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Jeannot Patrick Ngoulma Tang

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(IRSTEA)

Signal et information imparfaite : quelle efficacité pour les indications géographiques ? Une application aux fromages AOP d'Auvergne

Signal and imperfect information: what effectiveness for the geographical indications? An application to Auvergne PDO cheeses

Thèse Nouveau Régime
Présentée et soutenue publiquement le 12 Décembre 2017
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L'université n'entend donner aucune approbation ou improbation aux opinions émises dans cette thèse. Ces opinions doivent être considérées comme propres à leur auteur.

À ma regrettée grand-mère Séraphine BIDZOGO qui m'a inculqué les valeurs morales et éthiques, une discipline stricte, le goût de l'effort et l'esprit de sacrifice depuis mon enfance,

“Mbamba Mepam, Abougan”. J'espère que de la haut, t'es fiere de moi

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Résumé de la thèse

Les Indications Géographiques (IG), désignent un label particulier utilisé pour assurer la qualité, l'origine et protéger les produits de la contrefaçon. Elles lient la qualité et la réputation d'un produit à un territoire et sont très présentes en Europe, notamment en France. A l'heure où les consommateurs demandent davantage de transparence et d'information sur l'origine des biens qu'ils consomment, la valorisation des produits locaux représente un enjeu important. Nous analysons dans cette thèse, le consentement à payer des consommateurs pour les produits sous indications géographiques à l'aide de la base de données Kantar WorldPanel, qui regroupe des données d'achats des ménages français. L'accent étant mis sur les fromages AOP d'Auvergne, nous travaillons sur la période 2008-2010 qui représente la période de réforme et de restructuration des acteurs des filières AOP fromagères auvergnates. Dans un premier temps nous réalisons une méta-analyse afin d'observer ce que les études nous disent sur le sujet. Sachant que le consentement à payer est une prime du prix, nous estimons la dispersion et les déterminants des prix des fromages AOP d'Auvergne dans un second temps. Enfin, dans un troisième temps, nous répondons à notre question de recherche principale en estimant les déterminants de choix et le consentement à payer (CAP) des consommateurs. De façon globale, nous trouvons que l'indication géographique joue un rôle important dans l'esprit des consommateurs durant les actes d'achats, mais pour qu'elle soit plus efficace, elle doit être accompagnée par des stratégies de promotion initiée par les distributeurs et producteurs. De même les attributs des produits et les conditions de distributions jouent un rôle plus important dans les décisions d'achats, par rapport aux caractéristiques propres aux consommateurs. Enfin, nous notons que les consommateurs ont des CAP très différents d'un fromage AOP d'Auvergne à l'autre, mais ces CAP convergent tous vers un prix unique, qui représente le prix espéré par les consommateurs pour ces produits.

Mots clés : Indications géographiques, Labels, Consentement à payer, Dispersion des prix, Marchés agricole laitiers, Asymétries d'information, Qualité, Économétrie.

Summary of thesis

Geographical Indications (GIs) designate a particular label used to ensure quality, origin and protect products from counterfeiting. They bind the quality and the reputation of a product to a territory and are very present in Europe, especially in France. At a time when consumers are demanding more transparency and informations about the origin of the goods they consume, valuing local products represents an important issue. In this thesis, we analyze consumers' willingness to pay for products under geographical indications by using the Kantar WorldPanel database, which includes data of purchases of French households. With a focus on Auvergne PDO cheeses, we work on the period 2008-2010, which represents the period of reform and restructuring of actors in the Auvergne PDO cheeses sector. In a first step, we carry out a meta-analysis in order to observe what the studies tell us about the subject. Knowing that the willingness to pay is a price premium, we estimate the dispersion and the price determinants of Auvergne PDO cheeses in a second step. Finally, in a third step, we answer to our main research question by estimating determinants of choices and the consumers' willingness to pay (WTP). Globally, we find that the geographical indication plays an important role in the minds of consumers during purchasing activities, but in order to be more effective, it must be accompanied by promotion strategies initiated by distributors and producers. Similarly attributes of product and conditions of distribution play a more important role in the decisions of purchases, with regard to, the characteristics of consumers. Finally, we note that consumers have WTPs very different from a PDO cheese from Auvergne to another, but all these WTPs converge towards a single price, which represents the expected price of consumers for these products.

Keywords: Geographical Indications, Labels, Willingness to pay, Prices dispersion, Agricultural dairy products, Asymmetries of information, Quality, Econometrics analysis.

Introduction Générale

Contexte de la thèse

Les biens agro-alimentaires, notamment dans leurs composantes environnementales (origine, méthodes de production, savoir-faire, etc.) sont des exemples types de biens dont la plupart des utilisateurs peinent à évaluer la qualité intrinsèque. De nombreux scandales, dont certains très récents (le lait à la mélamine¹ – 2008 ; les graines germées contaminées² – 2011 ; l’affaire Spanghero³ – 2013, ou encore l’affaire des œufs contaminés⁴ – 2017), ont mis en évidence la quasi incapacité des consommateurs à connaître les véritables caractéristiques des biens consommés. Par conséquent, les achats se font généralement en se basant sur la qualité perçue, notamment au travers de signaux de qualité (type labels), mais dont la multiplicité semble affaiblir l’efficacité informationnelle conduisant à déconnecter le prix du bien de sa valeur.

Ces problèmes ont de nouveau soulevé les questions de sécurité alimentaire ([Pinstrup-Andersen, 2009](#)) et de risques sanitaires des aliments consommés ([World Health Organization, 2007](#)). Les consommateurs, désormais très préoccupés de l’origine des aliments qu’ils consomment, sont de plus en plus exigeants sur la qualité perçue, au travers de différents signaux d’informations.

Dans un tel contexte, les agriculteurs associés aux transformateurs, dans l’optique de protéger leurs produits de l’usurpation de notoriété, de se différencier des produits standards et de mieux informer les consommateurs, ont mis en œuvre avec l’appui des pouvoirs publics des démarches « qualité » fondées sur l’origine géographique et le respect des usages locaux loyaux et constants. Cette politique s’appuie sur l’utilisation et la promotion des Indications Géographiques (IG) et leur reconnaissance européenne à travers par exemple l’Appellation d’Origine Protégée (AOP) et l’Indication Géographique Protégée (IGP).

¹ Ce lait avait provoqué des intoxications en nombre. Six enfants sont morts, plus de 300 000 nourrissons avaient été malades en Chine.

² Causé par la bactérie E, ce scandale une quarantaine de morts et près de 4000 malades.

³ La viande de cheval non étiquetés était vendue à la place de la viande de bœuf.

⁴ Déclenché en France à cause des œufs belges ou néerlandais contenant des traces de fipronil, un insecticide et acaricide, normalement interdit d’usage sur des animaux destinés à la consommation humaine.

Les Indications Géographiques (IG) représentent un type particulier de label utilisés pour assurer l'origine et protéger les produits de l'usurpation, la qualité et les efforts collectifs visant à créer une réputation du produit. Les IG sont utilisées en Europe depuis des décennies avec des produits spécifiques pour lesquels la qualité est directement liée aux caractéristiques de l'origine, au savoir-faire traditionnel et à la capacité des acteurs de la chaîne de valeur à promouvoir ces spécificités et à protéger la réputation. La protection des IG a été largement débattue au sein de l'Organisation mondiale du commerce (OMC) pour savoir si les protections doivent être considérées comme *sui generis*⁵ ou comme marques de commerce.

Objectif du travail de thèse

Cette thèse de doctorat est une thèse en économie appliquée et traite de la question de l'efficacité de ces indications géographiques, comme outil d'amélioration de l'information auprès des consommateurs, permettant de reconnaître la qualité dans un contexte d'asymétries d'information (Akerlof 1970). L'accent est mis sur les Appellations d'Origine Protégées (AOP), qui désignent des produits dont toutes les étapes de fabrication (la production, la transformation et l'élaboration), sont réalisées selon un savoir-faire reconnu dans une même zone géographique, cette dernière donnant ses caractéristiques au produit.

Tout en s'appuyant sur l'analyse d'un marché particulier à savoir celui des fromages AOP d'Auvergne, nous testons des hypothèses économiques de rationalité et de préférences des agents. En effet, le marché des fromages présente les caractéristiques d'un marché imparfaitement concurrentiel où il existe plusieurs distributeurs proposant des produits différenciés, dont aucun ne peut capter l'intégralité de la clientèle de ses concurrents, en raison de la différenciation des biens régnant sur le marché. Les biens sont suffisamment semblables pour qu'il y ait concurrence par exemple dans les fromages à pâtes persillées et dans les fromages à pâtes molles. De même, ces biens sont suffisamment différents pour que les entreprises aient un pouvoir de monopole sur certains des produits. Nous évaluons donc le consentement à payer (CAP) des consommateurs pour les fromages AOP d'Auvergne afin de comprendre si l'identification géographique joue bien un rôle de signal de qualité dans l'esprit des consommateurs. Peri et Gaeta (1999) ont montré que les certifications IG visent à augmenter la valeur du produit car ces systèmes nécessitent une réglementation plus stricte,

⁵ Terme d'origine latine qui qualifie quelque chose de spécifique à une personne, un animal ou un objet.

ainsi, le label AOP fait en sorte que les consommateurs acceptent plus facilement le produit en augmentant leur conviction, surtout lorsqu'il s'agit de nouveaux produits. Ainsi, les IG réduisent la confusion et les coûts de recherche de l'information sur la qualité (Dimara, Petrou et al. 2004). Le cas des fromages AOP d'Auvergne est intéressant car ils rencontrent des difficultés à capter de la valeur qui pourrait être redistribuée en partie aux producteurs de lait.

La production, la normalisation ainsi que la commercialisation des biens agro-alimentaires sont donc des enjeux très importants aujourd'hui. Dans un monde dominé par la concurrence des produits dans le contexte de la mondialisation, les stratégies hors-coût telle que la différenciation par les signaux de qualité liée à l'origine peuvent apparaître comme une solution pertinente. Les marchés agroalimentaires se positionnent au centre de cette différenciation, car les consommateurs sont de plus en plus familiers des ces produits à cause de leur multiplicité et leur diversité. Mais la question de la structure d'organisation de ces marchés reste une question majeure, qui s'avère encore plus évidente pour l'industrie laitière et fromagère. En effet, ces produits peuvent être considérés comme des biens de croyance Nelson (1970) ; (Darby et Karni, 1973), car même l'habitude de consommation ne nous informe pas suffisamment sur leur qualité. Ce qui amène à se demander quel type de signaux de qualité on appose sur ce type de produits afin d'inciter les consommateurs dans leurs actes d'achat, sachant l'enjeu sanitaire et économique.

L'objectif des producteurs et des distributeurs étant d'informer les consommateurs sur la qualité de ces biens et par la suite de les inciter à passer à l'acte d'achat, la question est de savoir si l'indication géographique est un signal de qualité crédible permettant aux consommateurs de faire facilement leur choix ; ce qui pose un autre problème de mesure de leur consentement à payer (CAP) pour les produits portant ce type de signal. La démarche IG étant une démarche de qualité qui exige un suivi et le respect d'un cahier des charges strict et des règles de production très élaborées dont l'objectif est la différenciation, peut entraîner des coûts de production élevés qui sont généralement compensés par le prix élevé du produit final acheté par le consommateur. Mais les consommateurs quant à eux souhaitent acheter des produits de qualité à des prix moins élevés, et par conséquent risquent de préférer des produits standards qui sont à des prix abordables, rendant ainsi inefficace la politique de labellisation soutenue par les pouvoirs publics. Bonnet et Simioni (2001) ont montré par exemple que sur la base d'un même prix, les consommateurs vont préférer un fromage Camembert non AOP par rapport à un Camembert AOP. Selon les auteurs, les marques privées sont plus pertinentes

dans l'esprit des consommateurs ; ce qui pose le problème du prix d'équilibre permettant aux consommateurs, aux distributeurs et aux producteurs de produits IG de trouver satisfaction, d'où la nécessité d'évaluation du CAP des consommateurs.

Problématique de la thèse

Nous choisissons comme cadre d'application les fromages AOP d'Auvergne, car cette région française est assez rurale et regroupe à elle seule 5 des 45 fromages sous Appellations d'Origines Protégées que comptent la France, à savoir le Cantal, le St Nectaire, le Bleu d'Auvergne, la Fourme d'Ambert et le Salers. Ces produits représentent l'image de cette région et donnent aux habitants un sentiment de fierté régionale. D'après l'INAO⁶ et le CNAOL⁷ en 2014, les AOP fromagères représentaient 15,2 % des fabrications de fromages affinés français et environ 1,6 milliard d'euros de chiffre d'affaires. Depuis l'année 2000, le tonnage de fromages AOP français est stable avec près de 190 000 tonnes pour un chiffre d'affaires d'environ 1,4 milliard. Malheureusement, les fromages AOP de l'Auvergne ne connaissent pas la même stabilité qu'on retrouve au niveau national français. Plusieurs facteurs ont été évoqués afin d'expliquer cette tendance comme par exemple les *nouveaux modes de consommations* (les jeunes seraient moins attirés par les produits « typés » ; *le coût du fromage* ; *des établissements qui réduisent voire suppriment leur rayon coupe traditionnel* ; *la concurrence* accrue de certains fromages dit "marketés" (prenons à titre d'exemple le cas du Saint-Agur pour les pâtes persillées) ; *la difficulté de certaines fromageries* ou bien encore le *faible positionnement sur le libre-service*.

Suite aux difficultés rencontrées par ces filières fromagères d'Auvergne, une stratégie régionale fondée sur trois leviers a été mise en œuvre. Parmi lesquels :

- (1) la rénovation des cahiers des charges dans un double objectif d'amélioration de la qualité et de la crédibilité du signe AOP ;
- (2) un effort marketing et une campagne de promotion collective afin d'améliorer la notoriété de ces fromages auprès des consommateurs, de les fidéliser dans leur acte d'achat et d'augmenter leur consentement à payer ;

⁶ Institut national de l'origine et de la qualité

⁷ Conseil National des Appellations d'Origine Laitières

- (3) la mise en place d'une contribution volontaire obligatoire (CVO) afin de redistribuer le surplus espéré vers les éleveurs et financer les campagnes de promotion.

Malgré ces actions, les filières fromagères AOP en Auvergne connaissent toujours des résultats économiques très moyens tant en termes de prix du lait que de croissance du marché des fromages AOP. L'innovation étant très limitée, ils n'arrivent pas à retrouver les niveaux de commercialisation d'avant 2003.

Le niveau de performance faible de la stratégie de différenciation fromagère en Auvergne, de même l'écart existant entre les prix des produits sortis d'usine et les prix pratiqués au niveau des consommateurs finaux interpellent donc aujourd'hui les professionnels des filières, l'Etat et les collectivités territoriales. Ils exigent d'étudier les facteurs explicatifs de cette situation pour aller vers des propositions qui pourraient permettre la relance de ces filières essentielles pour le développement d'une région marquée par l'élevage et les handicaps de productivité et surtout permettre de retrouver la confiance des consommateurs.

La question de recherche appliquée que nous traitons est la suivante : Quels sont les déterminants de choix des fromages d'Auvergne sous AOP et quel est le consentement à payer des consommateurs pour ces produits?

Nous répondons à cette question à l'aide de la base de données Kantar WorldPanel, qui regroupe des données d'achats des ménages français. Nous privilégions la base Kantar par rapport aux données d'enquêtes terrain, car elle est basée sur les données scannées d'achats réellement effectués. Ce qui résout par ailleurs le problème de "biais" rencontré dans l'implémentation des enquêtes. Nous travaillons sur la période 2008-2010 qui représente la période de réforme et de restructuration des acteurs de la filière. Pour traiter cette question de recherche nous posons les hypothèses suivantes :

Hypothèse 1 : les fromages AOP d'Auvergne sont consommés par toutes les catégories de consommateurs. Mais les attributs du produit influencent plus les décisions d'achats par rapport aux caractéristiques propres aux consommateurs [Scarpa and Del Giudice \(2004\)](#) ; [Van der Lans, Van Ittersum et al. \(2001\)](#).

Hypothèse 2 : les producteurs des fromages AOP d'Auvergne ont des difficultés, car ils s'adressent à un marché dont ils n'ont pas l'œil critique (consommateurs très hétérogènes). Les produits étant traditionnels et patrimoniaux ([Benhamou, 2015](#)), ils ne correspondent pas

aux attentes des consommateurs, et du coup sont confrontés à un monde qui veut de l'innovation.

Hypothèse 3 : certains producteurs n'utilisent pas l'AOP comme vecteur d'information, par contre d'autres utilisent seulement le signal AOP (Laporte, 2000). Mais cela reste insuffisant, car la réputation du produit et le CAP des consommateurs dépendent du signal prix et d'autres signaux comme l'AOP et la promotion.

Hypothèse 4 : les fromages AOP d'Auvergne n'arrivent pas à capter suffisamment des parts de marché ou le CAP des consommateurs, car ils n'arrivent pas à multiplier et à combiner les promotions de leur produit. Ce sont économiquement des petits fromages n'ayant pas les moyens de développés des actes promotionnels (Ricard, 2014) ; (Menadier, 2012). On pourrait penser qu'il existe un certain pouvoir de marché.

Hypothèse 5 : Selon la structure du marché (plus ou moins oligopolistique, plus ou moins concurrentiel), le surplus capté par les producteurs sera plus ou moins important, du fait du pouvoir de marché dont dispose la distribution (prix au niveau de la distribution étant parfois le double du prix au sorti d'usine). La concurrence représentant ainsi un outil de limitation de la dispersion des prix (Gerardi and Shapiro, 2009).

L'originalité de cette thèse de doctorat est de mettre l'accent sur l'analyse des déterminants socio-économiques rarement étudiés dans ce genre d'approche. Des travaux ont par exemple été menés sur la différenciation et la valorisation du lait de montagne hors AOP en Auvergne (Jeanneaux et al 2011) ; mais aucune étude ne porte sur le consentement à payer des consommateurs pour les fromages AOP d'Auvergne. De même, les recherches réalisées sur les systèmes de production fromagère se sont concentrées sur des produits emblématiques et déjà en capacité de dégager une forte valeur ajoutée Hassan & Monier (2002) et Hassan & Monier (2002). Par ailleurs, peu de travaux traitent du rôle joué par la dispersion des prix dans les décisions de consommation des produits alimentaires, et particulièrement les produits sous Indications Géographiques (IG). Il existe très peu de travaux permettant de comprendre comment un fromage possédant déjà des caractéristiques de différenciation marquées, peut émerger sur un marché de qualité haute. Il est cependant possible de s'inspirer de la littérature existante afin de répondre à ces questionnements et ainsi contribuer aux disciplines d'économie de l'information et d'économie industrielle en éclairant sur les leviers sur lesquels pourrait s'appuyer une stratégie de reconquête de parts de marchés aussi bien au niveau national qu'international.

Contenu des chapitres de thèse

Pour ce faire, notre travail se compose de **6 chapitres** répartis dans **deux parties**.

La partie I, dans laquelle nous réalisons une revue de littérature contient **3 chapitres**.

Dans le **chapitre 1**, nous réalisons une revue de littérature sur les marchés agricoles laitiers (structure et fonctionnement) avec un focus sur le marché des fromages français en général et celui des fromages AOP d'Auvergne en particulier. Ce chapitre nous permet d'observer qu'il n'existe pas un '*marché du fromage d'Auvergne*' à proprement parler, puisque chaque fromage, en l'occurrence les AOP d'Auvergne, passe par différents circuits de distribution et est produit par différents acteurs (industriel, fromagerie, laiterie, fermiers...). Donc, chaque fromage AOP d'Auvergne a en quelque sorte son propre marché et la stratégie de différenciation est fortement liée au signal AOP comme moyen d'informer les consommateurs dans le cadre d'un marché imparfaitement concurrentiel avec un marketing agressif.

Le chapitre 2 est un chapitre qui pose et délimite le cadre théorique dans lequel s'inscrit cette thèse de doctorat, à savoir l'économie de l'information et l'économie industrielle. Nous faisons par conséquent une revue de littérature théorique des problèmes d'asymétries d'information que sont la sélection adverse et l'aléa moral. Cette revue de littérature montre que les problèmes que soulève l'économie de l'information à travers les asymétries d'information trouvent leur solution dans l'économie industrielle au travers de la réputation, la publicité, les certifications, etc. Ce chapitre présente aussi les indications géographiques comme un instrument de signalisation de la qualité autre que le prix, au travers de la démarche de production et de l'origine de provenance des produits.

Connaissant le cadre théorique de notre recherche, nous nous posons ensuite les questions suivantes : comment évalue-t-on le consentement à payer dans la littérature ? Quels sont les méthodes d'évaluation ? Et quels sont les grands résultats ? En nous basant sur des articles tels que ceux de [Bonnet et Simioni \(2001\)](#) ; [Santos et Robiero \(2005\)](#) ; [Saulais et Ruffieux \(2012\)](#), etc, nous réalisons une méta-analyse dans le chapitre suivant.

La méta-analyse du **chapitre 3** porte sur les produits laitiers (lait, beurre, fromage, yaourt). Nous trouvons qu'en moyenne dans les études, l'effet label est un signal de qualité important,

les indications géographiques telles que l'AOP/IGP⁸ (+39%) et le label BIO (+46%) augmentent le consentement à payer des consommateurs lorsqu'ils sont apposés sur les produits laitiers par rapport à d'autres signaux comme les OGM⁹ ou la démarche HACCP¹⁰, etc. Nous trouvons également que le type de méthodes d'évaluation influence les résultats sur le consentement à payer des consommateurs. Par exemple les méthodes hypothétiques (+18%) font apparaître en moyenne un consentement à payer positif par rapport aux méthodes non hypothétiques. Enfin, nous trouvons que parmi les produits laitiers, le fromage a en moyenne un consentement à payer des consommateurs faible (-36%), par rapport à d'autres produits laitiers comme le yaourt et le beurre.

Ce résultat novateur par rapport à celui [Deselnicu, Costanigro et al. \(2013\)](#) sur le fromage, nous amène à nous demander, quel consentement à payer des consommateurs pour les fromages sous indications géographiques, particulièrement sous Appellations d'Origine Protégées ? Ce chapitre est important dans la mesure où il nous apprend que le signal AOP a des effets positifs sur le CAP des consommateurs. De plus il nous enseigne que les caractéristiques du produit jouent un rôle important dans la détermination du CAP des consommateurs, mais ne nous renseigne pas beaucoup sur les caractéristiques des consommateurs. Ce qui nous conduit à la **partie II** de notre thèse.

Cette **partie II** qui est une partie empirique spécifique aux AOP d'Auvergne, est constituée de **3 chapitres**. Elle utilise la base Kantar WorldPanel.

Dans le **chapitre 4**, nous présentons cette base de données Kantar WorldPanel et nous analysons les données afin d'avoir une première idée de la dispersion des prix et des habitudes de consommation des consommateurs. L'analyse de la base de données montre que les régions françaises dans lesquelles les fromages se vendent à des prix élevés par rapport aux autres régions sont l'Ile-de-France, l'Alsace, Rhône-Alpes et l'Auvergne. Mais la région dans laquelle l'on dépense plus par acte d'achat reste la région d'Auvergne, qui est la région d'origine des 5 fromages AOP que nous étudions dans le cadre de cette thèse. Enfin, nous trouvons que les prix des fromages AOP d'Auvergne sont très disparates d'une région française à l'autre, ce qui invite à examiner les causes de ces dispersions dans le chapitre 5.

⁸ Indication Géographique Protégée

⁹ Organismes Génétiquement Modifiés

¹⁰ Hazard Analysis Critical Control Point

Dans ce *chapitre 5*, nous nous demandons, quels sont les déterminants du prix des fromages en général et des fromages AOP d'Auvergne en particulier ? Car ce sont ces déterminants que le consommateur observe et qui déterminent son consentement à payer. L'on se demande également ce qui peut expliquer la dispersion des prix observés d'une région française à l'autre et comment réduire cette dispersion des prix ? Nous trouvons que les déterminants du prix des fromages sont : les promotions, le type de présentation (Morceau, Entier, etc.), le type de conditionnement (Barquette, Sachet, Papier, etc.), le circuit de distribution (Hypermarché, Supermarché, Hard-Discount, Crémier ou fromager), la région de vente, la présence d'une marque de distribution, la saison d'achat (été, automne, hiver, printemps), l'indication géographique (AOP/IGP). Par ailleurs, nous trouvons que les indications géographiques comme les AOP (et les IGP) impactent positivement et significativement le prix des fromages en moyenne de +2.329 €/kg par rapport aux fromages sans indication géographique. Ensuite, nous trouvons que les agrégats expliquant les dispersions des prix des fromages AOP d'Auvergne sont : l'inflation, les promotions, la période d'hiver et la présence d'une marque de distribution apposée sur ces fromages. Enfin, il ressort des analyses que les agrégats permettant de réduire cette dispersion des prix observés sur les fromages AOP d'Auvergne sont : une augmentation des parts de marchés, la concurrence, le nombre de présentation par fromage, les achats dans les grandes et moyennes distributions (Hypermarché, Supermarché, Hard-Discount).

Connaissant désormais les déterminants des prix des fromages, nous répondons à notre question de recherche principale au *chapitre 6*, qui est de savoir quel est le consentement à payer (CAP) des consommateurs pour les fromages AOP d'Auvergne ? Car ce sont ces déterminants du prix calculé au *chapitre 5* qui déterminent le CAP des consommateurs. Rappelons que le consentement à payer ici est une prime du prix que les consommateurs sont prêts à payer par rapport au prix initial. Cette prime de prix peut être positive ou négative et représente parfois le surplus du consommateur. Nous trouvons que les caractéristiques des consommateurs n'influencent pas grandement leur décision d'achat, mais ce sont plutôt les attributs des fromages qui influencent les consommateurs. C'est-à-dire, la présence d'une marque de distribution apposée sur ces fromages, les canaux de distribution, le pourcentage de matière grasse de ces fromages, la promotion et la région de vente sont les attributs qui influencent les consommateurs durant les actes d'achats. Nous trouvons également que les consommateurs sont prêts à payer environ +2.681 €/kg pour l'AOP "Cantal" par rapport au prix initial du produit, -0.013 €/kg pour l'AOP "St Nectaire" par rapport au prix initial du

produit, +3.207 €/kg pour l'AOP "Bleu d'Auvergne" par rapport au prix initial du produit, +3.233 €/kg pour l'AOP "Fourme d'Ambert" par rapport au prix initial du produit et -4.619 €/kg pour l'AOP "Salers" par rapport au prix initial du produit. Nous trouvons que ces consentements à payer convergent vers un prix unique d'environ 12 €/kg pour les fromages AOP d'Auvergne. Enfin, nous trouvons qu'en termes d'utilité, les consommateurs ont une utilité plus élevée pour les fromages non AOP, viennent ensuite les fromages AOP d'autres régions, et en dernière position les fromages AOP d'Auvergne. Nous concluons que les fromages AOP en général et AOP d'Auvergne en particulier doivent améliorer et combiner leur stratégie de promotion ou de notoriété face aux fromages non AOP. Car ces produits ne peuvent plus se contenter du seul signal AOP comme vecteur d'information. Ils doivent combiner le signal AOP avec différentes promotions afin de se faire connaître et d'être plus crédible. Enfin, dans un objectif de relance des filières AOP fromagères auvergnates, les distributeurs en collaboration avec les producteurs pourraient pratiquer un prix moyen du produit d'environ 12 €/kg afin d'attirer plus de consommateurs et ainsi jouer sur l'effet quantités vendues et non sur l'effet prix élevé des produits.

Nous **concluons** la thèse par la suite en proposant de possibles extensions sur les nouveaux produits IG des pays en développement et en faisant une ouverture sur le rôle que peuvent jouer les interactions sociales ou encore « normes sociales », « influence des pairs », « effets du voisinage », « effets de conformité », « effets d'imitation », « effets de contagion » selon [Manski \(1993\)](#) dans les habitudes de consommations des individus.

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Part 1: Theoretical and Quantitative analysis of the Literature

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Chapter 1: The Market of dairy products

1.1. Introduction

The structure and functioning of agricultural markets is a national but also an international challenge for most countries. The export of these agricultural products is an indispensable source of income for farmers, but the volatility of these markets and the volatility of price make their participation to the international trade very risky. These multiple upheavals have led public authorities to adopt policies to regulate these markets.

This has been observed, for example, in the dairy quotas introduced in the Common Agricultural Policy in 1984, the aim of which was to limit and stabilize the milk production by regulating the price of milk in Europe, in particular by allowing breeders to sell their production at a price that satisfied them. This policy was strongly contested by farmers, particularly in France, hence their suppression in April 2015. This highlighted the importance of actors in the dairy sector in the majority of countries.

This chapter highlights the structure of dairy agricultural markets. The section 2 presents the functioning of international dairy markets. The section 3 presents the market structure of cheeses in France. The section 4 presents the functioning and structure of Auvergne PDO cheeses market. Finally, we conclude in section 5.

1.2. Dairy agricultural markets

Dairy markets are very complex markets, notably because these products are perishable. This chapter based on the descriptive data from the Inao¹¹, Cnaol¹², Idf¹³, and Fao¹⁴, gives us a comprehensive overview of the functioning of these markets.

1.2.1. World production of dairy products

World milk production is dominated by cow's milk, about 83% of quantities produced in 2014 (Table 1), followed by, buffalo milk which weighs 13%. It is derived from the female of

¹¹ Institut national de l'origine et de la qualité

¹² Conseil National des Appellations d'Origine Laitières

¹³ International Dairy Federation

¹⁴ Food and Agriculture Organization of the United Nations

buffalo and is rarely collected in Europe and mainly collected in Asian countries (India, Pakistan, and China). In last positions, appear the goat milk (2%), the sheep milk (1%) and other mammals (1%), such as the camel.

Table 1: production of milk

Million tons	2010	2011	2012	2013	2014
Cow milk	609.8	623.6	636.7	642.2	663.2
Buffalo Milk	93.1	97.0	99.9	101.8	106.3
Goat milk	17.7	18.2	18.4	18.6	18.8
Sheep milk	9.8	9.7	9.9	10.0	10.1
Other Milks	3.8	3.8	3.7	3.9	3.9
TOTAL	734.2	752.4	768.7	776.4	802.2

The data come from IDF (International Dairy Federation)

In 2014, world dairy production exceeded 800 million tons, an increase of 3.3% over the previous year. Among the largest continents producing milk, there are:

- Asia. The first place is attributed to India, the world's leading producer of milk, and its massive collection of buffalo milk (53% of its milk production in 2014).
- Europe (in the broadest sense, including Russia and the EU-28), takes the second rank.
- The American continent takes the third place. The US is the undisputed leader, representing almost half of the production of this continent.

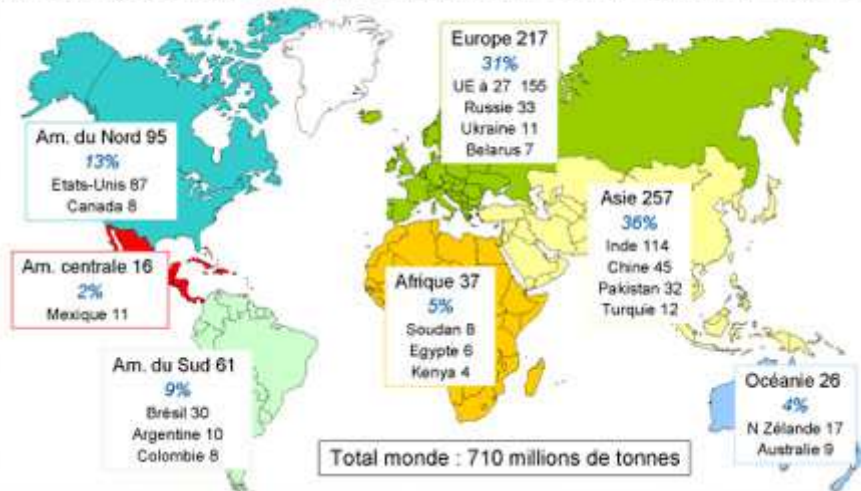
Nearly 69 million tons of milk and dairy products were traded on the world market in 2013, representing barely 9% of world production. The explanation is simple: since milk cannot be transported safely over long distances, most of the milk is consumed near the production regions. Butter, cheese and milk powder are more suitable for international trade. The world's major suppliers of dairy products in general are Europe and New Zealand. The latter has a special place. Its production is relatively modest (22 million tons in 2014), but its low domestic consumption favors export.

In 2013, there were 272 million dairy cows on the planet. Nearly 40% of the livestock lived in Asia, 14% in Europe and only a little over 3% in the United States. There are strong disparities in competitiveness and dairy yields. India became the world's first milk nation in

2001, ahead of the US. In 2012, it produced 145 million tons against 19 million 40 years earlier. China is the other Asian dragon of milk. Its evolution is dazzling. In 2004, its cow's milk production was 16 million tons, in 2014, it already reached 37 million tons, and the country is at third ranks in the world. Unlike India, the consumption of dairy products in China is not traditional, and it is growing rapidly.

Figure 1: repartition of the production of dairy products in the world in 2010

Répartition géographique de la production mondiale en 2010 (millions de tonnes)



Population et production laitière par habitant en 2010



In the dairy sector, for example, it should be noted that international trade represents only 6% of world milk production and prices are very volatile. Quite criticized, quotas in European Union have played an effective role in the control of supply of milk and dairy products, while

contributing to a territorial distribution of production on family structures. In addition, they helped to control the spending on the Common Agricultural Policy.

World trade of dairy products represented the equivalent of 65 million liters in 2014 (excluding intra-Community trade), about 8% of the world production. Most dairy products traded around the world consist of dry ingredients (milk and powders, caseins), cheddar cheese and butter and *butter-oil*, as well as easily transportable and stored products. Consumer products, heavy and perishable, are most often consumed as close to production zone as possible. If the global market is a real opportunity for large production areas, its narrowness contributes to increasing volatility: a small fluctuation in production volumes or demand can lead to large price fluctuations¹⁵.

1.2.2. World consumption of dairy products

The aim of suppression of quotas in Europe was to increase dairy exportations. But, the European consumption remained large and stagnant. On the other side of the globe, this increased, because Asia increased their consumption of dairy products. China leads the game, as often with raw materials. The tainted milk scandals that have affected the country on several occasions since 2008 have also led to an augmentation of importations of milk powder. In 2013, China absorbed 40% of world imports of skimmed milk powder with 215,000 tons purchased, compared to only 51,000 tons ten years earlier, according to the calculation of Agritel¹⁶.

The apparent consumption of dairy products varies greatly from one continent to another, due to different structure of agricultural production. If it is on average 104 kg per capita in 2010 in the world, it is 43 kg in Africa, 67 kg in Asia and 290 kg per capita in the 27 European Union countries (*source : CNIEL from FAO Food Outlook de juin 2011*).

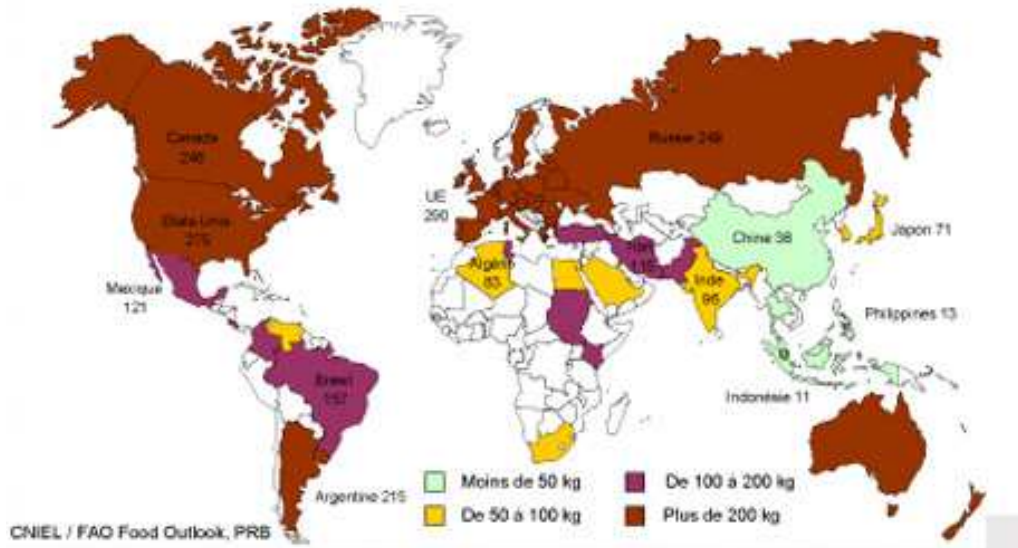
Dairy markets, which are generally considered to be close to saturation in the European Union, are, on the other hand, a great growth potential in emerging countries due to the globalization of consumption and foods patterns.

¹⁵ Analyse Bovins lait - Chine_ABCIS n°13 - Juillet 2015

¹⁶ Commodity consulting Company

Figure 2: repartition of the consumption of dairy products in the world in 2010

Niveau de consommation apparente de produits laitiers en 2010 (kg par habitant)



The average annual consumption of dairy products per capita increased by 10%, about 10 kg in the worldwide between 2000 and 2010, a period where the world population increased by about 800 million people. Moving from average consumption per capita to overall consumption, between 1970 and 2007, there is an increase of 1.2% per year in the quantity of dairy products consumed around the world. While consumption has barely increased in developed countries during this period, it has increased by 3.6% per year in emerging countries, with annual growth of 6.5% in East Asia and 4.3% in South Asia. This growth is not uniform. Depending on the country's population growth dynamics, it focuses on different dairy products and involves different trade channels. From 2005 to 2007, the consumption of dairy products was equal between developed and emerging countries with 350 to 360 million tons on both sides.

As the world's population could rise from 7 billion to 9 billion by 2050, FAO projections for dairy consumption show a global growth rate of 1% per year. During the period from 1970 to 2007, this growth was mainly driving by emerging countries: +1.8% per year against +0.2% per year for developed countries. By 2050, emerging countries would account for 65% of dairy consumption (680 million tons), compared to 35% for developed countries (370 million tons).

The growth in world population, the per capita consumption of dairy products in emerging countries, as well as legitimate and very strong demand for food safety following several scandals, including melamine in infant milks in China, are all new export opportunities for European dairy companies with the end of quotas. These opportunities are essential for cooperating partners who want to produce additional milk at a marginal cost.

Despite the increase of global consumption, the very strong growth of world production in 2014, the sudden stoppage of Chinese demand and the Russian embargo have contributed to the overcrowding of the world dairy market. The surplus supply, had a considerable effect on world prices of dairy ingredients (-56% for lean powder and -33% for butter between January 2014 and June 2015) and on the price of milk production in main exporting countries.

1.2.3. At the French national level

The collection of milk at the French national level is valued on the domestic market for about 64% of production (about 36% to 40% leave to the export every year) and covers between 75% and 80% of the French demand for dairy products. The French domestic market is a solid and mature base for processors. The French are large consumers of milk and dairy products, but their purchases are capped. The consumption of liquid milk gradually erodes and that of ultra-fresh products after a period of very dynamic growth in the early 2000s suffered from the economic crisis. The French remain among the largest consumers of cheese in the world, with nearly 24.3 kg per capita (whereas it is on average 17 kg per capita per year in the EU), but purchases have declined slightly since 2014. The consumption of cheese is generally closely related to the production.

Mass distribution is the first outlet in the domestic market with 59% of the material solid marketed far ahead of catering (9%); the second outlet being the agro-food industry (32%). The store supply, with an incomparable diversity, reflects the dynamism of the processors who innovate and ensure rather a captive market. However, this logic is confronted with the decline of the purchasing power of households. The French offer suffers from competition of cheaper imported products in the entry-level segment, whose market share increases. Importations of French dairy products (€ 3.3 billion in 2014) include mainly cheese (€ 1.3 billion), butter and cream (€ 1.1 billion) and liquid milk (€ 200 million). Relations between

processors and distributors are strained in a context of economic stagnation, and rather unbalanced to the advantage of the latter.

The international market increasingly affects the French milk production. In total, France exported 36% of its milk production in 2014, for a turnover of nearly 7.3 billion euros. The European market represented for two thirds of these exportations, the last third being directly shipped to the world market. French exports are boosted by non-EU demand. The value of direct exportations to China was impacted by the scandal of powders and infant milks, but France exported more to all other destinations. In particular, Algeria increased its purchases by more than 60%, mainly in lean powder. In total, more than half of the additional sales were made to third countries. Towards the EU, 80% of additional purchases were made by Germany, the Netherlands and Belgium. These three countries account for almost 44% of the value of French intra-Community exportations¹⁷.

1.3. Market structure of cheeses in France

The globalization of markets encourages farmers to adopt geographical indications in order to distinguish themselves by the quality. This leads to the rise of large and medium-sized distributions and their practices which incite to the competition.

