateral**

*Data expressed in €Billion.*

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<sup>9</sup> ECB (2011). “Recent Developments in Securitisation”.

<sup>10</sup> Nava, M., Marchesi, M. (2018). “The EU response to the financial crisis and the economic recession: The Juncker Plan, The Capital Market Union and The Banking Union”.



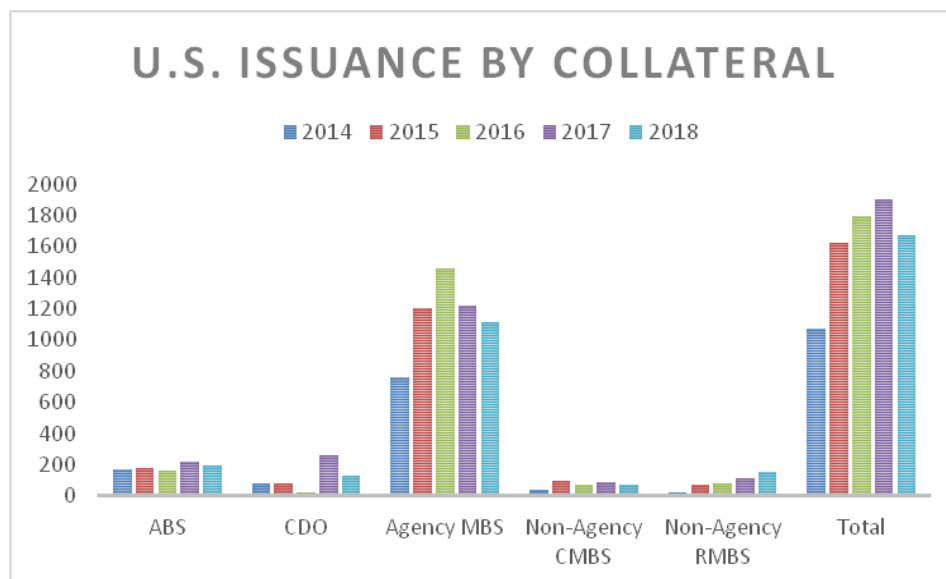
*Source: AFME (2018, 2017, 2016, 2015)*

In the figure above, it is shown the European issuance by collateral in the period starting 2014 ending 2018. The higher issuance activity in this timeframe is mainly due to Residential Mortgage Backed Securities (RMBS) and ABSs. Collateralized Debt Obligations (CDO), Collateralized Loan Obligations (CLO) and Small Medium Enterprise (SME) show positive momentum, this trend can be partially attributed to the NPLs securitization, heavily performed by banks to deleverage their balance sheet exposures. It is curious to note that Italy, as of 2017, was the main country in the EU to securitize NPLs<sup>11</sup>.

#### **Table 1.8 US Issuance by Collateral**

Data expressed in €Billion.

<sup>11</sup> Bergman, D. (2017). "NPL Securitisations: Italy continues to be the Main Market".



Source: AFME (2018, 2017, 2016, 2015)

During the same reference period, the US issuance composition differs a lot from the European one, here most secured assets are represented by Agency MBS, opposed to the EU, where RMBS account only for a residual part of the total issuance. The results of this outcome can be addressed to the role played by GSEs in the US. ABSs issuance remains stable and overall also in Non-Agency backed securities it is shown a positive issuance trend.

## 1.4 Securitization contribution to the Financial Crisis

Securitization is believed by many to be at the onset of the financial crisis in the US. While EU securitizations performed well overall, the crisis revealed flaws in the way securitization is regulated and supervised. (Dombrovskis, V., European Commission)<sup>12</sup>.

As it is already pointed out in the previous pages, Securitization without doubts shows some degree of correlation in triggering the Great Financial Crisis (GFC) started in 2007. Although the aim of this research has little to do with investigating the GFC, however, it

<sup>12</sup> Flunker, A., Dr Schlösser, T. & Weber, A. (2018). "The Securitisation Regulation and the CRR Amendments", Deloitte.

is considered important to lay down some of the matters which contributed to the financial instability withstand during and after the crisis.

The overall Securitization activity experienced an incredible flourishing period by the turn of the century, looking at table 6, it is easy to verify the strong pace at which the issuance growth in that period. It is important to highlight that not every type of securitized assets performed poorly during the GFC and its aftermath, in fact, several securitized asset classes left a solid track record of performance. Examples are provided by a lower default rate of Securitized mortgages in Italy with respect to not Securitized ones, European RMBS which outperformed most of European sovereign debt, bank debt and bonds during the tumultuous of 2011<sup>13</sup>. Hence, conclusions among the role played by securitization should be interpreted with caution and evaluated in their reference context.

A myriad of factors contributed to unwind the GFC, among those securitization does not appear to lead the chain, nonetheless a lack of supervision along with misaligned incentives contributed to create an unstable financial environment especially in the US.

At the rise of the century, government programs in the US promoting home ownership pushed loan origination toward high risk subprime clients<sup>14</sup>. Poor loan origination practices, led by a system of misaligned incentives reliant on origination volumes fees, have been reinforced by the adoption of the originate-and-distribute model: the loan originator did not bear the credit risk of subprime products thanks to the transferring of such to the market allowed by Securitization. That credit risk, bundled in structured product, was then evaluated by Credit Rating Agencies (CRAs) as S&P, Moody's and Fitch. At this point of the origination chain, some more pitfalls arose: again, misaligned incentives among CRAs, whose profits in the period were mainly driven by rating structured products, worked closely with originators of structured securities to

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<sup>13</sup> Segoviano, M. et al. (2013). "Securitization: Lessons Learned and the Road Ahead", IMF.

<sup>14</sup>Taylor, J.B. (2008). "The Financial Crisis and the Policy Responses: An Empirical Analysis of What Went Wrong", Bank of Canada.

manufactures highly rated investment grade products. Although the ratings assigned seemed legit at the time, research in the aftermath of the crisis has shown that models evaluating risk and its diversification properties were based on disconcerted assumptions. The investment community was heavily relying on CRAs, if it is added to the equation that investors were riding the accommodating monetary policy stance by exploiting the impressive amount of leverage that SIV and Asset Backed Commercial Paper (ABCP) conduits allowed for<sup>15</sup>, the financial crisis receipt was complete and ready to roll out.

## **1.5 Regulatory response**

During the decade following the GFC regulators did tons of work to reassure financial markets and establish back the loss of confidence which permeated investors there since. Trying to enhance the soundness of financial institutions, the first response enacted is the establishment in 2010-2011 of the Basel III regulatory framework. The effects of these reforms, along with other measures, pushed the brakes of the European Securitization market. However, the outcomes led to the realization that a high-quality securitization, sided by a proper functioning ABS market was needed and could expand credit facilities in the European economy up to €150 billion.<sup>16</sup>

Aiming at revitalizing the European Securitization market, the European Central Bank (ECB), the European Banking Authority (EBA), the Bank for International Settlement (BIS) European Commission and other advisors, worked closely to propose a new Securitization framework beneficial both for the originators and the investors, with the objective of distinguishing high-quality securitization in a Simple, Transparent and Standardized (STS) manner. These aspects have been concretely laid in Regulation (EU) 2017/2042 (Securitization Regulation) and Regulation (EU) 2017/2041 (CRR

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<sup>15</sup> Segoviano, M., Jones, B., Lindner, P. & Blankenheim J. (2013). "Securitization: Lessons Learned and the Road Ahead", IMF.

<sup>16</sup> Flunker, A., Dr Schlösser, T. & Weber, A. (2018). "The Securitisation Regulation and the CRR Amendments", Deloitte.

Amendments) which came into force from January 1<sup>st</sup>, 2019, while, for Synthetic securitization the negotiations are still open.

According to the purpose of this paper, the features leading to STS securitization of these regulations will be presented thereafter.

Broadly speaking, to receive the quality trade mark of “STS”, the securitization process and the parties involved must meet the requirements laid in Regulation (EU) 2017/2402. The criteria leading to STS high quality securitization imply that the underlying asset and its resulting cash flows to be as simple as possible, and the information journey must be fully transparent and comparable.<sup>17</sup>

Among all the regulation set:

Securitization Special Purpose Entities (SSPEs) to be located within the European Union (Article 4).