1.3.1. The presentation of market

More than 1,200 varieties of cheeses are produced in France per year, of which 45 benefit from the AOC¹⁸ or PDO at the level of EU and 6 benefits from the Protected Geographical Indication (PGI). The sector is present on the whole French territory, through some 70,000 dairy farms. Most of the French consumers consume cheese and the annual consumption is estimated at around 24 kg per capita. France presents itself as the leading exporter of cheeses in the world.

The cheese industry in France is very large. The sector is made up of 30,000 milk producers, 1,400 cheese producers, 227 private processors and 154 exclusive processors, according to data from the “Centre National Interprofessionnel de l’Économie Laitière” (CNIEL).

¹⁷ 2014 : l'année économique laitière. Perspectives 2015 (Dossier Economie n° 454).

¹⁸ Appellation d'origine contrôlée (At French national level)

Table 2 below shows the volume of PDO cheeses (in tons) marketed from 2012 to 2014, depending of the type of cheese.

Table 2: Volume of cheeses (tons)

	2012	2013	2014
PDO cheeses with cow's milk	163 395	163 535	165 941
“Pâtes persillées”	12 222	12 010	12 085
“Pâtes pressées cuites”	61 268	60 176	62 084
“Pâtes pressées non cuites”	53 357	54 550	55 119
“Pâtes molles”	36 548	36 799	36 653
PDO cheeses with goat's milk	6 275	6 367	6 471
PDO cheeses with sheep's milk	21 035	20 779	20 976
TOTAL PDO cheeses	190 705	190 681	193 388

The data come from ODG, INAO/CNAOL

It should be noted that cow's milk cheeses have different characteristics. We can distinguish:

- *Cheeses with “pâtes persillées”, a category in which Auvergne PDO cheeses such as Bleu d'Auvergne (42.58%) and Fourme d'Ambert (42.35%) predominate.*
- *Cheeses at “pâte pressée cuite” among which there are cheeses such as the Comté and the Beaufort, with the highest sales percentage for the Comté, about 87.39% in 2014 for the Comté. In this same category, there is also the French "Gruyère", and since February 11th 2013, its production is protected throughout the European Union (EU), by the PGI¹⁹ certification.*
- *Cheeses at “pâte pressée non cuite” where three PDO share the first place: the Reblochon with 27.47% and Auvergne PDO cheeses, the Cantal with 25.16%, and the Saint-Nectaire with 25.14% of sales marketed of this category.*
- *Finally, Cheeses at “pâte molle” whose leaders are Brie de Meaux, Camembert of Normandy, Mont d'Or and Maroilles. Their marketed rates range from approximately 11% to 17% of total cheeses of the market.*

¹⁹ Protected Geographical Indication

Among cheeses made with *goat milk*, the most sold in 2014 were: *Sainte-Maure de Touraine* (23.67%), *Rocamadour* (17.35%), and *Selle-sur-Cher* (15.04%) in the category of cheeses made with goat milk.

Regarding cheeses made with *sheep milk*, the *Roquefort* naturally ranks first in the market with marketed rate of more than 80% in this category of cheese.

Thus, the most marketed PDO/AOC cheeses are those made with cow's milk (with a share of 85.81% in the whole market), followed by cheeses made with sheep's milk and goat's milk. On the other hand, we can say that the total volume that was marketed increased by 1.3% between 2013 and 2014, compared with 0.75% for cheeses refined over the same period. During this period, cheeses made with sheep milk were the most stable.

PDO and non-PDO cheeses are mostly sold in hypermarkets and supermarkets. But, they are also found in the hard discount, small stores, on the internet as well as in other specialized shops. If the proportion of sales of PDO cheeses is decreasing in hard discount stores, small stores and on the internet, non-PDO cheeses are continuing to expand in online sales. Regarding prices, PDO cheeses are on average 65% more expensive than non-PDO cheeses. Nevertheless, there is a very large margin between prices of PDO cheeses at the factory level and prices of PDO cheeses at the level of final consumers.

In addition, France is the leading cheese-exporting country in the world in value, while Germany is the largest exporter of cheese in quantities. Among the European countries, the main exporting countries are Germany, UK, Belgium, Spain and Italy. Outside Europe, the United States holds the first place in imports of French cheeses, followed by Switzerland, followed by Japan in third place.

1.3.2. *The structure of market*

The structure of cheeses market at the level of the value chain is represented by several brands. The major national brands are: *Bongrain* has become *Savencia* (Coeur de lion, Elle & Vire, Saint-Moret), *Lactalis* (Président, Rondelé, Galbani), *Bel* (Apéricube, La Vache qui rit, Babybel, Boursin), *Entremont* (which passed to *Sodiaal*) and *Danone*. Major brands of

distributions are: *Auchan*, *Leclerc*, *Carrefour*, and *Intermarché*. But there are also cheeses which are sold without a distribution brand, as is the case in creamers and cheese stores.

The policy of product is usually determined by the format, texture or packaging of cheeses. The policy of communication is in particular through the television advertising and sampling. Price policy is the policy of alignment, because there is an alignment of prices to those of competitors at the level of the sector. But at the distribution level, each distributor sets its price according to its costs. The distribution is as follows: 43.7% in hypermarkets; 34.2% in supermarkets; 18.9% in hard discounts; 3.2% small and traditional markets.

In France, more than one third of French milk collected is destined for the cheese sector (36.8% in 2013 according to France AgriMer). The marketed quantities of PDO cheeses represent 91% of the turnover of cheeses under SIQO²⁰ and 9.5% of the marketed production of all cheeses in France, in increase since 2008. Within the dairy sector, this is a very important branch for the French economy. This turnover has increased significantly since 1998 (Inao). Between 2014 and 2015, the turnover of cheese PDO increased by 3%, partly due to higher prices for the *Comté*, *Roquefort* and *Saint-Nectaire* (about 40% of total turnover).

Within the PDO market cheeses, we concentrate on this thesis on the five cheeses from Auvergne. Indeed, *Cantal*, *Saint-Nectaire*, *Bleu d'Auvergne*, *Fourme d'Ambert*, and *Salers* are refined cheeses that shape the Auvergne dairy economy, and form the regional culinary heritage. They are products made in respecting traditional know-how, with strict and precise specifications, defining conditions of production allowing the former Auvergne region to offer typical and unique cheeses. These cheeses are present on the whole French territory and have undergone a series of reforms since the years 2009.

1.4. Market structure of Auvergne PDO cheeses

1.4.1. Auvergne PDO cheeses market in brief

Over the last few years, professionals have pointed to the difficulty of progression of Auvergne PDO cheeses in terms of marketed. Several causes have been mentioned, including:

²⁰ Signes d'identification de la qualité et de l'origine

the increase of the competition, the global economic crisis, restructuring of actors of the industry, ageing of customers, and difficulties to respond rapidly to changes in dairy consumption patterns and cheese products.

There is, however, a great diversity of performances within the sector. The PDO is supposed to represent a positive signal for the consumer; it puts him in confidence, brings a guarantee of quality and therefore appears as an added value for the consumers. However, the great diversity of performances within the sector brings back into question this commercial strategy, as is the case of cheeses from Auvergne.

Figure 3 shows a global view of sales of PDO cheeses, which clearly shows a general increase in sales of PDO cheeses, but a decrease in sales of Auvergne PDO cheeses. Nonetheless, the five PDO cheeses from Auvergne (*Cantal*, *Saint-Nectaire*, *Salers*, *Bleu d'Auvergne* and *Fourme d'Ambert*) have an important place, because they participate at almost 23.31% of the production in Tons) of PDO cheeses made with cow's milk and 19.96% of all French PDO cheeses. They also have a significant reputation in the national territory.

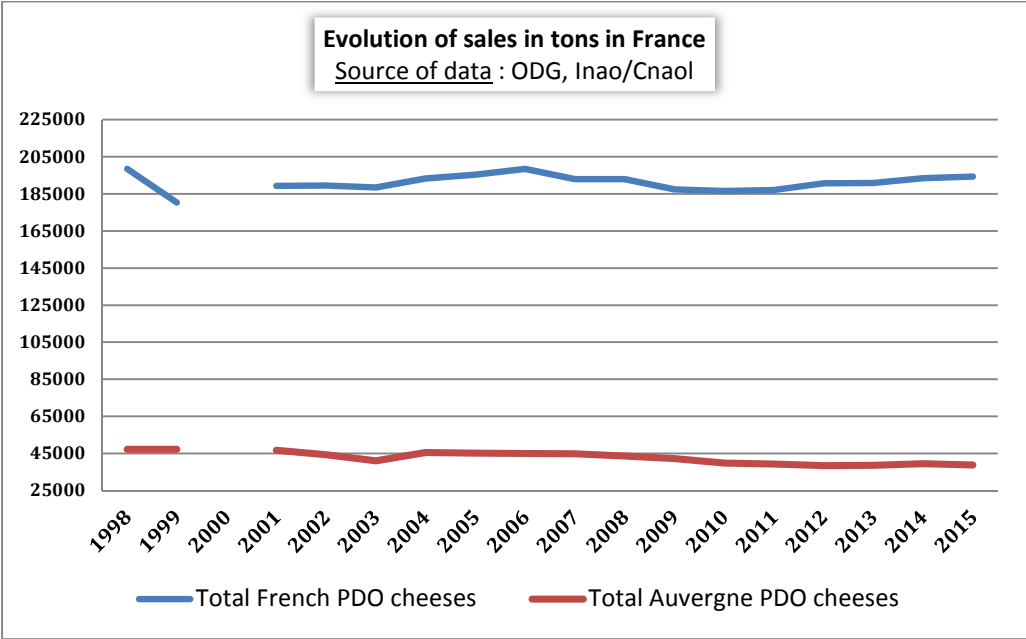


Figure 3: Sales (in tons) of all French PDO cheeses and Auvergne PDO cheeses, 1998-2015

Only the *Saint-Nectaire* (farmer) seems not to have experienced difficulties and even recorded a steady sales progression since 2002, as illustrated in Figure 4. The *Salers* seems to keep up, but for *Bleu d'Auvergne* or *Fourme Ambert*, we see a slight decrease, although the

Fourme Ambert seems to stabilize from 2012. The biggest drop here concerns the *Cantal*, which lost nearly 20% of sales between 1998 and 2015.

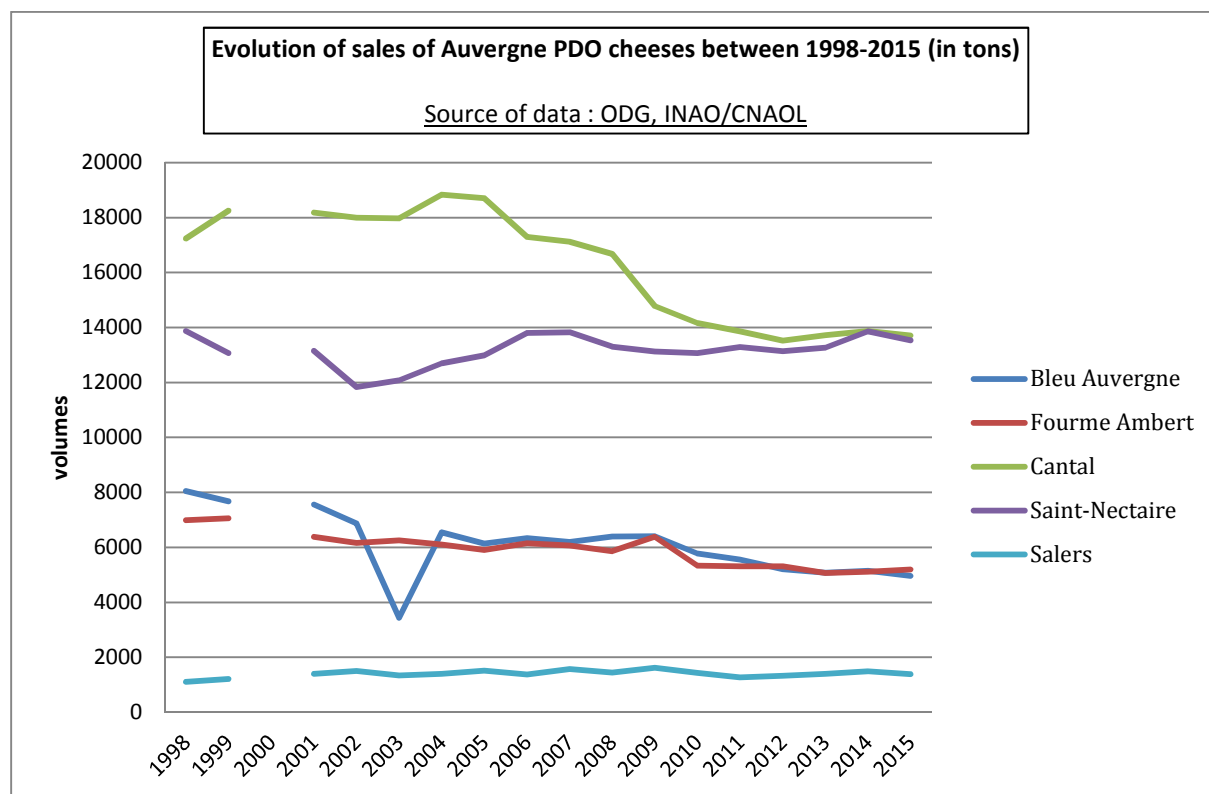


Figure 4: Sales (in tons) of the five Auvergne PDO cheeses (1998-2015), INAO/CNAOL

Conversely, cheeses from other regions such as *Abundance*, *Comté*, *Beaufort*, *Morbier*, *Brie de Melun*, and cheeses from Bourgogne region recorded the biggest increases, gaining a minimum of 20% sales growth between 2005 and 2015 (ODG, Inao/Cnaol). Despite a program of upgrading, Auvergne cheeses appear to be struggling to capture value and distribute the benefits in the sector. Incentives are still too low. At the same time, the national market of PDO cheeses appears to be relatively unaffected by the dairy crisis. It benefits from a differentiated tariff, and especially more stable by being disconnected to the price of the conventional milk.

1.4.2. Diversity of situations and performance

PDO are assets for economic development and can boost regional territories. However, Auvergne PDO cheeses perform differently depending on the cheese.

1.4.2.1. Fourme Ambert and Bleu Auvergne dominate the market of PDO “pâtes persillées”

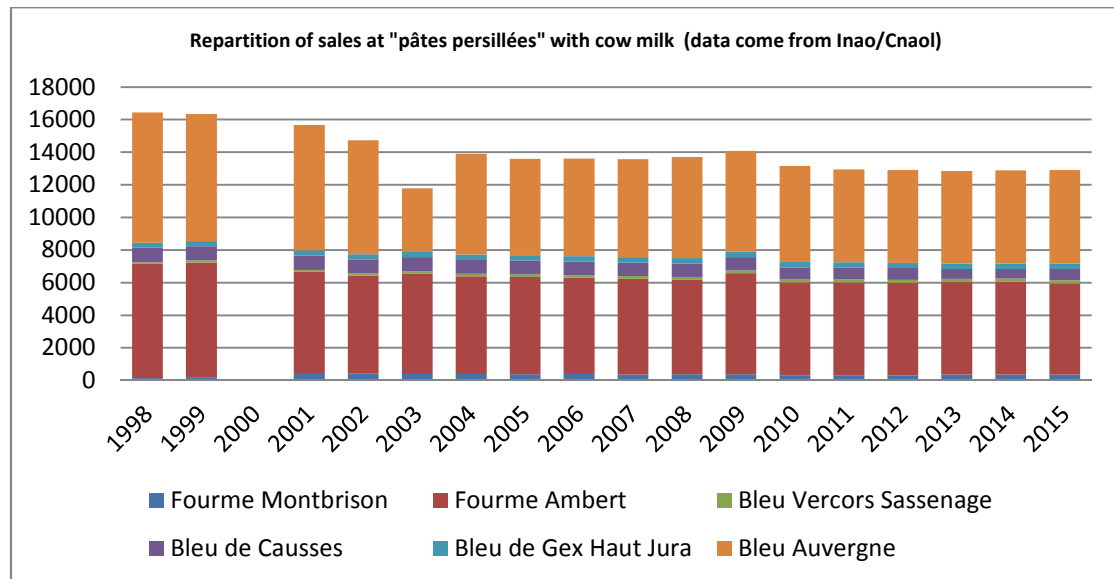


Figure 5: Distribution of sales (in tons) of “pâtes persillées” with cow's milk (1998-2015)

We observe the decrease of sales of all PDO cheeses to “pâtes persillées” (Figure 5), between 2005 and 2015, all PDO cheeses at “pâtes persillées” have declined by almost 15%. Cheeses at “pâtes persillées” from Auvergne are very well positioned on the market of PDO “pâtes persillées” with cow's milk. In 2015, sales of *Bleu Auvergne* represented 41.34% of the sales weight, and the *Fourme Ambert* represented 43.28% of sales. Together, they represented more than 84% of the market for “pâtes persillées” with cow's milk. Nevertheless, sales have decreased (-19.1% between 2005 and 2015), and these cheeses are heavily challenged at points of sale by products with a more standardized, creamy and softer taste, like *Saint-Agur*. They are also competing with equally typical products, such as the *Roquefort*, which dominates the shelves. Despite this, it is not the biggest drop; indeed, the *Bleu des Causses* for example, saw its sales decrease by 40.8% between 2005 and 2015. Note that the specification of *Bleu d'Auvergne* and *Fourme d'Ambert* authorizes the fabrication with both the raw milk and pasteurized milk.

1.4.2.2. Only the Saint-Nectaire (farmer) progresses within the “pâtes pressées non cuites” of Auvergne

It is in this category that we find three of our Auvergne cheeses, the *Cantal*, the *Saint-Nectaire*, and the *Salers* (Figure 6). Competition is more important, but the *Cantal* remains

the most sold within this family. However, it recorded a decrease in these sales, for example, a significant decrease of 26.7% between 2005 and 2015. In 2009, a major company in the sector closed its doors (*the Occitan cheese company*) because of certain difficulties met. At that time, the company accounted for 10,000 tons of the total marketed (16,500 tons), or about 60.60%. This landmark event had a negative impact on the PDO *Cantal* and contributed to negative effects that the sector suffered still today. This major event also affected sales of all other companies. The “*Occitan cheese company*” was bought by “*Sodiaal company*” in 2014, this new company represented in 2015 nearly 7,000 tons of the 14,000 tons marketed, that is to say 50%.

It should also be noted that since 2009 the PDO *Cantal* has invested approximately 2 million euros in the advertising campaign “*Chantal and Cantal*”. This advertising campaign that covered years 2009, 2010 and 2011 had a real effect on sales prices. But up to now, leaders of the sector can not quantify the impact of this advertising campaign on sales. This advertising campaign also enabled refiners to win new contracts outside the supermarket, for example at restaurants. It has also enabled the industry to rejuvenate its aging clientele. In 2012, the campaign “*Chantal and Cantal*” was replaced by the “*Moscato campaign*” for 4 new years. In total, the sector has invested approximately 9 million euros in communication (various and varied) since 2009.

The *Salers* also seems to have difficulty, seeing its sales decrease by 8.2%, still between 2005 and 2015. In 2005, a sanitary crisis involving the use of vats affected the PDO *Salers*. Traditionnaly, the *Salers* is made with “*wooden vats*”, but authorities demanded a “*stainless steel vats*”. Two years later, in 2007, leaders of the sector were able to convince authorities that “*wooden vats*” were able to give clean milk and the crisis was resolved.

Conversely, the *Saint-Nectaire* (dairy and farmer) has increased significantly inside the “*pâtes pressées non cuites*” category, with a slight rise of 4.2%. In 2012, this cheese also faced a scandal involving “*salmonella*” that produced infections among consumers. Salmonella-induced foodborne illness resulting in gastrointestinal disorders often accompanied by fever within 48 hours of consumption of contaminated products. *Saint-Nectaire* cheeses were therefore withdrawn from the sale due to this problem in several stores. Products concerned by this recall were those marketed between 10 August and 5 September

2012. This short-lived incident had an impact on quantities sold of *Saint Nectaire*. But the sector has not lost its sales momentum.

Overall, sales of all cheeses fluctuate but still remain steady, a decrease could be observed after 2008 but they were revitalized in 2010 and finally stabilized. But it is a decrease of nearly 5% that is recorded for the whole of this family between 2005 and 2015. After the years 2010, the *St Nectaire* and *Cantal* have comparable levels of quantities marketed, in spite of a reduction in sales of *Cantal* it remains the best sold among Auvergne PDO cheeses. But these quantities remain low compared to the *Reblochon* for example. Similarly the *Morbier* increased these quantities marketed to be today at the same level as the *Cantal* and the *Saint Nectaire*. This shows that Auvergne PDO cheeses outside the *Salers* are well positioned on the market, but are not the leaders.

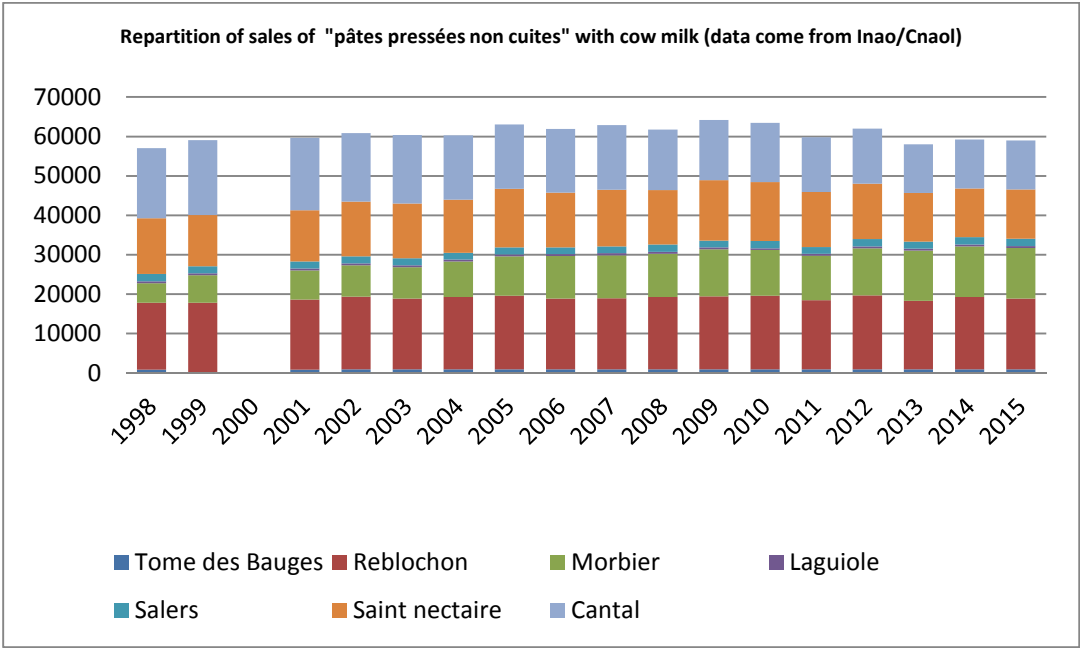


Figure 6: Distribution of sales (in tons) of cheeses at "pâtes pressées non cuites" made from cow milk (1998-2015)

1.4.3. Distribution channels

According to the INAO, in 2015, PDO cheeses in France were mainly sold (in terms of volumes) in hypermarkets, supermarkets and hard discount stores, at 80.6%. In the same year, Internet sales increased by 11.5%. Minimarkets accounted for 5.4% of sales, followed by the circuit of specialist shops (cheese makers, creamers, etc.) with 2.5%. Sales of cheeses within

the distribution were generally quite varied, almost as much as the number of PDO, and even the number of producers. The connecting networks depended on the store's policy, its location and whether it was an independent or integrated establishment. Similarly, each distributor practices its price, which is generally different from that practiced at the factory level. Prices of PDO cheeses at the retail level are sometimes twice prices practiced at the factory level; this denotes a capture of the surplus by distributors.

There is no “*Auvergne PDO cheeses market*”, since each cheese passes through different distribution channels and is produced by different actors (industrial, cheese dairy, creamer, farmers ...). Some products are mainly traded, bought and sold by national central purchasing or major groups of distribution in France, while others can be channeled through regional power stations. These purchasing centers may belong to integrated networks, but may also take the form of cooperatives in a part of the independent networks.

There are also wholesalers who can supply the distribution (integrated or independent) and also specialty stores that can not go through central purchasing. Finally, cheeses can also be sold directly, via manufacturers who can deliver their products directly to points of sale (especially in proven geographical proximity), or to small producers and local farmers. This is a rather complex organization, difficult to establish and standardize, which is dependent on each store and each brand. In addition, point-of-sale professionals are generally not very aware of all this routing.

Box 1: The diversity of modes of organization of distribution

There are two main modes of organization for the distribution sector. Establishments and central purchasing organizations are distinguished between two main types of networks, the integrated network and the independent network (including also the franchisees).

- Integrated networks:

This form of trade is based on a multitude of point-of-sale networks, all belonging to the same owner (the Casino group or the Auchan group for example). As a result, the establishment (the point of sale) is managed by the owner (group) and the sales outlets are managed by employees dependent on the group. The particularity of this mode of organization is that the one or those at the head of the network is in charge of the commercial policy (identical according to all the integrated stores) and the setting of prices otherwise.

- Independent networks:

The stores are owned by independent contractors who wish to take advantage of the group's purchasing conditions and exploit the name of a sign in exchange for the transfer of a part of the company's profits (In a franchise contract). E. Leclerc, Système U and Intermarché are part of a network of independents, points of sale are held by a person but not belonging to another legal entity, which manages the commercial policy of the establishment.

It is now complicated to carry out an organizational inventory of stores of the big distribution. The system is in motion; there are now meta-centers where different stores can buy and where sales manager's team can be partners to buy products at the lowest price. For example,

“Système U” joined forces with Auchan in 2015 with the objective of setting up common purchases but also of setting up common governance. This project was abandoned during the summer of 2016 (information relayed by “Le Monde” and “Les Echos”). This market seems increasingly oligopolistic, especially when it is known that “Intermarché” and “Casino” have also associated themselves with the purchase, just like “Cora” and “Carrefour”.

In spite of this, we list the most important players in the territory in Figure 7 below, in order of the weights of their turnover. This sector was able to adapt quickly to changes, new consumption patterns (drive development, proximity stores, etc.) by offering similar sales formats to each other.

Carrefour	Galec	ITM	Casino	Système U	Auchan	Provera
<ul style="list-style-type: none"> • Carrefour (Carrefour, Market, City, express, contact) • Shopi • Marché + • Huit à huit • Proxi • Ed • Dia 	<ul style="list-style-type: none"> • Leclerc (format hypermarché et supermarchés) • leclerc drive 	<ul style="list-style-type: none"> • Intermarché hyper • Intermarché super • Intermarché express • Intermarché Drive • Netto 	<ul style="list-style-type: none"> • Géant casino • Casino • Casino Shop • Petit Casino • Vival • SPAR • Franprix • Monoprix • Leader Price • Casino Drive • Sherpa 	<ul style="list-style-type: none"> • Hyper U • Super U • Marché U • U express • Course U.com 	<ul style="list-style-type: none"> • Auchan • ATAC • Simply Market • Les Halles d'Auchan • Maximarché • Auchan Drive • Auchan city • A2 Pas 	<ul style="list-style-type: none"> • Cora • Record • Match • CocciMarket • Coccinelle • Diagonal • G20 • Colruyt • Votre Marché • Halles Dis • Viveco • Sitis • Panier Sympa • Cora Drive

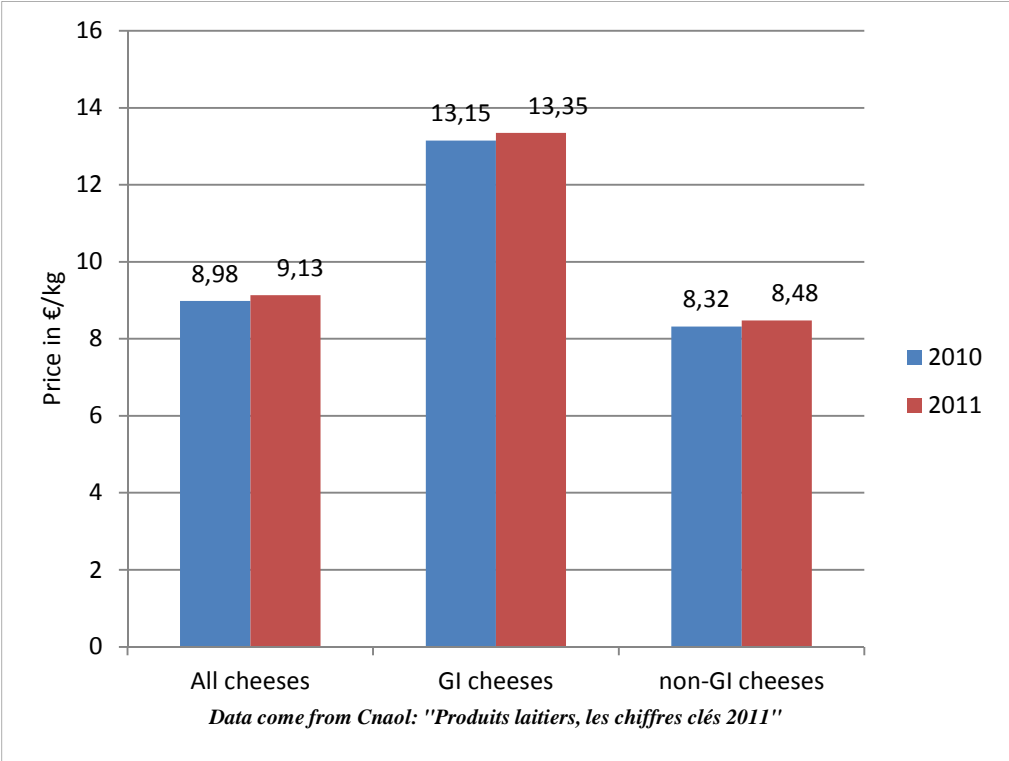
Figure 7: The main players in the retail sector in France

Within these same groups, stores can be independent or integrated, for example the “Casino” group offers entrepreneurs to become independent franchisees, therefore, not all stores in this large group are integrated. There are other brands, notably in hard discount stores, which occupy an important place in the distribution landscape: “Lidl” and “Aldi”, two German giants. Auvergne's PDO cheeses are generally passed by these various distributors, who practise their price at the level of the final consumer and it is these distributors who generally have the market power.

Figure 8 below shows the average prices of GI (PDO/PGI) cheeses in large & medium distribution and hard-discount over the period 2010-2011. We note that, on average, GI cheeses are more expensive than non-GI cheeses and this is linked to the code of practice related to the production of products under GI signal. We also observe that the price

differential between GI and non-GI cheeses remained stable between 2010 and 2011: 4.87 €/kg in 2011 (compared with 4.83 €/kg in 2010). GIcheeses were on average 57% more expensive for the consumer than non-GI cheeses.

Figure 8: average price of cheeses in euros/kg



1.5. Conclusion

The globalization of dairy markets and the exacerbation of competition in these markets have led producers to adopt different strategies. Some seek their competitiveness through the domination of costs, while others a non-cost competitiveness which takes the shape of a differentiation by the quality linked to the geographical origin of the product, this is the case of PDO cheeses in general and those of Auvergne in particular.

These Auvergne PDO cheeses do not escape the putting in the massive distribution by the large and medium surfaces whose objective is to make turn their sales stand. This involves a rotation of products on the sales stand, thus making promotions and the signalling of the quality as simple tools of functioning of stands of distributions. Indeed, in the reality the only signal of quality is not sufficient because there is a competition with a presence of non-PDO products which have marketing means.

In this chapter, we presented the functioning and the structure of the market of dairy products, particularly that of Auvergne PDO cheeses. These cheeses are very present in the French national markets. Knowing that they are massively sold in large and medium-sized surface, we ask ourselves if these cheeses would not have sufficiently adopted the techniques of sales of large and medium-sized surface by relying solely on the PDO signalling without sufficiently associate the advertising? Similarly, their characteristics do not confine them to remain cheeses without innovations, very traditional, not adapted to the expectations of the new generations and therefore the objective is to keep their traditional recipe which bases their reputation? In the next chapter, we set and delimit the theoretical framework allowing to answer these multiple questions, based on the economy of the information and industrial economy.

Chapter 2: Main Literature

Review

2.1. Introduction

Until the late 1980s, agriculture was a protected sector in Europe. Then the economy became global, and liberalization and deregulation became the dominant ideas. In 20 years, the market management tools of the Common Agricultural Policy have been dismantled. But the ideal world promised by economists has not materialized; agricultural markets are now suffering from a series of peaks and falls of prices, which generates unsustainable instability for farmers, threatening the survival of their activity. This can sometimes lead to public intervention. This public intervention is justified for at least three reasons: the natural instability of markets and prices; the provision of non-market public goods by farmers; And above all the need to guarantee the citizen access to adequate food in quantity and quality.

In the face of price changes in agricultural markets, there is a need to further coordinate global economic policies and to adopt regulatory measures. The instability of agricultural markets disrupts the economic decision-making of farmers and forces them to adapt to this phenomenon, which usually leads to additional costs, which are most often reflected by high prices at the level of the final consumer. In order to avoid or attenuate shocks resulting from agricultural price volatility, better coordination of economic policies is required in order to bring coherence to the economic orientations of the world economy, particularly in the European Union. It should be noted that the agricultural crisis, in a competitive context within the EU itself, strongly weakens certain agricultural exploitations, relegating them to the path of economic and ultimately social decline.

In such a context, economists have taken the habit to define the market as a meeting place between supply and demand of goods and services. This confrontation leads to exchange at a certain price, which is considered as the market price. The case of market PDO cheeses is interesting because consumers buy these products in large and medium-sized distributors, which is an essential mode of distribution for specific sales techniques, where products must constantly distinguish themselves in order to be chosen by consumers. Moreover, prices at the level of large and medium distributors do not always result from the confrontation of supply and demand, because these prices are sometimes twice as high as those practiced at the factory level. (Smith 1776) notes that individuals have a natural inclination to exchange and there is an invisible hand that allows natural regulation of activities in a market, for him outside

intervention is not desirable. But in the case of PDO market cheeses, the outside intervention is recommended to regulate this market and make the PDO signal effective.

Economic literature distinguishes several types of markets among which the perfect markets (perfect competition) and the imperfect markets (monopoly, oligopoly and monopolistic competition). The imperfect markets encounter most often functioning failures. The market failures can be of several types. We have failures related to the allocation of resources in the presence of public goods or externalities²¹ and the failures related to the asymmetries of information. We focus on the latter in this chapter; the section 2 presents the theoretical framework, with an emphasis on information economy and industrial economy. The section 3 presents different methods of valuation of willingness to pay of consumers. We conclude in section 4.

2.2. Theoretical Framework of Analysis

Information is said asymmetric when one of the parties has important information which the other party lacks, that it is information on herself or information concerning exchanged products. These problems of asymmetries of information lead to adverse selection. Adverse selection refers to a lack of information about a product to buy, for example, or an insured to an insurer. This information asymmetry will lead to bad selection and evaluation of the product, or to commit some error in the contract in the case of an insurer. The most famous example remains the purchase and the sale of second-hand cars, « the Market for Lemons », developed by (Akerlof 1970). This paper is without doubt relevant for addressing this notion of information asymmetries. The fact that sellers of "lemons" (this term refers to cars that are worthless) know much more about the state of their vehicles than buyers can lead them to anticipate hidden defects and offer low prices, with for consequence a withdrawal from the market of sellers of good quality cars, or even a collapse of exchanges.

Most markets are characterized by an asymmetry of information, as that of the car insurance where the insured knows more about his driver's qualities than about it the insurer, or still that of the credit where borrowers are better informed about their financial situation and about

²¹ We speak of externalities when the actions of an economic agent have a positive or negative impact on the well-being and the behavior of other agents without monetary compensation (this impact is not taken into account in the calculations of the agent that generates).

projects for which they try to finance that lenders. We also find this problem in the case of foodstuffs where the sellers know perfectly the quality of their product, whereas the buyers have only subjective information.

When it is considered necessary, public policies intervene to correct these failures, in particular by supporting the production of public goods and putting in place measures to reduce negative externalities or otherwise encouraging actions of general interest. The State can also force the agents to reveal the information (for example by requiring the mandatory display of food composition).

In perfect markets, consumers are informed of all characteristics of a product. However, some neo-classical economists have shaken this perfect information hypothesis, starting with Akerlof within “market for lemons”. It especially underlines that the consumer must make its consumption choice under limited information over the quality of the product. In most cases there exists an information bias between the producer and the consumer, the latter being not able to exhaustively assess characteristics of a good. The quality of a product is considered as the combination of a certain set of characteristics, some being known by the consumer, some not. There exist different types of products according to the ability of the consumer to assess its characteristics, i.e. its quality. The consumer can identify the product’s characteristics before (search goods) or after its consumption (experience goods (Nelson 1970)) or with important information costs (credence goods (Darby and Karni 1973)). Without State intervention, the consumer must make its consumption choice under strong uncertainty over the quality of the product. The information bias can significantly affect the general welfare. Whenever the trust of the consumer is deceived by the misleading quality signal of the producer, the latter capture a share of the value he should not. This market imperfection is considered as the economic rationale for the implementation of public policies decreasing consumers’ uncertainty. These can take the form of intellectual property rights (IPR) protecting the name associated with the specific quality of a product. For example, Geographical Indications (GIs) are a special case of IPR in the extent the specificity of the product is linked to its origin. If these IPR are properly enforced, they will drive producers whose products do not comply with the quality required to leave the market. Thus, by purchasing a product labelled as GIs, a consumer is insured for example to enjoy a certain typicity that is a given set of characteristics. As a consequence, a reputation common to all

producers is built upon this certain level of specific quality expected by the consumer and enforced by law.

2.2.1. The theory of signalling and its implications

It calls into question the transparency of the market, which is a condition of perfect competition. The economy of the information suggests that the asymmetry of information with regard to the quality of the product affects the performances of the market. Recent authors studied the problem of asymmetric information in the labor market (Rao, N. 2016), in the financial market (Roberts, M. R. 2015), in both bilateral or multilateral trade and insurance market Attar & d'Aspremont (2017). De Meza & Webb (2016) found that there is an asymmetry of information on the insurance market if buyers of a high coverage and low coverage contract, identical to the observation, have the same rate of loss. Glode & Opp (2016) proposes a parsimonious model of bilateral trade under asymmetric information. Their model presents a classic problem in economics where an agent uses its market power to inefficiently detect an informed private counterpart. They found that involving medium-sized intermediaries, also with market power, can improve trade efficiency. García-Sánchez & Noguera-Gámez (2017) examine the possible links between integrated information disclosure and the degree of asymmetry of information in the financial market. They found that there is a negative relationship between the asymmetry of information and the disclosure of an integrated report, indicating that the use of this tool for information can help to attenuate agency problems, to facilitate the company decision-making and to improve the information among investors. They also observe that companies that report a lower quality of financial information have a greater reduction effect on asymmetric information than companies with higher quality annual accounts. Seshan, G., & Zubrickas, R. (2017) examines the asymmetric information on migrant earnings and its implications for remittances behavior using a sample of Indian households with husbands working in Qatar. They found that, on average, wives do not report their husbands' income and under-reporting is more prevalent in households with high-income migrants. The difference in earnings ratios is strongly correlated with the change in remittances: greater under-reporting by women is associated with lower transfers of funds.

Previous theses authors, (Arrow 1973) and (Phelps 1972) studied principles of this type of problem "lemons" on the labor market. Based on the theory of discrimination, they show that employers attribute to the productivity of the minority races workers a lower subjective

probability with regard to the white workers. In case of asymmetry of information, "good" agents (quality seller, insured with not much risk, honest, competent person, etc.) fetch to distinguish themselves. But for this signal to be credible, it must not be sent by a "bad" agent. On the labor market, it is the diploma which plays this role. Indeed, the time dedicated to pass the diploma is expensive both in monetary terms, but also in term of efforts, because it means the sacrifice of immediate gains for the benefit of future income. Moreover, the effort is greater when skills are lower. Therefore, it is more expensive for a little talent agent to pass a diploma. So, it is possible to say that the signal of the diploma is credible, especially if the diploma is difficult to pass. In this case, it indicates even more capacities of agents.

Since the article of (Akerlof 1970), economists recognize that the asymmetry of information has important effects on the allocation and distribution of resources. It gives to participants of the market incentives to begin expensive actions to indicate their private information (Spence 1973), invest in the reputation (Klein and Leffler 1981), or emit guarantees. This shows that information asymmetries find their solution in the industrial economy.

(Nelson 1970) identify three categories of goods according to the ease with which the consumers can have access to the produced quality:

- *Search goods* (these are goods that consumers can determine the quality prior to purchase by means of inspection or investigation;
- *Experience goods* (these are goods that the consumer can define the quality only having consumed them;
- *Credence goods* (for this type of goods, neither the information supplied before the consumption of the good, neither the consumption of goods in posteriori allows to define the quality of the good.

Studies in the literature of the marketing on the relationship between price and quality are not conclusive. Many studies indicate that the price-quality relationship is weak ((Morris and Bronson 1969); (Sproles 1977); (Riesz 1978), (Riesz 1979); (Gerstner 1985)). Rao and Monroe (1988) provide a theoretical analysis of the influence of signals from the use of knowledge to deduct the quality of products. They show that a consumer with low knowledge uses extrinsic signals such as the price to estimate the quality. When the consumer reaches a moderate level of knowledge, it is able to consider the intrinsic information and the use of

extrinsic signals thus decreases over time; then the knower acquires the ability to diagnose if the extrinsic information is really correlated to the quality. (Scitovszky 1944) notes that the use of price as a quality signal corresponds to a rational behavior and reflects the learning on the correlation quality-price established on the market. Although the new consumers count on intrinsic characteristics of the product, experts consumers use signals such as the brand ((Bettman and Park 1980), (Cheskin 1971)).

For a wide variety of consumer goods, there are empirical proofs of a positive correlation between the quality and the price (Gerstner 1985). (Ruffieux and Valceschini 1996) present this quality as the result of a dialogue between producers and consumers. This dialogue would result, according to authors, in the socialization of preferences and signs of identification of products. But for some products the quality level is not so easy to identify, even when the signals exist. (Cooper, Bowen-Pope et al. 1982), (Rogerson 1980) also examine the supply of the quality in markets where consumers have imperfect information. (Dewally and Ederington 2006) discussed 3 possible strategies for retailers or suppliers in situation of asymmetry of information to supply a high quality signal. Among these strategies which we find in the industrial economy, we have: the reputation, the certification and the advertising.

2.2.2. Reputation

The role of the reputation in a competitive market where the quality of the product is not observable has been much studied in the literature. A number of authors have developed theories of the reputation which allow asymmetries of information to be overcome ((Weizsacker 1980); (Shapiro 1982)). In the presence of a large number of products, it is difficult to observe the quality before the purchase, and firms are therefore encouraged to sell low quality products at the same price as products that have a high quality. (Shapiro 1983) affirms that it is necessary to invest resources to build a reputation on the products of high quality or which have a good value. (Tirole 1988) and (Stiglitz 1989) show that the reputation of products allows to reduce the failures of market resulting from the asymmetry of information. Consequently, to be necessary in certain environment, the reputation is a reliable indicator of the quality (Hjorth-Andersen 1991). (Klein and Leffler 1981) develops a model of competitiveness, in which the firms that produce the poor quality goods and sell these goods at similar prices to the good quality goods, acquire a bad reputation and will consequently be to evict from the market. (Shapiro 1983) suggested a model without competitiveness of prices,

where firms enter on the market of high quality by selling first high quality products at a minimum price. The quality/price ratio is such that this initial investment allows to reconcile the premium for later periods provided that no company enters and increases its wealth. (Hayek 1948), but also (Marshall 1949) considers the reputation as an effective way to insure the realization of contracts in the absence of a third party (for example a referee). The solution remains, for sellers of high quality, to send other types of signals as: the advertising, guarantees, labels ((Spence 1974) and (Milgrom and Roberts 1986)). (Milgrom and Roberts 1986) focus on the phase of introduction of the life of no Sustainable goods and argue that prices will rise over time that buyers will repeat their purchases and learn on their own preferences and sellers acquire a reputation at the same time. In a dynamic model of learning of consumers, (Judd and Riordan 1987) shows that prices of the high-quality products tend to increase after the period of launch of products, because the signal does not happen until consumers have an experience with the product. Indeed, as demonstrated by (Klein and Leffler 1981) or (Shapiro 1983), to decrease the quality entails immediate cost savings, while the level of reputation will fall only in the long term (problem of transmission of information). These authors tend to conclude that the equilibrium price included a premium for quality. (Gergaud and Vignes 2000) show that for the case of the champagne (credence goods), companies exploit the fact that it is difficult to judge the quality of the champagne after consumption to invest in the reputation of this product either by means of the quality, or by that of the fame (via the advertising).

2.2.3. Advertising

In a general way, economic literature shows that, when the quality level becomes difficult to estimate, the producer will tend to emit signals of the quality level of the product in order to convince buyers. In his article, (Nelson 1974) provides evidence suggesting an important role of the advertising as channel allowing to transmit a quality signal. Joining this conclusion, (Nichols 1998) also find solid proofs of a positive correlation between the quality and the advertising. In a great majority of cases, standard models of signal of information predict a positive correlation between the quality, the advertising and the price for products recently introduced ((Kihlstrom and Riordan 1984); (Milgrom and Roberts 1986)). (Moorthy and Zhao 2000) find a positive relationship between advertising spending and perceived quality. So more advertising spending increases, more the quality perceived by consumers is high. (Nelson 1974) argues that for the quality of experiences goods, advertising cannot supply

solid information to consumers, but can convince them that goods is of high quality because the advertising is expensive. Indeed, only a company producing goods of high quality could produce enough to recover costs of advertising. (Schmalensee 1978) supporting Nelson's point of view developed a model in which the advertising is correlated to a low quality because of the limited rationality of consumers. On the other hand, (Horstmann and MacDonald 1994) contested this Nelson's idea, arguing that it is based on a thorough knowledge of quality after consumption. They developed a model in which they show that the experience of consumption is an imperfect indicator of the quality of the product. ((Butters 1977) and (Grossman and Shapiro 1984), show that the level of information of the advertising is a function of the size of the market. ((Kirmani 1990) and (Kirmani 1997)) show that, in the case of the advertising, the excessive spending suggests to consumers that the company is desperate. In this case, the relationship between advertising expenditure and perceived quality has an inverted U-shaped curve.

We thus observe that problems of asymmetry of information find their solution in the industrial economy through, for example, the reputation, and the advertising.

2.2.4. Others signals

Recent authors like Dehlen, Zellweger & al. (2014) show that the information asymmetry can be mitigated by activities such as the screening of owners and the transfer of efforts of candidates to reveal candidates' abilities in family firms. Tran & Desiraju (2017) show that social media and technology reduce the information asymmetry, in markets. Courtney, Dutta & al. (2017) relies on the information economy to examine when signals and references obtained from multiple information sources improve or decrease effects of the other. They found that signals through start-up actions (use of media) and characteristics (experience) can mitigate asymmetric concerns about the quality of information.

Other signs of qualities can be useful for consumers as information signals. We can quote: the name of the shop (Jacoby, Olson et al. 1971) ; ingredients (Rao and Monroe 1988) ; recommendations of friends (Nelson 1970) ; magazines intended for the consumers ((Archibald, Haulman et al. 1983), (Nelson 1970)) ; the previous use and the label (Stokes 1974) ; announcements ((Nelson 1974), (Milgrom and Roberts 1986)) ; country of origin

(Hong and Wyer Jr 1989). We will focus on certification labels, specifically on geographical indications (GIs).

2.2.5. The certification labels as a solution

Economic literature shows that labels and certifications are a means to overcome problems of asymmetries of information (Linnemer and Perrot 2000), but they require themselves a confidence and a correct interpretation of the supplied information (Larceneux 2003). Many consumer studies showed that individuals base their decisions of purchase on indications of information (Samiee 1994). Therefore, certifications and labels, which enter the disciplinary field of the industrial economy also appear as a solution to the problems of asymmetries of information.

2.2.5.1. Certification and labels

Certification can be defined as a process by which a level of unobservable quality of certain products or the company is known to the consumers by a system of labeling, which is usually delivered by a third independent party (Auriol and Schilizzi 2015). The latter examine the problem of signal of information of the quality of goods when the quality is never observable for consumers. For them the solution to this problem is the certification which acts by transforming unobservable attributes into observable attributes. Their analysis of the impact of systems of certification on the structure and the performance of the market leads to the conclusion that the certification is preferable when it is realized by an independent body which can be or a private firm or a public body (Marette, Crespi et al. 1999) and (Marette and Crespi 2003) argue that producers must indicate the quality to consumers, hence the necessity of certification. They show that in the absence of certification, consumers cannot know the total quality of the product which they buy, thus they can deduct an average quality.

(Caswell and Padberg 1992) discuss the possibility of a label of food as the answer to the imperfect information problem in food safety. (Caswell and Mojduszka 1996) claim that the signaling of quality through label promotes market incentives with a limited implication of the government. Labelling can play many different functions, such as the identification, the description or the promotion of food products ((Teague and Anderson 1995); (Bernués, Olaizola et al. 2003)). (McCluskey and Loureiro 2003) also show that the labeling of food

plays an increasingly important role in the food marketing system, as consumer demand for agricultural products becomes more and more complex and dynamic. Consequently, labels are a part of the set of information used by consumers to make decisions of purchase of products ((Verbeke and Viaene 1999) ; (Salaün and Flores 2001)). A quality label can differentiate products by widening the attractiveness of these products or by assuring consumers certain quality level ((Bernués, Olaizola et al. 2003) ; (Caswell and Mojduzka 1996)). ((Hennessy 1996); (Golan, Kuchler et al. 2001); (Hobbs 2003)) underline that the main reason of adoption of strategies of labels by agents is that they transmit the information to consumers and stakeholders. We note that several authors support the idea that labels have a positive effect on consumer demand, because they help the latter in their decision of choice of consumption of products.

2.2.5.2. Geographical indications

Geographical indications are positioned as important strategies of signaling information for consumers. Unlike other categories of intellectual property rights such as certificates and trademarks, there is no generally accepted definition worldwide for geographical indications (Escudero 2001). Nevertheless the World Intellectual Property Organization (WIPO) defines a geographical indication as a sign used on products which have a geographical origin and which possess qualities, reputation or characteristics essentially due to this place of origin. The article 22 of Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) defines geographical indications as « Indications which serve to identify a native product of a particular territory and where the quality, the reputation or the other characteristics of this product are essentially attributable to its geographical origin ». Most of the time, a geographical indication contains the name of the place of origin of products and evokes a complex image of a region, including the culture of the people who live there.

Agricultural products have generally qualities which result from their place of production and are influenced by specific local geographical factors such as climate and soil, where from it is easy to register these last under GIs. The recognition of a sign as a geographical indication matter of national law, thus it is not imposed by international authorities.

Geographical indications can be used for a big variety of products, be they natural, agricultural or manufactured. Geographical indications are not exclusively commercial or

legal instruments, they are multifunctional. On the development side, some GIs generate an increase of the rural employment and a better quality of this employment (Giovannucci, Josling et al. 2009). On the corporate side, GIs are directed to the market. They often align themselves with the emergent commercial requirements, because they tend to bring standards of quality, traceability and food safety (Giovannucci, Josling et al. 2009).

Among geographical indications, we can mention "Protected Designations of Origin" (PDO), "Protected Geographical Indications" (PGI), and "Traditional specialities guaranteed" (TSG), which are EU labels. These labels are instruments of a policy of rural development at the base, but they also help consumers in their choice because they are quality labels. The PDO label indicates that the product is both produced and processed in a particular geographical region and has qualities or characteristics essentially bound to this geographical area. The PGI label indicates that the product is produced and/or processed in a particular geographical area. The PGI has a greater flexibility than the PDO, as long as the product presents a well-defined quality, a reputation or other characteristics which are attributable to the geographical zone (Giovannucci, Josling et al. 2009). TSG indicates that the product is traditional, or established by the custom (at least a generation or 25 years). These GIs are not just for European farmers, but they are also open to farmers in non-European countries, such as those in developing countries. This window of opportunity for rural producers in developing countries to reach European markets with a geographical identity requires that the GI is protected in the country of origin with a detailed product description and a governing body that will supervise the conformity of the latter.

The European Union created these instruments of protection and certifications with the aim of guaranteeing the quality of products according to their link with a particular territory. In 1992 Regulations of the European Union (EEC) 2081/92 has established and harmonized a set of rules and certificates associated to promote and protected the agriculture and the production of goods in connection with a place of origin where from the PDO and the PGI. These labels, guarantee not only the territoriality but also the identity of products, in particular the PDO label, established by the EEC regulation N°2081/92, and replaced by the EC regulation N°510/2006. These certifications are indications intended to supply to consumers of the information on the authenticity, the origin and the safety of products in question. The diversity between the member of States of the EU, as well as the necessity of improving the image and the credibility of consumers, justified the implementation of these regulations

(ECC) N°2081/92 on the PGI and the PDO concerning agricultural products and foodstuffs. The interest of consumers for the authenticity of products is also one of the main reasons of the introduction of these regulations of the EU in 1992.

Empirical analyzes have shown for example that the PDO label seems to contribute positively to the promotion of sustainable rural development (Belletti and Marescotti 2011) and rural employment, especially through the market in "downstream" (Bouamra-Mechemache and Chaaban 2010). In a general way, GIs improve the use of local resources and prevent the usurpation of producers' rights (Vandecandelaere, Arfini et al. 2010). They also play a role of prevention of the failure of the market by correcting the asymmetry of information between sellers and consumers (Deppeler, Stamm et al. 2011).

Several authors studied the functioning of certain sectors under geographical indications and their economic impacts (Jeanneaux, Callois et al. 2009); (Barjolle and Chappuis 2000), (Jeanneaux 2009) ; (Barjolle and Jeanneaux 2012) ; (Jeanneaux and Perrier-Cornet 2011). (Peri and Gaeta 1999) show that the PDO/PGI systems aim to increase the value of the products as these systems require tighter regulation, in terms of respect for the code of practice. Thus, the label PDO makes that consumers accept more easily the product, by increasing their belief to this product, especially when they are new products. GIs labels were also considered by many authors as a tool to communicate not only the specific characteristics of the product linked to a specific area, but also the technical production requirements (Réquillart 2007). (Moschini, Menapace et al. 2008) found that GIs can provide competitive quality products and lead to welfare gains to be clear in competitive markets with free entry and exit. Thus these labels reduce the confusion and costs of search for the information about the quality (Dimara, Petrou et al. 2004). The food quality labels can be considered as having a supply and demand which interact to determine an equilibrium market price (Caswell and Mojduszka 1996).

(Barjolle, Sylvander et al. 2007) made a comparison of quantitative price data from various PDO, and show that the PDO cheese organizations can obtain a premium level of consumption and to distribute this additional value for producers. This means that the PDO label favors the emergence of a higher premium on the side of consumers, which could be captured by producers. (Valceschini 2000) shows that regional labels of certification indicate the authenticity of a product; they ensure that the protected product is an authentic product

actually produced in the region designated by the name of the product. The geographical origin of a product can thus have effects on the evaluation of this product by consumers, so that a particular origin can have a positive influence on the evaluation of a product, while having a negative influence on the evaluation of another one ((Wall, Liefeld et al. 1991). (Cañada and Vázquez 2005) argue that strategies based on PDO labels contribute to increase the value of the agricultural and rural resources corresponding to the demand of consumers. These labels allow consumers to have information about the quality and geographical origin of the products they consume.

On the other hand, some studies show that the quality of product is bound to the image of region of origin of product (Van Ittersum and Candel 1998). Thus the attitude towards the region of origin is considered as a measure of the general image that consumers hold of this region. As the attitude towards a region based on a wide range of beliefs and experiences, the attitude towards the region of origin is supposed to influence the preference of products both directly and indirectly, through the perception of the attribute of the product ((Hong and Wyer Jr 1990) ; (Hong and Wyer Jr 1989)) and the specific image of regional products. ((Kuznesof, Tregear et al. 1997) ; (Tregear, Kuznesof et al. 1998)) show that consumers place a high value to products which are associated with particular places and specific geographical regions. Therefore, authors identify characteristics such as the ethnocentrism (Shimp and Sharma 1987) and the patriotism of consumers (Han 1988) which can explain why certain consumers may more be interested to know the origin of products they consume. (Shimp and Sharma 1987) found that the ethnocentric consumers might more estimate negatively foreign products and less willing to buy imported products. According to them, these products do not guarantee a high quality, contrary to local products. (Han 1988) also noted that patriotic consumers have a negative bias towards the purchase of foreign products. However, contrary to conclusions of (Shimp and Sharma 1987), he found little evidence of negative bias evaluations of foreign products by consumers. This suggests that the strongly ethnocentric consumers use geographical labels to make decisions of purchase. Thus the information about the origin has a considerable influence on the acceptance by consumers and the success of products (Dichter 1962). In developing countries, an inverse effect was found, with consumers preferring foreign products with compared with those of state-owned companies ((Batra and Sinha 2000) ; (Okechuku and Onyemah 1999)). Thus consumers of these countries are not ethnocentric. Some studies also show that these labels of geographical origin can be used as a benchmark and as stimulus of information about a product used by consumers, to deduct

beliefs concerning attributes of products such as the quality ((Bilkey and Nes 1982) ; (Steenkamp 1990)). In addition to its role as a quality index, geographical origin labels have symbolic and emotional significance for consumers. Thus, there are cognitive, emotional and normative mechanisms which govern effects of these labels (Verlegh and Steenkamp 1999).

(Callois 2006) studied another angle of the question and reminds us that the objective of the label is not always the search for the quality, but it may be related to the specific image of a region. Thus, the GIs label can pursue objective of marketing (advertise quality), but it can also be a way for a region to improve its reputation. The fact that some products under PDO labels are associated with a region may cause or bring a development of the tourism in this region. He also found that the social impact of GIs is more important than the economic impact. The author analyzes the impact of collective social welfare, but he does not tell us how consumers of GIs product interact socially to build this well-being, hence the necessity to raise the problem of social interaction in decisions of consumptions of consumers. Because the author considers the reputation, the price, the advertising, labels and certifications as identifications signals of the quality of a product.

Thus, we note that the literature does not decide on what gives value to the GIs signal even if it suggests a high importance to the image of the region, sometimes more than the intrinsic quality of the product. Given the importance attached to geographical indications as an information signal, it seems increasingly important to evaluate the willingness to pay (WTP) of products bearing this label of quality and then evaluate its efficiency. But before, it will be important to know methods of evaluation used in the economic literature.

2.3. Willingness to pay of consumers: Methods of Evaluation in the Economic Literature.

The literature on willingness-to-pay (representing the price premium that an individual or a group is willing to pay to acquire or improve a given entity) is intended to identify parameters that determine consumer choices, in cases where property characteristics are poorly known (beliefs) or more generally when markets operate imperfectly. This literature has many applications in environmental economics, but it is also applied massively to products of consumption (Tse, 1999). This literature is generally divided into two main families of

assessment methods, namely: methods based on declared preferences and methods based on revealed preferences.

2.3.1. Declared preference methods

These models are frequently used when there are no markets for products to be evaluated. These models are based on hypothetical and not hypothetical scenarios. They are most often referred to as ex-ante methods. The great advantage of these models is that they make it possible to evaluate marketable goods and non-market goods. But in this thesis we do not use these models because we do not carry out field surveys or experiments.

2.3.1.1. Conjoint Analysis

It is based on the theory of [Lancaster \(1966\)](#) and is generally based on surveys. With this method, the monetary values are deduced from the arbitrations carried out by individuals interviewed between different attributes of the product. The price is also considered as an attribute. This method is very suitable to support decisions where several scenarios are possible and allows to classify the scenarios without necessarily estimating their respective monetary values. It can be used in many fields. It makes it possible to evaluate the value of goods, even by persons who do not use or consume these goods. It can be used to evaluate the value of all impacts of a scenario as well as that of an isolated impact. It makes the interview easier for interviewees, because they can make a qualitative choice between several alternatives, than to give a monetary value. Its greatest disadvantage is that it is based on surveys. This leads to several biases, for example the questionnaire bias, questions may be poorly formulated by the interviewer.

2.3.1.2. Contingent valuation

This method such as the conjoint analysis is based on survey data. It allows to obtain preferences of interviewees in monetary value, for a change of price or quality of a particular property or a service. It is very useful to evaluate the value of both marketed and non-marketed goods. These preferences, expressed in monetary value, provide information on the maximum WTP of respondents. The idea is to ask interviewees, the price they are willing to pay for the good or product. It is a method based on hypothetical scenarios. This method takes

into account responses of individuals who do not use the good and can be applied in many areas. We also find in this case the bias of the questionnaire and also the response bias, because interviewees may overestimate or underestimate their WTP.

2.3.1.3. Choice Experiment

It allows to measure the WTP of consumers for a good according to attributes of this good, the price being one of these attributes. There are some differences with respect to conjoint analysis and contingent valuation. It based on the theory of [Lancaster \(1966\)](#) and [Thurstone \(1987\)](#) which states that an individual that choose from a range of choices, maximizes this choice. This method takes into account the status quo in decisions, that is, situations where respondents are indifferent to all choices. The particularity of the "choice experiment" is that the information is gathered using a selection card, in which all the attributes of the product are presented to the interviewees. It is even possible in some situations to touch the product or taste it. The method of choice experiment is based on hypothetical and not hypothetical scenarios. The difference in results in the WTP assessment between these two scenarios is referred to by [Yue and Tong \(2009\)](#) as "hypothetical bias". [Kallas et al \(2007\)](#) show that the strength of this method is its ability to evaluate goods that consist of several attributes. This method is considered to give a response to the limits of the contingent valuation method.

2.3.1.4. Experimental auctions

This method is widely used in experimental economics. Here, participants submit bids for one or more products, with the ability to negotiate for products of higher quality. This particularity gives this method a certain difference compared to other methods, because here there is an incentive mechanism which encourages participants to reveal their true WTP and avoids strategic biases ([Sichtmann & Stingel 2007](#)). It is noted that people who overestimate their WTP will increase their chance of winning the auction, which generally leads to buying or acquiring the asset at a price higher than the veritable WTP. This method is very heavy; participants must be quite numerous. The literature states that there are two major auction types. Bottom-up auctions, we start with a low price and the good is awarded to the highest bidder. Top-down auctions, in this case, we start with a high price and this price decreases over time (example: auctions in a fresh fish market), the good is attributed to the highest

bidder, but the latter must also be reassured quality, because this type of auction is carried out on perishable products.

2.3.2. Revealed preference methods

These methods are used when goods or services for which the WTP is intended exist. They are most often referred to as ex-post methods because the data already exist. It should be noted that methods of disclosure and collection of information are very different from those based on declared preferences.

2.3.2.1. The method of transportation costs

With this method, we evaluate the value of a good according to expenses that we consent to acquire this good. For example, the economic value of a site for recreational use can be estimated from the expenditures incurred by users to go to this site. Access to the resource is usually free of charge, but the value of the resource is determined by the monetary value of time and all other expenditures made to access the site or resource. It is not based on hypothetical choices and is relatively inexpensive to implement. But as a disadvantage, we can observe that individuals who like the site too much will choose to live near and will not spend much to get there. It requires having people who come from different backgrounds and far enough so that the costs of transport are not all the same. This method is not suitable in the framework of this thesis, so we do not use it.

2.3.2.2. The hedonic price method

It consists in determining the implicit price of an asset, depending on attributes of this asset and characteristics of consumers. It was from the 1960s that analyzes of the hedonic prices of goods which differ in their characteristics started to develop. But, [Waugh \(1929\)](#) already stated that the quality of vegetables is defined by their characteristics. To do this, he calculated the price of each attribute by applying statistical techniques. Ten years later, [Court \(1939\)](#) studied the automobile market by analyzing the impact of various components of the automobile on the price of this good. Analyzes of [Adelman and Griliches \(1961\)](#), [Lancaster \(1966\)](#), [Griliches \(1971\)](#) and [Ironmonger \(1972\)](#) on the divisibility of goods provided the theoretical basis for the hedonistic method ([Soguel 1994](#)). [Lancaster \(1966\)](#) states that the satisfaction of consumer does not come from the product, but from attributes that characterize

it. Rosen (1974) has formalized the determination of demand functions of characteristics by using the hedonic price method. This method allows the evaluation based on values derived from choices actually observed and not hypothetical. But it should also be noted that results of this method depend strongly on the specification of the statistical model and also strongly on the accessibility to the data. We do not use this method as part of this thesis, despite its relevance.

2.3.2.3. Market price method

The method of market prices allows to estimate the economic value of goods or ecosystem services that are sold or bought in markets. It uses standard economic techniques to measure the economic benefits of goods and services available on markets. The measures are based on the quantities of goods or services purchased at different prices and on the quantities supplied at different prices. The market price represents here the value of an additional unit of a good or service. The advantage of this method is that it uses the observed data of preferences of consumers, but it remains limited to commercial goods and services. We use a version of this method as part of this thesis based on scanned data and econometric estimations to reveal preferences and WTP of consumers for Auvergne PDO cheeses.

2.4. Conclusion

In this chapter, we set out the theoretical framework on which our doctoral thesis is based, namely the economy of information and industrial economy, the first one finding its solutions in the second. We have shown that the signals of information such as the advertising, the reputation and certifications labels as the geographical indications allow to indicate the good quality of products and thus complete the traditional signal that is the “price” of the product, by reducing information asymmetries.

The theory of signals of information highlighted the problems of asymmetries of information existing on markets. Asymmetries of information do not facilitate the choice for a better satisfaction of consumers. The signal of quality “PDO” is likely to reduce these asymmetries of information but at the same time this type of signal is in competition with other information vectors (trademarks and private brands). Similarly, the advertising messages and sales techniques that not only transmit information but also play an incentive role that can also reduce information asymmetries. The theoretical literature remains very varied on these different information signals.

But it appears that, the advertising signal often favors large groups with large financial resources. Because they can indicate the quality of their products through a large-scale advertising, leaving little place for groups not having the big financial means. The example of PDO cheeses is interesting because non-PDO cheeses which are generally industrial and have the ability to indicate the quality of their products, will not hesitate to do it in view of their financial means. This strategy excludes not the cheaper cheeses but rather the traditional PDO cheeses which do not have the means to invest in the advertising to signal their good quality. The good product becomes the most widely signaled.

This leads us to ask ourselves the following questions: If these signals really influence the decisions of choice of consumers and otherwise their willingness to pay? How is the willingness to pay evaluated in the literature for products under sign of qualities? What are assessment methods commonly used? What are variables frequently used? And what are the great results observed? In order to answer these questions, we perform a meta-analysis on dairy products in the next chapter.

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Chapter 3: Consumers' willingness to pay for dairy products: what do the studies say? A Meta-Analysis²².

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Abstract

Willingness to pay (WTP) and consumer's preferences for dairy products (milk, yogurt, butter and cheese) have attracted the attention of researchers. Therefore, several studies have focused on the question of the measure of WTP for these different products. However, these studies found a value of WTP, which is positive or negative sometimes on the same types of dairy products and this in function to different types of signal of quality. We conduct a meta-analysis with the aim to observe the different factors, which can explain variations of results in studies. Therefore, we selected 24 studies (corresponding to 163 observations) that estimate the WTP of consumers for dairy products. A Geographical Indication (GI), a Bio label or other signs of quality, can differentiate these products. As main results, we found that on average in the studies, label's effect is an important signal of quality for consumers of dairy products. Indeed, on average, Geographical Indications (*GI*) and bio label (*BIO*), have on average a high WTP compared to other signals. On the other hand, it emerges from the studies that consumers seem to have a higher WTP for dairy products derived from cow's milk and goat's milk compared to *sheep milk*. In addition, studies reveal that, among dairy products, Cheese has on average a low WTP compared to other dairy products. Finally, studies of our sample highlighted that French consumers have on average a high WTP for dairy products compared to consumers in other countries; also hypothetical methods reveal on average a high WTP on the studies compared to non-hypothetical methods. These results are robust, with survey based on a sample of consumers and a scanner data based on a sample of prices. These results remain robust, with cluster and bootstrap options. These results remain also robust when we change estimates and use the weighted least squares (WLS).

Keywords: Consumer, Willingness to Pay, Meta-analysis, Dairy products

JEL classification: D12, C19, Q18, Q1

3.1. Introduction

Various health crises (e.g. the mad cow crisis or scandal of eggs contaminated with fipronil) of these last years have contributed to increase the mistrust of consumers to the food they eat. Thus, consumers' demand for quality foods has been the subject of several researches in the economic literature. Researches argue that, consumers conscious of their physical and nutritional health, have based their consumption choices on quality signals such as geographical indications (GI)²³, the bio label, the no-GMO (Genetically modified organism) aliments, the HACCP (Hazard Analysis Critical Control Point) method and others private labels or signals.

Caswell (1992), and Tse (1999) stated that consumers are willing to pay a premium to improve the safety and quality of foods they eat. Dairy products did not escape this rule. Many studies are interested to preferences and willingness to pay (WTP) of consumers for these products, which are generally considered as products of first necessity. We can quote for cheese cases ((Bonnet and Simioni 2001), (Hassan and Monier-Dilhan 2006), (Van Ittersum, Meulenbergh et al. 2007), (Vecchio and Annunziata 2011), (Adanacioglu and Albayram 2012)), for milk cases ((Wang and Sun 2003), (Wang, Mao et al. 2008), (Bai, Zhang et al. 2013), (Walley, Custance et al. 2014)), for butter cases (Saulais and Ruffieux 2012), finally for yogurt cases ((Carlucci, Monteleone et al. 2009), (Barreiro-Hurle, Gracia et al. 2010)). Generally, these studies have a positive or a negative WTP between same categories of dairy products.

We carry out a meta-analysis (Stanley 2001), in order to observe the different factors which can explain the variations in results of the studies. To do this, we retain 24 studies (163 WTP) carried out in different countries, that focus on preferences and WTP of consumers for one or more dairy products. These products are differentiated by the GI, the bio label, no-GMO foods and other private quality signals. Note that, a quality label helps consumers imperfectly informed in the process of taking their decision, in structuring their information environment (Van Trijp, Steenkamp et al. 1997).

²³ PDO (Protected Designation of Origin), PGI (Protected Geographical Indication) and TSG (traditional specialties guaranteed)

The Chapter is organized as follow. Section 2 presents a debate in the literature on dairy products. In section 3, we present the methodology used. Section 4 presents the model and estimation method. Section 5 presents results and interpretations. Finally, we conclude in section 6.

3.2. Background

The literature on preferences and WTP of dairy products is very rich. [Kuperis, Veeman et al. \(1999\)](#) studied the impact of the use of recombinant bovine somatotropin (rBST) in milk production, on a sample of 279 Canadian consumers. They found that a milk containing rBst has a negative WTP than milk free rBst, because this hormone is injected in cows to increase their milk production. Therefore, consumers fear the impact on their health. [Wang, Mao et al. \(2008\)](#), meanwhile studied the consumers' demand for dairy products, on a sample of 559 Chinese consumers. They found that dairy products under HACCP methods are sold with a premium of 5% in Beijing supermarkets compared to products without this label, because Chinese consumers are concerned about the quality and safety of the food they eat. Therefore, the HACCP method appears as ensuring the safety and quality. Still working on the Chinese case, [Bai, Zhang et al. \(2013\)](#) studied preferences and WTP of consumers for milk. Using a sample of 799 consumers, they found that consumers in urbans areas have a strong preference for the traceability of the milk and WTP of these consumers is very high for milk certified by the government, then by an industrial association and finally by a third party. In this case, the government certification appears to guarantee a better quality. [Walley, Custance et al. \(2014\)](#) studied influences of COOL²⁴ on demand and consumption of Chinese consumers' choices. Based upon a survey of 430 individuals, they found that in the minds of consumers, milk from other countries is perceived as being a better quality compared to the one produced in China. Nevertheless, these consumers are always forced to consume Chinese milk, due to numerous markets barriers imposed on foreign companies. Finally, in Turkey, [Adanacioglu and Albayram \(2012\)](#) studied preferences of consumers for traditional cheeses. From a sample of 185 consumers (divided into two groups), they found that consumers of both groups are willing to pay a premium for regional cheeses, compared to non-regional cheeses. Therefore, the regional attribute is important for these consumers.

²⁴ Country Of Origin Labelling

In opposition to these findings, studies conducted in the European context have found results with very contrasting preferences, mainly for the WTP of consumers for dairy products. Indeed, if some works show that consumers have a clear preference for labeled products or whose origin is known or reputed, for others, these differentiation signals have mixed effects, and sometimes, preferences are not clear.

From a sample of 658 prices, Santos and Ribeiro (2005) studied regional reputation and WTP for Portuguese cheeses, they found that, not only the type of milk but also the region of origin of cheeses have a significant impact on cheese's prices. Specifically, cheeses made from sheep milk have a positive WTP (+33%), while cheeses made from cow milk and goat milk have a negative WTP (-36% and -17% respectively); cheeses with a mixture of milk have a very varying WTP. In addition, cheeses made in the regions of "Minho e Trás-os-Montes" and "Ribatejo e Estremadura" can have positive WTP, while those of "Alentejo" and "Ilhas" regions have negative WTP. For these authors, the type of milk, and the origin of the product are important attributes for consumers. In 2010, Barreiro-Hurle, Gracia et al. (2010) are studying effects of quality labels on Spanish consumers consumption decisions. Based on a sample of 400 consumers, they found that Spanish consumers have a high WTP for products, including yogurt, with a nutritional label or health label, compared to those without label. This result supports the idea that a label on products may be an important signal of quality for consumers. Similarly, conducting a study on preferences of consumption of 471 Italian consumers, Pilone, De Lucia et al. (2014) found that for consumers in South of Italy, the presence of quality label on cheeses is seen as an important signal, allowing an increase in the consumption of cheeses.

However, referring to a sample of 1002 prices (scanner data), Bonnet and Simioni (2001) studied WTP of French consumers for camembert cheese and found that on the basis of the same price, only a small proportion of consumers will prefer to buy a PDO camembert cheese compared to those who prefer to buy a brand of camembert without PDO. They concluded that private labels appear more relevant in the mind of consumers than the PDO label. Similarly, Hassan and Monier (2002) studied WTP of French consumers for blue-veined cheeses under AOC²⁵ label and non-AOC label. They found that the AOC label is not always associated with a positive willingness to pay. By the same token, based on a sample of 85

²⁵ Controlled Designation of Origin, it's the equivalent of PDO in the European Union (EU)

individuals, [Saulais and Ruffieux \(2012\)](#) demonstrate in their study of WTP of French consumers for butter, that differentiation of products, notably on the basis of nutritional criteria, does not increase the WTP of consumers for butter; in contrary, it decreases. Outside of the French context, [Vecchio and Annunziata \(2011\)](#) were based on a sample of 400 Italian consumers to study the role of PDO/PGI labels in food consumption choices. They found that in the case of cheese, PDO/PGI labels are on average an important quality signals only to consumers who have some knowledge of these labels, as they increase their WTP. On the other hand, consumers who do not know these labels make their consumption choices based upon a low price products, better appearance or Italian origin.

All these results show that there are different WTP for the same category of dairy product, depending on the region or country where the study was conducted. In the light of these different results, we conduct a meta-analysis on dairy products (milk, cheese, yogurt, and butter), as these products are of similar nature (made with milk). The goal is to understand the variations of results from one study to another in order to synthetize and integrate results of these studies and to better explain the explanatory factors for these variations.

3.3. Methodology

3.3.1. Meta-analysis

The term meta-analysis comes from [Glass \(1976\)](#), and is defined as the statistical analysis of results of individual studies, with the aim to integrate them. [Pignon and Poynard \(1993\)](#) defined the meta-analysis as the use of statistical techniques for the synthesis of a set of separate but similar experiments. For [Stanley and Jarrell \(1989\)](#), the meta-analysis is an analysis of the "empirical analysis" which attempts to explain the differences in results between studies. Meta-analysis is a simultaneous analysis of a set of studies addressing the same question, in order to obtain the information that none of these studies taken singly could provide and explain differences in results of these studies. The first meta-analysis has been realized in the medical field. The objective was to reduce costs of experimental studies, which often led to different results. Very quickly, this method has spread in other areas of research such the environment, marketing and social sciences. In the agricultural and agri-food field, several meta-analyses were conducted. We can mention: "A meta-analysis of the willingness to pay for reductions in pesticide risk exposure" ([Florax, Travisi et al. 2005](#)), which contain

15 studies and 331 observations ; "A meta-analysis of Genetically Modified Food Valuation Studies" (Lusk, Jamal et al. 2005), which contain 25 studies and 57 observations ; "A meta-analysis of willingness to pay for traceable meat attributes" (Cicia and Colantuoni 2010), which contain 23 studies and 88 observations. Closer to us, we have: "A meta-analysis of consumer willingness to pay for farm animal welfare" (Lagerkvist and Hess 2011), which contain 24 studies and 106 observations ; "A meta-analysis of Geographical Indication food valuation studies" (Deselnicu, Costanigro et al. 2013) which contain 25 studies and 134 observations. Based on 140 meta-analysis, Nelson and Kennedy (2009) carry out a meta-analysis of "meta-analysis". All these meta-analyses show that, this method is used increasingly in the economic literature.

3.3.2. Database

Based on online search engines such as: "Google", "Google Scholar", "Science Direct", "Web of Science" and "Scopus", we list 25 studies that can form the basis of our meta-analysis. Among these studies, we have 7 "conference papers", 16 "journal papers" and 2 "working papers". Keywords used to select our studies were "willingness to pay AND cheese", "willingness to pay AND butter", "willingness to pay AND milk", "willingness to pay AND yogurt", "willingness to pay AND dairy products". These studies are generally about preferences and WTP of consumers for one or more dairy products (milk, yogurt, butter and cheese). In some cases WTP are directly given in articles and other cases, they are calculated using the formula: $WTP = -(\beta_{attribute} / \beta_{price})^{26}$. Following Cicia and Colantuoni (2010), we separate valuation methods of WTP in two families: hypothetical methods (choice experiment, conjoint analysis, hedonic price, contingent valuation and simple survey) and non-hypothetical methods (experimental auctions). In the latter, consumers are confronted with real choices situations and they have real possibilities to buy. We choose to exclude the article of Di Pasquale, Adinolfi et al. (2011)²⁷ because willingness to pay calculated are unusable. Therefore, there are 24 studies left for our final estimates, including 163 WTP values. Table 3 presents the list of articles used in our meta-analysis.

²⁶ Case studies using a "logit" model for estimates.

²⁷ The authors introduce the formulas for the calculation of the WTP, but these formulas are not exploitable.

3.3.3. Data description

We select different variables²⁸ that could influence WTP of consumers in studies. Our study period extends from 1998 to 2014. The oldest paper of our study is from 1998 (Gath and Alvensleben 1998) and the most recent papers are from 2014 ((Pilone, De Lucia et al. 2014), (Garavaglia and Marcoz 2014), (Walley, Custance et al. 2014), (Imami, Shkreli et al. 2014)). Following (Deselnicu, Costanigro et al. 2013) and (Cai and Aguilar 2013), we pose the formula of $WTP(\%)$:

$$\%WTP = \left(\frac{(Base\ price + premium) - (Base\ price)}{base\ price} \right) \times 100 \quad (a)$$

Therefore,

$$\%WTP = \left(\frac{premium}{base\ price} \right) \times 100 \quad (b)$$

In equations (a) and (b), "*premium*" represents the surplus of the base price of the product that a consumer is ready to buy.

During construction of our database, we faced some challenges. For example, the study of (Kaye-Blake, Saunders et al. 2004) does not provide the "*base price*" of milk and butter for 2004 in New Zealand. Thus, we take prices of these products on the website of the FAO²⁹ for the survey period. We had the same problem on the study of (Walley, Custance et al. 2014) concerning the price of milk in China in 2012. We referred once more to the price of milk from the website of the FAO³⁰.

Study of (Van Ittersum, Meulenberg et al. 2007) does not also provide base prices for cheeses, but we were able to note directly two WTP. Another feature of this study is related to the fact that it is realized considering consumers of three European countries (Greece, Italy and The Netherlands). We decided not to impute a "*base price*" at the two WTP proposed, because we have just two WTP instead to three. Knowing that it is consumers of three countries that are analyzed, it would have been necessary to have for this study three WTP according to

²⁸ See Table 2

²⁹ Perspectives agricoles de l'OCDE et de la FAO 2003

³⁰ Perspectives agricoles de l'OCDE et de la FAO 2006-2015

consumers of each of 3 countries. Finally, before exploiting WTP and prices of each study constituting our database, we convert all prices in US³¹ dollar.

Table 4 shows descriptive statistics of different variables. We observed that the minimum WTP is -90.57%. For example, This value can be observed for the *Gjirokastra cheese*³², from the study of (Imami, Shkreli et al. 2014) and the maximum is *Canestrato di Moliterno cheese*³³ (383.33%), from the study of (Pilone, De Lucia et al. 2014). In the same table, there is a minimum base price of 0.00001 \$US³⁴ (Adanacioglu and Albayram 2012), which represents the price of the “*Tulum cheese*”, of Turkey. The maximum base price being 16.914 \$US³⁵ (Bernabeu, Olmeda et al. 2008), which represents the price of cheese from “*Castilla-La Mancha*”, in Spain.