An enhanced framework of transparency requirements to better inform investors (Article 7), sided by the introduction of a securitization repository, a legal entity authorized by European Securities and Market Authority (ESMA) with the purpose of gathering, collecting and granting availability of securitization data to the public through the ESMA website (Articles 10 – 17).

It is imposed a fundamental ban on re-securitization with some exceptions (Article 8).

New criteria for credit granting are established, loans for residential properties cannot be securitized anymore (Article 9).

Requirements for STS securitization are laid out (Articles 18 – 28), among all, those encompasses a distinction between long term transactions and short term – Asset Backed Commercial Paper (ABCP) transactions. EU is set to be the location where originator, sponsor, and conduit are established. Originator and sponsor are liable of notifying that STS criteria are met to the ESMA which will publish the list of notified securitizations

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<sup>17</sup> EBA (2014). “Discussion paper on simple standard and transparent securitisation”.

online. An authorized third party shall aid in verifying that the compliance with STS criteria is fulfilled, such third party is subject to certain conditions, as it cannot be neither a regulated financial institution nor a CRA.

Supervisory, investigatory and sanctioning powers will be designated by EU Member States within one year (Articles 29 – 37).

The above presented regulatory framework<sup>18</sup> it is aimed at insuring a proper contribution of securitization to the European economy, identifying and differentiating high quality securitization under the STS umbrella.

Along with Regulation (EU) 2017/2042, has been published Regulation (EU) 2017/2041 amending the capital requirements (CRR) a financial institution must meet to participate in securitization activities. The amendments to the CRR came into force in January 1<sup>st</sup>, 2019<sup>19</sup>. A new hierarchy of methods it is introduced to calculate the risk-weighted exposure for securitized positions: at the top it is positioned the securitization internal rating-based approach (SEC-IRBA) aimed at reducing reliance on external assessment; if the SEC-IRBA is not applicable it should be adopted the standardised approach (SEC-SA), otherwise it can be applied the external rating-based approach (SEC-ERBA). If the inferred or external rating is not applicable, hence no one of the three approaches holds, the maximum risk weight of 1,250% in the calculation of the risk weighted assets (RWA) is conceived<sup>20</sup>. The hierarchy is presented in the table below.

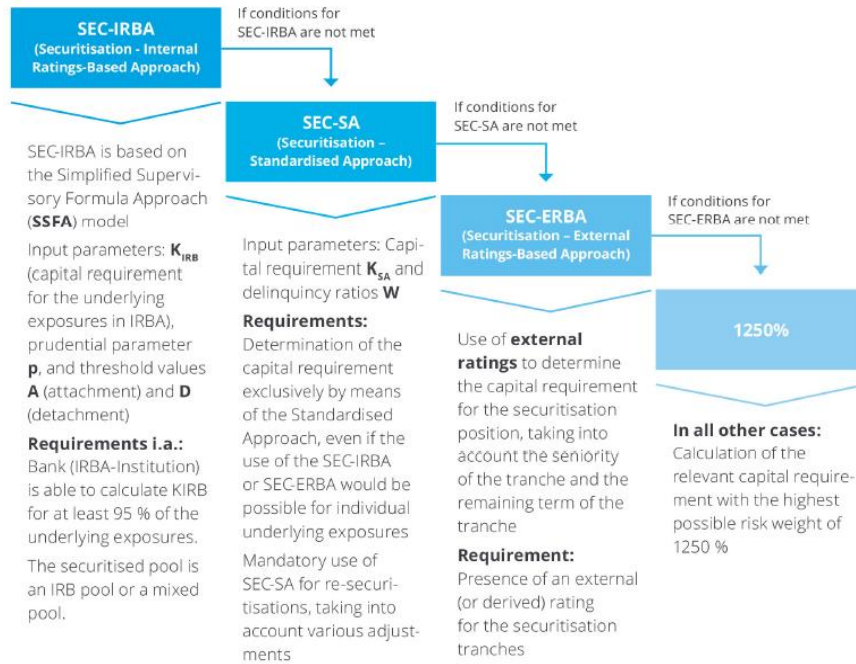
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<sup>18</sup> Regulation (EU) 2017/2042.

<sup>19</sup> Regulation (EU) 2017/2041.

<sup>20</sup> Flunker, A., Dr Schlösser, T. & Weber, A. (2018). “The Securitisation Regulation and the CRR Amendments”, Deloitte.

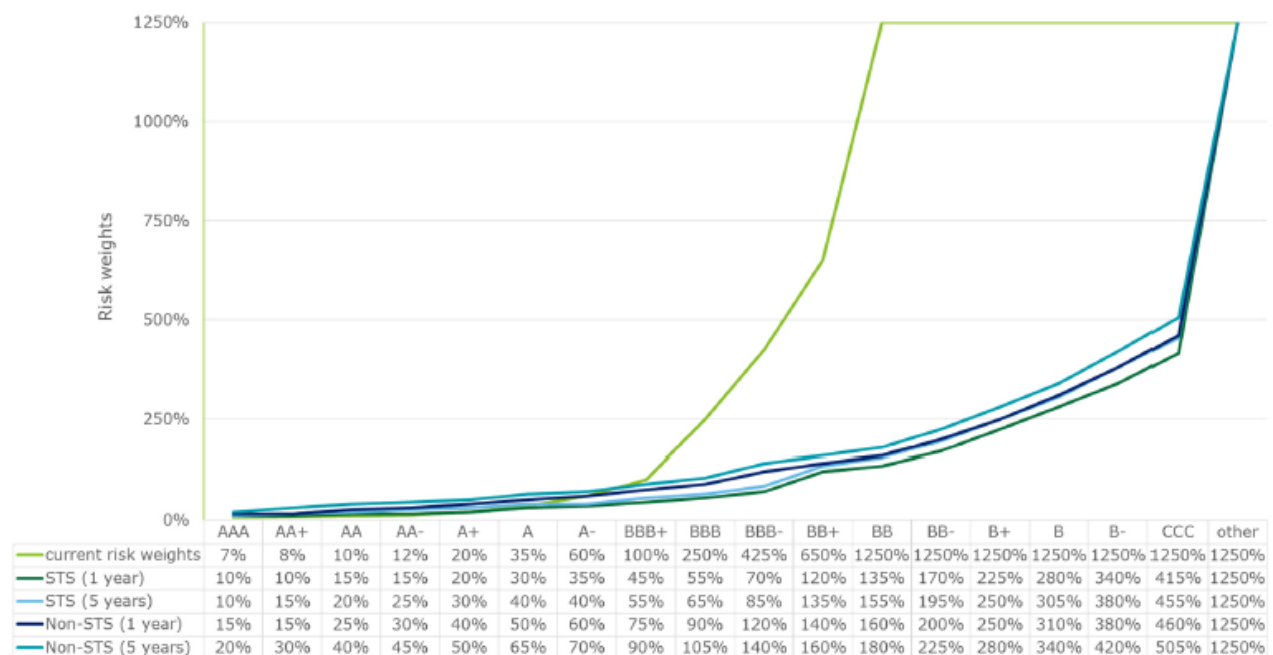
**Table 1.9 – Securitization risk weight approaches hierarchy**



Source: Flunker, A., Dr Schlösser, T. & Weber, A. (2018). “The Securitisation Regulation and the CRR Amendments.” Deloitte

Because SEC-IRBA and SEC-SA are based on internal estimations, for comparison’s purposes it will be analysed the effect of the CRR on the SEC-ERBA thanks to its standardization, desirable or not, based on external assessment.

**Table 1.10 – Ex ante and ex post 2017/2041 regulation SEC-ERBA risk weights**



Source: Flunker, A., Dr Schlösser, T. & Weber, A. (2018). “The Securitisation Regulation and the CRR Amendments”, Deloitte

In the figure above are presented STS and Non-STS risk weights with respect to credit ratings, it is important to specify that the green line denominated “current risk weight” shows the risk weights before the regulation came into force as the research from which the figure is retrieved was published prior to January 2019. It is easy to see from the figure that the impact of amendments has increased the floor weights for AAA securities of 3 p.p. but eased the requirements from A+ ratings onward. Further, incentives for STS securitization are ruled in form of lower risk weight for such securities with respect to Non-STS of the same maturity. The maximum risk weighted capital requirement is set at 1,250%.