³¹ platform OANDA, allows us to convert prices at the exchange rate of the survey year

³² Cheese produced in southwestern Albania. – $(\beta_{attributes}/\beta_{price}) \times 100 = -(2.80158/3.09328) \times 100 = -90.57\%$

³³ Cheese produced in Basilicata, in southern Italy. $(\text{premium}/\text{base price}) \times 100 = (4.60/1.20) \times 100 = 383.33\%$

³⁴ The initial value is 10 TL/kg. This price is converted using the exchange rate \$US/TL of 2011

³⁵ The initial value is 12/kg. This price is converted using the exchange rate \$US/€ of 2008

Table 3: Summary of studies on dairy products

N°	Authors (year of publication)	Products	Year of survey	Methods	number of WTP	region	country	Sample of consumers or price
1	Gath and Alvensleben (1998)	cheese	1998	hypothetical	2	Europe	Germany	200
2	Kuperis, Veeman et al. (1999)	milk	1996	hypothetical	8	America	Canada	279
3	Bonnet and Simioni (2001)	cheese	2000	hypothetical	1	Europe	France	1002
4	Alvensleben and Schrader (1998)	butter	1998	hypothetical	3	Europe	Germany	265
5	Hassan and Monier-Dilhan(2002)	cheese	1999	hypothetical	2	Europe	France	5000
6	Hassan and Monier-Dilhan (2002)	cheese	1998	hypothetical	6	Europe	France	5000
7	Wang and Sun (2003)	milk	2002	hypothetical	7	America	Usa	519
8	Kaye-Blake, Saunders et al. (2004)	butter & milk	2003	hypothetical	13	Oceania	New Zealand	701
9	Santos and Ribeiro (2005)	cheese	2004	hypothetical	6	Europe	Portugal	658
10	Hassan and Monier-Dilhan (2006)	yogurt, milk & cheese	2000	hypothetical	6	Europe	France	8000
11	Van Ittersum, Meulenber et al. (2007)	cheese	2007	hypothetical	2	Europe	Greece, Italy, Netherlands	1232
12	Wang, Mao et al. (2008)	milk	2005	hypothetical	1	Asia	China	559
13	Bernabeu, Olmeda et al. (2008)	cheese	2006	hypothetical	12	Europe	Spain	420
14	Carlucci, Monteleone et al. (2009)	yogurt	2008	auction	4	Europe	Italy	104
15	Barreiro-Hurle, Gracia et al. (2010)	yogurt	2007	hypothetical	4	Europe	Spain	400
16	Di Pasquale, Adinolfi et al. (2011)	yogurt, milk & cheese	2009	hypothetical	3	Europe	Italy	163
17	Vecchio and Annunziata (2011)	cheese	2007	hypothetical	6	Europe	Italy	400
18	Adanacioglu and Albayram (2012)	cheese	2011	hypothetical	6	Europe	Turkey	185
19	Saulais and Ruffieux (2012)	butter	2008	auction	22	Europe	France	86
20	Bai, Zhang et al. (2013)	milk	2011	hypothetical	9	Asia	China	799
21	Tempesta and Vecchiato (2013)	milk	2010	hypothetical	12	Europe	Italy	400
22	Pilone, De Lucia et al. (2014)	cheese	2013	hypothetical	9	Europe	Italy	471
23	Garavaglia and Marcoz (2014)	cheese	2010	hypothetical	12	Europe	Italy	200
24	Walley, Custance et al. (2014)	milk	2012	hypothetical	1	Asia	China	800
25	Imami, Shkreli et al. (2014)	cheese	2011	hypothetical	9	Asia	Albania	210

3.4. Model and estimation methods

Following [Lusk, Jamal et al. \(2005\)](#), [Cai and Aguilar \(2013\)](#) and [Cicia and Colantuoni \(2010\)](#), we modeled a consumers' WTP as a function of the base price of the product, the method of the survey, attributes of products and characteristics of the sample. We also choose to introduce 2 study periods: periods before the global economic crisis (1996-2007) and periods during global economic crisis (2008-2014), the objective being to observe the influence of economic situation on preferences of choices of consumers. We estimate two Ordinary Least Square models (OLS), using the software Stata 13. For the robustness checks³⁶ we change estimates and use the weighted least squares (WLS).

In model 1, whose results are presented in table 5, we introduce the dummy "*sample consumers*" among explanatory variables. This variable captures the effect of the use of a survey of consumers for measuring the WTP. Furthermore, given that there may be a within-study autocorrelation leading to the dependence of regressions within one article, we ran OLS with cluster-robust inference. Because, it is very possible that the WTP within each studies may not be independent, and this could lead to residuals that are not independent within studies. Therefore, we use the cluster option to indicate that observations are clustered into studies and that the observations may be correlated within studies, but would be independent between studies. Standard errors are clustered by each study. Such an approach has been used, for instance, by [Barrio and Loureiro \(2010\)](#) and [Choumert, Motel et al. \(2013\)](#). Finally, we perform a bootstrap to deal with non-normality of residuals and to get reliable standard errors.

The specification of the model 1 is as follows.

$$\text{Model (1): } \%WTP_{ij} = \beta_0 + \beta_1(\text{Base}_{price})_i + \beta_2(\text{hypothetical})_i + \beta_3(\text{cow}_{milk})_i + \beta_4(\text{goat}_{milk})_i + \beta_5(\text{cheese})_i + \beta_6IG(\text{PDO/PGI})_i + \beta_7(\text{BIO})_i + \beta_8(\text{sample}_{consumers})_i + \beta_9\text{year}_{of_survey(2008-2014)}_i + \beta_{10}(\text{France})_i + \beta_{11}(\text{Italy})_i + \beta_{12}(\text{USA})_i + \varepsilon_{ij}$$

For the variable "*hypothetical*" the benchmark is "*non-hypothetical method*". For variables "*Cow_milk*" and "*goat_milk*" the benchmark is "*sheep milk*". For the variable "*cheeses*"

³⁶ See results in appendix a

benchmarks are “*butter*”, “*yogurt*”. For variables “*IG(PDO/PGI)*” and “*BIO*” benchmarks are “*GMO*”, “*HACCP*”, “*COOL*”, *etc.* For the variable “*sample_consumers*” the benchmark is “*sample prices*”. For the variable “*year_of_survey[2008-2014]*” the benchmark is “*year of survey[1996-2007]*”. Finally, for variables “*France*”, “*Italy*” and “*Usa*”, benchmarks are “*Other countries*”.

In model 2, whose results are presented in table 6, we remove the dummy “*sample consumers*” and introduce the dummy “*sample price*” that captures the effect of the use of a scanned data of prices for measuring the WTP. The specification of the model 2 is as follows.

Model (2):
$$\%WTP_{ij} = \beta_0 + \beta_1(Base_{price})_i + \beta_2(hypothetical)_i + \beta_3(cow_{milk})_i + \beta_4(goat_{milk})_i + \beta_5(cheese)_i + \beta_6IG(PDO/PGI)_i + \beta_7(BIO)_i + \beta_8(sample_{price})_i + \beta_9year_of_survey(2008-2014)_i + \beta_{10}(France)_i + \beta_{11}(Italy)_i + \beta_{12}(USA)_i + \varepsilon_{ij}$$

In the two models, $\%WTP_{ij}$ represents i^{th} WTP estimated, corresponding to the j^{th} study. The “robust” option, allows us to solve the potential heteroscedasticity problems with White correction. Following [Chatterjee and Hadi \(2006\)](#), to ensure that the model does not suffer of multicollinearity problem among explanatory variables, we calculate the VIF³⁷ (variance inflation factor). Results give a VIF inferior to 10, allowing us to conclude that our variables are not multicollinear.

³⁷ The results are presented in Appendix b

Table 4: Description of variables

Variables	Description	Mean	Min	Max	SD
WTP%	premium price in %	43.109	-90.57	383.33	60.128
base_Price	baseline price per each study and each product in US dollar	3.543	0.001	16.914	3.956
hypothetical	binary variable coded 1 if the method is: conjoint analysis, choice experiment, hedonic pricing and simple survey, 0 otherwise	0.654	0	1	0.476
Non_hypothetical	binary variable coded 1 if the method is experimental auction and 0 otherwise	0.157	0	1	0.365
Cow_milk	binary variable coded 1 if the product made from cow's milk and 0 otherwise	0.521	0	1	0.501
goat_milk	binary variable coded 1 if the product made from goat's milk and 0 otherwise	0.121	0	1	0.327
sheep_milk	binary variable coded 1 if the product made from sheep's milk and 0 otherwise	0.175	0	1	0.381
other_attribute	binary variable coded 1 for other attributes (example: nutrition information and production process, cholesterol etc., 0 otherwise)	0.303	0	1	0.460
cheese	binary variable coded 1 if the product is cheese and 0 otherwise	0.466	0	1	0.500
milk	binary variable coded 1 if the product is milk and 0 otherwise	0.333	0	1	0.472
other_product	binary variable coded 1 if the product is yogurt and butter, 0 otherwise	0.236	0	1	0.426
Usa	binary variable coded 1 if US consumers, 0 otherwise	0.042	0	1	0.202
France	binary variable coded 1 if French consumers, 0 otherwise	0.224	0	1	0.418
Italy	binary variable coded 1 if Italian consumers, 0 otherwise	0.260	0	1	0.440
IG(PDO/PGI)	binary variable coded 1 if product is PDO/PGI, 0 otherwise	0.424	0	1	0.279
BIO	binary variable coded 1 if product is BIO, 0 otherwise	0.115	0	1	0.320
other_Signal	binary variable coded 1 if product is GMO, HACCP, COOL, private certifications, 0 otherwise	0.375	0	1	0.485
sample	sample size of each study	791.193	7	8000	1751.002
sample_price	binary variable coded 1 if it's a scanner data of price, 0 otherwise	0.127	0	1	0.334
sample_consumers	binary variable coded 1 if it's a survey consumers, 0 otherwise	0.751	0	1	0.433
year_of_survey[1996-2007]	binary variable coded 1 if the study is the period 1998-2007, 0 otherwise	0.478	0	1	0.501
year_of_survey[2008-2014]	binary variable coded 1 if the study is the period 2008-2014, 0 otherwise	0.521	0	1	0.501

Finally, in our major regressions, we have R-square superior to 0.2, following [Greene and Hensher \(2003\)](#), we conclude that our exogenous variables significantly explain our dependent variable.

3.5. Results interpretation

Table 5 presents the results of the model (1). The main results of regression [1] are the following.

On average in studies of our sample, the use of *Hypothetical* methods increase the WTP of consumers for dairy products by 18.109% compared with non-hypothetical methods. This result is significant at 5%. Thus, when we use a hypothetical method to collect the data, this can increase on average the premium paid by consumers of 18.109%. It can be explained by the fact that hypothetical methods generate biases, because they are generally based on field surveys.

Furthermore, on average in studies, products made from *cow milk* and *goat milk* increases WTP of consumers for dairy products by 19.706 % and 64.399% respectively compared to products made with *sheep's milk* and these results are significant at 10% and 1% respectively. These results are very important, because they demonstrate that dairy products, which are derived from cow's milk and goat's milk, encourage consumers to pay a high premium.

Then, among dairy products used in studies, the WTP of *cheese* is on average low (-36.783%) relative to other dairy products. This result is significant at 1%. Therefore, for the case of cheese, consumers want to pay on average 36.783% less compared with other dairy products like butter and yogurt. This result is contrary the result of [Deselnicu, Costanigro et al. \(2013\)](#), which found that, among products under geographical indications, the WTP of *cheese* is on average high (+43.48%). This difference in results is explained by the fact that in their sample, they mix different types of products (wine, cheese, meat, olive oil and grain). Therefore, in this case, consumers for example may prefer the cheese than the wine due to the difference in the nature of products. In the case of our study, we choose products of the same nature and we find that, in this case, *cheese* has a low WTP. So, consumers would tend to pay on average 36.783% less for the cheese among dairy products.

We also found that the label effect is very important, because *IG(PDO/PGI)*, and *BIO* have on average a high WTP at 35.14% and 68.86% respectively compared to other signals like GMO, HACCP, etc. These results are significant at 5%. The presence of these labels on dairy products encourages consumers to pay more. Therefore, they are important and reassuring signals for consumers.

Then, we found that in studies, French consumers (*France*) have on average a high WTP for dairy products of 25.699% compared to consumers of other countries. This result is significant at 5%. The US consumers (*Usa*) have on average a low WTP for dairy products of -55.887% compared to consumers of other countries. This result is also significant at 1%. We are concluding that among European consumers, French consumers have strong preferences for dairy products, given that France is one of the first consumer countries of dairy products in Europe. Therefore, they are a high premium for these products. However, US consumers want to pay 55.887% less for dairy products, certainly because they prefer other basic products.

In regression [2], which represents a cluster regression, standard errors are clustered by each study. Such an approach has been used, for instance, by [Barrio and Loureiro \(2010\)](#) and [Choumert, Motel et al. \(2013\)](#). We note that, our main results remain significant. *Hypothetical* methods make appears on average a high WTP of consumers for the dairy products compared with *non-hypothetical* methods. *Cow's milk* and *goat's milk* increases on average WTP of consumers for dairy products compared to products made with *sheep's milk*. On average, among dairy products, the WTP of *cheese* is low relative to other dairy products. *IG(PDO/PGI)*, and *BIO* have on average a high WTP compared to other signals. French consumers (*France*) have on average a high WTP for dairy products compared to consumers of other countries. Finally, The US consumers (*Usa*) have on average a low WTP for dairy products compared to consumers from other countries.

In regression [3], we perform a bootstrap to deal with non-normality of residuals and to get reliable standard errors. We note that, our main results are still significant.

Table 5: Results of regression with dummy sample consumers

VARIABLES	OLS-Robust	OLS Cluster- Robust	Boostrap OLS- Robust
	WTP	WTP	WTP
	[1]	[2]	[3]
Base_Price	-2.296 (1.615)	-2.296 (1.474)	-2.296 (1.677)
Benchmarks: no hypothetical methods			
hypothetical	18.109** (8.636)	18.109** (7.212)	18.109** (9.109)
Benchmarks: Sheep milk			
Cow_milk	19.706* (10.280)	19.706* (9.700)	19.706* (10.609)
goat_milk	64.399*** (23.789)	64.399*** (19.730)	64.399*** (24.772)
Benchmarks: butter, yogurt			
cheeses	-36.783*** (11.868)	-36.783*** (10.537)	-36.783*** (12.862)
Benchmarks: GMO, HACCP, COOL, etc			
IG(PDO/PGI)	39.401** (18.916)	39.401*** (11.500)	39.401* (20.459)
BIO	46.813** (21.755)	46.813** (19.900)	46.813** (22.668)
Benchmarks: sample prices			
sample_consumers	15.607 (9.704)	15.607 (10.678)	15.607 (10.062)
Benchmarks: year of survey[1996-2007]			
year_of_survey[2008-2014]	5.063 (12.691)	5.063 (10.326)	5.063 (12.907)
Benchmarks: Other countries			
France	25.699** (10.377)	25.699** (5.448)	25.699** (10.414)
Italy	3.838 (18.455)	3.838 (12.026)	3.838 (19.670)
Usa	-55.887*** (20.371)	-55.887*** (17.669)	-55.887*** (21.083)
Constant	-2.295 (5.996)	-2.295 (7.035)	-2.295 (6.437)
Observations	163	163	163
R-squared /Pseudo R-Squared	0.332	0.332	0.279
Replications			1000

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In table 6, which presents results of model (2), the regression [1] presents results that converge towards those of table 5 above.

In regression [1], *Hypothetical* methods make appears on average a high WTP of consumers for dairy products of 17.949% compared to non-hypothetical methods. This result is significant at 10%.

Products made from *cow's milk* and *goat's milk* on average increase WTP for dairy products of 19.399% and 62.448% respectively compared to products made with *sheep's milk* and these results are significant at 10% and 1% respectively.

Among dairy products, *cheese* has on average a low WTP (-34.752%) relative to other dairy products. This result is significant at 1%.

The label effect is also very important in this model, because *IG(PDO/PGI)*, and *BIO* have on average a high WTP at 38.678% and 55.373% respectively compared to other labels. These results are significant at 5%.

French consumers (*France*) have on average a high WTP of 25.132% compared to consumers from other countries; this result is significant at 5%. The US consumers (*Usa*) have on average a low WTP for dairy products of -72.377% compared to consumers from other countries; this result is significant at 1%.

In regression [2], which represents a cluster regressions, standard errors are also clustered by each study. We note that, our main results remain significant.

In regression [3] like in the model (1), we perform a bootstrap to deal with non-normality of residuals and to get reliable standard errors. We note that, our main results are still significant.

In additional robustness checks of our results, in the “*appendix a*” below, we change the estimation and we use a weighted least squares regression (WLS) by removing dummies variables *sample_consumers* and *sample_price*. Our results remain stable in terms of significance and the sign of coefficients.

Table 6: Results of regression with dummy sample prices

VARIABLES	OLS-Robust	OLS Cluster-Robust	Boostrap OLS-Robust
	WTP	WTP	WTP
	[1]	[2]	[3]
Base_Price	-2.595 (1.668)	-2.595 (1.725)	-2.595 (1.849)
Benchmarks: no hypothetical methods			
hypothetical	17.949* (9.526)	17.949 (11.356)	17.949* (10.559)
Benchmarks: Sheep milk			
Cow_milk	19.399* (10.521)	19.399* (10.309)	19.399* (10.886)
goat_milk	62.448*** (23.711)	62.448*** (19.484)	62.448*** (24.257)
Benchmarks: butter, yogurt			
cheeses	-34.752*** (11.745)	-34.752*** (10.657)	-34.752*** (11.588)
Benchmarks: GMO, HACCP, COOL, etc			
IG(PDO/PGI)	38.678** (18.809)	38.678*** (11.815)	38.678* (20.316)
BIO	55.373** (23.342)	55.373** (24.664)	55.373** (26.068)
Benchmarks: sample consumers			
sample_price	-4.670 (17.139)	-4.670 (20.663)	-4.670 (19.141)
Benchmarks: year of survey[1996-2007]			
year_survey[2008-2014]	12.015 (12.036)	12.015 (11.812)	12.015 (12.978)
Benchmarks: Other countries			
France	25.132** (12.346)	25.132* (12.129)	25.132* (12.909)
Italy	5.429 (18.221)	5.429 (11.962)	5.429 (19.055)
Usa	-72.377*** (18.496)	-72.377*** (17.755)	-72.377*** (20.18)
Constant	6.673 (7.183)	6.673 (9.913)	6.673 (7.482)
Observations	163	163	163
R-squared /Pseudo R-Squared	0.328	0.328	0.274
Replications			1000

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

3.6. Conclusion

Various health crises of the past years have contributed to increase the mistrust of consumers to the food they eat. (Schröder and McEachern 2004), (Miles and Frewer 2001) and (Bernués, Olaizola et al. 2003) showed that the quality of life, food ethics, the environment and health have become important attributes for consumers.

Dairy products are no exception to this tendency. Many studies, which have focused on preferences and willingness to pay of consumers for these products, have led to very different results. Therefore, we have implemented in this chapter, a meta-analysis on preferences and WTP of consumers for dairy products (milk, cheese, butter, and yogurt). These products are differentiated compared to all products available in the market by specific information indicating their geographical origin (IG) or their mode of production “healthy” (bio label, no-GMO, and other private signals). We selected 24 studies on dairy products. These studies addressed more specifically the effect of these distinguishing characteristics on WTP of consumers for these products.

Results on WTP of consumers in this chapter shows us that attributes of product influence consumers in their purchasing decision, but does not inform us much about the role of personal characteristics of consumers. So results of the studies of our meta-analysis depend on average of the survey methods used, the region where the study was carried out, the type of labels affixed on dairy products. We also observe that the signal “PDO” increases the WTP of consumers for dairy products, but “cheeses” have a low WTP among dairy products. We wonder therefore, what are determinants of WTP of consumers for PDO cheeses? We answer this question in the part II of the thesis using the Kantar WorldPanel database and considering the case of Auvergne PDO cheeses which are *Cantal*, *St Nectaire*, *Bleu Auvergne*, *Fourme Ambert* and *Salers*. Thus we will ask ourselves in particular if the WTP is not influenced by the way by which processors position the PDO cheeses (packaging methods, presentation methods, distribution channels).

Appendix

Appendix a: robustness with “weighted least squares regression”

VARIABLES	WLS-estimation
	WTP
Base_Price	-9.177*** (3.034)
Benchmarks: no hypothetical methods	
hypothetical	26.169** (29.751)
Benchmarks: Sheep milk	
Cow_milk	18.208 (5.661)
goat_milk	41.342*** (15.022)
Benchmarks: butter, yogurt	
cheeses	-50.445*** (20.070)
Benchmarks: GMO, HACCP, COOL, etc	
IG(PDO/PGI)	54.004*** (19.979)
BIO	74.179*** (32.963)
No Benchmarks	
sample	0.064 (0.056)
Benchmarks: year of survey[1996-2007]	
year_of_survey[2008-2014]	17.697 (20.746)
Benchmarks: Other countries	
France	54.538** (24.755)
Italy	-32.566 (13.908)
Usa	-79.176*** (32.711)
Constant	12.256** (6.1451)
Observations	163
R-squared /Pseudo R-Squared	0.433
Robust standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Appendix b: Variance inflation factors

Variance Inflation Factors (VIFs), regression 1 of Table 5

variables	VIF[1]
Base_Price	3.58
hypothetical	1.83
Cow_milk	1.64
goat_milk	1.50
cheese	2.94
France	1.54
Italy	2.72
Usa	3.46
IG(PDO/PGI)	5.05
BIO	5.95
sample_consumers	2.83
year_of_servey[2008-2014]	2.90
<i>Mean VIF</i>	2.99

Variance Inflation Factors (VIFs), regression 1 of Table 6

variables	VIF [1]
Base_Price	4.32
hypothetical	3.01
Cow_milk	1.65
goat_milk	1.48
cheese	2.91
France	2.93
Italy	2.70
Usa	2.81
IG(PDO/PGI)	5.04
BIO	7.50
sample_price	5.00
year_of_servey[2008-2014]	3.42
<i>Mean VIF</i>	3.56

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Part 2: Data Analysis

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Chapter 4: Prices in the regional cheese markets in France

4.1. Introduction

The French cheese market is one of the largest markets in Europe and French consumers have a high demand for cheese products (The first ones in Europe). This market concentrates both cheeses under geographical indications (PDO, PGI) and those without this label of geographical origin. In addition, these cheeses come from many European countries. This market of cheeses under geographical indications (PDO and PGI) represents about 15.2% of the total cheeses market, the rest representing non-GI cheeses. According to INAO in 2015, among the most commercialized French GI cheeses we found the “PDO Comte” (54,704 tons), followed by the “PDO Roquefort” (16,784 tons), the “PDO Reblochon” (15,658 tons), the “PDO Cantal” (13,704 tons) and the “PDO St Nectaire” (13,532 tons), the rest being less than 10,000 tons. But the market remains widely dominated by non-GI cheeses, which do not undergo the same production constraints as the GI cheeses linked to the code of practice and which sometimes have higher financial means than cheeses under GI, which allows them to be known through advertising strategies and other acts of promotions.

Thus, there are a number of questions about consumption habits of consumers for these cheeses products. As for example, what are their practices of consumptions of cheeses in general and those from the Auvergne region in particular? The Kantar WorldPanel database helps us to better understand practices of consumptions of French consumers. To realize this type of analysis, some authors choose to conduct directly consumer surveys. But this remains a heavy and very expensive task. In addition, the drawback of surveys remains the “response bias”. We choose to use the Kantar WorldPanel data as part of this thesis, because the Kantar Company has a big experience in the elaboration of consumer surveys and their data are very original and concerns “effective” purchases of consumers. This database is representative of all French households and combines together characteristics of consumers, attributes of products and information on purchases. It is based on effective purchases made by consumers; therefore this database helps us to reveal actual and not hypothetical preferences of consumers.

In this chapter we analyze the data from this database, in order to highlight the distribution of quantities and prices by taking into account the regional aspect and identifying habits of consumption of French households. To do so, we present some descriptive analysis based on the data from this database. We focus on the most sold GI (PDO/PGI) cheeses (national and

foreign) in France as well as some non-GI cheeses which are equally marketed, finally on Auvergne PDO cheeses. The descriptive analysis focuses on purchases variables, products variables and household variables.

The chapter is organized as follows. Section 2 presents the Kantar WorldPanel database. Section 3 describes data and descriptive statistics. Section 4 presents graphics evolution of purchases, products and households data. We conclude in section 5.

4.2. The Kantar WorldPanel Database

Kantar WorldPanel (formerly TNS Worldpanel) is an international company dealing in consumer knowledge and insights based on continuous consumer panels. Kantar Worldpanel is part of the Kantar Group of the Data Investment management Division of WPP³⁸ Group.

Through market monitoring, advanced analytics and tailored market research solutions, Kantar Worldpanel analyses what people buy, what they consume and the attitudes behind this behavior. Their clients include brand owners, private label manufacturers, meat, dairy producers, fruit and vegetable suppliers, retailers, market analysts and government organizations.

Kantar Worldpanel data that we use in this thesis are household food consumption data in metropolitan France. It presents itself year by year and exists since 1975, but data are available only from the year 1998.

The data are divided into three parts: the household's data, the products data and the purchases data. They are linked to one another by identifiers.

4.2.1. Households data

A part of the data is dedicated to the description of households belonging to WorldPanel. They concern socio-demographic characteristics of households as the size of the family, the level of education of each member, the class of income, the professional category, etc.

³⁸ Wires & Plastic Products

Household data are composed of two big sections being in separate files:

- First files: The description of household and individual data through a hundred variables.
- Second files: The activity and the weight of the households in the survey

Households are uniquely identified by the identifier “*household_number*”. This identifier is unique from one year to the next. In the Kantar data, the panelist indicates the person responsible for purchases in the household during the year.

4.2.2. Data of products

The dataset of products contains approximately 160,000 descriptions of manufactured or fresh products divided into 300 product groups such as cereals, milk, etc. Kantar data have a very detailed “food” reference frame. We find general information there such as the price, the retailer, the brand, the packaging, the quantity, the nature of products, the date of purchase, etc.

The description of products is not simple from part of their structures and their evolutions over time. This difficulty results from several reasons:

- Food supply changes over time. New products and new categories appear (*Example: the organic food in 2003*).
- The data are described firstly at the request of industrialists. This is reflected in the structure chosen. Their demands also evolve over time.

A large part of Kantar's work is to describe the food supply and he does not proceed in the same way with products possessing an “EAN” (European Article Number or “Barcode”) and others products without "EAN".

Products with “EAN”

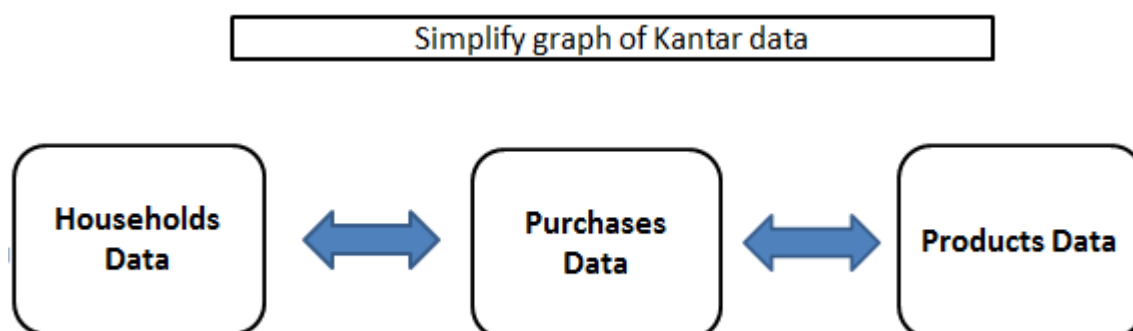
These products are listed by Kantar investigators directly in the store. The latter, using “scannettes”, travel the shelves in search of products not included in their base. They note their barcode and some information such as the brand, the quantity etc. Households are also equipped with a “scannette”. They scan these barcode products at home.

Products without “EAN”

These products are defined upstream by Kantar which has built a dictionary of products identified by their weights and their types. Households are equipped with a “scannette” and a barcode listing the set of these products. They scan the barcode of the product getting closer most to their purchase.

4.2.3. Purchases data

It is the central part of the data. They connect households and products bought in the form of baskets of purchases. In this file, you will find all the information about purchases such as their date, the store chain in which they were bought, the expense by act of purchase as well as their quantity.



The data of purchases of Kantar are the result of the collection of statements of purchases by panelists throughout the year. The latter have the responsibility to inform their purchases of foodstuffs throughout their period of recruitment. The method of collection is made in two stages:

- First stage: The panelists make their purchases in hypermarkets or supermarkets, grocery stores, markets etc.

- Second stage: Once they return home, they scan the purchases made.

In order not to overburden households, Kantar divided the food supply into several panels. A household belongs to one or several panels, the aim is to inform on purchases of products which are dedicated to him.

The Kantar data (all years combined) have the following 4 panels:

- *First Panel*: staple products (GC). This panel is present for every year Kantar and concerns products of the big consumption. All households scan purchases of this panel.
- *Second Panel*: Meats, Fish and Wines (VP). This panel is present on the years prior to 2009. It concerns more particularly meats, fish and wines. A subset of households scans purchases of this panel.
- *Third Panel*: Fruits & Vegetables (FL). This panel is present on the years prior to 2009. It concerns fruit and vegetables. A subset of households also scans purchases of this panel.
- *Fourth Panel*: Meats & Fish and, Fruits & Vegetables (PF). This panel has replaced VP and FL from year 2009. It results from the fusion of these two panels. A subset of households also scans purchases of this panel.

In the Kantar data, each line corresponds to an act of purchase of a product by a household. To do this each line has two identifiers whatever the years:

- **household_number**: the identifier of the household having made the purchase.
- **id_product**: The identifier of the product bought.

No data on the place of house of the household exists. However, information on the type of store (store chain, surface, purchasing center) is available for each purchase.

The Kantar database sometimes contains certain purchases not corresponding to the reality (about 1% are concerned). This can occur in several cases:

- Input error,
- Exceptional purchases

To minimize these "out-of-standards" purchases, Kantar has set up an adjustment coefficient (*gros_achats*) to adjust the quantity purchased and the amount spent, which is based on household habits and the relationship between the quantity purchased and the price paid.

4.2.4. Data treatment

We concentrate within the framework of this thesis on the data on cheeses provided by Kantar. The data are provided over the period 2008-2010. The database being expensive, we retain this period because it corresponds to the period of restructuring of actors of the sector of PDO cheeses from Auvergne.

For each year, we have 5 files under Stata format:

- **Purchases:** This provides us the information on purchases like “Purchase center”, “Total expense”, “Total quantities purchased”, “PDO or not”, etc.
- **Activities:** This provides us the information on the activity of individuals in the household like “Panelist socio-professional category”, “Professional activity of the panelist”, etc.
- **Individual:** This gives us the information on individuals in the households “Age of the panelist”, “Level of diploma and/or study of panelist”, “Year of birth of the panelist”, etc.
- **Households:** This gives us the information about the household like “income of family”, “Number of persons at home”, etc.

Using the household identifier (*household_number*), we merge the first 4 files (Purchases, Activities, Individuals and Households). The database thus obtained is merged with the last file (Products) using the identifier of the product purchased (*product*). This treatment allows

us to obtain a single database for each year. Then we merge each annual file, in order to get our final database covering the period 2008-2010.

We choose to retain in our database, purchases in large and medium-sized distribution such as supermarkets, supermarkets and hard-discount stores, because they represent about 90% of acts of purchase. We also choose to retain specialized stores such as cheese dairies stores.

On prices, the database just gives us the data relating to the expenses made by act of purchase in “Euros”. Given that we have data on the quantities of products purchased in kilograms by acts of purchase, we deduce the unit price of products in “Euros/kilogram”. Then, we delete acts of purchase corresponding to aberrant prices, for example acts of purchase with prices of 0.001 €/kg (which correspond to errors of imputations), because it is impossible to buy a cheese at this price. We retain the interval of price between the fifth percentile $p(5)$ and the ninety-fifth percentile $p(95)$ of the unit price, this allows us to remove also the absurd values of price and to maintain the existing variability between unit prices.

Finally, we delete irrelevant variables as for example: the fact of having a vehicle; the fact of family possessed an oven; the fact of having a second home, the fact of having a cat, or a dog; etc. In our final database (2008-2010), we retain the Auvergne PDO cheeses: “Cantal”, “St Nectaire”, “Bleu Auvergne”, “Fourme Ambert”, and “Salers”. Given that the Auvergne PDO cheeses are not the only ones sold on markets, we also retain the best-selling GI(PDO/PGI) cheeses on the French market: “Roquefort”, “Comte”, “Mozzarella”, “Reblochon”, “Tomme”, “Gruyere”, “Morbier”, “Gorgonzola”, “Feta”, “Brie de Meaux”, “Grana”. Finally, we retain the non-GI cheeses which are most sold on the French market: “Camembert”, “Coulommiers”, “Raclette”, “French Emmental”, and “Other Blue Cheese”.

4.3. Descriptive Statistics

4.3.1. Expenses during act of purchase

Table 7 below shows prices of the top 20 cheeses the most sold on the French market, according to our sample of data from Kantar WorldPanel. We observe that the cheese which gathers the most act of purchase is the French “Emmental” (471,538 purchases) over the period 2008-2010. This cheese which is of industrial manufacture is very bought in France.

Table 7: Total Expense in euros in the period (2008-2010)

Variables	Obs	Mean	Std. Dev.	Min	Max
Cantal	21902	4.98	1.59	0.60	27.24
St Nectaire	12940	5.55	3.05	0.72	35.02
Bleu Auvergne	12241	2.75	0.97	0.51	26.18
Fourme Ambert	9536	3.68	1.28	0.57	26.23
Salers	1580	8.09	2.88	1.50	36.13
Roquefort	59272	2.44	1.12	0.85	41.99
Comte	74342	3.91	2.07	0.58	39.11
Camembert	240776	1.98	0.88	0.51	22.08
Coulommiers	104399	2.15	0.94	0.75	14.80
Mozzarella	71925	1.78	1.19	0.50	19.14
Reblochon	22275	4.35	2.36	0.72	43.66
Gruyere	8778	3.29	2.03	0.53	29.88
Raclette	44192	5.76	3.40	0.53	44.34
Morbier	15225	2.83	1.33	0.71	27.34
Gorgonzola	7361	2.61	1.14	0.70	25.93
Emmental	471538	2.46	1.47	0.51	33.41
Feta	27545	2.40	0.96	0.84	16.5
Tomme	24506	3.48	2.13	0.51	47.28
Brie de Meaux	10700	3.24	1.76	0.59	50.46
Grana	24073	1.57	0.83	0.69	13.48

In terms of acts of purchase, the French “Emmental” cheese is followed by others non-GI cheeses such as the “Camembert” (240,776 purchases) and the “Coulommiers” (104,399 purchases). Followed by French PDO such as the PDO “Comte” (74,342 purchasing acts) and the PDO “Roquefort” (59,272 purchasing acts).

Auvergne PDO cheeses are far behind this first group of cheeses. The PDO “Cantal” registered 21,902 acts of purchase, followed by the PDO “St Nectaire” (12,940 purchases), the PDO “Bleu Auvergne” (12,241 purchases), the PDO “Fourme Ambert” (9,536 purchases), and finally the PDO “Salers” (1,580 purchases).

The table 7 also shows that the smallest expenses registered during an act of purchase are for, the PDO “Mozzarella” (0.5 €), the non-PDO “Camembert” (0.51 €), the French “Emmental” (0.51 €), the PDO “Bleu Auvergne” (0.51 €) and the PGI “Tomme” (0.51 €). While the biggest expenses registered during an act of purchase are for the PDO “Brie de Meaux”

(50.46 €), the PGI “Tomme” (47.28 €), the non-GI “Raclette” (44.34 €), the PDO “Reblochon” (43.66 €) and finally the PDO “Roquefort” (41.99 €).

4.3.2. Prices

Table 8: Prices³⁹ in euros/kg during the period (2008-2010)

Variables	Obs	Mean	Std. Dev.	Min	Max
Cantal	21902	9.62	1.50	7.30	13.64
St Nectaire	12940	12.23	2.86	7.55	19.42
Bleu Auvergne	12241	9.01	1.10	6.59	12.45
Fourme Ambert	9536	9.43	1.47	7.14	13.02
Salers	1580	17.42	2.59	11.20	23.08
Roquefort	59272	15.08	3.17	11.26	24.37
Comte	74342	11.92	2.03	8.78	17.13
Camembert	240776	6.76	1.40	4.24	10.64
Coulommiers	104399	5.26	0.83	4.08	7.91
Mozzarella	71925	7.44	2.63	4.00	15.44
Reblochon	22275	12.43	1.92	9.02	18.12
Gruyere	8778	10.87	3.10	6.17	17.47
Raclette	44192	8.78	1.94	5.72	13.36
Morbier	15225	9.96	1.38	7.96	13.86
Gorgonzola	7361	12.66	2.24	9.13	18.82
Emmental	471538	7.37	1.21	5.60	11.01
Feta	27545	9.40	1.55	6.3	14.23
Tomme	24506	11.38	2.40	7.47	17.70
Brie de Meaux	10700	12.54	2.79	7.35	19.43
Grana	24073	12.01	1.86	9.97	18.33

Table 8 above shows the price of cheeses in euros per kg. We observe that, cheeses sold with a higher price are the PDO “Roquefort” (24.37 €/kg) and the PDO “Salers” (23.08 €/kg), these cheeses are followed by the PDO “Brie de Meaux” (19.43 €/kg) and the PDO “St Nectaire” (19.42 €/kg). This shows that the Auvergne PDO cheeses like “St Nectaire” and “Salers” are among cheeses with a high price in France. But we buy on average the “Salers” at 17.42 €/kg and “Roquefort” at 15.08 €/kg. Cheeses with on average a low price are “Coulommiers” (5.26 €/kg), “Camembert” (6.76 €/kg) and French “Emmental” (7.37 €/kg). This shows that on average, non-GI cheeses are less expensive than cheeses under GI.

³⁹ In current euros

4.3.3. Quantities

Table 9: Quantities purchased in kg in the period (2008-2010)

Variables	Obs	Mean	Std. Dev.	Min	Max
Cantal	21902	0.51	0.16	0.06	3.34
St Nectaire	12940	0.45	0.24	0.06	3.44
Bleu Auvergne	12241	0.31	0.10	0.06	2.6
Fourme Ambert	9536	0.39	0.12	0.06	2.47
Salers	1580	0.46	0.18	0.10	2.42
Roquefort	59272	0.16	0.06	0.05	2.15
Comte	74342	0.33	0.18	0.06	3.74
Camembert	240776	0.29	0.12	0.08	2.64
Coulommiers	104399	0.41	0.18	0.11	3.5
Mozzarella	71925	0.24	0.14	0.10	2.4
Reblochon	22275	0.35	0.18	0.07	4.5
Gruyere	8778	0.32	0.20	0.06	3.42
Raclette	44192	0.67	0.39	0.07	5.7
Morbier	15225	0.28	0.12	0.06	2.94
Gorgonzola	7361	0.20	0.08	0.06	2
Emmental	471538	0.34	0.20	0.06	5
Feta	27545	0.26	0.11	0.06	1.8
Tomme	24506	0.31	0.20	0.06	4.4
Brie de Meaux	10700	0.26	0.13	0.06	2.98
Grana	24073	0.13	0.06	0.04	1

The table 9 above shows the quantities purchased by act of purchase. We observe that the non-GI “Raclette” is the most purchased cheese in kg, with 5.7 kg on an act of purchase. So the non-GI “Raclette” was purchased at 5.7 kg for an expense of 44.34 €, that is to say 7.77 €/kg on average over the period 2008-2010. Then we have the PDO “Reblochon” (4.5 kg) for an expense of 43.66 € that is to say 9.70 €/kg and the PGI “Tomme” (4.4 kg) for an expense of 47.28 € that is to say on average 10.74 €/kg.

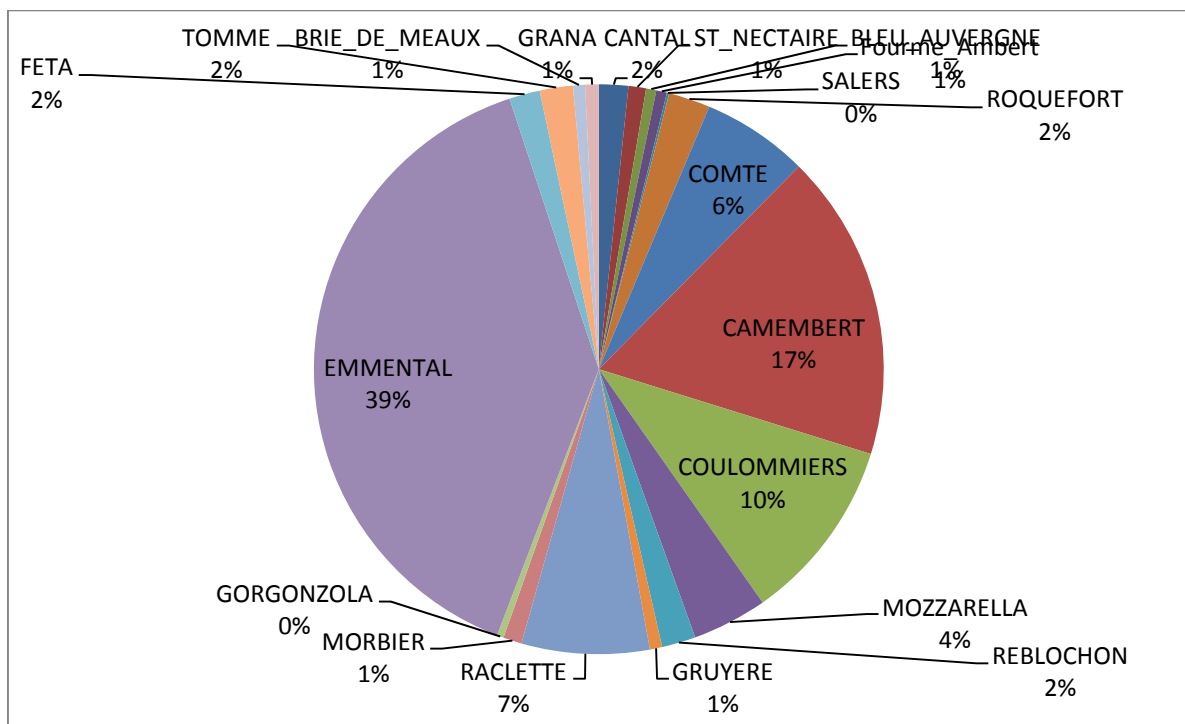
By reading simultaneously the three tables 7, 8 and 9, we note, for example, that on average, the PDO “Cantal” is sold on average at 9.62 €/kg, but we spend on average by act of purchase for this cheese 4.98 €, which means that on average by act of purchase we buy 0.51 kg of cheese “Cantal”. Similarly, the PDO “St Nectaire” for example is sold on average at 12.23 €/kg, but we spend on average by act of purchase for this cheese 5.55 €. This means that, on average, by act of purchase we buy 0.45 kg of cheese “St Nectaire”.

4.4. Graphic representations

4.4.1. Purchases

The figure 9 shows that, in terms of quantities purchased over the period 2008-2010 on the French market of cheeses, the French “Emmental” is the most purchased (39%), followed by the “Camembert” (17%) and the “Coulommiers” (10%). This result joins that found on acts of purchase above (table 9). The more we have acts of purchases, the more we have quantities purchased, the market being widely dominated by the non-GI cheeses. According to Inao and Cnaol in 2009 the non-GI cheeses represented 84.5% of part of cheeses marketed in France, while the GI cheeses represented 15.5%.

Figure 9: Total quantity purchased in the French market cheeses (2008-2010)



When we consider only the market of GI cheeses (figure 10), the PDO “Comte” (27%) is the first GI cheese in terms of quantities purchased in the French market, followed by the PDO “Mozzarella” which is a cheese from Italy, the PDO “Roquefort” (10%), the PDO “Reblochon” (8%) and the PGI “Tomme”.

Auvergne PDO cheeses are so far behind, the first one being the PDO “Cantal” (7%), followed by the PDO “St Nectaire” (4%), the PDO “Bleu Auvergne” (3%), the PDO “Fourme Ambert” (3%), finally the PDO “Salers” (1%) which is the French PDO cheese the less purchased in our database.

Figure 10: Total quantity purchased of GI cheeses (2008-2010)

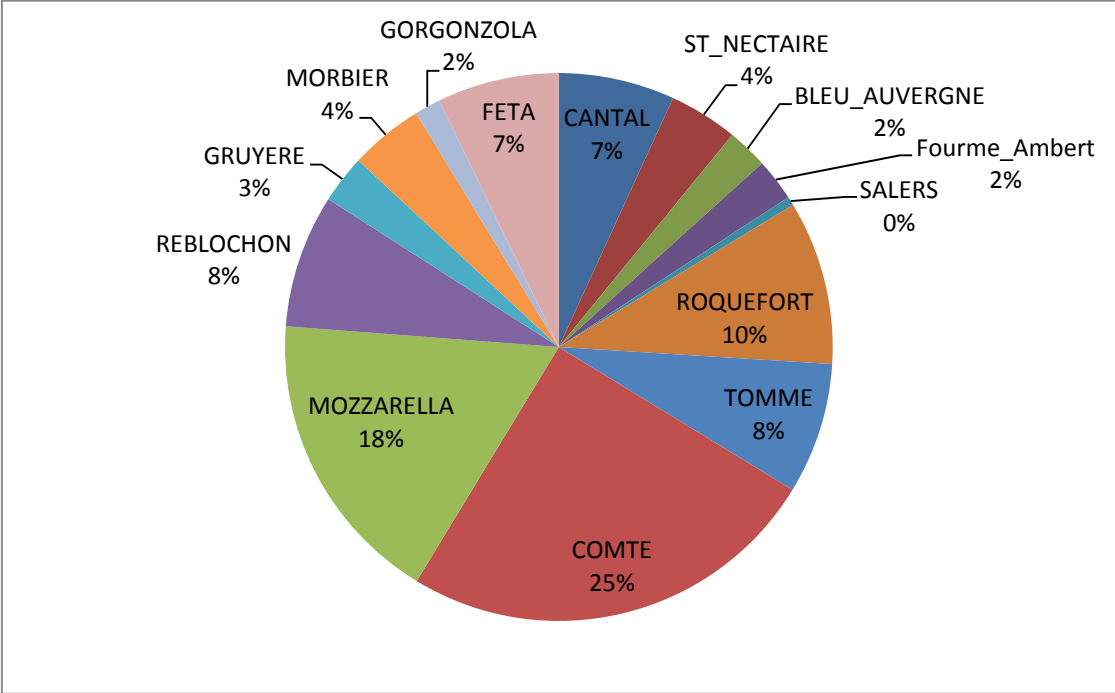
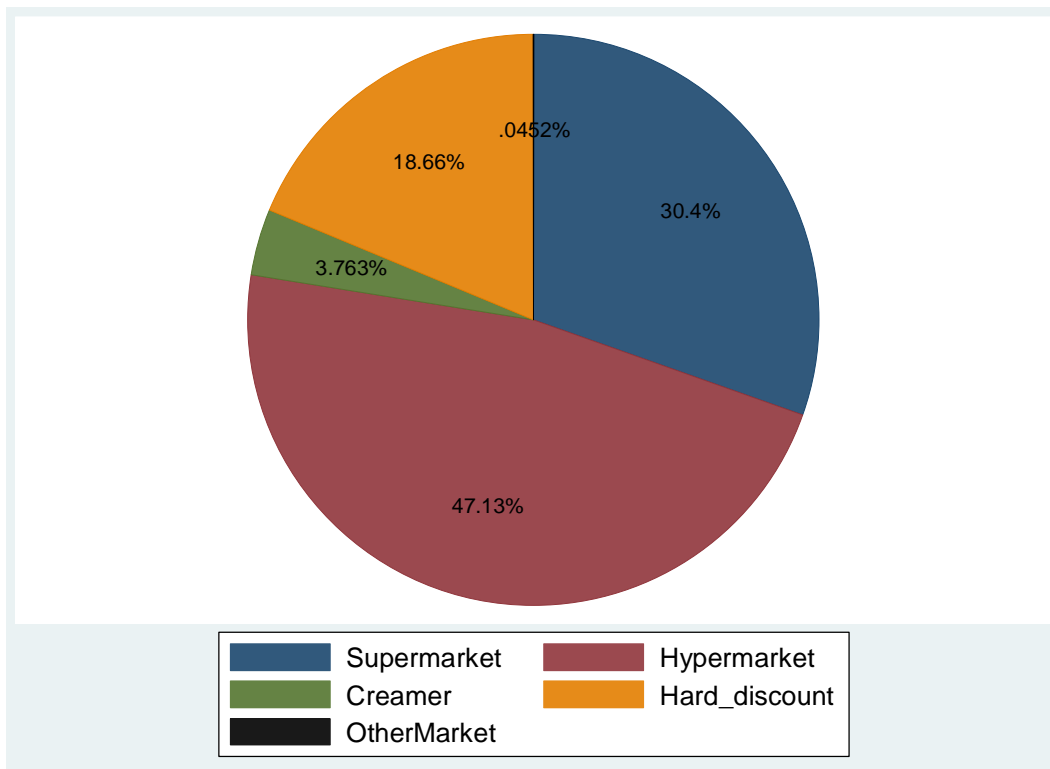


Figure 11 below shows that cheeses are the most purchased in hypermarkets (47.13%) and supermarkets (30.4%), these two distribution channels represent more than 77%. The other distribution channels are hard discount (18.66%) creamer 3.77%. This result shows that hypermarkets and supermarkets are privileged for purchases of cheeses. We find a large French PDO cheeses such as PDO “Comte”, PDO “Roquefort” and non-PDO cheeses such as “Camembert” and “Coulommiers” are purchased mainly in supermarkets and hypermarkets. This figure shows us that the large and medium distributions are the most privileged sales channels. According to Inao and Cnaol, over the period 2008-2010, the large distribution (hypermarkets and supermarkets) represented 70.26% of purchases of cheeses under geographical indications, while purchases in hard-discounts represented 14.23%. Our results are in the same order of magnitude, which suggests that our database is representative at the French national level.

Figure 11: Distribution of purchases by distribution channels (2008-2010)



4.4.2. Current prices

Figure 12 below presents the distribution of price per kilogram. We observe that on average cheeses are purchased under 20 €/kg, the highest density⁴⁰ being for cheeses at almost 7 €/kg. This figure 12 reveals that consumers buy more cheeses which are sold about 7 €/kg. Remember that these low prices are driven by non-GI cheeses, because they are more sold than cheeses under GI.

Then, we try to analyze this trend according to the best-selling cheeses non-GI and GI to observe if there are regional differences.

We see that the French “Emmental” cheese, which is the cheese the most purchased in our database, is much more bought when it is sold between 6 €/kg and 7 €/kg (Figure 13). Indeed, consumers buy the “Emmental” on average at less than 11 €/kg, the density of highest purchases being between 6 €/kg at 7 €/kg.

⁴⁰ The ordinate at the origin representing here the density of purchasing acts

Figure 12: price of cheeses (2008-2010)

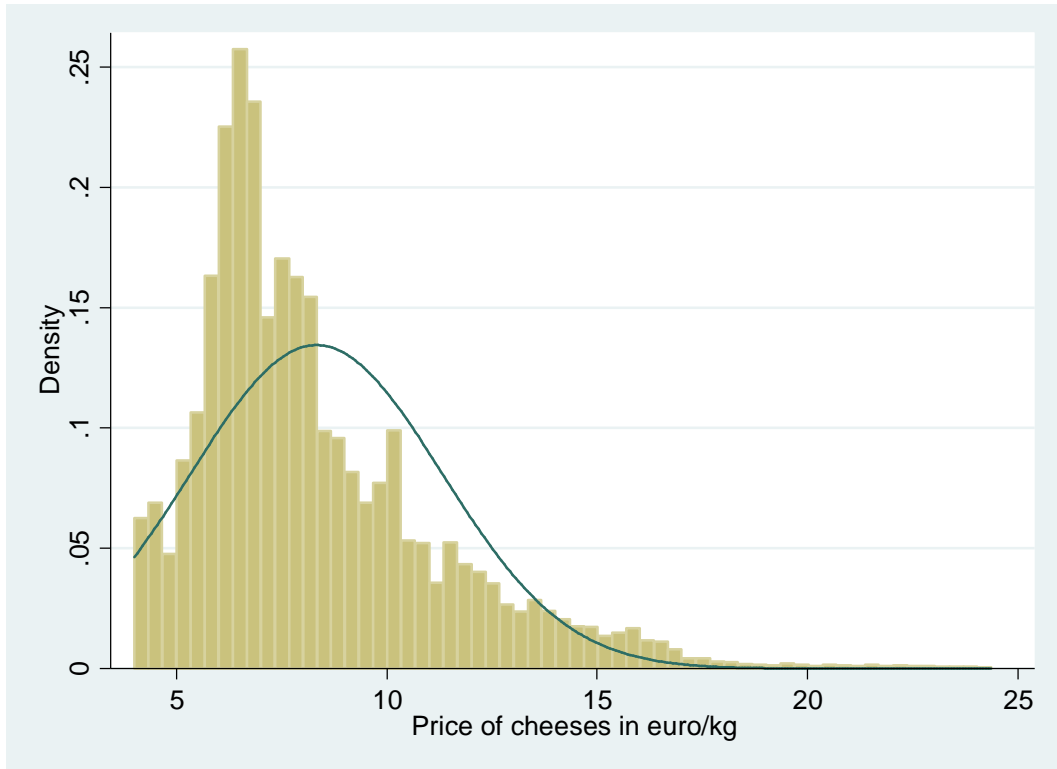


Figure 13 : Price of Emmental (2008-2010)

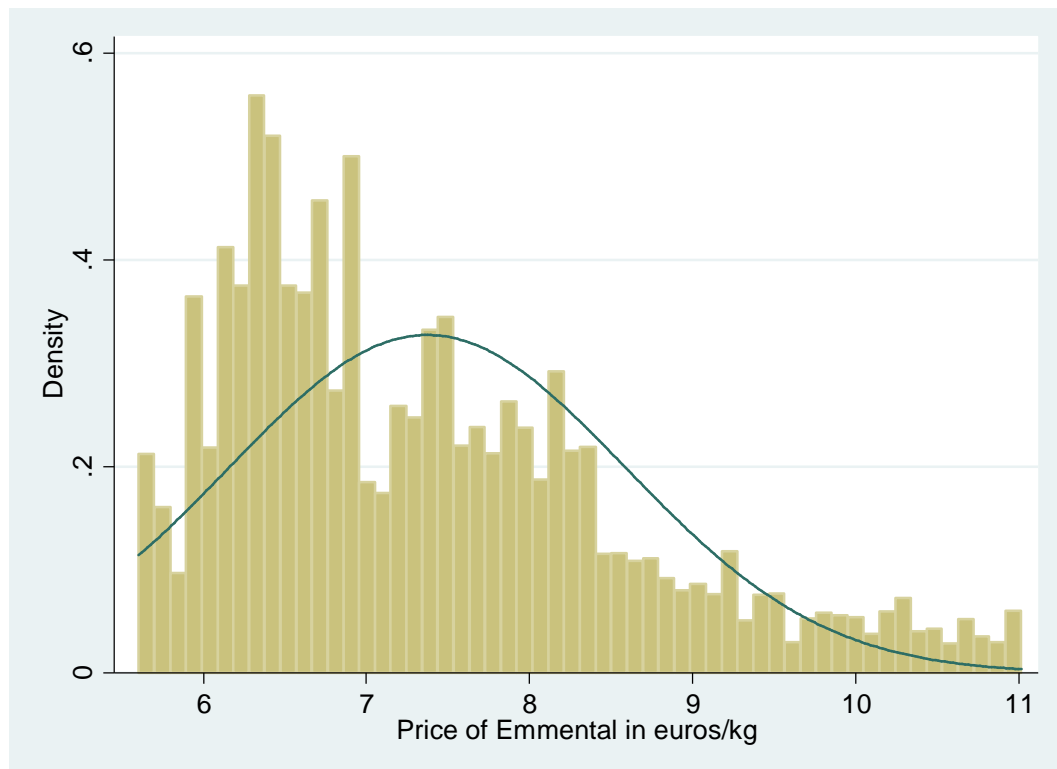


Figure 14 below shows prices of non-PDO “Camembert”. We observe that consumers buy this cheese at less than 12 €/kg and the highest buying density is for the “Camembert” sold between 6 €/kg at 7 €/kg. The observation of several high densities of purchases can be explained by the variant prices from one region to another.

Figure 14: The price of Camembert (2008-2010)

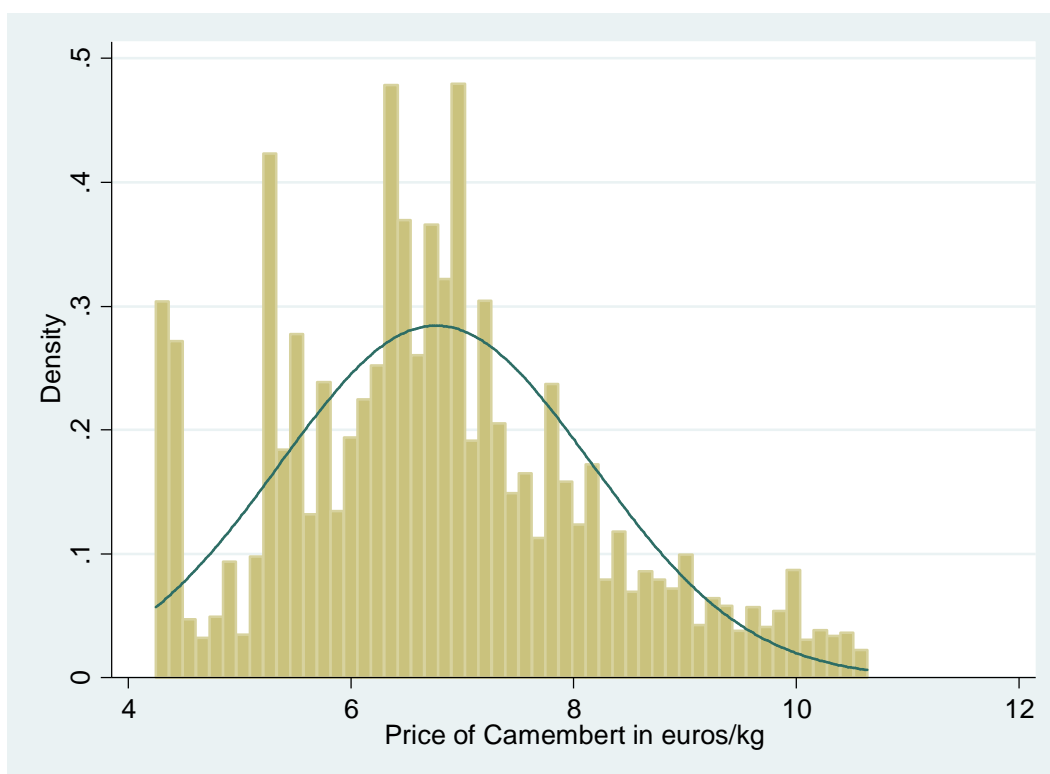


Figure 15 below shows, which presents the price of non-PDO “Coulommiers” cheese, shows that this cheese is bought at less than 8 €/kg and the highest density of purchase for a “Coulommiers” being at 4.03 €/kg. This means that consumers buy most of the time a “Coulommiers” cheese at 4.03 €/kg compared to when it is sold more expensive.

Figure 16 below shows the price of PDO “Comte”, which is the first French PDO cheese in terms of quantities sold in our database. We observe that the PDO “Comte” is bought between 9 €/kg and 17 €/kg, with the highest density of purchase being for a “Comte” at 11 €/kg. The fact of having several modalities on the figure 16 can be explained by the dispersion of prices from one region to another.

Figure 15: The price of Coulommiers (2008-2010)

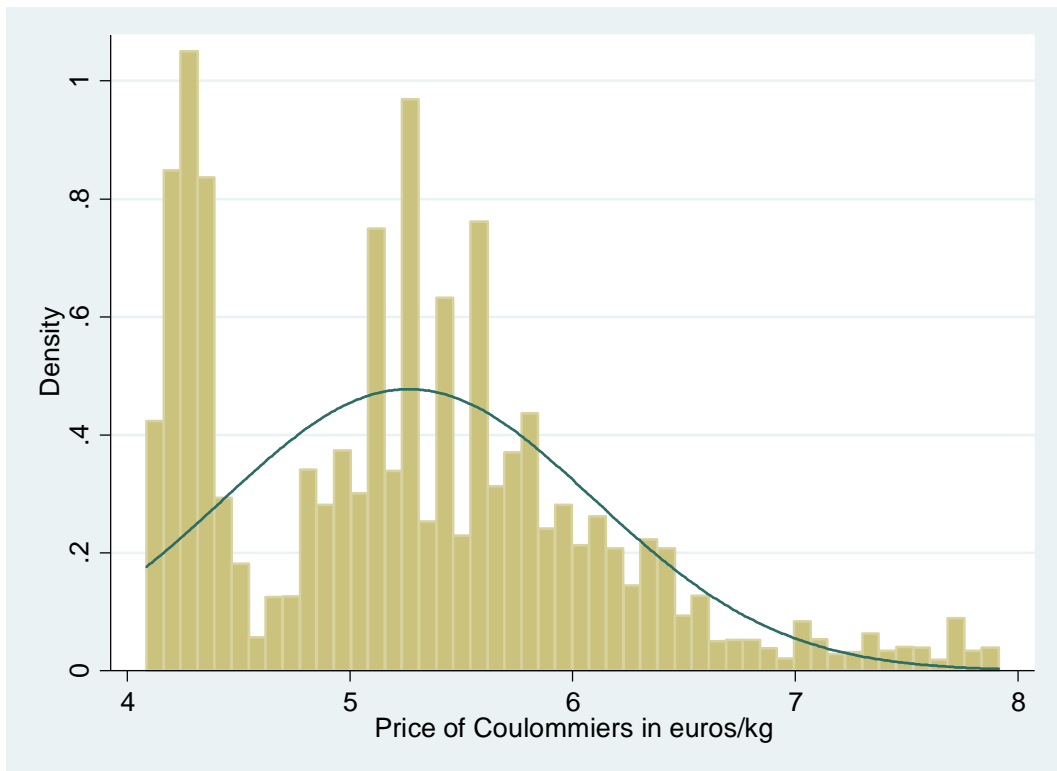
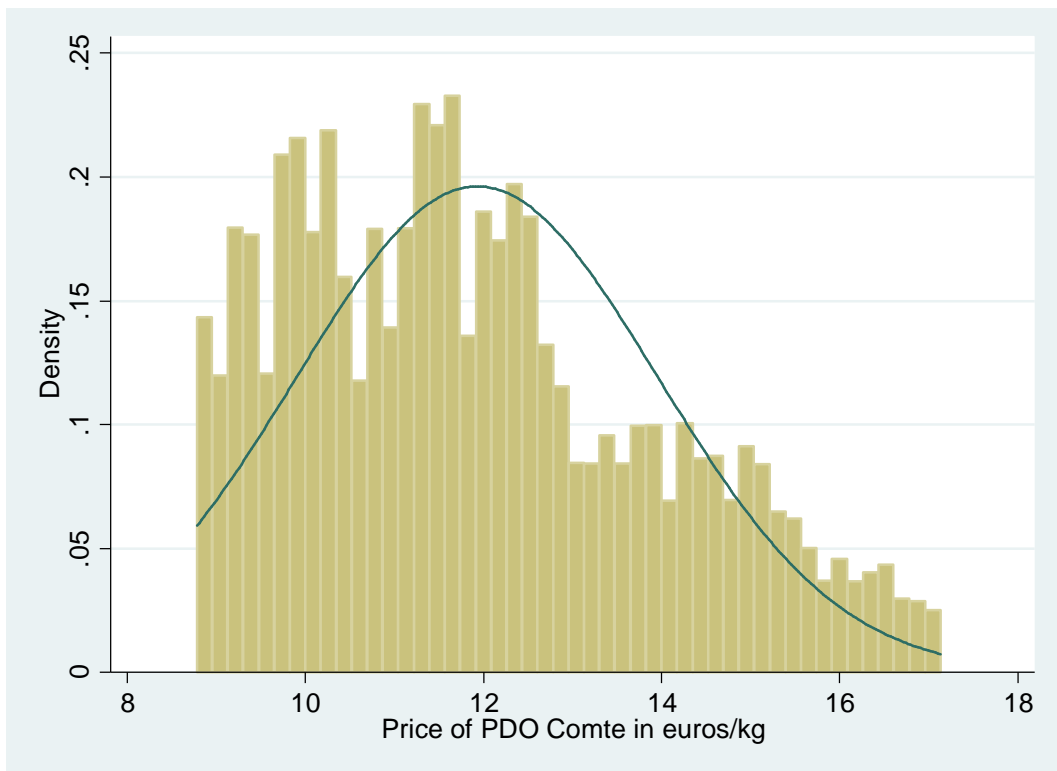


Figure 16: The price of PDO Comte (2008-2010)



Concerning the 5 Auvergne PDO cheeses, figure 17 below shows the price of the PDO “Cantal”, which is an Auvergne cheese made with cow's milk, at uncooked pressed dough and a dry crust.

We observe that the PDO “Cantal” is bought at less than 14 €/kg. The distribution of price is clearly multimodal, with modes at 11 €/kg and 7 €/kg. So consumers buy most of the time the PDO “Cantal” at 7 €/kg or 11 €/kg. Because there are three types of Cantal (“Entre deux”, “Jeune” and “Vieux”), so the price varies in function of the type purchased by consumers. This price is not so far from that observed for the PDO “Comte”.

Figure 17: The price of PDO Cantal (2008-2010)

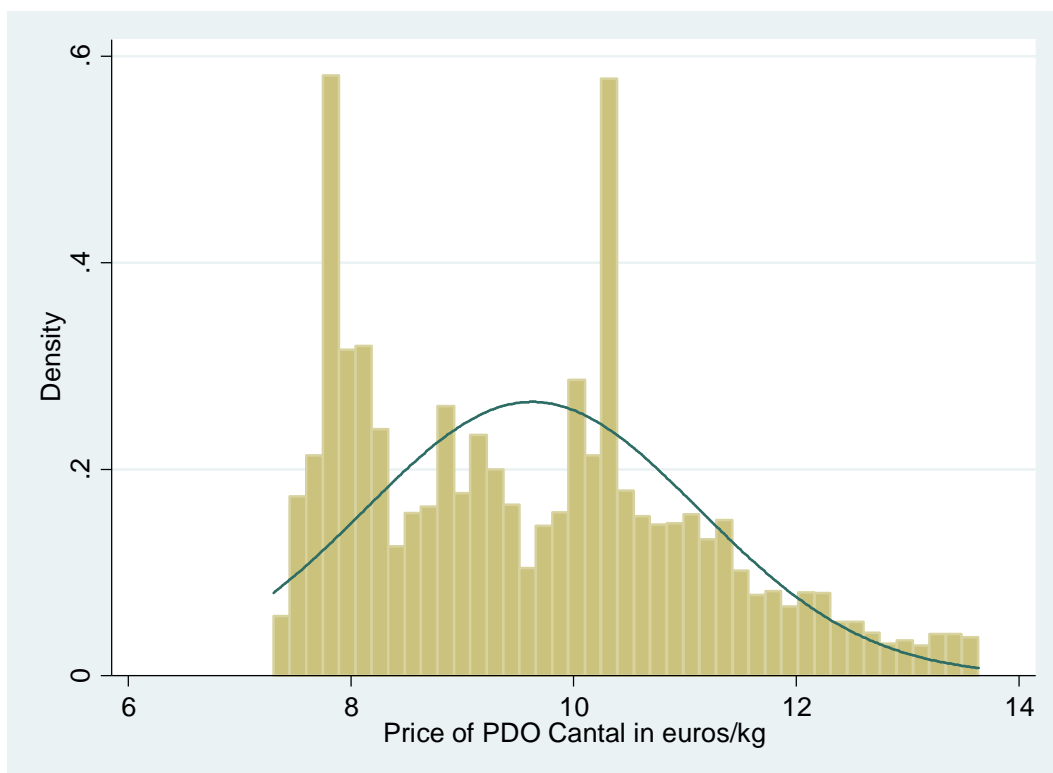
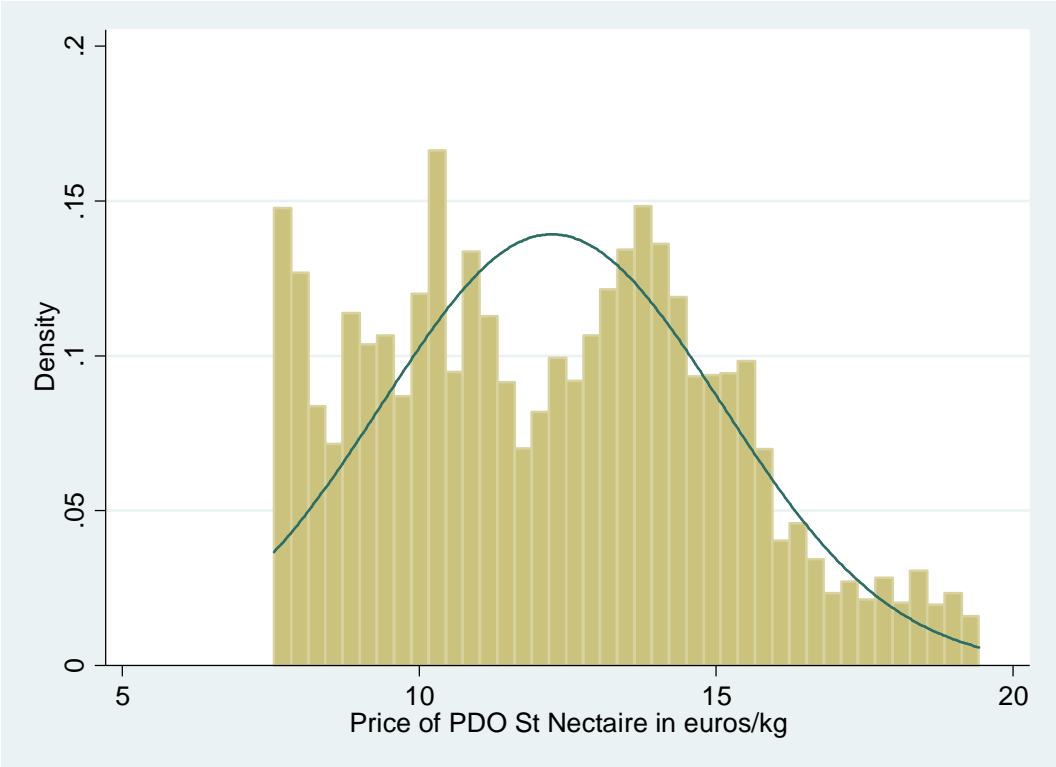


Figure 18 below shows the price of PDO “St Nectaire”, which is an Auvergne cheese made with cow's milk, at uncooked pressed dough semi-hard.

We observe that this cheese is bought at less than 20 €/kg, with the highest density of purchase being for the PDO “St Nectaire” sold at 14 €/kg and 10 €/kg.

This bimodal distribution can be explained certainly by the fact that there are two types of PDO “St Nectaire”, the dairy and the farmer, the latter being generally more expensive. This result shows that the PDO “St Nectaire” is one of the most expensive Auvergne cheeses sold per kilogram. Consumers buy more the PDO “St Nectaire” which is sold at 14 €/kg and at 10 €/kg.

Figure 18: The price of PDO St Nectaire (2008-2010)



Figures 19 and 20 below show the price of PDO “Bleu Auvergne” and PDO “Fourme Ambert”, which are Auvergne cheeses made with blue-veined cow's milk, not pressed, uncooked, fermented and salted. We observe that these two cheeses are bought at less than 14 €/kg, the highest density of purchase being when they are sold at almost 8 €/kg.

Knowing that they are "Blue" cheeses, the figures 19 and 20 reveal that consumers buy most of the time these cheeses when they are practically sold to the same price.

Figure 19: The price of PDO Bleu Auvergne (2008-2010)

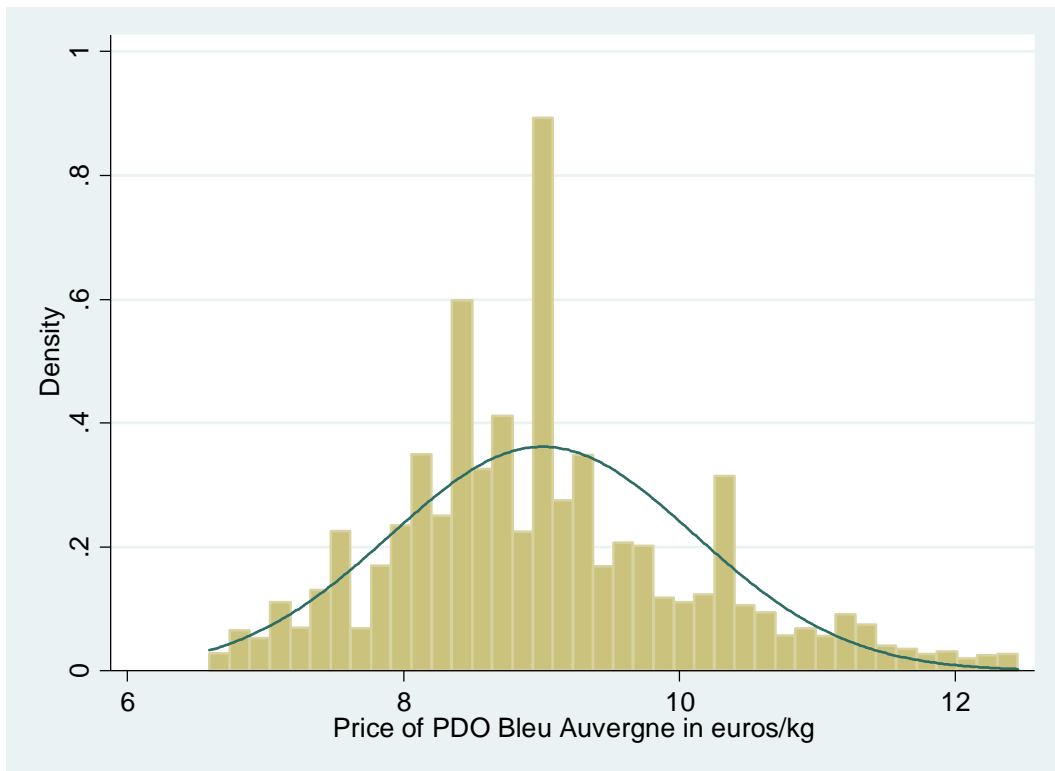


Figure 20: The price of PDO Fourme Ambert (2008-2010)

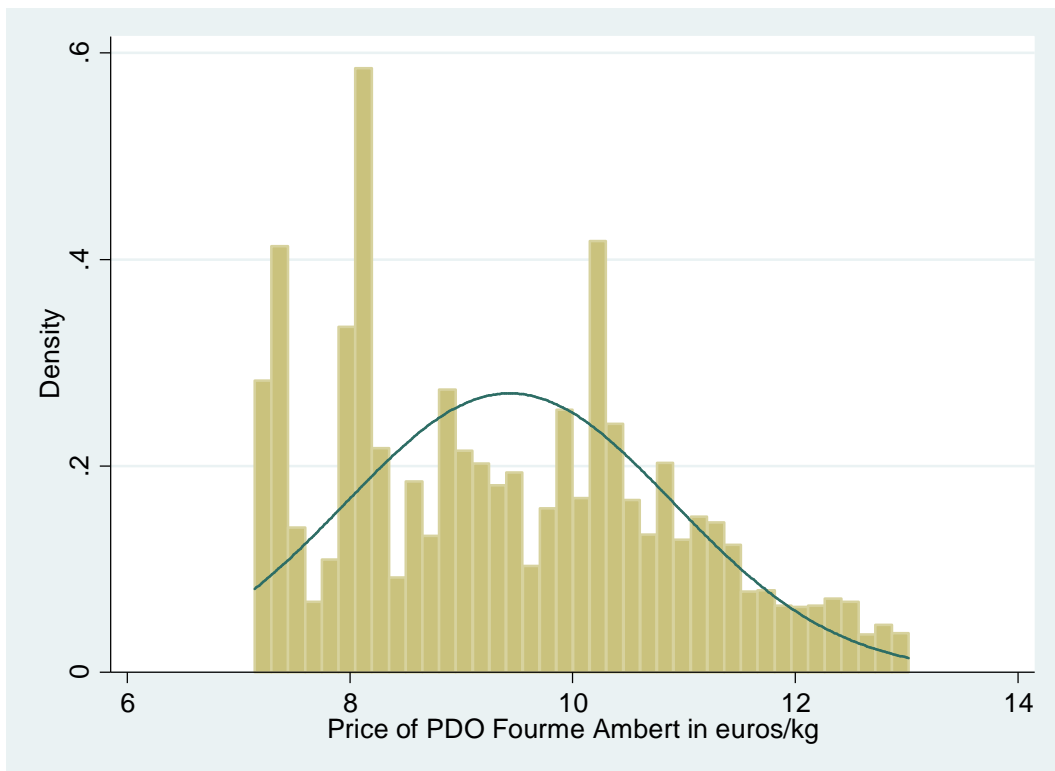
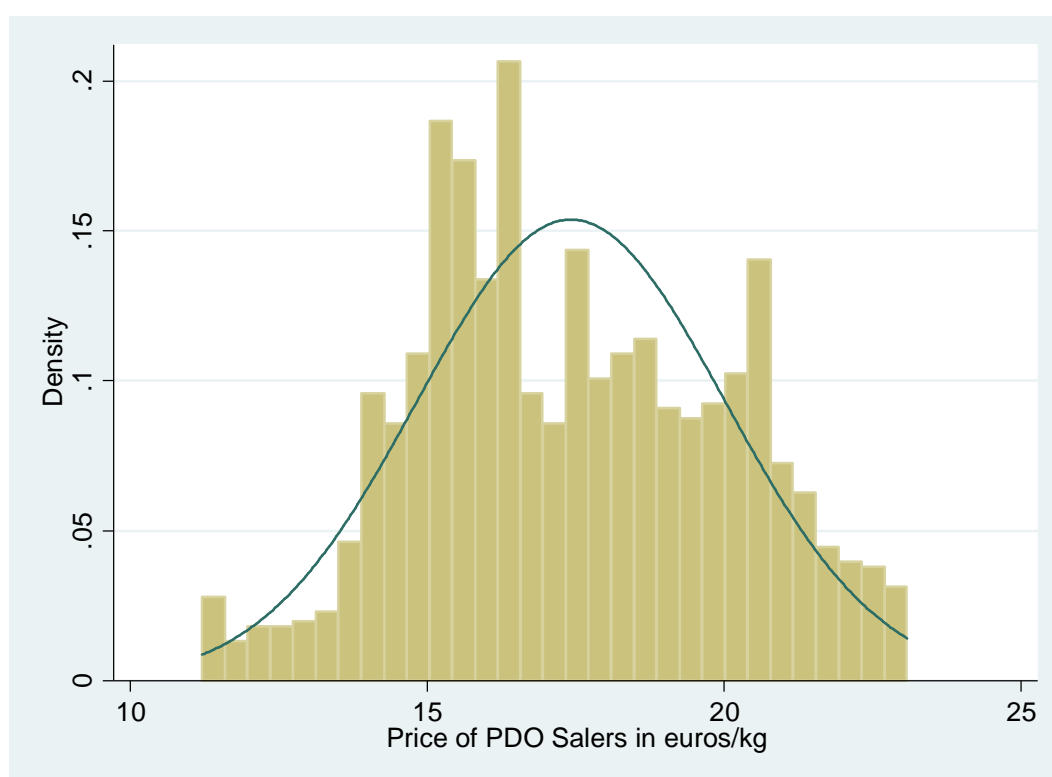


Figure 21 below shows the price of the PDO “Salers”, made with strong dough, pressed and not cooked with a dry, thick, flowery crust. It is the smallest Appellation of the Auvergne region.

We observe that this cheese is sold less than 25 €/kg. It is the most bought when it is sold at almost 16 €/kg. Although it is the smallest Appellations of the Auvergne region, the PDO “Salers” is one of the most expensive Auvergne cheeses on the market with the PDO “St Nectaire”.

Figure 21: The price of PDO Salers (2008-2010)



4.4.3. Regional comparison

We now turn to an analysis at regional level. Figure 22 below presents the average of effective expenditure by acts of purchase for cheeses from our database by French region.

We observe that, on average, we spend more in regions Auvergne, Franche-Comte and Corse, with an average expense of more than 3 € by act of purchase for an any cheese. This high expenditure in the case of the Auvergne region can be explained by the fact that it produces

two of cheeses the most expensive under geographical indications, namely “Salers” and “St Nectaire” and they are more sold in their region of origin. On the other hand, we spend less for cheeses sold in regions Basse-Normandie and Bretagne.