At this point of the research, the puzzle figuring why securitization exists starts to be clearer. As already illustrated in the precedent pages, securitization as proven itself as a powerful tool capable, if used in a simple, transparent and regulated environment, to bring several advantages to the economy.

It enables the trading of assets before bounded out of capital markets, hence, enhancing their liquidity. It expands the credit facilities and the investment opportunities in certain

sectors, as we have seen with European RMBS, contributing to the growth and development of such, and provide alternative investments outperforming several major credit asset classes. Considering the new STS and CRR framework, securitization could bring solid diversification possibilities for regulated financial institutions, thus paving the way to further develop their central role in our economy amid stringent overall regulations and challenging business cycles.

Once understood the features and the positive impacts implied by Securitization, the aim of this paper hinges upon finding a way to expand credit facilities to the farming industry employing Securitization. In the next chapter will be proposed an unconventional collateral not exploited hitherto and the potential market arising from it.

# Chapter 2 – The Cow backed securities

## 2.1 Cow Backed Securities collateral proposal

The aim of this paper is to show that exist some unconventional collateral assets which have not been a subject of interest in the securitization market yet, probably due to their non-financial characteristics, but still eligible to be securitized following the assumptions founding securitization highlighted in the previous chapter.

Centuries ago, before capitalism imposed itself as the main productive base mechanism, nature was the principal factor in the production process, an example of its magnitude can be retrieved in the “Tableau Economique”<sup>21</sup> which define the primary role of nature and its ability to generate what at the time were the mostly traded goods, e.g. foods. At this point it arises spontaneously to ask how nature can be linked to securitization, the answer it is found in the intrinsic power that nature harnessed to some alive creatures, in our case: cows.

Although it has been already stated, it is noteworthy to remind that any asset producing a cash flow is eligible for securitization<sup>22</sup>.

Here, the basic idea hinges on performing a securitization using cows as collateral, which, at first sight, it may not be straightforward, so it will be show how this can be made possible and why it has been opted for cows among the universe of eligible collaterals.

First, it must be defined which is the effective collateral of the whole securitization process: this is not represented by the market value arising from the sale of the cow, in fact, similar transactions have been implemented since 2000 in Colombia through the issuance of livestock-backed securities where the credit origination was used to feed the

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<sup>21</sup> R.L., Meek (1963). “The economics of Physiocracy”.

<sup>22</sup> Caselli, S. & Gatti, S. (2005). “Structured Finance Techniques, Products and Markets”.

cattle<sup>23</sup>. Further evidence of structured finance applications in the agricultural and farming business arises in some developing countries, which started to adopt this financing tool in lieu of conventional credit supply such as loans, grants etc... mostly due to the lack of collaterals necessary to fulfil the traditional lenders' requirements. Examples of the adoption of collaterals beyond the financial assets sphere can be found in the African countries of Zimbabwe, Nigeria, Ghana, and Malawi which pledged livestock to finance their working capital needs<sup>24</sup>. Before structured finance has been applied in farming, there is some evidence showing the positive impact of these instruments on small-scale businesses in the agriculture sector<sup>25</sup>.

Here, regarding the Cow-Backed Security model that this thesis sought to develop, the collateral is represented by the future cash flows produced by the cows, e.g. the milk production revenues stream. As will be highlighted in the next chapter, the production cycle (cash flows) of a cow is very stable and predictable, a characteristic that through securitization could lead to a very low risk product, beneficial not only to the farmer as a cheaper cost of capital but also to investors looking to enhance the diversification of their portfolios.

To make this assumption work it is necessary to rely on future flow securitization, a tool widely used in financing projects such as railways, toll roads, public utilities, airline businesses, communication infrastructures etc...<sup>26</sup> The concept of future flow securitization derived by the cows' production is detailed in the following figure.

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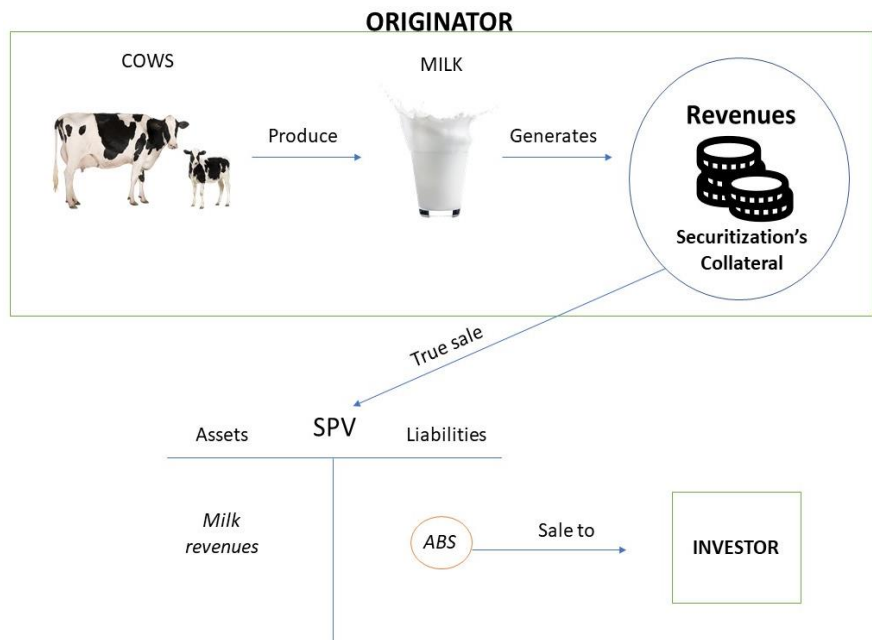
<sup>23</sup> Winn, M., Miller, C. & Gegenbauer, I. (2009). "The use of Structured Finance instruments in agriculture in Eastern Europe and Central Asia", FAO, Rome, IT.

<sup>24</sup> Hawkins, T., Cotteril, J. (2017) "Zimbabwe to allow goats, cows and sheep as bank collateral" Financial Times.

<sup>25</sup> Njovo, M., Caroliny, M. (2014). "Analysing the Role of Structured Finance on Productivity and Livelihoods of Small-Scale Farmers in Zimbabwe", European Journal of Business and Management.

<sup>26</sup> Japan Credit Agency (2016). "Future Flow Securitization".

**Table 2.1 Cow Backed Securities Mechanism**



*Source: Author*

The process starts with the originator, in this case a farmer, who is willing to raise some liquidity. Future flow securitization comes in support of his financing needs. Through a true sale of assets, the farmer sells the future revenues which will be produced by his cows' livestock to a Special Purpose Vehicle (SPV) which pays in cash the farmer, thus providing liquidity. To finance the acquisition of the farmer assets (future cash flows), the SPV issues claims on those assets, hence, it originates ABSs which are sold to investors in the capital markets. Securitization occurred and going forward, depending on the agreed terms of the contracts, each part will satisfy their obligations: the originator will transfer the revenues to the SPV and the SPV will pay interests on its debt to investors until maturity.