Figure 22: Total expense by region (2008-2010)

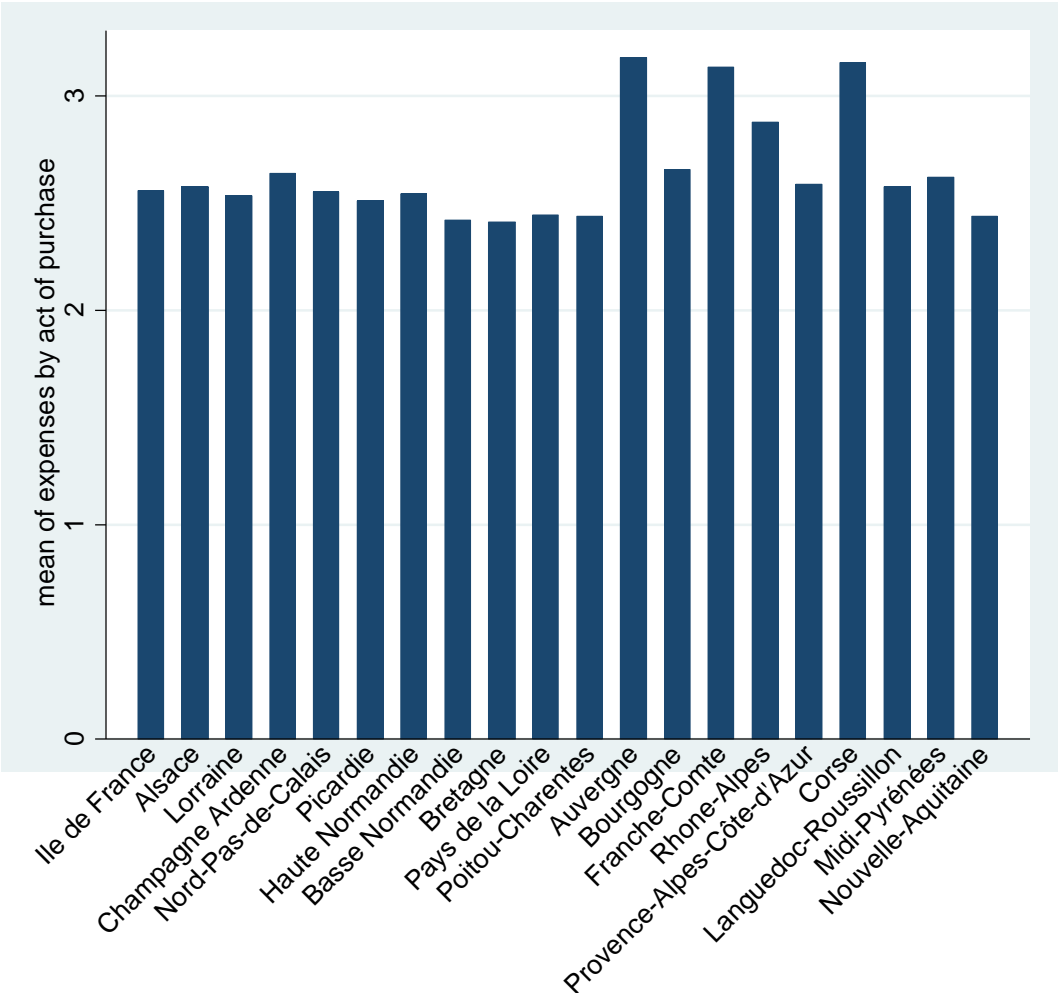


Figure 23 below shows the price per kilogram of cheeses purchased. We observe that the Ile-de-France region is the one region where cheeses are sold on average most expensive per kilogram purchased, about 9 €/kg for any cheese. This may explain the low average expense observed in this region (Figure 22 above). In addition, in this region the purchases are generally made in small convenience stores, but the latter practise generally high prices because supermarkets and hypermarkets are generally far from dwellings. It is also probably related to the land prices in particular. The region Ile-de-France is followed by regions Alsace, Auvergne and Rhône-Alpes.

In these regions, the consumers spend more during purchases of cheeses. This is explained by the very high price per kilogram purchased. The region of Auvergne appears very atypical, because cheeses are sold very expensive, but it is less a cosmopolitan region as regions Ile-de-France and Rhône-Alpes. This is probably due to the fact that certain Auvergne PDO cheeses are considered rather expensive by consumers in particular “Salers” and “St Nectaire”; furthermore they are the most sold in their region of origin, it explains the high prices observed in the region of Auvergne. On the other hand, regions in which cheeses are sold at low prices per kilogram purchased are Basse-Normandie and Pays-de-la-Loire.

Figure 23: Average price of cheeses by region (2008-2010)

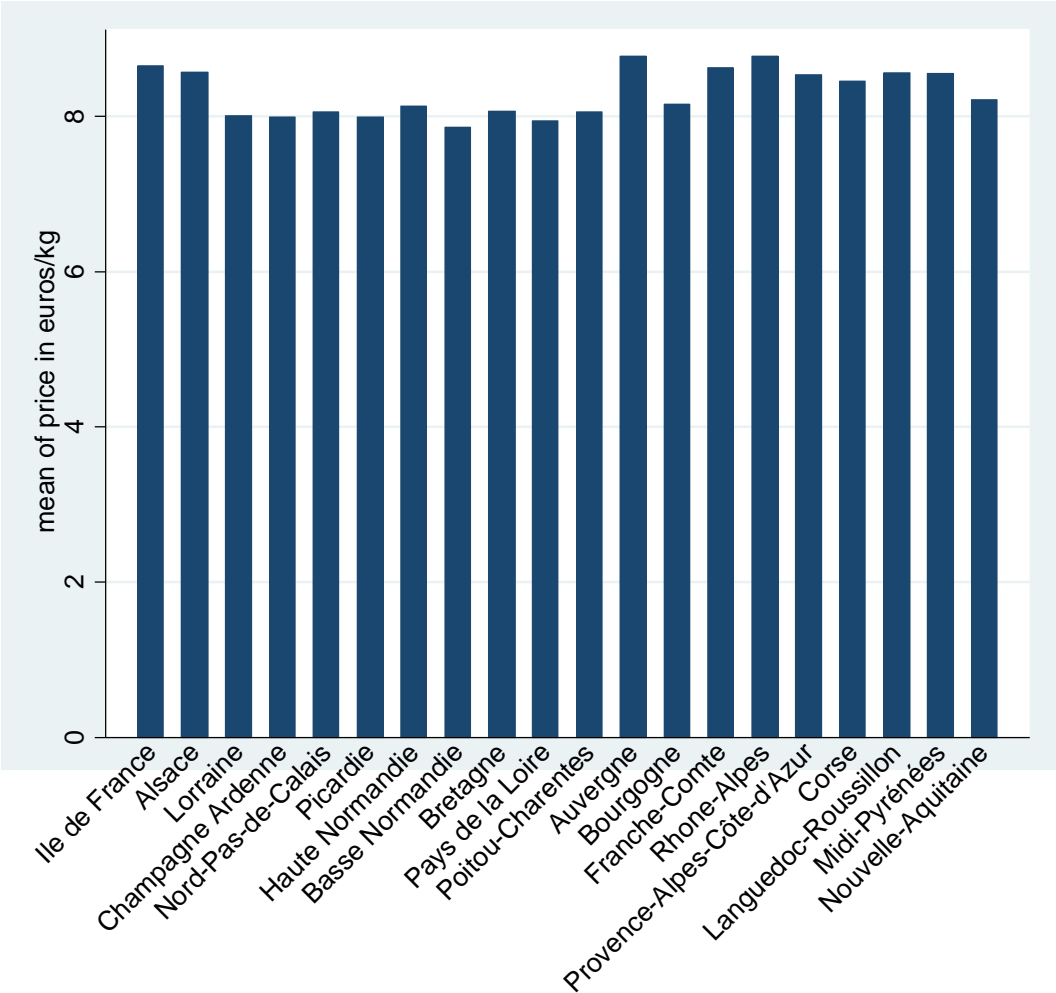


Figure 24 below shows the average prices per distribution channels. We observe that on average cheeses are more expensive in the specialized shops like “Creamer” (more than 10 €/kg). Large and medium-sized distributions (Hypermarkets, Supermarkets, and Hard-

discounts) appear as being the ideal places to purchase cheeses, because they are less expensive compared to specialty stores. This finding is generally made in all French regions.

Figure 24: Prices by store of distribution

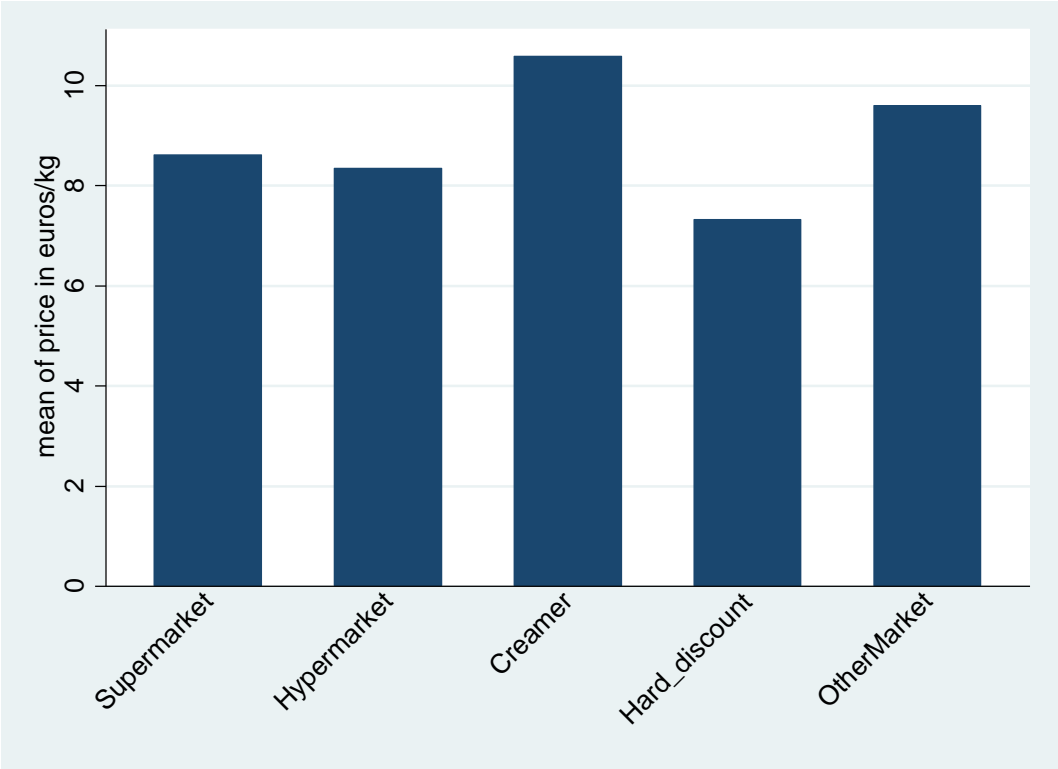
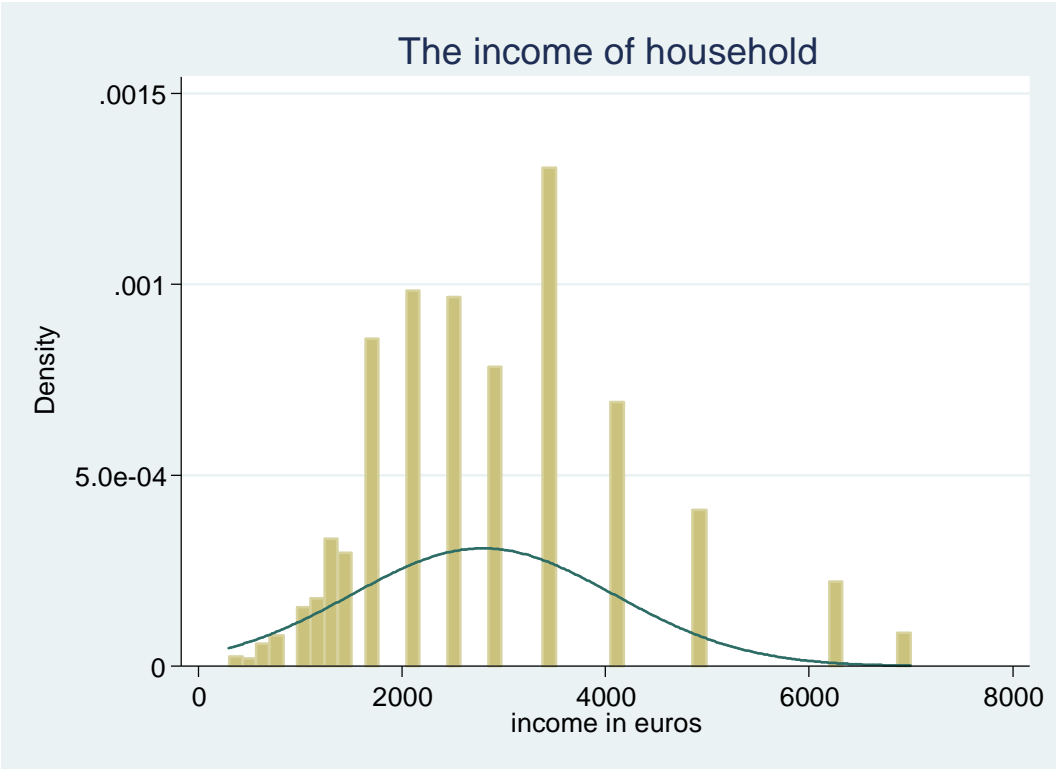


Figure 25 below shows the income of households which consume cheeses. We observe that incomes of households consuming the most cheeses are between 2000 € and 4000 €, the biggest density of consumption being for the households having about 3500 € monthly of income.

Households with low incomes consume little cheeses, as well as households with very high incomes. Figure 25 shows that the consumption of cheeses is largely realized by modest households.

Figure 25: the income of household (2008-2010)



4.5. Conclusion

The French market of cheeses is a very cosmopolitan market which groups together foreign cheeses and national cheeses. In these two big groups of cheeses we find GI cheeses and non-GI cheeses. These signs of quality have been established to serve as a signal of information for consumers on the quality of products purchased.

The purpose of this chapter was therefore to present the tendencies on prices and quantities observed and habits of consumers over the period 2008-2010. To do so, using the Kantar WorldPanel database, which provides us information on the purchases made by consumers over the period considered, we have carried out descriptive statistics of the main variables in order to have a state of the art of the main stylized facts observed.

As main results, we found that among GI-cheeses the PDO “Comte” is the most purchased in terms of quantities on the French market of cheeses, followed by the PDO “Mozzarella” and the PDO “Roquefort”. The Auvergne PDO cheeses are so far from this top trio. We also found that despite the low quantities purchased of Auvergne PDO cheeses compared to other large cheeses, they record the highest prices on the market and this is more verified for the PDO “Salers” and the PDO “St Nectaire”. These results are the same that those observed at the French national level via reports of the Inao and the Cnaol, which suggests that our database is representative for our purposes. We also observe that, on average, cheeses that they are GI or non-GI are sold fairly expensive in the Ile-de-France region, followed by the Alsace, Rhone-Alpes and Auvergne regions. Consumers spend on average more for cheeses sold in the region of Auvergne, but cheeses are less sold in this region in term of quantities, due to their high price. This result is probably also due to a local effect or a structure effect of consumption.

We conclude that the Auvergne region appears to be quite special because cheeses are on average more expensive in this region compared to other French regions, which leads to higher expenditure by act of purchase in this region, hence the lower number of acts of purchase and quantities purchased in this region. Finally, we find that prices of cheeses are very disparate, probably because of the regional diversities and types of stores of distribution. This invites us to examine the causes of these dispersions in the following chapter, with an emphasis on Auvergne PDO cheeses.

Chapter 5: Prices determinant and prices dispersion: An estimation of a multiplicative heteroscedasticity model on the Auvergne PDO cheeses⁴¹

⁴¹ - A version of this chapter has been submitted for publication.

- A version of this chapter was presented at the "*Doctorales*", organized by the Regional Science Association of French Language (ASRDLF). Clermont-Ferrand (France), 15-17 March 2017.

Abstract

In this chapter, we estimate determinants of prices of cheeses in general and Auvergne PDO cheeses in particular. To do this, we use an estimation of a multiplicative heteroscedasticity model, which is a two-step model. In the first step, we find that the main price determinants of cheese are: the type of presentation (Piece, Whole, etc.); the type of packaging (Barquette, sachet, paper, etc.); the circuit of distribution (Hypermarket, Supermarket, Hard-discount, Creamer or cheesemaker); sales region; promotions on cheeses; the presence of a store brand; the season of purchase (summer, autumn, winter, spring); geographical indication (PDO/PGI). Indeed, the geographical indication label like the protected designation of origin (*PDO*) and the protected geographical indication (*PGI*) impact positively and significantly the price of cheeses on average of +2.329 €/kg compared to non-GI cheeses. In the second step, we focus on Auvergne PDO cheeses and explain the dispersion of prices observed from one French region to another. We found that aggregates explaining the price dispersion of Auvergne PDO cheeses are: promotions; inflation; the winter season; and the presence of store brand. Finally, aggregates allowing to reduce this price dispersion observed on Auvergne PDO cheeses are: the increase of market shares; competition; number of format presentation by cheese; purchases in large and medium-sized distributions (Hypermarket, Supermarket, Hard-Discount). The major contribution of this chapter is to be the first empirical paper to assess the price dispersion region by region for geographical indications products with original data from Kantar WorldPanel.

Keywords: Geographical Indications, Cheese products, Prices dispersion, Econometric model

JEL classification: C19, D23, Q11, Q13,

5.1. Introduction

In imperfect information, or in situation of asymmetry of information, prices are not always enough to signal the quality of goods, so other signals are generally necessary. Because there are usually two types of price: a practised price and a competitive price, the difference between both measures the concentration of the market. This is why several devices have been put in place to reveal more information to consumers, among which Geographical Indications (GI).

Geographical Indications such as Protected Designations of Origin (PDO) are supposed to play this signaling role to help consumers in their decision of purchase. Indeed, the PDO label specifies that the product purchased is of good quality and that it is manufactured with a particular know-how, in the required conditions and especially in a given geographical place which specifies that this product cannot be produced anywhere else.

The market of Auvergne PDO cheeses is a good case study to understand price formation mechanisms, because unlike other PDO cheeses of similar characteristics, they are sold at relatively low prices, except “St Nectaire” and “Salers”. These PDO cheeses are only produced in the region of Auvergne. Prices of Auvergne PDO cheeses (“Cantal”, “St Nectaire”, “Bleu Auvergne”, “Fourme Ambert” and “Salers”) are equal to the marginal cost of production if the market is competitive. The profit will therefore be zero in this case. In imperfect competition, the margin is rather upper to zero. But despite a relatively low average price, it turns out that consumers consider PDO cheeses from Auvergne as being rather expensive, and prices of these PDO cheeses are quite disparate depending to the region of purchase. This raises a problem of attractiveness of these cheeses, and also the question of the willingness to pay of consumers for these products, knowing that this willingness to pay is a price premium.

The aim of this chapter is to better understand the real determinants of the price of Auvergne PDO cheeses, in order to determine factors that could lower price distortion and hence improve the functioning of the market and the fair distribution of value-added, because it is these determinants that consumers observe and can potentially determined their willingness to pay. How to explain prices dispersion from one region to another? And how to reduce them? In order to answer these questions, we analyze a panel of retail prices of cheese products over

the period 2008-2010 from Kantar WorldPanel database. To do this, we estimate a multiplicative heteroscedasticity model to measure determinants and prices dispersion of Auvergne PDO cheeses.

The chapter is organized as follows. Section 2 gives a literature review on issues related to prices dispersion. Section 3 describes data and gives descriptive statistics. Section 4 presents econometric specifications. Section 5 presents results and interpretations. Finally, we conclude in section 6.

5.2. Literature review

5.2.1. Theoretical Literature

The price is the monetary expression of the value of a good. It is also a signal of the market situation: a high price indicates that the activity is profitable, encouraging so other companies to enter in the sector. The price is also an incentive mechanism: if the demand for a good increase, the price will increase inciting the existing companies to produce more. It is also a process of rationing: if the demand for a good increase, the price will increase and the quantity requested will be reduced again (rationing). To make decisions, economic agents take into account transaction costs, benefits they expect from this transaction and the risk that benefits obtained will not be commensurate with the cost.

Producers make a choice between goods to be produced according to the price. If the price of a good is sufficiently high to yield a sufficient profit, they will produce the good. When the price of a good increases, providers are incited to increase their offer to increase their profit, when the price of a good falls, providers whose costs are high compared to the market price will not produce any more this good.

In a market economy, prices play the dual role of signal and principle of action, thus conveying information about preferences of agents. The signal of prices is confronted with the monetary conditions of production by entrepreneurs. They transform desires of consumers into goods and services if the operation allows to generate a profit. This notion of profit is not separable from that which forces a consumer to choose a cheaper product to increase his purchasing power. The hypothesis of the price as a transmitter of the credible information is

also defended by [Hayek \(1945\)](#). For the latter, prices transmit information about the state of rarity of goods.

But [Galbraith \(1980\)](#) criticizes this neoclassical theory of the price, as well as the sovereignty of the consumer (as decision-maker of his consumption), and the self-regulating role of the market. According to him, consumers do not really decide on their demand of products, their decisions are directed by techniques of sales of firms based on the advertising that influence their behavior, and the marketing that allows the producer to seize their competencies and to orient them. He calls this phenomenon the “reverse sector”.

Consumers will tend to buy more easily goods which are more expensive, when the guarantee of quality is attributed to them. However, the price of a product can increase without an increase in quality. This phenomenon was illustrated by [Akerlof \(1970\)](#) in the context of asymmetries of information, in which consumers are confronted with products of good qualities and bad qualities having the same price. Consumers do not have a perfect information to judge the quality of the product purchase, price fluctuations, thus prices dispersion can therefore appear resulting of this situation.

5.2.2. Price dispersion

The term “price dispersion” describes generally the firms of the same market selling identical products at different prices in the same time ([Lewis 2008](#)).

Prices dispersion has been studied at length within the framework of the purchases of air tickets.

[Borenstein and Rose \(1994\)](#) study price dispersion of airfare of passengers on a same airline. They show that the expected difference between two passengers on the same line is about 36% of the average price of tickets. This dispersion of prices increases on flights with more competition or with a lower density of flights. [Hayes and Ross \(1998\)](#) by using three alternative measures of prices dispersion, develop a price dispersion model on airline tickets to estimate the impact of the discrimination on prices. But, they do not find a clear connection between market structure and prices dispersion. They find a persistent discrimination at monopolized endpoints, most of the dispersions are associated with the tariff wars and peak

load pricing schemes. [Piga and Bachis \(2006\)](#) study the dispersion of prices in European airlines companies. By using rates for approximately 650,000 flights operated by the low-cost and full-service, they find that price volatility increases during the last four weeks before the departure. Thus for them, the pressure of the demand from a company to another one may justify this dispersion of prices. [Stavins \(2001\)](#) tests the hypothesis that the price discrimination increases with the competition on the market of airline companies, he finds that prices dispersion attributed to the ticket restrictions increases as markets become more competitive.

On the other hand, some authors find contradictory effects of the competition on the dispersion of prices. [Gerardi and Shapiro \(2009\)](#) analyze effects of the competition on price dispersion. By using panel data over the period 1993-2006, they find that competition has a negative effect on prices dispersion, so competition can reduce prices dispersion. Their result contrasts with those of [Borenstein and Rose \(1994\)](#), who found that competition rather increased the dispersion of prices. [Gaggero and Piga \(2011\)](#) also analyze the empirical relation between the market structure and prices dispersion on air-travel markets between the UK and the Republic of Ireland. The dispersion of prices is calculated by using a number of inequality indices calculated by using prices displayed on the internet at specific days before takeoff. They find a negative correlation between the market dominance and prices dispersion; thus competition appears to hinder the airlines' ability to price discriminate to exploit consumers' heterogeneity in booking time preferences.

Closer to our subject in terms of prices dispersion observed according to the geographical localization, authors were interested in effects of the dispersion of prices observed in gas stations according to places of purchase.

[Barron, Taylor et al. \(2004\)](#) examine various approaches to generate a prices dispersion at equilibrium and then empirically estimate the relation between the seller's density (number of competitors in a market), the average price of the product and prices dispersion in the market of retail industry using four sets of gasoline pricing data in the USA. By controlling characteristics of the level of the station, they find that an increase of the density of the station decreases both the level of prices and prices dispersion in four geographical areas in their sample. [Hosken, McMillan et al. \(2008\)](#) use a data set compound of a three-year price panel from a sample of gasoline stations located in the suburbs of Washington DC and a census of

stations in the region to develop new empirical results on the retail gasoline pricing. They find that there is a substantial heterogeneity in pricing behavior: stations with very low or very high prices are more likely to maintain prices at these levels compared to stations with near-average prices. [Lewis \(2008\)](#) measures the dispersion of prices among gasoline retailers and examines the link between the dispersion and the local competitive environment. They find that there is a significant price dispersion even after controlling for the characteristics of stations and characteristics of different sellers. The extent of prices dispersion is linked to the density of local competition, but this relation varies considerably according to the type of seller and the composition of its competitors. Their findings imply that consumers may have imperfect price information and that consumer search could be an important aspect of competition in these markets. The level of price dispersion that is observed is sensitive to both the number of local competitors and the nature of local competitors. Price dispersion is larger for high-brand stations when they have a higher number of competing low brand stations nearby. In contrast, price dispersion is lower for both high brand and low-brand stations when there are more competitors of their own type in the local market.

These effects of price dispersion were also addressed in the framework of food consumption products.

[Richards, Hamilton et al. \(2016\)](#) start from the idea that prices of similar products often differ between retail outlets, which brings consumers to actively seek out products which meet their needs at the lowest possible price. Prices differ among retailers and the intensity of research differs among consumers because search is an expensive activity and consumers differ in their research costs. They use the online grocery price data from four retailers in the UK to estimate costs of search and price dispersion at the equilibrium. They find that when consumers search individual products, this variety increases the cost of the research and encourages consumers to seek less, which increases the power of pricing for online retailers, resulting a wide dispersion of prices. However, when consumers search several products, costs of research still fall into the variety, but consumers search more intensely into stores, what increases potentially the competitiveness of online retail markets, hence a low price dispersion. [Choi and Choi \(2016\)](#) analyze a panel of retail prices of 45 products for 48 USA cities over the period 1985-2009 and show that the physical distance and costs of transport have a positive impact on the volatility and the persistence of the dispersion of interurban prices. The nominal rigidities have a positive impact on the persistence but a negative impact on the price

volatility. [Grieco, Li et al. \(2016\)](#) consistently estimate production functions in the presence of input price dispersion when the intermediate input quantities are not observed. They find a significant dispersion of input prices and a greater dispersion of productivity.

This literature review shows that there are very few studies on the dispersion of foodstuffs prices in general and products under geographical indication in particular. This is due to the difficulty of having databases that reconcile both the consumer's data and the data on products purchased according to regions of purchase. The Kantar World Panel database allows us to do this type of study, because it provides this type of data.

There is a very large empirical literature on the effect of geographical indication labels in decisions of consumptions of consumers. [Ngoulma \(2016\)](#) for the case of Auvergne PDO cheeses, [Bonnet and Simioni \(2001\)](#) for the case of Camembert cheeses, ([Hassan and Monier-Dilhan 2002](#)) for the case of Roquefort cheese, etc. However, very few studies have examined price dispersion observed on these products under geographical indication, hence the need to address this problem in this chapter.

5.3. Descriptive statistics

Table 10 below shows acts of purchases and the number of stores (hypermarkets, supermarkets, hard-discounts, creamer and other stores of distribution) per region in our sample for the period 2008-2010.

The region of "Auvergne" appears to be very atypical, because it is one of regions with the most stores, more exactly the third region behind "Ile-de-France" and "Rhone-Alpes", with about 69 stores of cheeses distribution, but for only 23,467 acts of purchase in 3 years. Thus, it is one of the regions where we buy little with regions "Franche-Comte" and "Corse" in terms of number of acts of purchases.

Table 1 shows that our sample contains 20 cheeses among which: "Cantal", "St_Nectaire", "Bleu_Auvergne", "Fourme_Ambert", "Salers", "Roquefort", "Comte", "Camembert", "Coulommiers", "Mozzarella", "Reblochon", "Gruyere", "Raclette", "Morbier", "Gorgonzola", "Emmental", "Feta", "Tomme", "Brie-de-Meaux" and "Grana". These cheeses

are sold in all regions of our sample, except for the “Corse” region which sells only 15 cheeses. See the list of cheeses in Appendix C.

Table 10 : Characterization of the sample over the period 2008-2010

Market	Number of observations	Number of cheeses in a sample	Number of stores
Auvergne	23467	20	69
Ile_de_France	218960	20	99
Aquitaine	60850	20	61
Midi-Pyrénées	53506	20	66
Languedoc_Roussillon	52822	20	66
Corse	1501	15	3
Provence_Alpes_Cote_Azur	103192	20	71
Rhone_Alpes	116194	20	91
Franche_Comte	23339	20	43
Bourgogne	25544	20	48
Poitou_Charentes	34031	20	53
Pays_de_la_Loire	87764	20	64
Bretagne	70453	20	54
Basse_Normandie	90279	20	68
Haute_Normandie	55078	20	64
Picardie	41484	20	46
Nord_Pas_de_Calais	88883	20	58
Champagne_Ardenne	30806	20	37
Lorraine	55729	20	53
Alsace	31224	20	43

Table 11 below shows that quantities purchased of cheeses increased in almost all regions over the period 2008-2010, except in regions “Auvergne”, “Languedoc Roussillon”, where they decreased. In the region “Midi Pyrénées” quantities of purchased remained stable.

Table 11: Quantities sold by year and by region of purchase over the period 2008-2010

Year	Obs in kg	%	Obs in kg	%
	Auvergne		Poitou_Charentes	
2008	2971.84	34%	3452.68	32%
2009	2756.67	32%	3802.40	35%
2010	2807.38	34%	3610.67	33%
	Ile_de_France		Pays_de_la_Loire	
2008	21299.80	31%	8889.51	31%
2009	22970.44	34%	9655.17	34%
2010	23732.38	35%	9724.38	35%
	Aquitaine		Bretagne	
2008	6095.84	32%	7000.11	32%
2009	6343.68	33%	7295.48	33%
2010	6643.37	35%	7804.04	35%
	Midi_Pyrénées		Basse_Normandie	
2008	5713.16	33%	8618.14	30%
2009	5813.66	34%	10234.07	35%
2010	5745.35	33%	10268.99	36%
	Languedoc_Roussillon		Haute_Normandie	
2008	5716.53	34%	5344.29	30%
2009	5715.72	34%	6142.58	34%
2010	5411.66	32%	6426.37	36%
	Corse		Picardie	
2008	181.69	31%	4267.53	31%
2009	206.88	35%	4659.42	34%
2010	198.40	34%	4761.24	35%
	Provence_Alpes_Côte_Azur		Champagne_Ardenne	
2008	10256.10	30%	3481.17	32%
2009	11466.20	35%	3660.45	35%
2010	11441.28	35%	3592.68	33%
	Rhone_Alpes		Franche_Comte	
2008	12360.88	31%	2570.39	30%
2009	13235.76	34%	2940.54	34%
2010	13731.95	35%	3025.8	36%
	Nord_Pas_de_Calais		Lorraine	
2008	9620.29	32%	5812.14	31%
2009	9893.12	33.5%	6454.60	35%
2010	10035.59	34.5%	6287.04	34%
	Alsace			
2008	2971.24	30%		
2009	3333.91	34%		
2010	3553.10	36%		

Table 12 below presents prices statistics. We observe that the minimum price in each region is about 4 €/kg. For all regions the maximum price of cheeses is about 24 €/kg, but this table also informs us that the average price of the cheese turns around 8 €/kg in almost all regions.

Table 12: Descriptive statistics of prices by region over the period 2008-2010

Market	Obs	Mean	Std. Dev.	Min	Max
Auvergne	23467	8.77	2.92	4.02	24.19
Ile_de_France	218960	8.64	3.09	4	24.36
Nouvelle_Aquitaine	60850	8.20	2.98	4	24.35
Midi_Pyrenies	53506	8.55	3.19	4.02	24.36
Languedoc_Roussillon	52822	8.55	3.20	4	24.32
Corse	1501	8.44	2.37	4	24.15
Provence_Alpes_Cote_Azur	103192	8.53	3.08	4	24.37
Rhone_Alpes	116194	8.76	3.01	4	24.36
Franche_Comte	23339	8.62	2.94	4	23.98
Bourgogne	25544	8.15	2.89	4.02	24.32
Poitou_Charentes	34031	8.05	2.87	4.02	24.36
Pays_de_la_Loire	87764	7.94	2.72	4.02	24.34
Bretagne	70453	8.06	2.78	4	24.3
Basse_Normandie	90279	7.86	2.71	4	24.24
Haute_Normandie	55078	8.12	2.80	4.02	24.26
Picardie	41484	7.98	2.79	4	24.32
Nord_Pas_de_Calais	88883	8.05	2.85	4.02	24.33
Champagne_Ardenne	30806	7.98	2.82	4	24.23
Lorraine	55729	8.01	2.84	4	24.05
Alsace	31224	8.56	3.07	4	24.36

In the remainder of this descriptive section, we focus on prices of Auvergne PDO cheeses (Cantal, St Nectaire, Bleu Auvergne, Fourme Ambert and Salers) over the period 2008-2010 by region.

Figure 26 (*see appendix a*) presents the average price of the PDO Cantal. We observe that this cheese is sold on average more expensive in the region “Ile-de-France”; it is certainly due to the high cost of living in this region, followed by the region “Province-Alpes-Cote-d'Azur”. We note also strong price dispersion from a region to another for this cheese, with low average prices in the “Alsace”, “Lorraine” and “Franche-Comte” regions and high average prices in the regions of “Ile-de-France” and “Province-Alpes-Cote-d'Azur”. This cheese is not sold in the “Corse” region.

Figure 27 (*appendix a*) presents the average price of PDO “St Nectaire”. As for the PDO “Cantal”, we observe that this cheese is more expensive in the “Ile-de-France region”. The dispersion of prices is more important for this cheese.

The average prices are low in “Franche-Comte” region, less than 10 €/kg and high average prices are observed in “Ile-de-France” more than 14 €/kg. Like the PDO “Cantal”, this cheese is not sold in the “Corse” region.

Figure 28 (*see appendix a*) presents the average price of the PDO “Bleu Auvergne”. We observe that the “Bleu Auvergne” is sold more expensive in the “Ile-de-France” region, followed by the “Nord-Pas-de-Calais” and “Auvergne” regions. This PDO cheese is sold less expensive in the “Corse” region.

The dispersion of regional prices is not great for this cheese compared to the “Cantal” and the “St Nectaire”. The average price of the PDO “Bleu Auvergne” from a region to another is practically in the same order of magnitude.

Figure 29 (*see appendix a*) presents the average price of the PDO “Fourme Ambert”. We observe that the “Fourme Ambert” is sold more expensive in the region “Rhone-Alpes”, followed by regions “Ile-de-France” and “Alsace”. This PDO cheese is sold less expensive in the “Bourgogne” region. But it does not sell in the “Corse” region.

As for the PDO “Fourme Ambert”, the dispersion of regional prices is not most high for this cheese compared to the “Cantal” and the “St Nectaire”. Average prices of the PDO “Fourme Ambert” are practically in the same range from a region to another.

Figure 30 (*see appendix a*) presents the average price of the PDO “Salers”. We observe that the “Salers” is more expensive in the “Ile-de-France” region like for the “Cantal” and the “St Nectaire”. This PDO cheese is less expensive in the regions “Franche-Comté” and “Champagne-Ardenne”. But it does not sold in the “Corse” region.

We also note a strong regional dispersion of average prices of this cheese. The average high prices are around 18 €/kg and are observed in the ‘Ile-de-France’ region. While average low prices are around 14 €/kg and are observed in the ‘Franche-Comte’ region.

For more descriptive statistics see the ‘*appendix b*’ for the definition of variables and *appendix c* for the descriptive statistics on quantities purchased by region.

5.4. Econometric estimations

Waugh (1929) observed that prices of certain fresh vegetables varied considerably on the wholesale market of Boston and estimate the price as a function of various physical characteristics of vegetables. But his analysis did not take into account the dispersion of prices on the market. Rosen (1974) in the same line shows in which market conditions the implicit price can be interpreted as the value that consumers place on an additional unit of the characteristic. If the estimated implicit price is not significantly different from zero, the characteristic is not evaluated by consumers, or the characteristic is not considered as important or relevant in relation to the product.

In this chapter, we use the multiplicative heteroskedasticity model provided by Harvey (1976). This method is best suited for the analysis of price dispersion (Cardebat, Gergaud et al. 2015). The general specification of the model (in panel) is as follows:

$$P_{it} = \alpha + \beta X'_{it} + \varepsilon_{it} \quad (1)$$

$$E(\varepsilon_{it}) = 0 \quad (2)$$

$$Var(\varepsilon_{it}) = e^{\alpha z'_{it}} \quad (3)$$

Where X'_{it} is a vector of independent variables and z'_{it} is a vector of variables which are usually, though not necessarily, related to regressors, ε_{it} is the error term. Equation 3 represents the measure of price dispersion.

The method consists then in two-step regressions:

- First stage: we do the ordinary least square (OLS) regression of equation (1) to obtain $\hat{\varepsilon}_{it}$

- Second stage: fixed effects regression of $\log(\hat{\varepsilon}_{it}^2)$ as an estimation of $Var(\varepsilon_{it})$, see [Harvey \(1976\), p.462](#).

According to ([Cardebat, Gergaud et al. 2015](#)) this model is particularly well adapted to our issue because the procedure allows for:

- The estimation of the price dispersion (i.e. $Var(\varepsilon_{it})$ in the 2nd stage, corresponding to the second moment of the price distribution).
- Once the price is purged from the influence of sellers and product characteristics (1st stage, price in level corresponding to the first moment of the price distribution).

By following the approaches of [Lach \(2002\)](#) and [Sorensen \(2000\)](#) we introduce the individual and temporal fixed effects in the second step of our estimation.

The estimated equation is the following one:

First stage: we choose the main variables that determine prices

$$P_{it} = \alpha + \mathbf{Cheeses}_{it} \beta_1 + \mathbf{Distribution}_{it} \beta_2 + \mathbf{Region}_{it} \beta_3 + \mathbf{Promotion}_{it} \beta_4 + \mathbf{MDD}_{it} \beta_5 + \mathbf{Packaging}_{it} \beta_6 + \mathbf{Presentation}_{it} \beta_7 + \mathbf{GI(PDO/PGI)}_i \beta_8 + \mathbf{Season}_i \beta_9 + \varepsilon_{it} \quad (4)$$

Where, i represents the cheese and t represents the time.

P : represents the price of cheese purchased;

$Cheeses$: represents cheeses purchased;

$Distribution$: represents the distribution channel like Supermarket, Hypermarket, Hard-discount and Creamer;

$Region$: represents the region of purchase like 'Auvergne', 'Ile de France', etc;

$Promotion$: dummy variable represents the sale with a promotion or the purchase during the promotion;

MDD : represents the existence of a store brand affixed on cheeses or not;

Packaging: represents the packaging method like “Barquet”, “Sachet”, “Box” and “Paper”

Presentation: represents the shape of presentation of the cheese like “Piece”, “whole”, “grated”

GI(PDO/PGI): represents the dummy variable which take 1 if the cheese purchased has a geographical indication (GI) label and 0 otherwise;

Season: represents the dummy variable of season of purchased cheeses

\mathcal{E}_{it} : represents the error term.

Second stage: we choose the main variables that determine the dispersion of prices

$$\begin{aligned} \log(\hat{\varepsilon}_{it}^2) = & \alpha + \textit{Competition}_i \beta_1 + \textit{Winter}_i \beta_2 + \textit{Distribution}_i \beta_3 + \\ & \textit{Promotion}_i \beta_4 + \textit{MDD}_i \beta_5 + \textit{Inflation}_{it} \beta_6 + \textit{Market_Share}_i \beta_7 + \\ & \textit{Presentation}_i \beta_8 + \textit{Packaging}_i \beta_9 + \textit{Nber_presentation}_i \beta_{10} + \delta_i + \gamma_t + \varphi_{it} \end{aligned} \quad (5)$$

Where $\log(\hat{\varepsilon}_{it}^2)$ represents a proxy of price dispersion, according to [Cardebat, Gergaud et al. \(2015\)](#). We consider that the region in which we buy can play on prices at national level, so we use residues at national level to estimate prices dispersion at regional level;

Competition: represents a proxy of the competition which is calculated by making the inverse of number of stores of distribution by department of a region (1/n);

Winter: represents the dummy variable of season such as winter;

Distribution: represents other distribution channel like internet, market, fair, etc.

Inflation: represents the annual French inflation;

Market share: represents a proxy of the structure of expenses of households, which is calculated by making the ratio of price times quantity by act of purchases to the sum of prices times quantities of all purchasing acts $(\frac{P_i q_i}{\sum p_i q_i})$ ([Deaton and Meulbauer 1980](#)). This variable is estimated with “log”;

Presentation: represents other type of presentation of cheeses;

Packaging: represents other packaging method like “plastic” “Aluminum”;

Nber_presentation: represents the number of format presentations by cheese;

δ_i : represents households fixed effects

γ_t : represents temporal fixed effects

φ_{it} : represents the error term.

5.5. Results and interpretations

Tables 13, 14 and 15 below present results for prices determinant and prices dispersion of cheese products.

5.5.1. First step equation: Full sample with all cheeses

In table 13, the regression [1] which presents the estimation on our full sample (national level and all cheeses) with all acts of purchases shows that:

Auvergne PDO cheeses like “St Nectaire”, “Cantal” “Bleu Auvergne”, “Fourme Ambert” have on average a discount of -2.290 €/kg, -4.439 €/kg, -4.981 €/kg, -4.798 €/kg respectively with respect to the cheese PDO “Grana”, which represents my benchmark. While the other Auvergne PDO cheese namely the “Salers” has on average a higher price of 2.548 €/kg with respect to the cheese PDO “Grana”. It still shows that cheeses from Auvergne are not the most expensive sold on the market except the “Salers”. This shows that there are foreign PDO cheeses like Italian cheese “Grana” which also sells at high prices.

If consumers purchases cheeses in large and medium distribution channel such as “Hypermarket”, “Supermarket” and “Hard-discount”, they will buy on average with a discount respectively, of -0.720 €/kg, -0.969 €/kg and -1.991 €/kg compared to other distribution channels like traditional shops. While, if consumers purchases in a dairy store (*Creamer*), they will buy on average with a majoration of +0.431 €/kg, compared to other distribution channels like traditional shops. On average, consumers buy cheese products with a discount in the large and medium distribution compared to small retailers.

Consumers who buy cheeses in the “*Auvergne*” region spend on average -0.333 €/kg less than consumers who buy in the Alsace region, while consumers who buy cheeses in the “*Ile-de-France*” region spend on average 0.072 €/kg more than consumers in the Alsace region. This result confirms the observations of descriptive statistics, that is to say regions Ile-de-France and Alsace are among the most expensive in terms of cheese prices per kilogram compared to the Auvergne region.

The type of “*presentation*” of cheeses impacts significantly their price. For example the presentations in “*piece*” (*Present_piece*), in “*whole*” (*Present_whole*) and “*grated*” (*Present_grated*) impacts positively and significantly the price of cheeses on average of +0.731 €/kg, +0.980 €/kg, and +0.119 €/kg respectively compared to other formats of presentations like “*cube*”, “*little ball*”, “*tip*” and “*portion*”. This shows that the format of presentation is an important determinant of the price of cheeses. This result shows that if consumers buy cheeses under graded format, they will spend less.

The type of “*packaging*” has a significant impact on prices. For example, the “*Paper*” packaging (*packaging_PAPER*) impacts positively and significantly the price of cheeses on average of +0.456 €/kg compared to other methods of packaging like “*Aluminum*”, “*Plastic*” and “*wood*”. While the “*Sachet*” packaging (*packaging_SACHET*), the “*Film*” packaging (*packaging_FILM*), the “*Barquette*” packaging (*packaging_BARQUET*), and the “*box*” packaging (*packaging_BOX*) impact negatively and significantly prices of cheeses on average of -2.157 €/kg, -1.172 €/kg, -1.479 €/kg and -1.929€/kg respectively, compared to other packaging methods like like “*Aluminum*”, “*Plastic*” and “*wood*”. These results show that the packaging method of cheese influence consumers in their decision to purchase.

The “*season*” of purchase has a significant impact on prices of cheeses. Indeed, purchases during seasons of “*summer*” and “*spring*” have on average a discount on prices of -0.032 €/kg and -0.025 €/kg respectively compared to the “*winter*” season. So, cheeses are more expensive during the “*winter*” compared to “*summer*” and “*spring*”. Because during the *winter* grass is rare to feed cows, this leads to more constraining conditions of production, thus impacting the price of cheeses.

The geographical indication label (*GI*) like the protected designation of origin (*PDO*) and the protected geographical indication (*PGI*) impact positively and significantly the price of

cheeses on average of +2.329 €/kg compared to non-GI cheeses. The geographical indication (GI) being seen as a sign of quality by consumers, when is affixed on cheeses, it increases the price of these cheeses, because the production of cheeses under the PDO or PGI implies high production costs, these costs are reflected on the price of the final product, hence the increase of the price in the presence of a product under IG. This result is in line with that of the Inao and the Cnaol.

Now that we know prices determinants of cheeses in general, we now focus on prices determinants of Auvergne PDO cheeses.

5.5.2. First step equation: only Auvergne PDO cheeses

In regressions [2] and [3] of the table 13, we focus on data of the 5 PDO cheeses from the Auvergne (national level). In regression [3] we add all regions in our sample, 'residues' of this regression [3] are used in the second step equation.

Results of the regression [2] show that:

Auvergne PDO cheeses like "St Nectaire", "Cantal" "Bleu Auvergne", "Fourme Ambert" have on average a discount of -4.796 €/kg, -7.129 €/kg, -7.783 €/kg, -7.290 €/kg respectively, with respect to the PDO "Salers". It still shows that the PDO "Salers" is the most expensive sold on the market among the 5 Auvergne PDO cheeses, followed by the PDO "St Nectaire".

If consumers purchases Auvergne PDO cheeses in dairy shops (*Creamer*), they will buy on average with a majoration of +0.796 €/kg compared to others distribution channels like traditional shops. While, if consumers purchases in a "Hard-discount", they will buy Auvergne PDO cheeses with a discount of -1.972 €/kg compared to others distribution channels like traditional stores. Therefore, consumers have an interest to buy in "Hard-discounts", while producers have an interest to sell their products in dairy shops.

On the other hand, we find that the "region" of purchase impacts significantly the prices of Auvergne PDO cheeses. For example, the fact of purchasing Auvergne PDO cheeses in their region of origin (*Auvergne*) impacts positively and significantly the prices of these cheeses on average of +0.170 €/kg compared to the Alsace region. Similarly, Consumers pay on average a higher premium on Auvergne PDO cheeses of +0.605 €/kg and +0.213 €/kg in 'Ile-de-

France” region and the “*Rest-of-France*” respectively. These findings confirm those found in the descriptive statistics (*see appendix a*), that is to say, regions of “Auvergne” and “Ile-de-France” are those where we spend more on PDO cheeses from Auvergne.

We also find that the type of “*presentation*” of cheeses impacts significantly prices of Auvergne PDO cheeses. For example, presentations in “pieces” (*Present_piece*), in “whole” (*Present_Whole*) and in “grated” (*Present_grated*) impact positively and significantly prices of Auvergne PDO cheeses on average of +1.510 €/kg, +1.867 €/kg and +3.762 €/kg respectively, compared to the other formats of presentation like “portion”.

The method of “*packaging*” impacts significantly prices of Auvergne PDO cheeses. Indeed, methods of packaging like “Barquette” (*packaging_BARQUET*), “Sachet” (*packaging_SACHET*), “Paper” (*packaging_PAPER*) and “Film” (*packaging_FILM*) impact negatively and significantly prices of Auvergne PDO cheeses of -1.489 €/kg, -1.555 €/kg, -2.165 €/kg, -1.544 €/kg compared to other packaging methods like “Plastic”. Thus it is interesting for consumers to buy cheeses having these various types of packaging.

The “*season*” of purchase has a significant impact on prices of Auvergne PDO cheeses. Indeed, purchases during seasons of “*summer*”, “*spring*” and “*autumn*” have on average a majoration on prices of +0.067 €/kg, +0.039 €/kg and +0.118 €/kg respectively compared to the “*winter*” season. So, Auvergne PDO cheeses are more expensive these seasons. Contrary to our result based on the total sample, we find here that Auvergne PDO cheeses are more expensive during the “spring”, the “summer” and the “autumn”. So it is interesting for consumers to buy the Auvergne PDO cheeses during the “winter”, although the taste will be slightly different, because the taste of the cheese depends largely on the milk used for its manufacture. However, it is linked to the feeding of animals. The “winter”, the cold, the lack of light and the humidity damage pastures. Cows, sheeps and goats are thus often fed with hay and thus give milk with a little aroma. This does not mean that cheeses are less good in “winter”, but just that the taste may be different, which can have an impact on prices.

The “*promotion*” (*sale_promo*) is a negative determinant of Auvergne PDO cheeses. The current promotion has a negative and significant impacts on prices of Auvergne PDO cheeses on average of -0.350 €/kg compared to cheeses purchased without promotion. So, the current promotion does not encourage individuals to buy more Auvergne PDO cheeses. It is

important for professionals of Auvergne PDO cheese to diversify their advertising because the geographical indication label as the only signal of quality is not any more enough, it is also necessary to make themselves known, and this requires highly targeted promotions.

In order to estimate the dispersion of prices, we introduce all variables of regions of our sample into the regression [3] of this table 13. This leads us to remove the variable “*Rest_of_France*”, and the benchmark always remains the region “Alsace”. The complete results of this regression [3] are presented in “*appendix f*”. It is the residues of this regression [3] that we use in the second step of our model.

Table 13: First stage (Price equation)

	[1]	[2]	[3]
	Full sample	Auvergne PDO Sample	Auvergne PDO Sample ⁴²
VARIABLES	Price	price	price
<i>Cheeses variables: benchmark being "Grana cheese" for [1] and "Salers cheese" for [2] and [3]</i>			
SALERS	2.548*** (0.0470)		
ST_NECTAIRE	-2.290*** (0.0204)	-4.796*** (0.0451)	-4.794*** (0.0451)
CANTAL	-4.439*** (0.0174)	-7.129*** (0.0448)	-7.119*** (0.0448)
BLEU_AUVERGNE	-4.981*** (0.0207)	-7.783*** (0.0480)	-7.789*** (0.0481)
Fourme_Ambert	-4.798*** (0.0223)	-7.290*** (0.0467)	-7.304*** (0.0469)
ROQUEFORT	1.351*** (0.0155)		
COMTE	-2.095*** (0.0140)		
Other_french_Cheeses	-4.932*** (0.0120)		
Other_foreign_Cheeses	-4.519*** (0.0133)		
<i>Distributions variables: benchmark being "other market"</i>			
Supermarket	-0.720*** (0.0751)	-0.332 (0.308)	-0.269 (0.307)
Hypermarket	-0.969*** (0.0751)	-0.364 (0.308)	-0.300 (0.307)
Creamer	0.431*** (0.0755)	0.796*** (0.308)	0.860*** (0.308)
Hard_discount	-1.991*** (0.0752)	-1.972*** (0.308)	-1.908*** (0.309)
<i>Variables of regions: benchmark being "Alsace region"</i>			
Auvergne	-0.333*** (0.0156)	0.170*** (0.0642)	0.169*** (0.0641)
Ile_de_France	0.0728*** (0.0109)	0.605*** (0.0625)	0.604*** (0.0624)
Rest_of_France	-0.247*** (0.0103)	0.213*** (0.0606)	

⁴² See the whole results of this regression in appendix f regression [3]

continued

	[1]	[2]	[3]
	Full sample	Auvergne PDO Sample	Auvergne PDO Sample
VARIABLES	Price	price	price
<i>Presentation variables: benchmark being "other type of presentation"</i>			
Present_piece	0.731*** (0.00784)	1.510*** (0.204)	1.520*** (0.204)
Present_whole	0.980*** (0.0120)	1.867*** (0.214)	1.883*** (0.213)
Present_grated	0.119*** (0.00822)	3.762*** (0.353)	3.695*** (0.353)
<i>Packaging variables: benchmark being "other types of packaging"</i>			
packaging_BARQUET	-1.479*** (0.0115)	-1.489*** (0.205)	-1.498*** (0.205)
packaging_BOX	-1.929*** (0.0116)		
packaging_SACHET	-2.157*** (0.00779)	-1.555*** (0.207)	-1.581*** (0.207)
packaging_PAPER	0.456*** (0.0187)	-2.165*** (0.225)	-2.177*** (0.225)
packaging_FILM	-1.172*** (0.0107)	-1.544*** (0.204)	-1.548*** (0.204)
<i>Variables of seasons: benchmark being "Winter season"</i>			
Summer	-0.0325*** (0.00447)	0.0673*** (0.0196)	0.0685*** (0.0195)
spring	-0.0252*** (0.00449)	0.0391** (0.0196)	0.0396** (0.0196)
autumn	0.00445 (0.00435)	0.118*** (0.0188)	0.119*** (0.0188)
<i>Other attributs of product</i>			
sale_promo	0.00263 (0.00389)	-0.350*** (0.0347)	-0.350*** (0.0347)
GI (PDO/PGI)	2.329*** (0.00965)		
Constant	13.22*** (0.0772)	17.09*** (0.316)	17.03*** (0.315)
Observations	1,265,106	58,199	58,199
R-squared	0.634	0.552	0.553
With all regions			Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: - See results of the regression [1] with all regions and all cheeses in appendix f.

5.5.3. Second step equation with only Auvergne PDO cheeses regression

Table 14 and 15 below present the results of regressions on price dispersions, which represents the second step equation of our model. The proxy of price dispersions corresponds to $\log(\text{residuals}^2)$ of Auvergne PDO cheeses equation of the regression [3] of our first step equation (see table 13 above). In this second stage of estimation of our model, estimations are realized region by region, because the region in which we buy a product can influence prices at the national level.

We find a positive relation between “promotions” (*sale_promo*) and the dispersion of prices on Auvergne PDO cheeses. An increase of promotions of 1% leads to an increase of prices dispersion of +1.008% in “Auvergne”, +0.524% in “Ile-de-France”, +1.3% in “Aquitaine”, +1.301% in “Midi-pyrénées”, +0.888% in “Languedoc-Rousillon”, +0.456% in “Provence-Alpes-cote-Azur”, +1.306% in “Rhone-Alpes”, +1.560% in “Franche-comte”, +0.067% in “Bourgogne”, +1.915% in “Poitou-charentes”, +2.649% in “Bretagne”, +1.806% in “Basse-normandie”, +1.369% in “Haute-normandie”, +0.438% in “Picardie” and +1.687% in “Champagne-Ardenne”. As each store has their types of promotions in function of seasons of the year and there is no agreement between stores on promotions, this leads to a high dispersion of prices one store to another. Thus, promotions appear to favor the dispersion of prices.

We find a positive relation between the price dispersion on Auvergne PDO cheeses and the type of “presentation” of cheeses (*Present_OTHER*) like “portion”. Cheese in a “portion” format increases prices dispersion of +5.75% in “Ile-de-France”, +0.778% in “Languedoc-Rousillon”, +2.564% in “Provence-Alpes-cote-Azur”, +1.9% in “Rhone-Alpes”, +0.453% in “Bourgogne”, +0.595% in “Bretagne” and +0.556% in “Champagne-Ardenne”, compared to formats of presentation such as “Piece”, “Whole” and “grated”. So, presented Auvergne PDO cheeses in “portion” will increase prices dispersion, because this format is rare compared to others. Consequently the sellers can adjust the price in function to the knowledge of the buyers.

We also find a positive relation between prices dispersion on Auvergne PDO cheeses and the “store brand” (*MDD*). The sale of Auvergne PDO cheeses with a distribution brand affixed to it increase prices dispersion of +0.199% in “Ile-de-France”, +0.605% in “Aquitaine”, +0.535% in “Midi-pyrénées”, +0.597% in “Languedoc-Rousillon”, +0.403% in “Provence-Alpes-cote-Azur”, +0.501% in “Rhone-Alpes”, +0.358% in “Bourgogne”, +0.396% in “Poitou-charentes”, +0.433% in “Basse-normandie” and +0.554% in “Picardie”. Because there are several distribution marks on the market and each brand has its price of the product. This can lead to a dispersion of prices in function to existing brands.

We also find a positive relation between prices dispersion on Auvergne PDO cheeses and “inflation”. An increase of the inflation of 1% leads to an increase of prices dispersion of +0.270% in “Ile-de-France”, +0.062% in “Aquitaine”, +0.029% in “Midi-pyrénées”, +0.324% in “Languedoc-Rousillon”, +0.272% in “Provence-Alpes-cote-Azur”, +0.135% in “Rhone-Alpes”, +0.655 in “Franche-comte”, +0.514% in “Bourgogne”, +0.249% in “Poitou-charentes” and +0.250% in “Bretagne”. An increase of the general level of prices will increase the dispersion of prices, because each seller will practice its price according to how he is impacted by the inflation.

The “season” of purchases like “winter” has a positive relation with prices dispersion. During the winter prices dispersion on Auvergne PDO cheeses increase of +0.1% in “Auvergne”, +0.266% in “Ile-de-France”, +0.025% in “Aquitaine”, +0.132% in “Midi-Pyrénées”, +0.169% in “Languedoc-Rousillon”, +0.208% in “Bretagne”, +0.150% in “Haute-Normandie”. Thus, during the winter we note a greater dispersion of prices, because it is the season where they are most consumed.

Among variables allowing to reduce this dispersion of prices observed on PDO cheeses from Auvergne, we find a negative relation between distributions channels such as “Supermarket”, “Hypermarket” and “Hard-discount”. Thus, buying PDO cheeses from Auvergne in the large and medium distribution reduces the dispersion of prices by -1.5% compared small distributions such as traditional shops. Because, the large distribution practice about the same price generally, while the small distribution practice prices according to their location and charges.

We find a negative relation between price dispersion and “market shares” (*Log (market_share)*). The market shares are here a proxy of the structure of market of Auvergne PDO cheeses. An increase of 1% of market shares will reduce prices dispersion of -0.060% in “Auvergne”, -0.004% in “Midi-Pyrénées”, -0.042% in “Languedoc-Rousillon”, -0.054% “Provence-Alpes-cote-Azur” in -0.204% in “Franche-Comte”, -0.083% in “Haute-Normandie”, -0.253% in “Picardie”. [Hayes and Ross \(1998\)](#) does not found a clear connection between the market structure and prices dispersion. We find that there is a connection between the market structure and prices dispersion of Auvergne PDO cheeses. The higher market shares of products, leads to less prices dispersion, because products will be available in stores and easily accessible to consumers, the dispersion of prices will be reduced.

We find also a negative relation between prices dispersion on Auvergne PDO cheeses and the “competition”. An increase of 1% of the competition, that is to say the inverse of number of stores, decreases the dispersion of prices by -25.207% in “Ile-de-France”, -16.433% in “Aquitaine”, -31.921% in “Languedoc-Rousillon”, -27.821% in “Provence-Alpes-cote-Azur”, -8.368% in “Rhone-Alpes”, -30.9271% in “Bourgogne”, -11.772% in “Poitou-Charentes”, -20.766% in “Basse-Normandie”, -11.606% in “Haute-Normandie”. The increase of the number of stores in a region increases the competition and subsequently leads to a decrease of prices dispersion. More we have the stores, less we will observe the prices dispersion. But it also depends on the type of store (large, medium or small distribution shop) where we purchase. In our sample, we have more hypermarkets and supermarkets where this results, but if we had many more small stores, we could have an inverse result. Our result is in line with those of [Gerardi and Shapiro \(2009\)](#), who show that the competition reduces prices dispersion in the case of airlines industry.

Finally, we find a negative relation between prices dispersion and the “number of format” presentation (*nber_presentation*) by Auvergne PDO cheeses. An increase of number of format of 1% leads to a decrease of prices dispersion of -0.410% in “Auvergne”, -0.560% in “Ile-de-France”, -0.672% in “Aquitaine”, -0.686% in “Midi-pyrénées”, -0.536% in “Languedoc-Rousillon”, -0.667% in “Provence-Alpes-cote-Azur”, -0.511% in “Rhone-Alpes”, -0.868% in “Franche-comte”, -0.795% in “Bourgogne”, -0.855% in “Poitou-charentes”, -0.679% in “Bretagne”, -0.602% in “Basse-normandie”, -0.627% in “Haute-normandie”, -0.464% in

“Picardie” and -0.716% in “Champagne-Ardenne”. Diversifying presentation formats reduces prices dispersion, because each format will have a known price.

Table 14 : second stage (Price dispersion regressions on Auvergne PDO cheeses)

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
	Auvergne	Ile_de_France	Aquitaine	Midi_Pyrénées	Languedoc_Roussillon	Provence_Alpes_Ctte_Azur	Rhone_Alpes	Franche_Comte
VARIABLES	lresidus2 (Price dispersion)	lresidus2 (Price dispersion)	lresidus2 (Price dispersion)	lresidus2 (Price dispersion)	lresidus2 (Price dispersion)	lresidus2 (Price dispersion)	lresidus2 (Price dispersion)	lresidus2 (Price dispersion)
sale_promo	1.008*** (0.247)	0.524*** (0.0935)	1.300*** (0.172)	1.301*** (0.151)	0.888*** (0.159)	0.456*** (0.125)	1.306*** (0.116)	1.560*** (0.306)
Supermarket	-0.0879 (0.0886)	-1.241*** (0.0775)	-0.880*** (0.169)	-0.966*** (0.110)	-0.231 (0.155)	-0.338** (0.158)	-0.335*** (0.0972)	-0.721** (0.315)
Hypermarket	-0.143* (0.0769)	-0.626*** (0.0724)	-0.126 (0.161)	-0.0957 (0.114)	0.110 (0.153)	-0.0319 (0.151)	-0.627*** (0.0996)	-0.701** (0.311)
Hard_discount	-0.0638 (0.102)	-0.896*** (0.0849)	-1.151*** (0.177)	-1.225*** (0.126)	-1.356*** (0.163)	-0.656*** (0.159)	0.162 (0.107)	-1.233*** (0.338)
MDD	0.0566 (0.0961)	0.199*** (0.0559)	0.605*** (0.105)	0.535*** (0.0896)	0.597*** (0.0895)	0.403*** (0.0789)	0.501*** (0.0732)	0.120 (0.230)
Present_Other	1.084 (2.052)	5.759*** (0.956)	0.341 (0.667)	0.0471 (0.867)	0.778*** (0.102)	2.564*** (0.859)	1.900*** (0.638)	3.162 (1.927)
packaging_OTHER	0.0315 (2.056)	-4.596*** (0.956)	0.466 (0.672)	0.0541 (0.868)		-1.712** (0.859)	-1.233* (0.641)	-4.195** (1.928)
inflation	0.00288 (0.0518)	0.270*** (0.0459)	0.0623** (0.0842)	0.0293** (0.0606)	0.324*** (0.0728)	0.272*** (0.0635)	0.135** (0.0566)	0.655*** (0.175)
Log(market_share)	-0.0604** (0.0286)	-0.0288 (0.0341)	0.0289 (0.0627)	-0.00496* (0.0373)	-0.0425*** (0.0505)	-0.0544** (0.0501)	0.0134 (0.0392)	-0.204*** (0.126)
competition	21.622*** (3.478)	-25.207* (3.982)	-16.433*** (5.041)	-4.688 (2.974)	-31.921** (2.490)	-27.821*** (7.340)	-8.368* (4.300)	-8.240 (2.004)
Winter	0.100* (0.0590)	0.266*** (0.0516)	0.0251** (0.0988)	0.132* (0.0705)	0.169** (0.0822)	0.0188 (0.0719)	0.0268 (0.0644)	0.265 (0.188)
nber_presentation	-0.410*** (0.0258)	-0.560*** (0.0263)	-0.672*** (0.0529)	-0.686*** (0.0410)	-0.536*** (0.0472)	-0.667*** (0.0383)	-0.511*** (0.0306)	-0.868*** (0.101)
Constant	1.220*** (0.377)	0.594*** (0.487)	2.891*** (0.778)	1.988*** (0.481)	0.618*** (0.679)	1.686*** (0.621)	0.354*** (0.509)	0.178*** (1.774)
Observations	5,696	9,764	2,434	4,520	3,675	3,996	6,076	506
R-square	0.973	0.919	0.882	0.863	0.822	0.944	0.971	0.973
Number of fromage	5	5	5	5	5	5	5	4

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 15: second stage (Price dispersion regressions on Auvergne PDO cheeses) (continued)

	[9]	[10]	[11]	[12]	[13]	[14]	[15]
	Bourgogne	Poitou_Charentes	Bretagne	Basse_Normandie	Haute_Normandie	Picardie	Champagne_Ardenne
VARIABLES	lresidus2 (Price dispersion)	lresidus2 (Price dispersion)	lresidus2 (Price dispersion)	lresidus2 (Price dispersion)	lresidus2 (Price dispersion)	lresidus2 (Price dispersion)	lresidus2 (Price dispersion)
sale_promo	0.0679 (0.231)	1.915*** (0.205)	2.649*** (0.172)	1.806*** (0.149)	1.369*** (0.152)	0.438* (0.265)	1.687*** (0.248)
Supermarket	-0.753** (0.309)	-0.834*** (0.280)	-1.043*** (0.218)	-0.445*** (0.169)	-0.360*** (0.110)	-1.243*** (0.445)	-0.274 (0.333)
Hypermarket	-0.451 (0.311)	-0.420 (0.273)	-0.830*** (0.218)	-0.00834 (0.165)	-0.0874 (0.106)	-1.148*** (0.444)	-0.354 (0.327)
Hard_discount	-0.685** (0.312)	-1.548*** (0.294)	-1.394*** (0.239)	-0.538*** (0.186)	-1.031*** (0.132)	-1.219*** (0.449)	-1.285*** (0.351)
MDD	0.358*** (0.132)	0.396*** (0.130)	0.00987 (0.108)	0.433*** (0.0927)	0.00470 (0.0776)	0.554*** (0.178)	0.199 (0.133)
Present_Other	0.453*** (0.154)	0.0103 (0.153)	0.595*** (0.138)	0.160 (1.129)	0.0814 (1.376)	1.327 (1.707)	0.556*** (0.160)
packaging_OTHER				0.147 (1.132)	0.646 (1.378)	-0.528 (1.713)	
inflation	0.514*** (0.113)	0.249** (0.100)	0.250*** (0.0802)	0.0517 (0.0736)	0.0762 (0.0617)	0.0928 (0.138)	0.122 (0.120)
log(market_share)	-0.0788 (0.0887)	-0.0182 (0.0748)	0.0351 (0.0667)	-0.0635 (0.0540)	-0.0832** (0.0379)	-0.253** (0.108)	-0.0065 (0.100)
competition	-30.927** (13.203)	-11.772*** (10.312)	-3.190 (6.955)	-20.766*** (4.147)	-11.606** (6.372)	0.151 (8.819)	2.178 (2.573)
Winter	0.0594 (0.129)	0.0899 (0.113)	0.208** (0.0920)	0.0602 (0.0851)	0.150** (0.0687)	0.245 (0.152)	0.0613 (0.138)
nber_presentation	-0.795*** (0.0597)	-0.855*** (0.0579)	-0.679*** (0.0430)	-0.602*** (0.0412)	-0.627*** (0.0339)	-0.464*** (0.0785)	-0.716*** (0.0648)
Constant	1.169*** (1.208)	3.532*** (0.991)	2.146** (0.848)	1.750*** (0.638)	0.434** (0.480)	4.801*** (1.500)	1.808** (1.253)
Observations	1,100	1,464	2,352	3,472	4,062	1,180	908
R-square	0.891	0.851	0.936	0.878	0.927	0.781	0.903
Number of fromage	5	5	5	5	5	5	5

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

5.6. Conclusion

The objective of this chapter was to estimate determinants of price levels and price dispersion of Auvergne PDO cheeses. To do this, we used the multiplicative heteroscedasticity model which is a two step model. In the first step we estimate price determinants and in the second step we estimate determinants of prices dispersion.

In our full sample with all cheeses products, we found that determinants of cheeses prices in general are: promotions, distribution channels, the region of sales, the packaging method, the presentation format, the season of purchases and the geographical indication (GI) label. The geographical indication label like the protected designation of origin (PDO) and the protected geographical indication (PGI) impact positively and significantly the price of cheeses on average of +2.329 €/kg compared to non-GI cheeses, but this label must be associated with a more targeted promotions, because the GI as the only quality signal is not sufficient, it is necessary be known.

Then, we use only the Auvergne PDO cheeses sample. We derived residuals from the estimation of this sub-sample (Auvergne PDO cheeses) and then we estimated the determinants of prices dispersion in the second stage equation region by region. We find that prices dispersion depends on several aggregates, both microeconomic and macroeconomic, but to reduce the existing prices dispersion observed on Auvergne PDO cheeses, the market must be very competitive. In addition, these cheeses must sell with distribution brands affixed to them, increase their market share and to sell in the large and medium distribution. All this will allow them to control prices of cheeses and otherwise negotiate well with the large distribution on the sharing of the value, because it is the large distribution that captures the added value and moreover the surplus of consumers, given that the price of products is fixed at this level of the value chain.

Knowing the determinants of prices of Auvergne PDO cheeses, we answer our research question in the next chapter where we will evaluate the willingness to pay of consumers for Auvergne PDO cheeses. Because it is these determinants that the consumer observes and this determines his WTP, knowing that the WTP is a price premium that the consumer is willing to add or remove to acquire a product knowing the price of a «basic» counterpart.

Appendix

Appendix a: Prices of cheeses purchased by region

Figure 26: Average Price of “Cantal” by region over the period 2008-2010

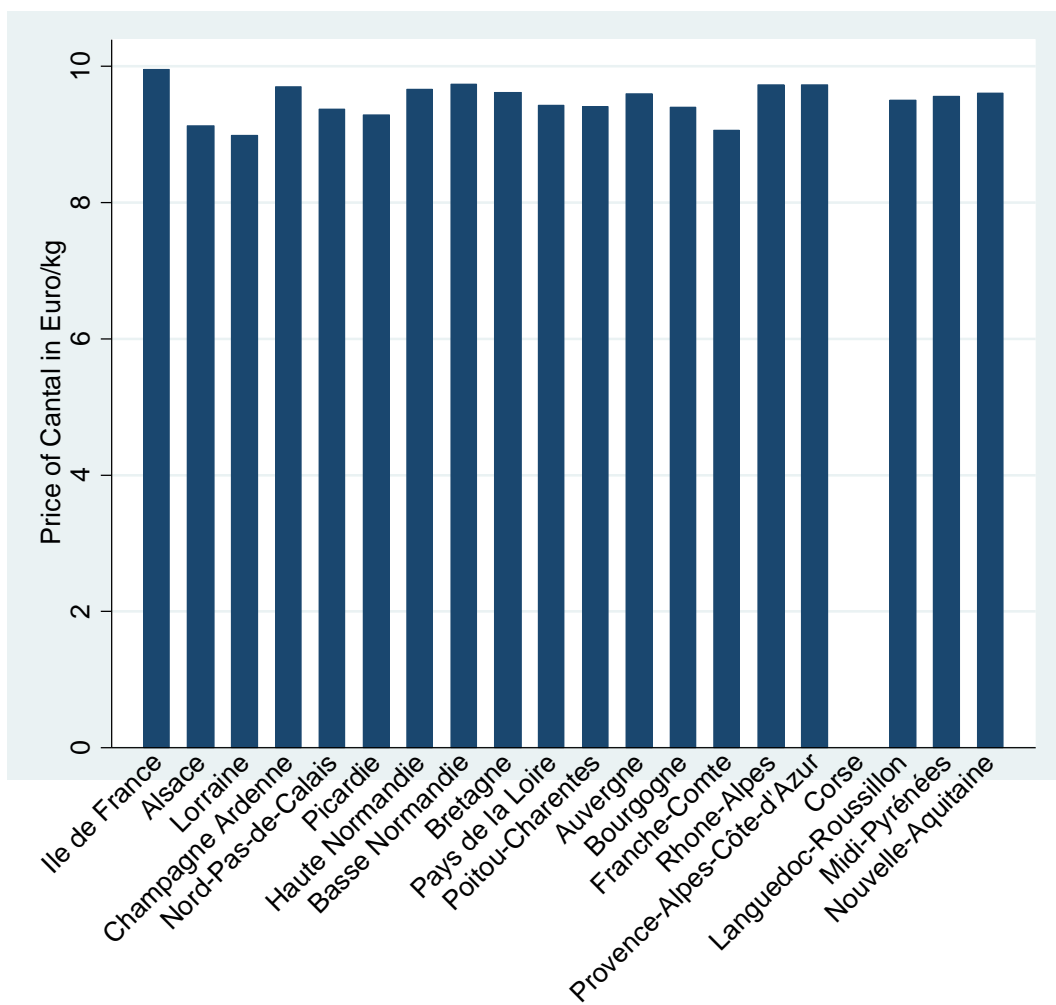


Figure 27: Average Price of St Nectaire over the period 2008-2010

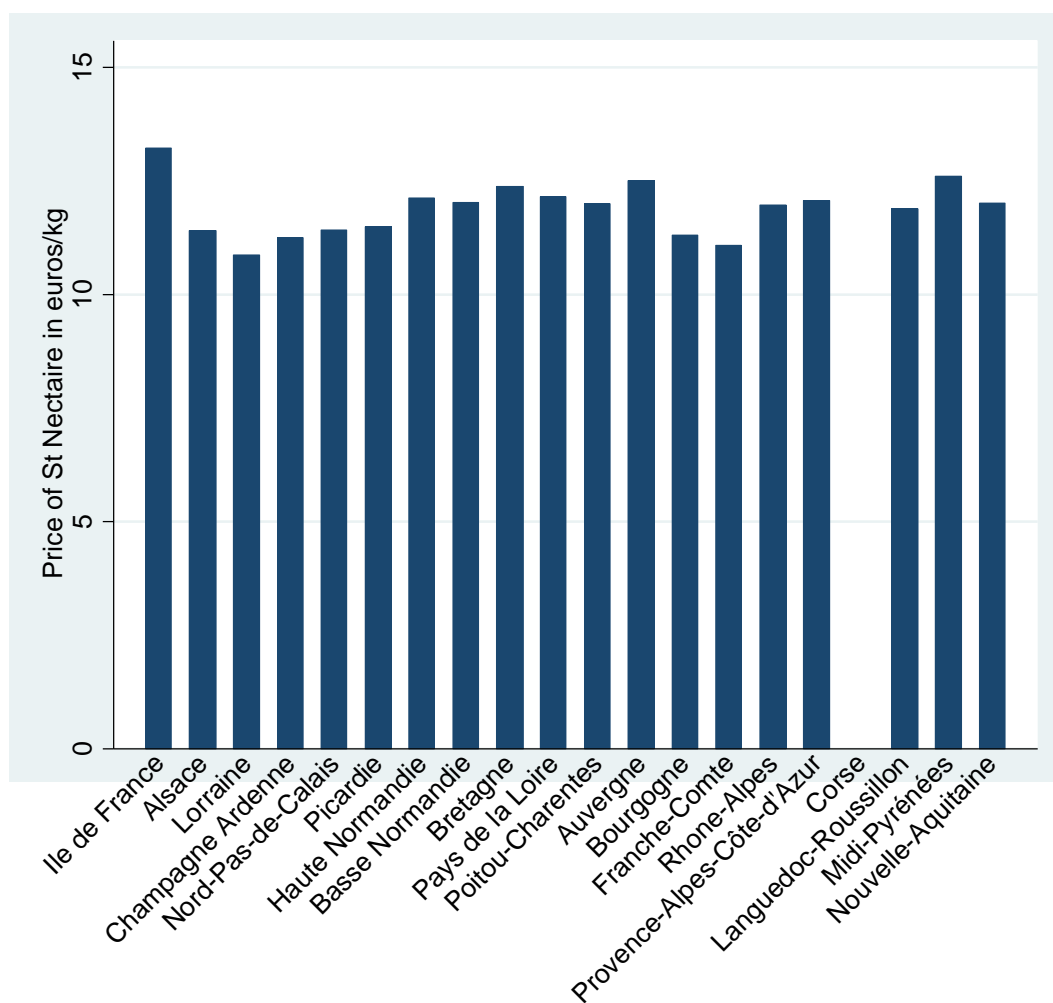


Figure 28: Average Price of Bleu Auvergne over the period 2008-2010

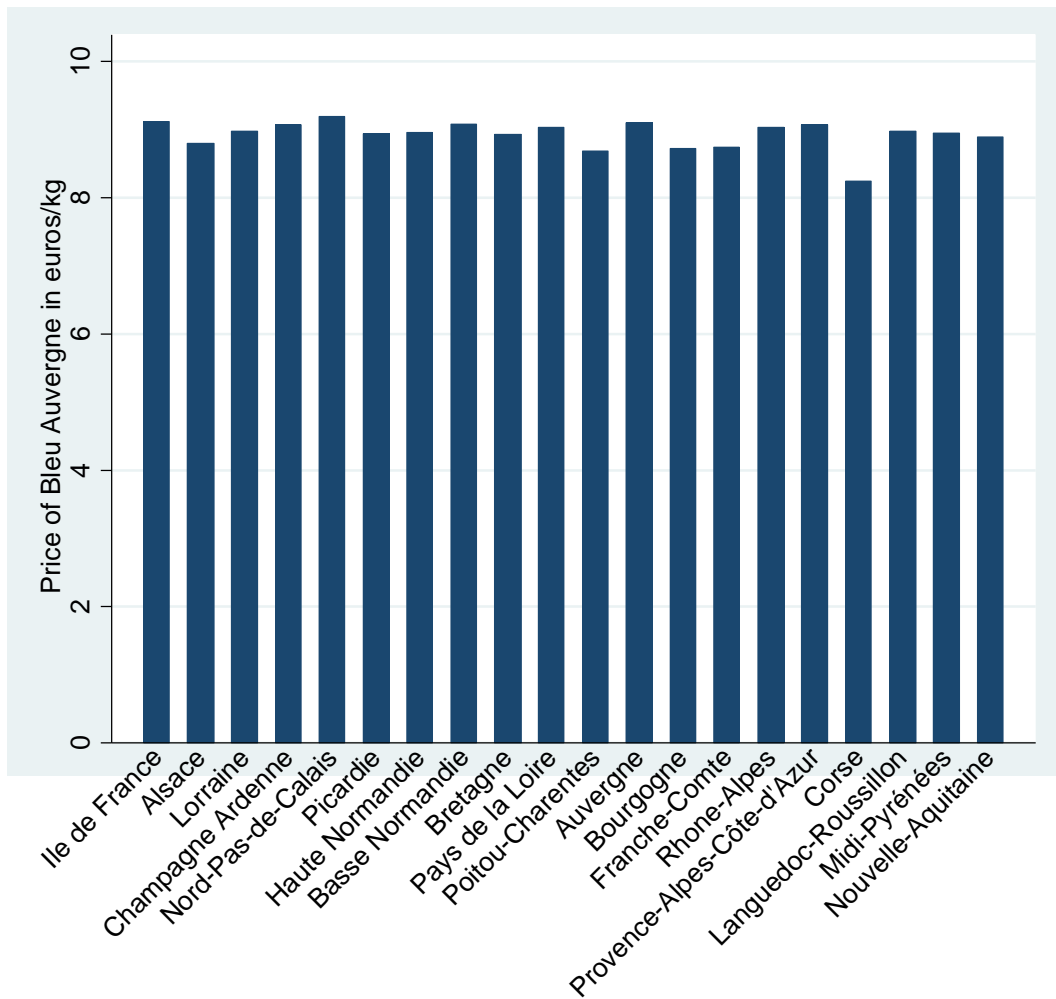


Figure 29: Average Price of Fourme Ambert over the period 2008-2010

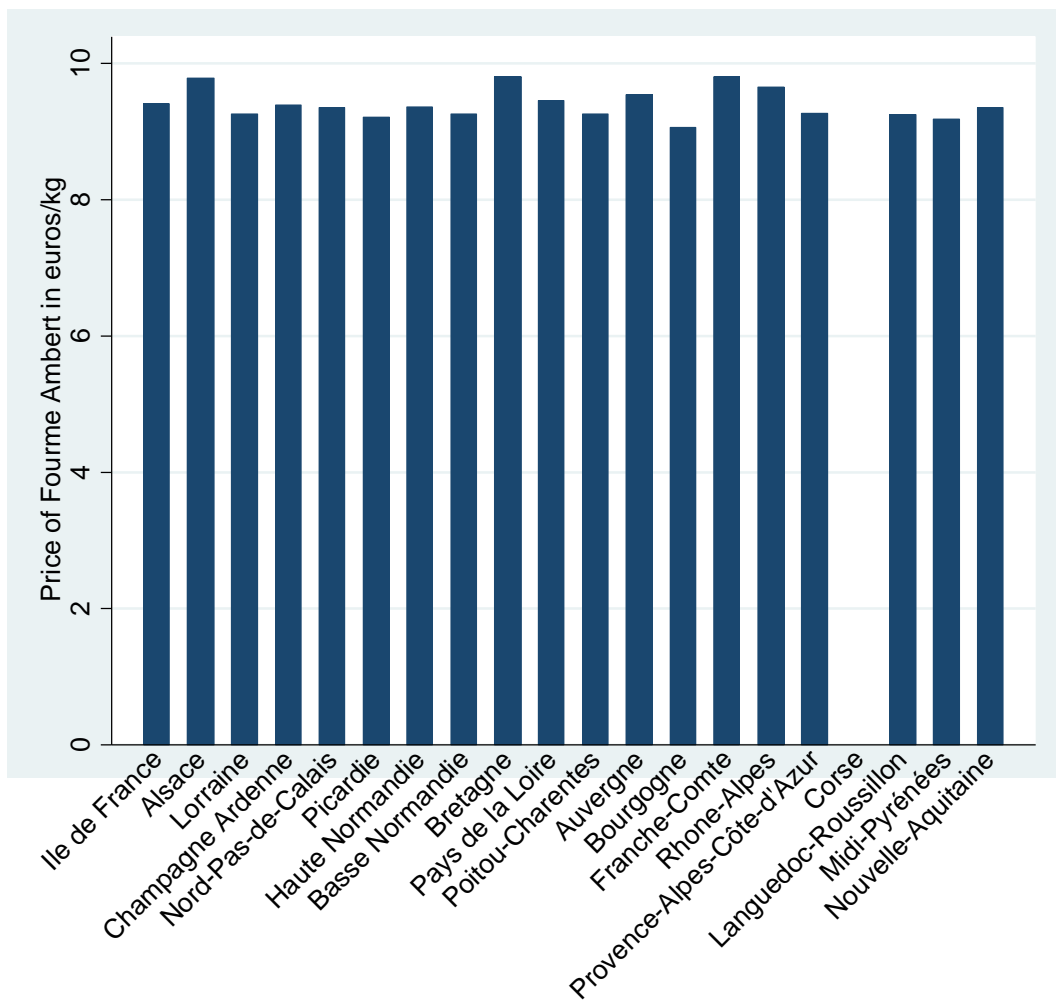
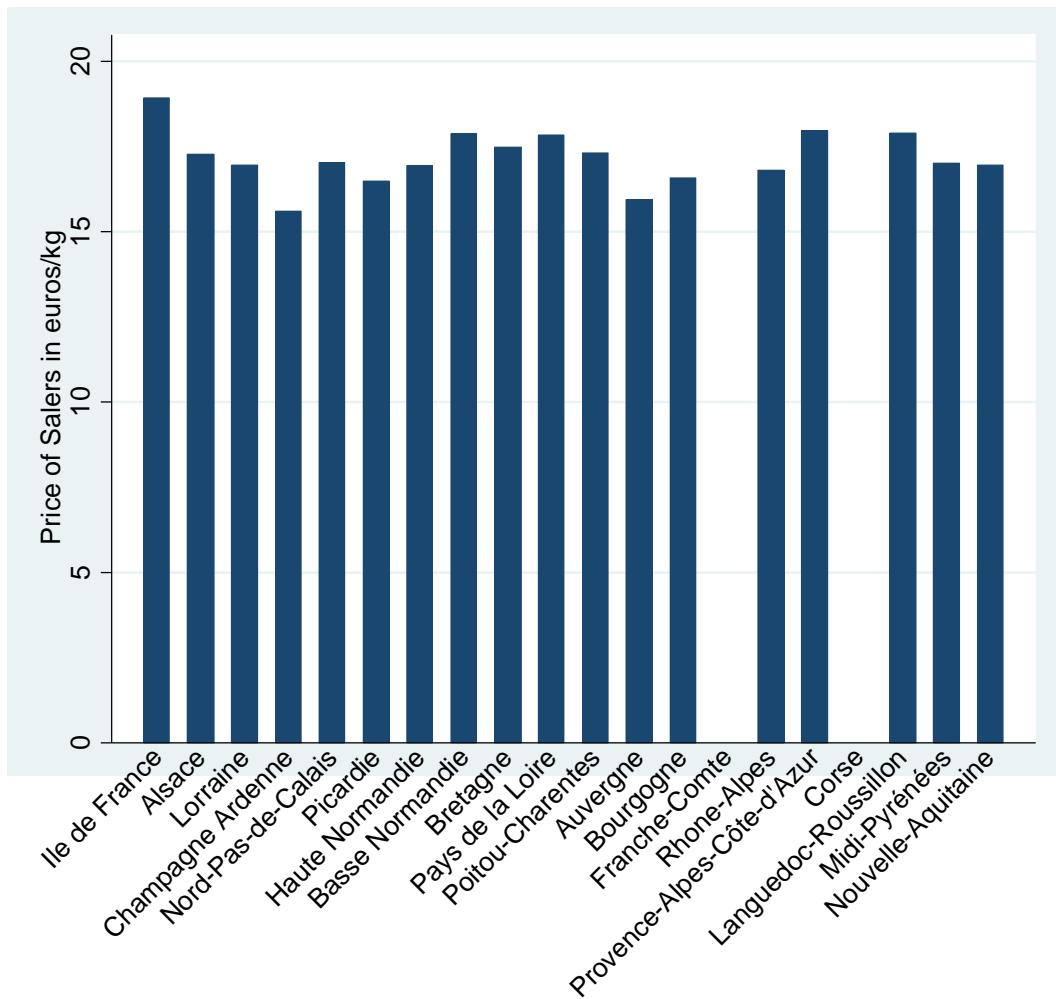