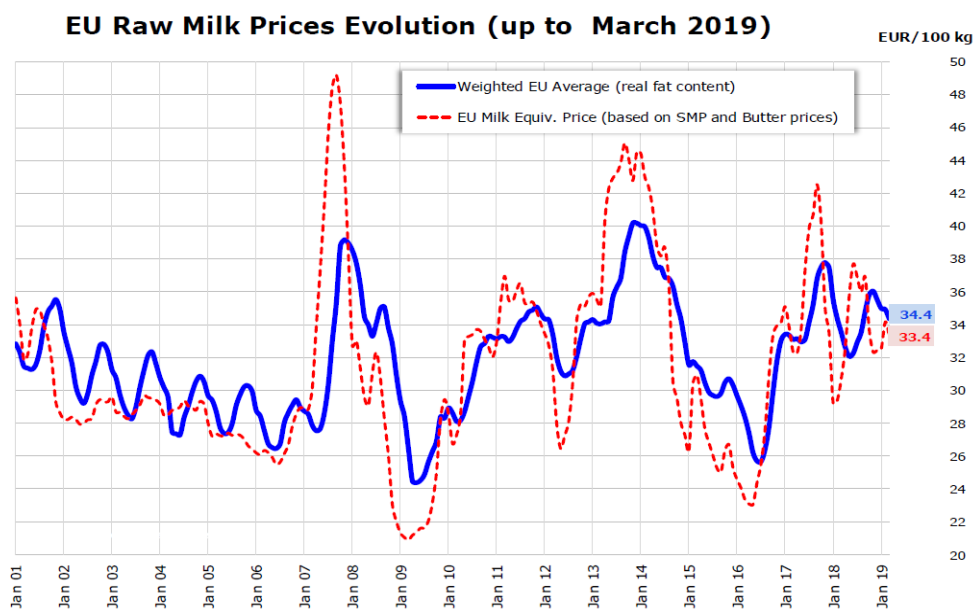
So far, it has been shown how an exotic collateral such as the cow could power the securitization mechanism, to understand the gains such product could deliver an economic analysis along with market estimations will be provided.

## 2.2 The Milk Market

Given that milk represent the main revenue stream arising from cow's production, it takes a central stage in this dissertation. Thus, is deemed necessary to analyse recent developments in the milk and cheese markets.

Following the path by the end of the year, in 2019 the milk and cheese market is experiencing a tailwind start particularly due to a strong rise in global demand for the commodity. Milk and its derivative disclosed a solid growth driven especially by Chinese demand which paved an increase both to its prices and to cheese ones. The following figure shows the prices' history in the last two decades.

**Table 2.2 Milk Prices**



*Source: European Commission*

During the period highlighted in the above figure, milk prices, which are mainly driven by annual production, experienced periods of increase and decrease with a tendency toward the mean, indeed, although several swings occurred, 2019 prices are just above the 2001 ones defining an overall positive trend which sees a single digit appreciation. At first glance, major oscillations lasted on average 5 years: if it is assumed 2002 as starting

point with a 5 years frequency, ending period prices oscillated in the range of lower double digit. Further research should be performed on prices and productions to better define their impact on the final securitized structures.

In 2018, EU exports of butter decreased (-8% respect to 2017) followed by whole milk powder (-14%) while cheese ones remained stable, the contraction was partially due to the lower Chinese demand that shifted upon the New Zealand products and lower north African consumption<sup>27</sup>.

Instead, since the start of 2019 the exports trends registered are positive both for skimmed milk powder (+37%) and cheese (+7%)<sup>28</sup>.

The tables below show the export of milk and derivatives from the EU.

**Table 2.3 Milk derivatives exports**

BUTTER				SKIMMED MILK POWDER			
tons	2017	2018	var.%	tons	2017	2018	var.%
EXTRA EU	171,396	158,353	-8%	EXTRA EU	779,825	821,521	5%
US	27,569	28,733	4%	Algeria	132,738	143,264	8%
Saudi Arabia	13,990	14,656	5%	China	71,066	91,910	29%
Cina	13,428	10,024	-25%	Indonesia	58,827	56,208	-4%

CHEESE				WHOLE MILK POWDER			
tons	2017	2018	var.%	tons	2017	2018	var.%
EXTRA EU	828,574	832,499	0%	EXTRA EU	382,786	328,363	-14%
US	140,684	133,621	-5%	Oman	41,660	48,438	16%
Japan	94,786	106,585	12%	Algeria	63,869	26,353	-59%
Switzerland	60,229	61,645	2%	China	19,206	19,013	-1%

Source: ISMEA

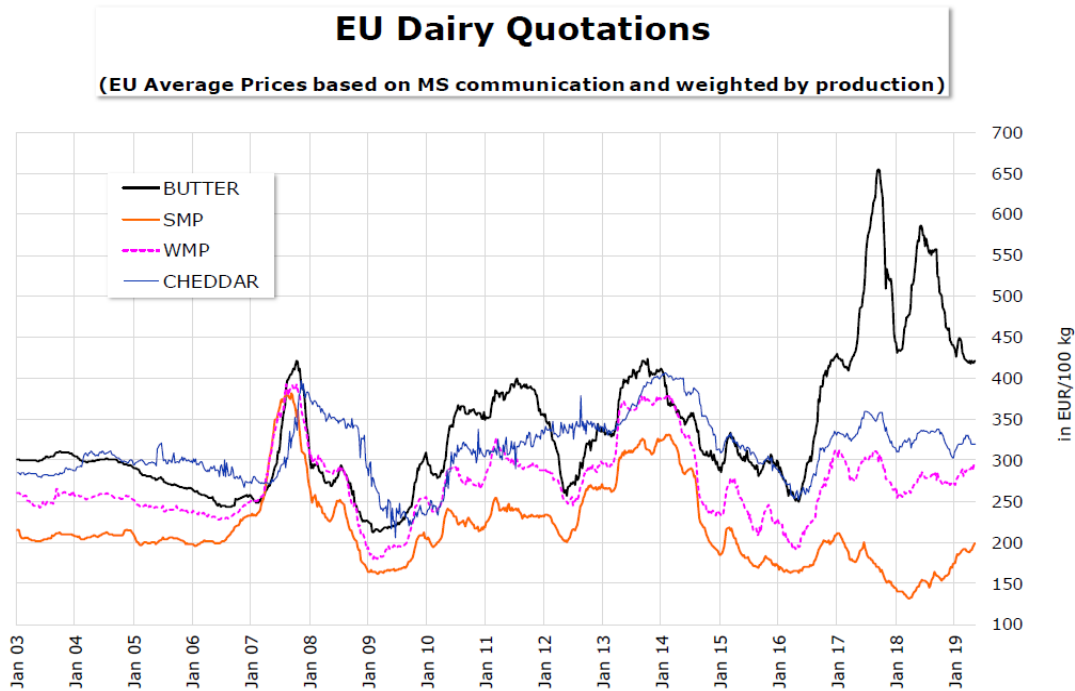
Because the Cow Backed Securities are by construction influenced by milk prices, a closer look to the latter it is necessary to start inferring about those products' riskiness.

<sup>27</sup> Ismea (2019). "Settore lattiero caseario".

<sup>28</sup> Ismea (2019). "Settore lattiero caseario".

So, in the following figure it is provided the prices' evolution of butter, milk powders and cheddar which offers a proxy for worldwide cheese demand.

**Table 2.4 Milk Derivatives Prices**

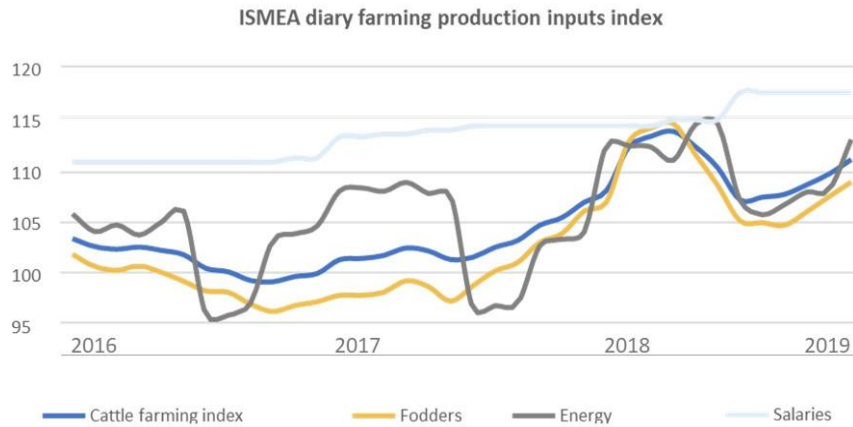


*Source: European Commission*

Analysing the graph can be seen that butter price is now consolidating after the sharp swing of the last year. Except of skimmed milk prices trending positive with respect to the start of 2018, whole milk powder and cheddar prices remain in line with the precedent 2 years. Overall the situation is smooth and does not show any variable particularly volatile, this finding could benefit the risk assessment of the end structured product, hence a better credit rating.

To understand the situation of the production side, a figure showing a farming cost index and the main factor of production adopted by a farm it is provided below.

**Table 2.5 Inputs cost index**



*Source: ISMEA*

Observing the blue line, which represents the overall cost to cattle farming, a positive trend is delineated: inputs are becoming more expensive at different pace, salaries are the slowest one, opposed to the fast-rising energy and fodders.

Considering the stable price trends previously highlighted and the increasing production costs, it is clear that the farming industry is moving toward a situation where profit margins will decrease year over years unless a technological breakthrough will enhance productivity. Nonetheless, a technology shift will require appropriate capital resources which may not be available due to the profit squeeze firms are facing. It is in this context that the Cow Backed Securities (CBS) poses itself as a beneficial tool to farmers whom may require liquidity to improve their productivity, e.g. investing in renewable energy plants to cut energy costs and promote a sustainable business growth, adopt business and farming practises to enhance their products quality.

So far, prices and productions behaviours have been analysed, but how large could the CBS market be estimated in monetary terms?

To answer this question, simple calculations will be performed to estimate the total revenues amount eligible for securitization. Given the broad array of milk manufactured products it is assumed that: the calculations refer only to a simplified scenario where all

the milk produced it is sold in form of raw milk (nowadays the share of whole milk processed by dairies and sold as drinking milk is about 1/10 of the total<sup>29</sup>) at a price calculated as the last 3 years average of the December weighted average EU-28 price, and the total production calculated as the last 3 years average aggregate EU production. Following the assumptions, it is easy to see the result will underestimate the aggregate value because cheese and milk derivatives are characterized by higher prices than the raw commodity and account for 9/10 of dairies production, however, this thesis is intended to show the potential that could arise from the CBS application, hence a very conservative approach targeting raw milk it is adopted. Both production and price levels are provided in the following tables.

**Table 2.6 Aggregate EU-28 Raw cows' milk delivered to dairies ('000 tons)**

2016	2017	2018
153,171	156,067	157,416

*Source: CLAL*

Last 3 years aggregate production average:

$$\frac{153,171+156,067+157,416}{3} = 155,551 \text{ ('000 tons)}$$

**Table 2.7 EU-28 December weighted average price €/100kg**

2016	2017	2018
33.06	37.48	35.54

*Source: European Commission (2019). "Milk Market Observatory".*

Last 3 years average price:

$$\frac{33.06+37.48+35.54}{3} = 35.36 \text{ €/100kg}$$

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<sup>29</sup> Eurostat (2018). "Agriculture, forestry and fishery statistics".

The total revenues amount it is given by: Price \* Quantity.

$$0.3536 * 155,551 \text{ ('000 tons)} = 55,002,833,600\text{€}$$

According to the calculations, revenues deriving from the sole EU-28 raw milk sale are about 55 €billion, thus pledging 100% of these revenues to securitization could generate an equal amount of new issuance, CBS application could create a market worth 55 €billion.

### **2.3 Gains arising from CBS securitization**

According to the preliminary estimations presented above, the estimated maximum of 55 €billion of milk revenues could be eligible to undergo the CBS securitization. Comparing this amount with the 2018 EU securitization issuance, which stood at 269 €billion (see table 1.7), CBS securitization could expand the total EU securitization market by 20.44%.

With regards to credit facilities to the farming industry, a total of 57.2 €billion of capital have been invested across Europe in 2017<sup>30</sup>, thus an expansion of credit up to 55 €billion would mean almost doubling the current capital investments.

Since these findings show strong effects compared to current market's levels, it is important to note that the calculations are based on assumption which could be challenged either negatively lowering the estimates, or positively increasing the estimated results, further research it is needed to provide more accurate estimations. Moreover, under the originator point of view, it would not always be rational to securitize 100% of yearly revenues, in fact, the undertakings should choose an economically efficient share of revenues evaluated case by case. However, considering the conservative effect of the milk only sale assumption and a lower share of securitized revenues, the expected impact of CBS is still in the scale of billion.

From the intermediary point of view, conduits and SPVs could, accordingly, cash in million euros of commissions for structuring the deals, gains which can be magnified if it

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<sup>30</sup> Eurostat (2018). "Agriculture, forestry and fishery statistics".

is accounted the effect of leverage these investment vehicles are subject. More will be presented in the next chapter.

### 2.3.1 Diversification opportunities

Diving in the investors point of view, the benefits arising from holding and trading CBSs could be even more appealing. The availability of a new financial asset on the market could capture the demands of different players with specific risk appetites. Indeed, it is believed that strong gains could arise thanks to the diversification features deriving from the nature of the underlying asset. An example can be the retrieved in the risk exposure diversification of a financial institution Risk Weighted Assets (RWA) in light of the new STS securitization framework. Moreover, what it is considered to be the main advantage is the weak correlation between such underlying asset (milk) and the financial markets, several diversification possibilities could emerge if the hypothesis is validated. To prove its validity are performed two linear regressions plotting the EU-28 milk prices against the FTSE MIB and the DAX30: the choice of the benchmarks is not aleatory, it is believed these offer a good proxy for inferring about the correlation showed within the European economy because the Italian and German aggregate milk production has been around 30% of the EU-28 total<sup>31</sup>.

The econometric model adopted for the purpose is a linear regression where the Y variable represents the milk prices and the X variable represents the indexes:

$$(A) \quad Y_{MILK} = a + \beta_A X_{DAX30} + e$$

$$(B) \quad Y_{MILK} = a + \beta_B X_{FTSEMIB} + e$$

The data set analysed is composed by 169 observations, with monthly frequency, disclosing the closing price of the variables. The reference period starts on January 2003

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<sup>31</sup> CLAL, (2019). "EU-28: milk production and population".  
[https://www.clal.it/en/?section=produzioni\\_popolazione](https://www.clal.it/en/?section=produzioni_popolazione)

and ends on April 2019. All the data can be found in the Appendix. The output is provided below.

#### Output (A):

Regression statistics					
R multiple	0.437943775				
R <sup>2</sup>	0.19179475				
Adjusted R <sup>2</sup>	0.187628743				
Standard error	3.28486455				
Observations	196				

Variance analysis					
	df	SS	MS	F	Significance F
Regression	1	496.7658236	496.7658236	46.03803484	1.37018E-10
Residuals	194	2093.325011	10.79033511		
Total	195	2590.090835			

	Coefficients	Standard error	t-stat	p-value	Lower 95%	Upper 95%
Intercept	27.62207416	0.667080375	41.40741533	2.94103E-98	26.3064132	28.93773513
Variable X 1 (DAX30)	0.000557613	8.21816E-05	6.785133369	1.37018E-10	0.000395529	0.000719698

#### Output (B):

Regression statistics					
R multiple	0.233764289				
R <sup>2</sup>	0.054645743				
Adjusted R <sup>2</sup>	0.049772783				
Standard error	3.552662278				
Observations	196				

Variance analysis					
	df	SS	MS	F	Significance F
Regression	1	141.5374381	141.5374381	11.21407564	0.000975233
Residuals	194	2448.553397	12.62140926		
Total	195	2590.090835			

	Coefficients	Standard error	t-stat	p-value	Lower 95%	Upper 95%
Intercept	34.59068386	0.854270178	40.49150344	1.44079E-96	32.90583452	36.27553319
Variable X 1 (FTSEMIB)	-0.000113013	3.37479E-05	-3.348742397	0.000975233	-0.000179573	-4.64532E-05

Source: Author.

The hypothesis testing for correlation are presented thereafter:

$$(A) H_0: \beta_A = 0; H_a: \beta_A \neq 0$$

$$(B) H_0: \beta_B = 0; H_a: \beta_B \neq 0$$

In both tests the null hypothesis implies no correlation and the alternative hypothesis, on contrary, implies that correlation exists.

The level of significance chosen is 95% so the t-critical value from t-distribution with  $n - k - 1$  degrees of freedom is  $1.960 \leq t_c \leq 1.984$

The t-statistic are respectively:

(A)  $T\text{-stat} = 6.78$

(B)  $T\text{-stat} = -3.35$

Given both (A) and (B)  $t\text{-stat} > |t_c|$ , both  $H_0$  are rejected, hence there exist correlation.

(A) Milk prices and the DAX30 correlation coefficient is 0.44 and the model has an  $R^2 = 0.192$ .

(B) Milk prices and the FTSEMIB correlation coefficient is  $-0.23$  and the model has an  $R^2 = 0.055$ .

Although the presence of correlation at first sight could be detrimental for diversification purposes, the findings show that the degrees to which milk prices are correlated with the chosen benchmark indexes are very low in case A and even negative in case B.

Moreover, it is important to highlight that the low levels of  $R^2$  arising from the regression are probably due to omitted variable bias. Since the aim of this thesis is to show viable applications of the CBSs, it would not be analysed more in depth the behaviour of milk prices, however, further research could address this topic to provide more detailed info on the interaction among prices constituents.

Drawing preliminary conclusions, it has been shown that CBS applications could expand credit facilities to the farming industry up to 55 €billion, consequently enlarging the EU securitization market by 20%. Furthermore, the CBS could drive the demand of financial players appealed by the diversification features arising from the weak correlation with capital markets. In the next chapter will be proposed a case study aimed at providing a preliminary guidance on pricing, risk and contracting considerations.

# Chapter 3 - CBS case study

So far, it has been presented the economic framework around CBSs and the estimated contributions in fostering growth and allowing different parties to fulfil their financial needs across the value chain. As the broad picture has been laid out, it is time to investigate closely a viable application. The aim of this chapter is to define the foundations for future deals.

## 3.1 Assumptions

Since the fundamental assumption of securitization hinges on cash flow generation, in trying to provide a pricing method suitable to the CBSs it has been decided to rely on the most widespread concept in finance: discounted cash flows (DCF) and present value. The composition and granularity of cash flows arising from milk revenues is going to be analyzed.

When the heifer, a young cow, has reached 2 years of age is ready undergo the breeding process which could be either artificial or natural depending on farmer vision. After 9 months, it calves and then starts the lactation cycle which will last for 10 months on average, after which it will be subject to a dry period without lactation and then ready to start the cycle back again.<sup>32</sup>

To isolate the effective production cycle, matter of farming practices, from the revenue stream of milk sales, going forward it will be relied on the average yearly production per cow. In Italy, the average production in 2016 has been 6,326 kg of milk per cow<sup>33</sup>.

Making an effort to simplify as much as possible the analysis of the CBS, it is opted for a yearly cash flow. Given the various undertakings' financial needs and preferences each

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<sup>32</sup> Vet in Training (2018). "Life cycle and lactation cycle in dairy cows".

<http://vetstudentresearch.blogspot.com/2015/06/life-cycle-and-lactation-cycle-of-dairy.html>

<sup>33</sup> TESEO CLAL, (2016) "EU-28 Produzione media per vacca". [https://teseo.clal.it/?section=vacche\\_italia](https://teseo.clal.it/?section=vacche_italia)

case could be different. In this case study it will be considered a situation in which a farmer is willing to securitize the next 3 years revenues arising from milk sales.

It is hypothesized that the farmer can count on a livestock composed by 200 productive cows in perfect health status.

It is assumed that markets are efficient, frictionless and lacking transaction costs.

### 3.2 Collateral Valuation

To estimate the potential availability of credit generated by the financial value of the CBS' collateral, future milk revenues are discounted to present value, in doing so it is adopted the following formula:

$$PV = \sum_{i=1}^n E(\text{MilkRevenues})_i * \frac{1}{(1+r)^i}$$

Where  $E(\text{MilkRevenues})_i$  stands for expected milk revenues at year  $i$  calculated using the price already adopted in section 2.2 and one Italian cow average yearly production  $Q_m$ , according to the formula:

$$E(\text{MilkRevenues})_i = P_i * Q_m$$

Assuming a price of 0.3536 €/kg and the average yearly production  $Q_m$  of 6,326 Kg:

$$E(\text{MilkRevenues})_i = 0.3536 * 6,326 = 2236.874 \text{ €}$$

The interest rate chosen is 10%.

Following the assumptions, the time spans 3 years hence:

$$PV = \sum_{i=1}^3 2236.874 * \frac{1}{(1+10\%)^i} = 5,562.774$$

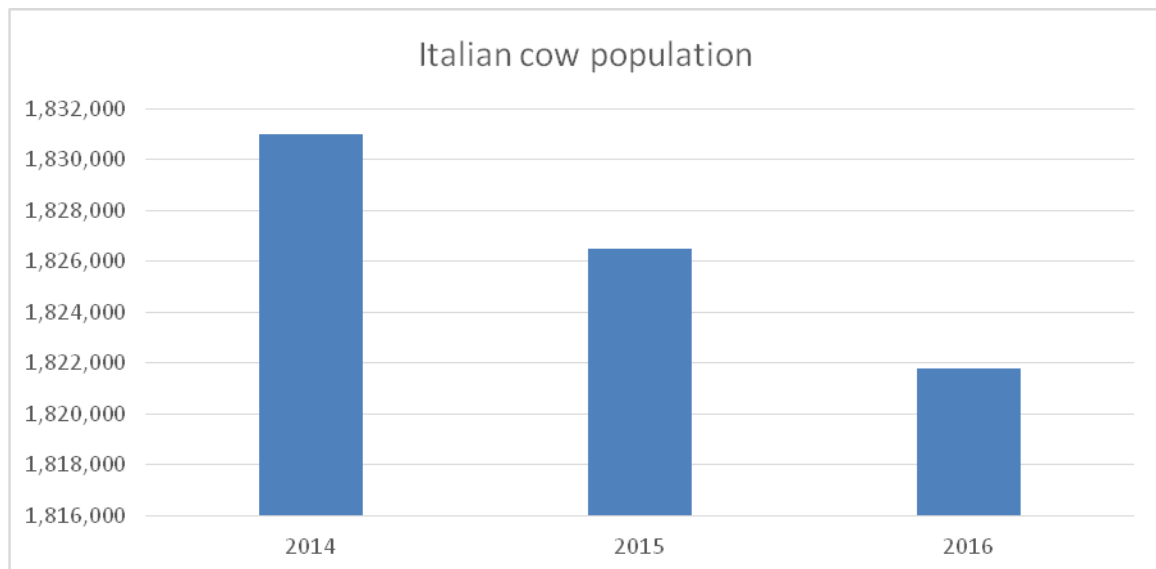
According to the estimate, a single cow cash flow over 3 years it is worth 5,562.774 €.

The farmer owning 200 cows by selling all the cash flows for the upcoming 3 years could originate as much as 1,112,554.71 €. As already stated, it would not be rational to securitize all cash flow because on one hand leverage could become unsustainable and on the other no diversification within the livestock can be performed.

### 3.3 Collateral risk

It is fundamental to investigate the risk of default to which a livestock is subject given that the underlying assets features will impact the CBS at a financial level shaping a risk profile. Given the collateral is generated by a living creature, it is assumed that the mortality risk can be intended in financial terms as the default rate, hence at macro level it is analyzed the change in the Italian cow population. It is presented below a graph with the population stock during the 2014 -2016 triennium, a 3 years period is chosen to be consistent with the valuation reference period previously adopted.

**Table 3.1 Cow population developments in Italy**



*Source: CLAL.*

As it is evidenced a negative trend, during the period highlighted the cow population recorded a -0.5039% change. This finding points out the overall stability of cow population, probably due to its productive and breeding cycle characteristics, setting a low risk scenario associated with CBS. Considering the evolution of the population at macro level, it is assumed the yearly change in its stock can be applied at micro level to foresee the probability of default (mortality) of a single cow influencing its cash flow production.

To find the probability of default it adopted the following calculation:

$$PD = (\#pop_t - \#pop_{t+1}) / \#pop_t$$

Where  $\#pop_t$  stands for stock number of the population at year t.

The probability of default (PD) is calculated over the same reference period presented in the graph, averaging the estimated yearly PD in both years it comes out that the probability of default, thus the probability that next year the farmer will lose a cow is 0.0025.

It is now possible to calculate the expected loss in our scenario:

$$EL_t = EAD * PD * LGD_t$$

Where exposure at default (EAD) is represented by the #cows in the livestock:

$$EAD = 200$$

Loss given default (LGD) is the loss given a cow dies with probability PD, hence is the single cow contribution to the total in each year, so that in year 1 is:  $LGD = 2236.874 \text{ €}$  and in the next years is the above amount discounted at present value.

Thus, the expected loss is:

$$EL_1 = 200 * 2236.874 * 0.0025 = 1118.437 \text{ €};$$

$$EL_2 = 200 * (2236.874 / (1+10\%)) * 0.0025 = 1016.761 \text{ €}$$

$$EL_3 = 200 * (2236.874 / (1+10\%)^2) * 0.0025 = 924.328 \text{ €}$$

$$EL_{tot} = EL_1 + EL_2 + EL_3$$

$$EL_{tot} = 3,059.53 \text{ €}$$

Hence, the SPV should be structured to provide enough equity capital to absorb at least the expected losses predicted, in this scenario would imply a leverage of about 360x.

It must be noted that considering the mortality rate as default risk could underestimate the effect of other external variables not accounted therein such as country risk, economics outlook etc., further research should provide a more detailed approach in measuring all the contributions to overall risk, since then mortality rate it is believed could offer a good proxy.

As the finding concern the macro level, on micro scale the scenario would not diverge much from the former thanks to the intrinsic characteristic of farming, where milk production and reproduction converge.

Previously, it has been stressed the concept that securitizing 100% of milk revenues could turn detrimental for the farmer during moments of financial distress, indeed an appropriate level should be chosen case by case. Moreover, to benefit from diversification within a farm livestock and be consistent with the EL definition provided above, it is advocated that the amount of revenues pledged are not linked one to one with a designed cow, instead, these should be agreed in advance and concerning revenue amount. Fixing the expected amount upon contracting will avoid misaligned incentives to arise, causing the burden of default to shift on the farmer who pledged a determined amount at inception. The farmer will then bear all the risk for livestock management without transferring it to investors through capital markets.

Breaking down the risk composition, embedded in the collateral, one share would be determined by the risks derived from the milk market and the other share arising from the ability of the entrepreneurs (farmer) to fulfil his contractual obligation: in both cases the membership in a consortium such as the Parmigiano Reggiano one, would to some extent guarantees the quality of the production chain and reduce the exposure to market risk by the single party. Furthermore, to better assess the farming risk, advisors should rely on existing government agencies that investigate the field, or it could be established an ad hoc agency as in the case of Colombian livestock securitization<sup>34</sup>.

### **3.4 Contracting considerations**

Concluding the section, it emerged the need for developing a well-suited risk model which accounts for both market and farming risk to evaluate the appropriate yield to compensate investors, although primary findings have provided an overall low risk assessment which seems to be eligible for manufacturing investment grade securities, it should be born in mind that credit risk can still be enhanced thanks to the hedging possibility made available by synthetic securitization.

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<sup>34</sup> Winn, M., Miller, C. & Gegenbauer, I. (2009). “The use of Structured Finance instruments in agriculture in Eastern Europe and Central Asia”, FAO, Rome, IT.

So far, it has been presented the main features of a Cow Backed Security, but when it is time for a deal, the considerations go beyond the pure theoretical framework. Contracting parties in the real business world face constraints and operational costs. To understand if a CBS would be beneficial as theorized, a cost benefit analysis should be performed, accounting all the advisory costs involved in structuring this type of deals, to understand at which scale such financing option could become competitive among the universe of existing options.

Since the probability of default estimated for CBS is extremely low, a wide plateau of institutional and private investors could be appealed in sponsoring the product. However, it is believed that the involvement of national and local players such as regional cooperative banks or the veterinary pension fund (ENPAV is the Italian one) could build an environment of aligned incentives, aimed at pursuing on one side regional financial soundness and quality control enhancement on the other, avoiding falling in the vicious cycle already experienced with MBS in the US and pushing for a better and innovative farming sector.

# Conclusions

Securitization is a young industry far from its peak, throughout the years has proven to be a powerful tool capable of meeting the most disparate financial needs, both in advanced economies and developing ones: examples retrieved in African agricultural securitization and Latin America livestock securitization demonstrated a considerable contribution to finance production where usual financing options were not available cause of an underdeveloped financial and business environment. In western economies, structured finance and securitization are often deemed to be at the onset of the great financial crisis started in 2007, however, findings show that the overall structured products performance, especially in continental Europe, was above certain sovereign debt benchmarks. A different story can be told for US Agency MBS which concurred heavily in triggering financial instability in the US, mainly caused by a vicious feedback loop and poor business practises. Considered the versatility and the wide spectrum of applications provided by securitization, this thesis proposes the adoption of an unconventional collateral arising from the cow production aimed at manufacturing new marketable securities: The Cow Backed Securities (CBS). The impact generated by the origination of CBS has been estimated it could bring considerable credit facilities enhancements to the European farming sector, potentially doubling the current credit supply, and to the European securitization market, where it is forecasted a market expansion of about 20%. Along with credit expansion, primary estimations have shown there exist a weak correlation between CBS and the financial markets making the product very appetible for diversification purposes. Lastly, it is presented a CBS case study to analyse a viable application, although assessing all the risk remains an open challenge, a primary analysis has estimated the incredible low level of risks associated with the underlying asset, thanks to his productive and breeding cycle characteristics. Future contracting, especially for small scale farmers will mainly depend on CBS origination costs. In conclusion, this thesis has demonstrated there are available opportunities in the field of securitization and structured finance which have not been exploited yet. Those investment opportunities

could heavily contribute to the developments of financial markets promoting growth and innovation in a myriad of sector not already considered. It is hoped this paper could pave the way for further research.

# Appendix

Historical prices analysed in the correlation analysis in Section 2.3.1; *Source: European Commission (2019), Investing.com.*

Date	Milk EU-28 Price	DAX 30	FTSE MIB
Apr-19	34.52	12,344.08	21,881.33
Mar-19	34.39	11,526.04	21,286.13
Feb-19	34.94	11,515.64	20,659.46
Jan-19	35.02	11,173.10	19,730.78
Dec-18	35.54	10,558.96	18,324.03
Nov-18	36.07	11,257.24	19,188.97
Oct-18	35.83	11,447.51	19,050.22
Sep-18	34.83	12,246.73	20,711.70
Aug-18	33.57	12,364.06	20,269.47
Jul-18	32.94	12,805.50	22,215.69
Jun-18	32.27	12,306.00	21,626.27
May-18	32.09	12,604.89	21,784.18
Apr-18	32.66	12,612.11	23,979.37
Mar-18	33.57	12,096.73	22,411.15
Feb-18	34.41	12,435.85	22,607.61
Jan-18	35.56	13,189.48	23,507.06
Dec-17	37.48	12,917.64	21,853.34
Nov-17	37.80	13,023.98	22,368.29
Oct-17	37.53	13,229.57	22,793.69
Sep-17	36.83	12,828.86	22,696.32
Aug-17	35.25	12,055.84	21,670.02
Jul-17	34.17	12,118.25	21,486.91
Jun-17	33.13	12,325.12	20,584.23
May-17	32.97	12,615.06	20,731.68
Apr-17	33.17	12,438.01	20,609.16
Mar-17	33.12	12,312.87	20,492.94
Feb-17	33.38	11,834.41	18,913.28
Jan-17	33.44	11,535.31	18,590.73
Dec-16	33.06	11,481.06	19,234.58
Nov-16	31.84	10,640.30	16,930.41
Oct-16	29.93	10,665.01	17,125.05

Sep-16	27.82	10,511.02	16,401.00
Aug-16	26.42	10,592.69	16,943.38
Jul-16	25.68	10,337.50	16,846.86
Jun-16	25.71	9,680.09	16,197.78
May-16	26.22	10,262.74	18,025.25
Apr-16	27.40	10,038.97	18,600.56
Mar-16	28.35	9,965.51	18,116.88
Feb-16	29.07	9,495.40	17,623.07
Jan-16	29.69	9,798.11	18,657.29
Dec-15	30.33	10,743.01	21,418.37
Nov-15	30.72	11,382.23	22,717.98
Oct-15	30.49	10,850.14	22,442.51
Sep-15	29.84	9,660.44	21,294.98
Aug-15	29.64	10,259.46	21,941.92
Jul-15	29.71	11,308.99	23,538.03
Jun-15	29.90	10,944.97	22,460.71
May-15	30.48	11,413.82	23,495.68
Apr-15	31.24	11,454.38	23,045.52
Mar-15	31.50	11,966.17	23,157.12
Feb-15	31.77	11,401.66	22,337.79
Jan-15	31.57	10,694.32	20,503.38
Dec-14	32.95	9,805.55	19,011.96
Nov-14	34.36	9,980.85	20,014.82
Oct-14	35.27	9,326.87	19,783.99
Sep-14	36.36	9,474.30	20,892.11
Aug-14	36.84	9,470.17	20,450.49
Jul-14	36.92	9,407.48	20,570.80
Jun-14	37.51	9,833.07	21,283.03
May-14	37.51	9,943.27	21,629.71
Apr-14	38.20	9,603.23	21,783.38
Mar-14	39.31	9,555.91	21,691.92
Feb-14	39.99	9,692.08	20,442.41
Jan-14	40.06	9,306.48	19,418.34
Dec-13	40.21	9,552.16	18,967.71
Nov-13	40.21	9,405.30	19,021.48
Oct-13	39.40	9,033.92	19,351.52
Sep-13	38.44	8,594.40	17,434.86
Aug-13	36.86	8,103.15	16,682.21
Jul-13	36.31	8,275.97	16,482.35
Jun-13	35.68	7,959.22	15,239.28

May-13	34.25	8,348.84	17,214.08
Apr-13	34.19	7,913.71	16,767.66
Mar-13	34.07	7,795.31	15,338.72
Feb-13	34.11	7,741.70	15,921.25
Jan-13	34.33	7,776.05	17,439.06
Dec-12	34.19	7,612.39	16,273.38
Nov-12	34.07	7,405.50	15,808.24
Oct-12	33.16	7,260.63	15,539.71
Sep-12	32.08	7,216.15	15,095.84
Aug-12	31.24	6,970.79	15,100.48
Jul-12	31.02	6,772.26	13,890.99
Jun-12	30.90	6,416.28	14,274.37
May-12	31.19	6,264.38	12,873.84
Apr-12	32.04	6,761.19	14,592.34
Mar-12	33.45	6,946.83	15,980.07
Feb-12	34.32	6,856.08	16,351.41
Jan-12	34.36	6,458.91	15,828.05
Dec-11	34.69	5,898.35	15,089.74
Nov-11	35.10	6,088.84	15,268.66
Oct-11	34.91	6,141.34	16,017.73
Sep-11	34.79	5,502.02	14,836.33
Aug-11	34.39	5,784.85	15,563.20
Jul-11	34.23	7,158.77	18,433.68
Jun-11	33.79	7,376.24	20,186.94
May-11	33.25	7,293.69	21,109.75
Apr-11	32.99	7,514.46	22,417.96
Mar-11	33.27	7,041.31	21,727.44
Feb-11	33.30	7,272.32	22,466.57
Jan-11	33.16	7,077.48	22,050.45
Dec-10	33.25	6,914.19	20,173.29
Nov-10	33.31	6,688.49	19,105.71
Oct-10	32.88	6,601.37	21,450.61
Sep-10	32.67	6,229.02	20,505.20
Aug-10	31.74	5,925.22	19,734.57
Jul-10	30.59	6,147.97	21,021.56
Jun-10	29.64	5,965.52	19,311.75
May-10	28.73	5,964.33	19,543.97
Apr-10	28.18	6,135.70	21,562.48
Mar-10	28.13	6,153.55	22,847.97
Feb-10	28.63	5,598.46	21,068.32

Jan-10	28.94	5,608.79	21,896.29
Dec-09	28.31	5,957.43	23,248.39
Nov-09	28.40	5,625.95	21,928.16
Oct-09	26.92	5,414.96	22,060.33
Sep-09	26.30	5,675.16	23,472.73
Aug-09	25.66	5,464.61	22,420.43
Jul-09	24.89	5,332.14	20,575.52
Jun-09	24.53	4,808.64	19,063.12
May-09	24.39	4,940.82	19,884.00
Apr-09	24.48	4,769.45	19,177.00
Mar-09	26.47	4,084.76	15,875.00
Feb-09	28.42	3,843.74	15,282.00
Jan-09	29.37	4,338.35	17,934.00
Dec-08	30.92	4,810.20	19,460.00
Nov-08	32.80	4,669.44	19,985.00
Oct-08	33.82	4,987.97	21,367.00
Sep-08	35.09	5,831.02	25,530.00
Aug-08	35.01	6,422.30	28,789.00
Jul-08	34.11	6,479.56	28,331.00
Jun-08	33.32	6,418.32	29,346.00
May-08	34.00	7,096.79	33,225.00
Apr-08	34.51	6,948.82	33,954.00
Mar-08	36.40	6,534.97	31,616.00
Feb-08	37.76	6,748.13	33,587.00
Jan-08	38.54	6,851.75	34,230.00
Dec-07	39.03	8,067.32	38,554.00
Nov-07	39.20	7,870.52	38,975.00
Oct-07	38.81	8,019.22	40,512.00
Sep-07	35.37	7,861.51	39,889.00
Aug-07	33.03	7,638.17	40,187.00
Jul-07	30.36	7,584.14	40,221.00
Jun-07	28.63	8,007.32	41,954.00
May-07	27.69	7,883.04	43,079.00
Apr-07	27.58	7,408.87	43,755.00
Mar-07	27.88	6,917.03	41,771.00
Feb-07	28.57	6,715.44	41,155.00
Jan-07	28.72	6,789.11	42,197.00
Dec-06	28.99	6,596.92	41,434.00
Nov-06	29.44	6,309.19	40,270.00
Oct-06	29.10	6,268.92	39,558.00

Sep-06	28.64	6,004.33	38,475.00
Aug-06	28.06	5,859.57	37,938.00
Jul-06	26.77	5,681.97	36,606.00
Jun-06	26.47	5,683.31	36,444.00
May-06	26.53	5,692.86	36,450.00
Apr-06	26.76	6,009.89	37,773.00
Mar-06	27.58	5,970.08	37,928.00
Feb-06	28.46	5,796.04	37,650.00
Jan-06	28.80	5,674.15	36,654.00
Dec-05	29.95	5,408.26	35,704.00
Nov-05	30.29	5,193.40	34,090.00
Oct-05	30.23	4,929.07	32,782.00
Sep-05	29.76	5,044.12	34,775.00
Aug-05	29.12	4,829.69	33,520.00
Jul-05	27.93	4,886.50	33,693.00
Jun-05	27.45	4,586.28	32,343.00
May-05	27.39	4,460.63	31,739.00
Apr-05	27.74	4,184.84	30,911.00
Mar-05	28.73	4,348.77	32,302.00
Feb-05	29.42	4,350.49	31,850.00
Jan-05	29.61	4,254.85	31,334.00
Dec-04	30.77	4,256.08	30,903.00
Nov-04	31.15	4,126.00	29,615.00
Oct-04	30.85	3,960.25	28,681.00
Sep-04	30.15	3,892.90	27,794.00
Aug-04	29.30	3,785.21	26,913.00
Jul-04	28.60	3,895.61	27,538.00
Jun-04	27.51	4,052.73	28,092.00
May-04	27.48	3,921.41	27,355.00
Apr-04	27.61	3,985.21	28,020.00
Mar-04	29.79	3,856.70	27,148.00
Feb-04	30.42	4,018.16	27,957.00
Jan-04	31.02	4,058.60	27,774.00
Dec-03	31.27	3,965.16	26,887.00
Nov-03	32.26	3,745.95	27,156.00
Oct-03	32.06	3,655.99	25,973.00
Sep-03	31.16	3,256.78	24,615.00
Aug-03	30.14	3,484.58	25,247.00
Jul-03	28.94	3,487.86	25,132.00
Jun-03	28.18	3,220.58	24,677.28

May-03	28.30	2,982.68	24,945.70
Apr-03	28.80	2,942.04	23,886.67
Mar-03	29.59	2,423.87	21,605.12
Feb-03	30.62	2,547.05	23,279.07
Jan-03	31.12	2,747.83	22,532.38

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