Figure 30: Average Price of Salers over the period 2008-2010



Appendix b: Quantities purchases by regions

Figure 31: PDO Cantal by region

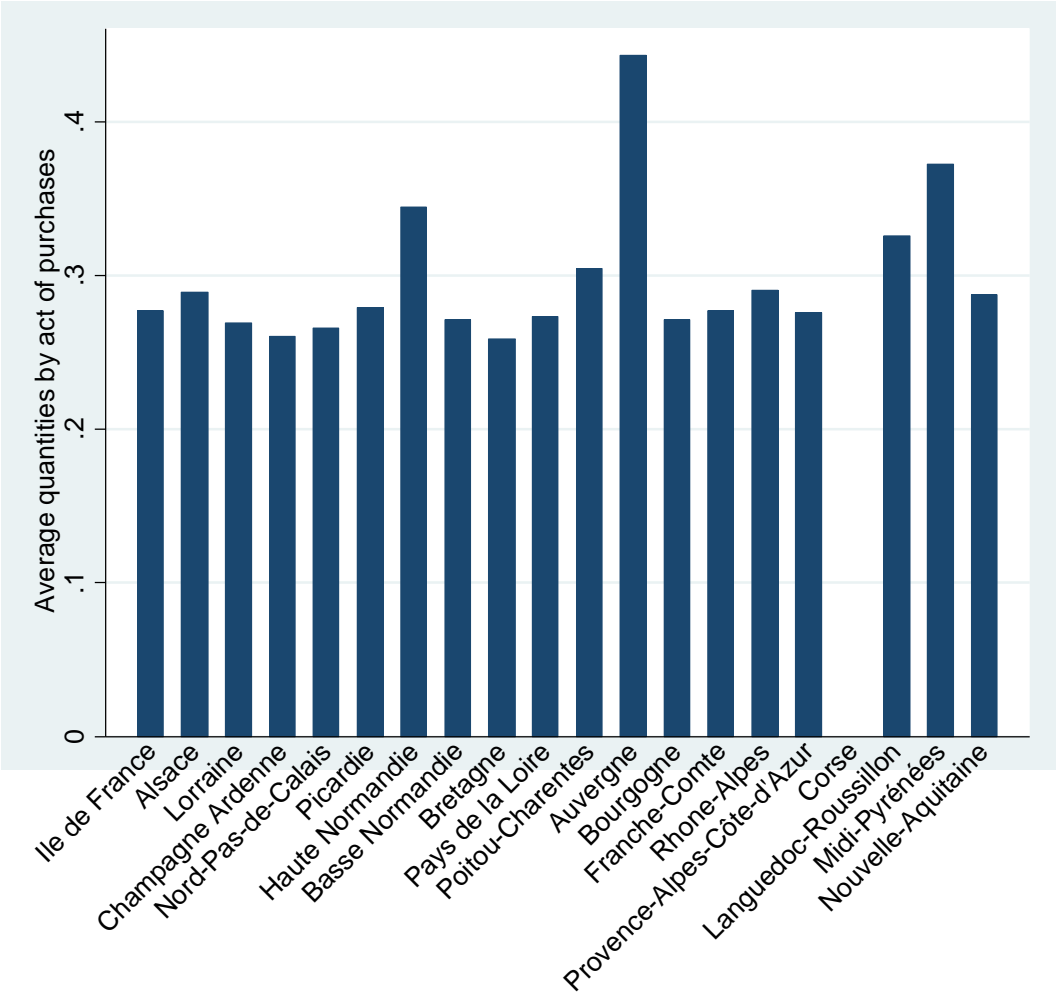


Figure 32: PDO St Nectaire by region

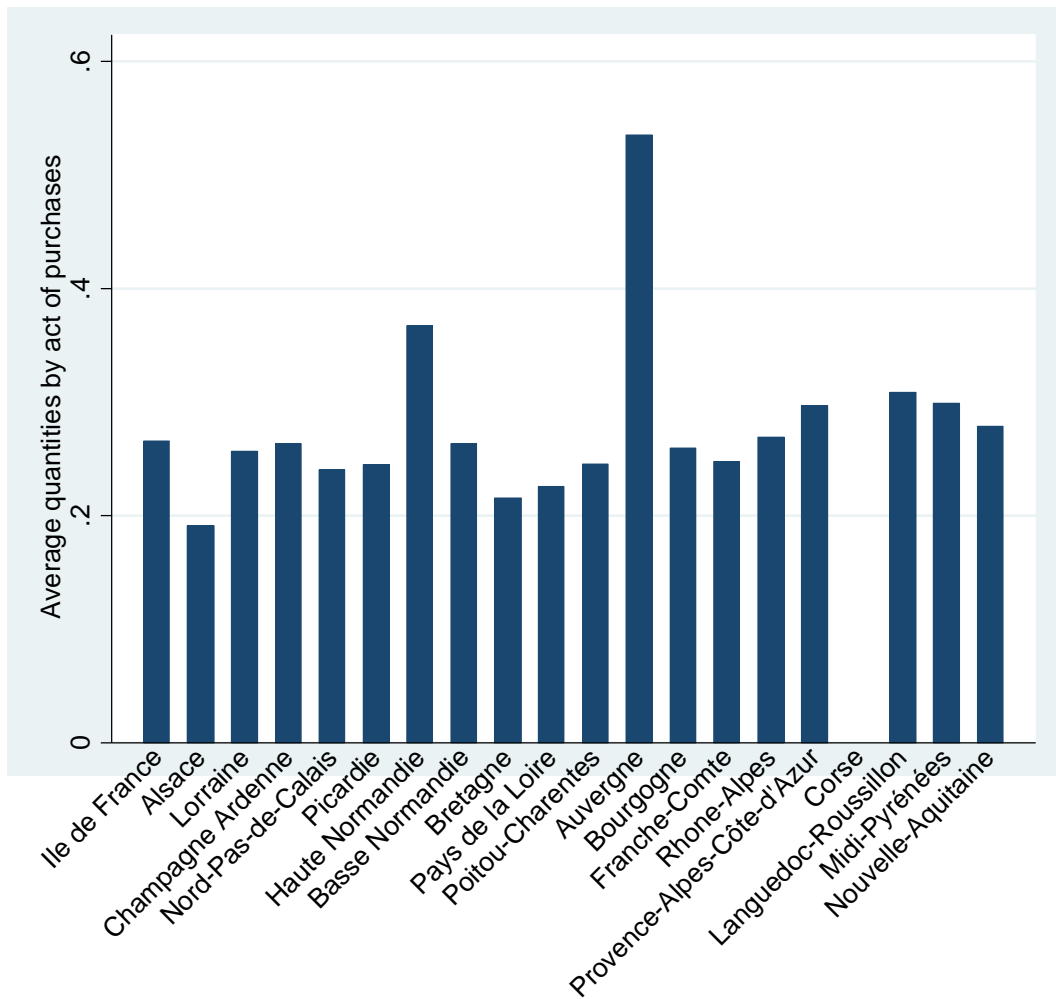


Figure 33: PDO Bleu Auvergne by region

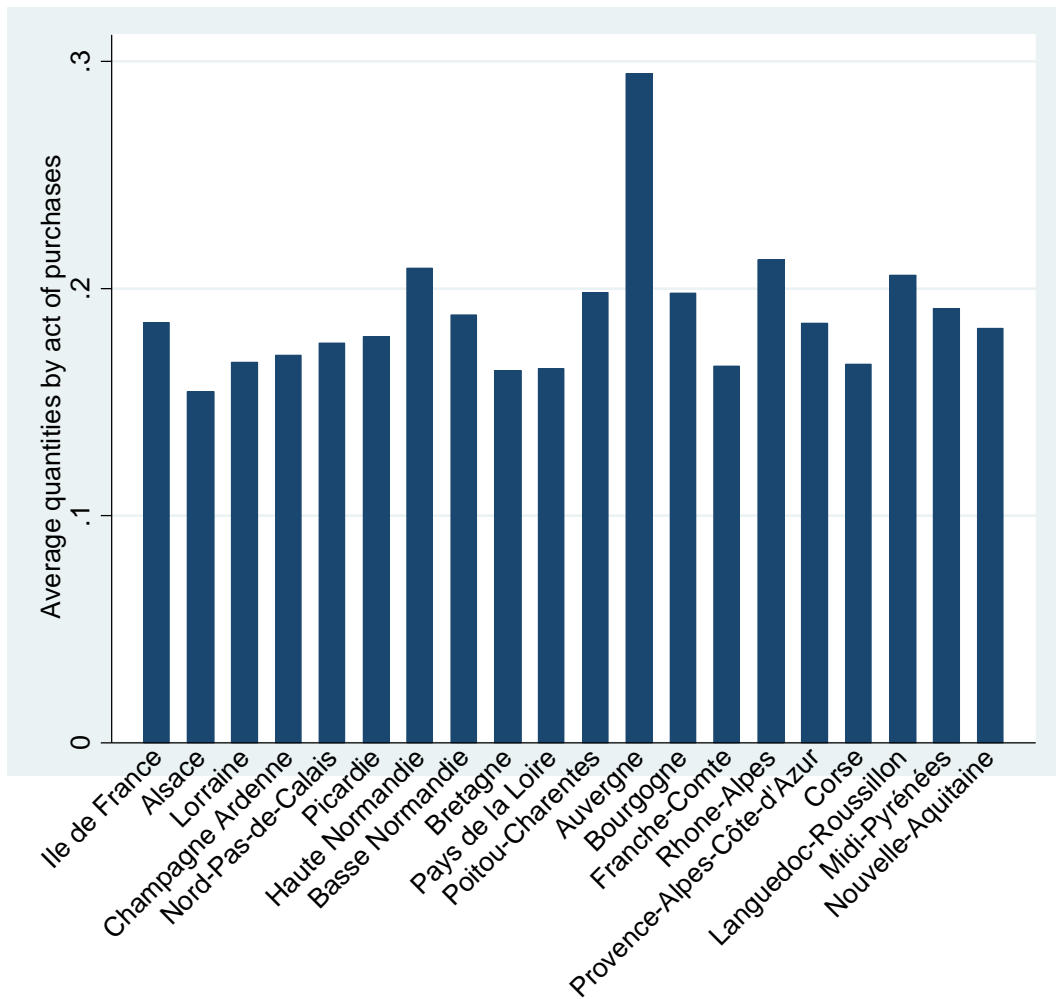


Figure 34: PDO Salers by region

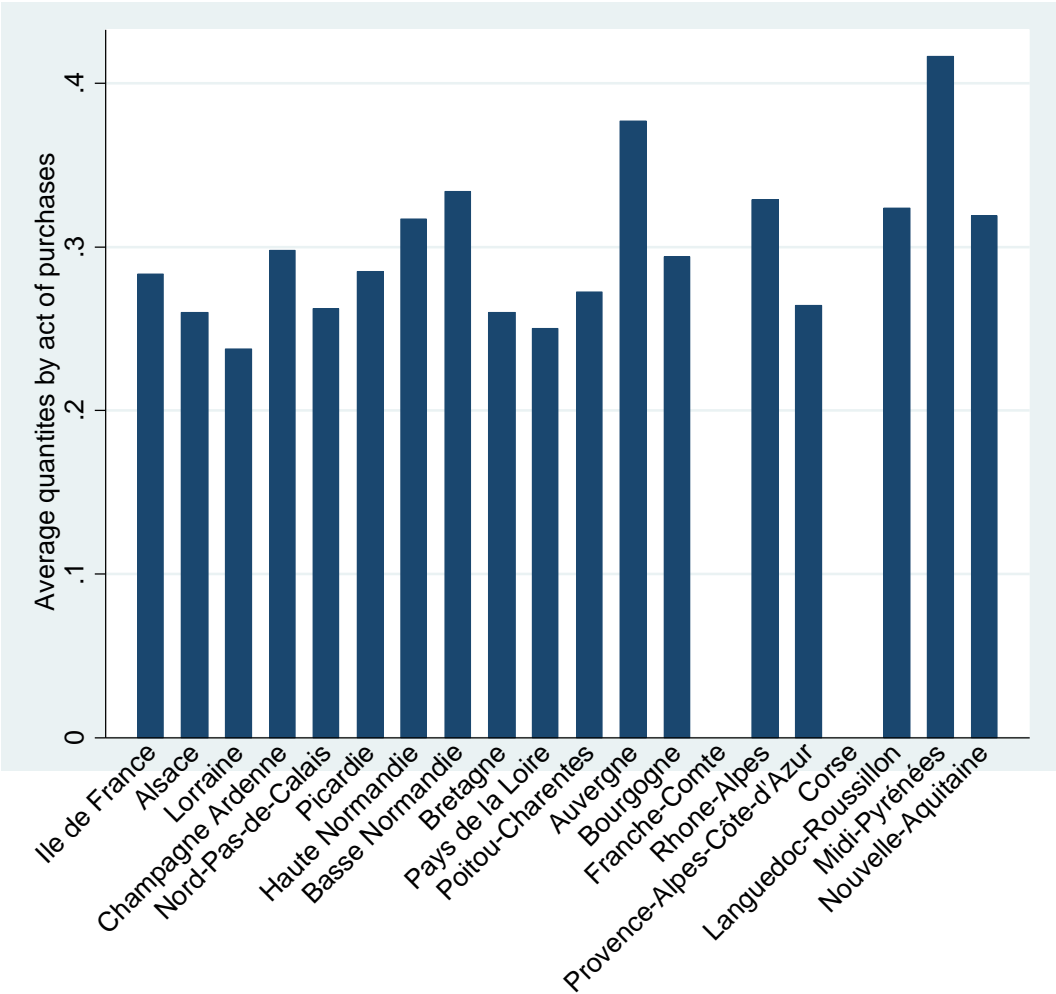
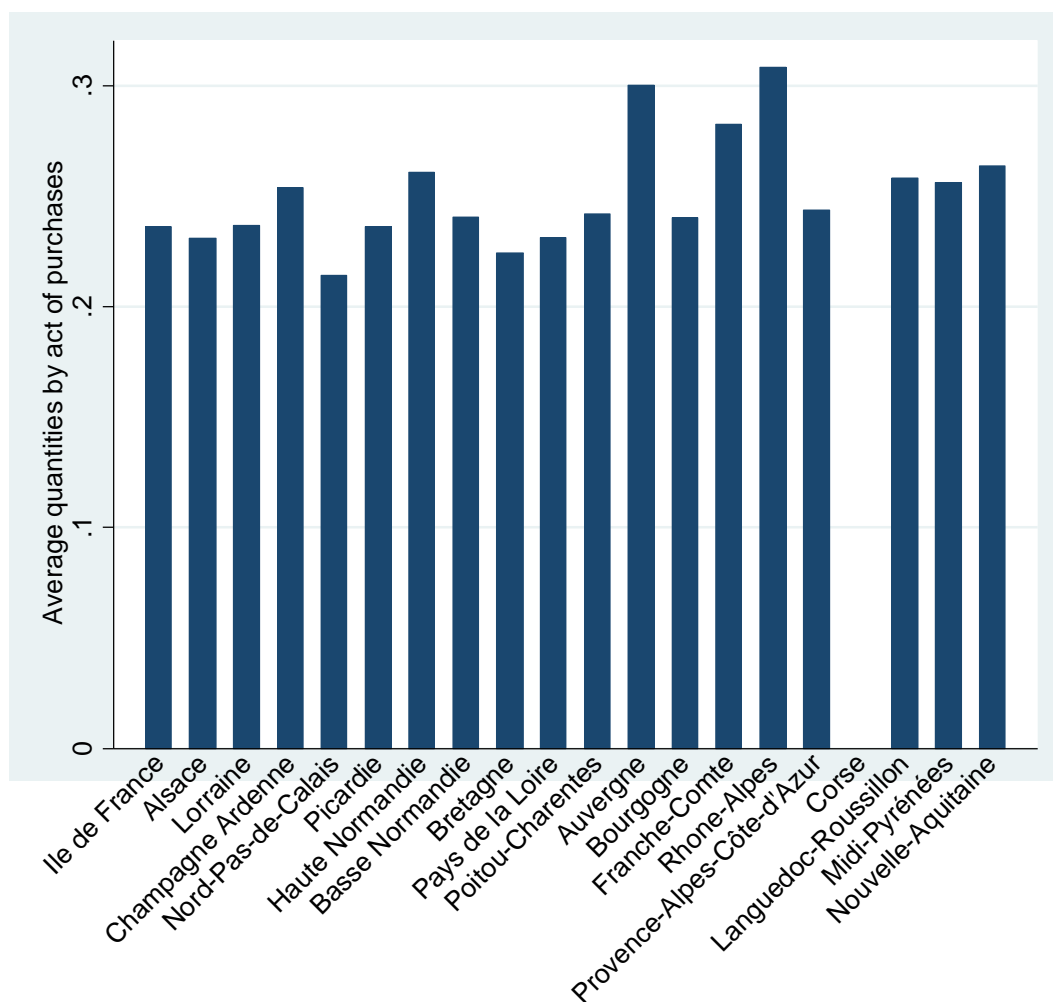


Figure 35: PDO Fourme Ambert by region



Appendix c: Definition and descriptive statistics of variables

Table 16 : Descriptive statistics and definition of variables

Variable	Obs	Mean	Std. Dev.	Min	Max	Definition
price	1265106	8.327	2.966	4	24.375	Price in €/kg
Quantity	1441745	.3248086	.2109054	.04	5.7	Quantity purchases in kg
$\log(\hat{\varepsilon}_{ijt}^2)$	1265106	-.6114545	2.316851	-22.78246	4.554615	Price Dispersion measure
CANTAL	1265106	0.017	0.130	0	1	Dummy Cantal cheese
ST_NECTAIRE	1265106	0.010	0.100	0	1	Dummy St Nectaire cheese
BLEU_AUVERGNE	1265106	0.009	0.097	0	1	Dummy Bleu Auvergne cheese
Fourme_Ambert	1265106	0.007	0.086	0	1	Dummy Fourme Ambert cheese
SALERS	1265106	0.001	0.035	0	1	Dummy Salers cheese
ROQUEFORT	1265106	0.046	0.211	0	1	Dummy Roquefort cheese
COMTE	1265106	0.058	0.235	0	1	Dummy Comte cheese
CAMEMBERT	1265106	0.190	0.392	0	1	Dummy Camembert cheese
COULOMMIER	1265106	0.082	0.275	0	1	Dummy Coulommiers cheese
BRIE_DE_MEAUX	1265106	0.008	0.091	0	1	Dummy Brie de Meaux cheese
EMMENTAL	1265106	0.372	0.483	0	1	Dummy Emmental cheese
MOZZARELLA	1265106	0.056	0.231	0	1	DummyMozzarella cheese
REBLOCHON	1265106	0.017	0.131	0	1	Dummy Reblochoncheese
GRUYERE	1265106	0.006	0.083	0	1	Dummy Gruyère cheese
RACLETTE	1265106	0.034	0.183	0	1	Dummy Raclette cheese
MORBIER	1265106	0.012	0.109	0	1	Dummy Morbier cheese
GORGONZOLA	1265106	0.005	0.076	0	1	Dummy Gorgonzola cheese
FETA	1265106	0.021	0.145	0	1	Dummy Feta cheese
TOMME	1265106	0.019	0.137	0	1	Dummy Tomme cheese
GRANA	1265106	0.019	0.136	0	1	Dummy Grana cheese
Other_french_Cheeses	1265106	0.703	0.456	0	1	Dummy of other cheeses
Other_foreign_Cheeses	1265106	0.126	0.332	0	1	Dummy of foreign cheeses

sale_promo	1265106	0.542	0.498	0	1	Dummy promotion
Supermarket	1265106	0.303	0.459	0	1	Dummy Supermarket
Hypermarket	1265106	0.471	0.499	0	1	Dummy Hypermarket
Creamer	1265106	0.037	0.190	0	1	Dummy Creamer
Hard_discount	1265106	0.186	0.389	0	1	Dummy Hard discount
OtherMarket	1265106	0.001	0.021	0	1	Dummy other distribution channel
sale_promo	1265106	0.542	0.498	0	1	Dummy Brand of distribution
MDD	1265106	0.534	0.498	0	1	Percentage of fat content
PDO_dummy	1265106	0.747	0.434	0	1	Dummy PDO label
Auvergne	1265106	0.018	0.134	0	1	Dummy Auvergne region

Table 17: Descriptive statistics and definition of variables (*Continued*)

Variable	Obs	Mean	Std. Dev.	Min	Max	Definition
Ile_de_France	1265106	0.173	0.378	0	1	Dummy Ile de France region
Aquitaine	1265106	0.048	0.213	0	1	Dummy N. Aquitaine region
Midi_Pyrénées	1265106	0.0427	0.201	0	1	Dummy M. Pyrenees region
Languedoc_Roussillon	1265106	0.041	0.200	0	1	Dummy L. Rousillon region
Corse	1265106	0.001	0.034	0	1	Dummy Corse region
Provence_Alpes_Côte_Azur	1265106	0.081	0.273	0	1	Dummy P.A. Cote Azur region
Rhone_Alpes	1265106	0.091	0.288	0	1	Dummy Rhone Alpes region
Franche_Comte	1265106	0.018	0.134	0	1	Dummy Franche Comte region
Bourgogne	1265106	0.020	0.140	0	1	Dummy Bourgogne region
Poitou_Charentes	1265106	0.026	0.161	0	1	Dummy P. Charentes region
Pays_de_la_Loire	1265106	0.069	0.254	0	1	Dummy P. de la Loire region
Bretagne	1265106	0.055	0.229	0	1	Dummy Bretagne region
Basse_Normandie	1265106	0.071	0.257	0	1	Dummy B. Normandie region
Haute_Normandie	1265106	0.043	0.204	0	1	Dummy H. Normandie region
Picardie	1265106	0.032	0.178	0	1	Dummy Picardie region
Nord_Pas_de_Calais	1265106	0.070	0.255	0	1	Dummy N. P. de Calais region
Champagne_Ardenne	1265106	0.024	0.154	0	1	Dummy C. Ardenne region
Lorraine	1265106	0.044	0.205	0	1	Dummy Lorraine region
Rest_of_France	1265106	0.783	0.411	0	1	Dummy representing the rest of France
packaging_BARQUET	1265106	0.091	0.288	0	1	Dummy packaging
packaging_SACHET	1265106	0.420	0.493	0	1	Dummy packaging
packaging_PAPER	1265106	0.009	0.098	0	1	Dummy packaging
packaging_BOX	1265106	0.262	0.439	0	1	Dummy packaging
packaging_FILM	1265106	0.044	0.207	0	1	Dummy packaging
packaging_OTHER	1265106	0.170	0.376	0	1	Dummy packaging
Present_Piece	1265106	0.219	0.413	0	1	Dummy Presentation of cheese

Present_Whole	1265106	0.285	0.451	0	1	Dummy Presentation of cheese
Present_grated	1265106	0.288	0.453	0	1	Dummy Presentation of cheese
Present_Other	1265106	0.206	0.404	0	1	Dummy Presentation of cheese
Winter	1265106	0.286	0.452	0	1	Dummy winter
Spring	1265106	0.227	0.419	0	1	Dummy spring
Summer	1265106	0.231	0.421	0	1	Dummy summer
autumn	1265106	0.253	0.435	0	1	Dummy autumn
nber_presentation	1265106	4.392	0.891	1	5	number of format presentation by cheese
Inflation	1265106	1.433	1.092	.1	2.8	Annual French inflation in %
market_share	1265106	7.90e-07	5.33e-07	1.53e-07	.0000155	Cheeses Market share index

Appendix d: list of cheeses

Table 18: List of cheeses used in the Full sample estimation

Cheeses	Freq.	Percent
CANTAL	21,902	1.73
ST_NECTAIRE	12,94	1.02
BLEU_AUVERGNE	12,241	0.97
Fourme_Ambert	9,536	0.75
SALERS	1,58	0.12
ROQUEFORT	59,272	4.69
COMTE	74,342	5.88
CAMEMBERT	240,776	19.03
COULOMMIERS	104,399	8.25
MORBIER	15,225	1.20
TOMME	24,506	1.94
BRIE_DE_MEAUX	10,7	0.85
REBLOCHON	22,275	1.76
EMMENTAL	471,538	37.27
GRUYERE	8,778	0.69
FETA	27,545	2.18
MOZZARELLA	71,925	5.69
RACLETTE	44,192	3.49
GORGONZOLA	7,361	0.58
FETA	27,545	2.18
GRANA	24,073	1.90
Total	1,265,106	100.00

Appendix e: Correlation matrix (first stage and second stage)

Variables	price	SALERS	ST_NECTAIRE	CANTAL	BLEU_AUVERGNE	Fourme_Ambert	ROQUEFORT	COMTE	Other_french_Cheeses
price	1.0000								
SALERS	0.1084	1.0000							
ST_NECTAIRE	0.1339	-0.0036	1.0000						
CANTAL	0.0582	-0.0047	-0.0135	1.0000					
BLEU_AUVERGNE	0.0227	-0.0035	-0.0100	-0.0131	1.0000				
Fourme_Ambert	0.0326	-0.0031	-0.0089	-0.0116	-0.0086	1.0000			
ROQUEFORT	0.5047	-0.0078	-0.0225	-0.0294	-0.0219	-0.0193	1.0000		
COMTE	0.3034	-0.0088	-0.0254	-0.0332	-0.0247	-0.0218	-0.0554	1.0000	
Other_french_Cheeses	-0.5304	-0.0544	-0.1564	-0.2042	-0.1521	-0.1341	-0.3411	-0.3845	1.0000
Other_foreign_Cheeses	0.0325	-0.0134	-0.0387	-0.0505	-0.0376	-0.0331	-0.0843	-0.0950	-0.5850
sale_promo	-0.1806	-0.0385	-0.1108	-0.1401	-0.0452	-0.0751	0.0191	-0.1803	0.2432
Supermarket	0.0662	-0.0069	0.0013	-0.0018	0.0239	-0.0047	-0.0052	0.0277	0.0078
Hypermarket	0.0064	-0.0044	-0.0129	-0.0216	-0.0242	-0.0157	-0.0029	0.0071	0.0053
Creamer	0.1507	0.0564	0.0631	0.0257	0.0165	0.0256	-0.0033	0.0458	-0.0451
Hard_discount	-0.1605	-0.0137	-0.0158	0.0173	-0.0052	0.0131	0.0115	-0.0642	0.0061
PDO_dummy	0.4212	0.0206	0.0591	0.0772	0.0575	0.0507	0.1289	0.1453	-0.3779
Auvergne	0.0207	0.0434	0.1144	0.0529	0.0292	0.0492	-0.0109	-0.0092	-0.0379
Ile_de_France	0.0497	0.0061	-0.0052	-0.0004	-0.0026	-0.0003	-0.0076	0.0114	-0.0133
Rest_of_France	-0.0572	-0.0184	-0.0320	-0.0121	-0.0045	-0.0132	0.0140	-0.0103	0.0300
Present_Piece	0.3318	-0.0187	-0.0538	0.0297	0.0889	0.0169	0.3550	0.1385	-0.3731
Present_Whole	-0.3761	-0.0224	-0.0643	-0.0840	-0.0554	-0.0461	-0.1377	-0.1581	0.3977
Present_grated	-0.1538	-0.0225	-0.0648	-0.0841	-0.0630	-0.0555	-0.1413	-0.1197	0.3088
packaging_BARQUET	0.3259	-0.0112	-0.0323	-0.0421	0.1348	-0.0204	0.5536	-0.0793	-0.4374
packaging_BOX	-0.4113	-0.0211	-0.0606	-0.0792	-0.0590	-0.0520	-0.1309	-0.1491	0.3758
packaging_SACHET	-0.1507	-0.0301	-0.0866	-0.0859	-0.0842	-0.0743	-0.1890	-0.0826	0.1372
packaging_FILM	0.1084	-0.0077	-0.0221	0.1069	0.0426	0.1002	-0.0480	0.2155	-0.1050
Summer	-0.0123	-0.0009	-0.0012	-0.0008	-0.0028	-0.0014	-0.0053	-0.0040	-0.0225
Spring	-0.0115	0.0006	-0.0003	-0.0022	-0.0012	-0.0016	-0.0057	-0.0038	-0.0135
autumn	0.0170	0.0002	0.0018	0.0014	0.0004	0.0014	0.0088	0.0072	0.0050

Variables	Other_foreign_Cheeses	sale_promo	Supermarket	Hypermarket	Creamer	Hard_discount	PDO_dummy	Auvergne	Ile_de_France	Rest_of_France
Other_foreign_Cheeses	1.0000									
sale_promo	-0.0794	1.0000								
Supermarket	-0.0195	0.0754	1.0000							
Hypermarket	0.0231	0.1553	-0.6240	1.0000						
Creamer	-0.0049	-0.0712	-0.1307	-0.1867	1.0000					
Hard_discount	-0.0044	-0.2530	-0.3165	-0.4523	-0.0947	1.0000				
PDO_dummy	0.2211	-0.2073	-0.0173	0.0056	0.0311	-0.0022	1.0000			
Auvergne	-0.0117	-0.0288	-0.0156	0.0095	0.0312	-0.0089	0.0281	1.0000		
Ile_de_France	0.0173	-0.0110	-0.0264	-0.0039	0.0909	-0.0082	0.0032	-0.0629	1.0000	
Rest_of_France	-0.0212	0.0248	0.0298	0.0041	-0.0878	0.0027	-0.0203	-0.2617	-0.8708	1.0000
Present_Piece	0.1921	0.0054	0.0096	0.0232	-0.0295	-0.0267	0.2894	-0.0216	0.0075	-0.0028
Present_Whole	-0.2280	0.2252	0.0117	-0.0048	-0.0396	0.0119	-0.8938	-0.0309	0.0088	0.0114
Present_grated	-0.2254	0.1209	-0.0113	0.0169	-0.0538	0.0183	0.3706	-0.0018	-0.0271	0.0245
packaging_BARQUET	0.3168	-0.0090	-0.0092	-0.0044	-0.0274	0.0299	0.1845	-0.0110	-0.0041	0.0067
packaging_BOX	-0.2116	0.2404	0.0169	-0.0186	-0.0334	0.0204	-0.9078	-0.0305	0.0109	0.0094
packaging_SACHET	0.0326	0.1563	-0.0290	0.0517	-0.0557	-0.0046	0.4956	-0.0132	-0.0062	0.0036
packaging_FILM	-0.0412	-0.0816	0.0207	-0.0200	-0.0183	0.0102	0.1138	-0.0086	0.0099	-0.0044
summer	0.0378	0.0044	0.0003	-0.0009	-0.0011	0.0015	-0.0028	-0.0012	-0.0137	0.0125
spring	0.0261	0.0058	0.0027	-0.0031	-0.0025	0.0020	-0.0063	-0.0023	0.0023	-0.0013
autumn	-0.0187	-0.0187	-0.0014	0.0019	0.0085	-0.0049	0.0075	-0.0001	0.0066	-0.0056

Variables	Present_Piece	Present_Whole	Present_grated	packaging_BARQUET	packaging_BOX	packaging_SACHET	packaging_FILM	summer	spring	autumn
Present_morceau	1.0000									
Present_entier	-0.3351	1.0000								
Present_rape	-0.3376	-0.4032	1.0000							
packaging_BARQUET	0.5754	-0.1829	-0.2022	1.0000						
packaging_BOITE	-0.2924	0.9141	-0.3802	-0.1893	1.0000					
packaging_SACHET	-0.0879	-0.5348	0.7470	-0.2704	-0.5084	1.0000				
packaging_FILM	0.3118	-0.0590	-0.1380	-0.0688	-0.1294	-0.1849	1.0000			
summer	-0.0039	-0.0016	-0.0216	-0.0158	0.0061	0.0153	-0.0046	1.0000		
spring	-0.0142	0.0032	-0.0146	-0.0237	0.0072	0.0149	-0.0081	-0.2982	1.0000	
autumn	0.0225	-0.0043	0.0103	0.0328	-0.0066	-0.0180	0.0077	-0.3202	-0.3165	1.0000

Variables	sale_promo	Supermarket	Hypermarket	Hard_discount	MDD	Present_Other	packaging_OTHER	inflation	lmarket_share	competition	winter	nber_presentation
sale_promo	1.0000											
Supermarket	0.0682	1.0000										
Hypermarket	0.0189	-0.5418	1.0000									
Hard_discount	-0.0259	-0.3358	-0.3870	1.0000								
MDD	0.3300	0.1083	0.0080	-0.0314	1.0000							
Present_Other	-0.4775	0.0035	0.0591	-0.2038	-0.3867	1.0000						
packaging_OTHER	-0.4787	0.0018	0.0624	-0.2053	-0.3887	0.9972	1.0000					
inflation	0.0085	-0.0033	0.0017	0.0022	-0.0717	0.0367	0.0368	1.0000				
lmarket_share	-0.3402	-0.0830	0.0485	-0.1343	-0.3007	0.4175	0.4148	-0.0146	1.0000			
competition	-0.0135	-0.0012	0.0072	0.0022	-0.0298	0.0757	0.0755	0.0040	0.0821	1.0000		
winter	0.0078	0.0014	-0.0035	0.0034	-0.0223	0.0058	0.0058	-0.0131	-0.0148	0.0024	1.0000	
nber_presentation	0.1667	0.0070	-0.0245	0.1164	0.1537	-0.3373	-0.3362	-0.0091	-0.3228	-0.0768	0.0084	1.0000

Appendix f: Estimation with all regions and all cheeses

VARIABLES	[1] Full sample (All cheeses) Price	[3] Auvergne PDO sample Price
<i>Cheeses variables : benchmark being "Grana cheese" for [1] and "Salers cheeses" for [3]</i>		
SALERS	4.470*** (0.0419)	
ST_NECTAIRE	-0.429*** (0.0186)	-4.794*** (0.0451)
CANTAL	-2.793*** (0.0159)	-7.119*** (0.0448)
BLEU_AUVERGNE	-3.320*** (0.0191)	-7.789*** (0.0481)
Fourme_Ambert	-2.899*** (0.0202)	-7.304*** (0.0469)
ROQUEFORT	2.854*** (0.0155)	
COMTE	-0.635*** (0.0129)	
CAMEMBERT	-3.474*** (0.0228)	
COULOMMIER	-4.642*** (0.0238)	
MOZZARELLA	-4.846*** (0.0149)	
REBLOCHON	0.291*** (0.0174)	
GRUYERE	-1.567*** (0.0204)	
RACLETTE	-3.385*** (0.0157)	
MORBIER	-2.314*** (0.0176)	
GORGONZOLA	0.298*** (0.0223)	
EMMENTAL	-4.972*** (0.0108)	
BRIE_DE_MEAUX	-0.292*** (0.0196)	
FETA	-3.034*** (0.0169)	

VARIABLES	[1]	[3]
	Full sample (All cheeses and all regions))	Auvergne PDO sample (All regions)
	Price	Price
TOMME	-0.928*** (0.0157)	
<i>Distribution variables : benchmark being "Other market"</i>		
Supermarket	-0.506*** (0.0667)	-0.269 (0.307)
Hypermarket	-0.775*** (0.0667)	-0.300 (0.307)
Creamer	0.331*** (0.0670)	0.860*** (0.308)
Hard_discount	-1.701*** (0.0667)	-1.908*** (0.309)
<i>Variables of regions : benchmark being "Rest of France"</i>		
Auvergne	-0.285*** (0.0139)	0.169*** (0.0641)
Ile_de_France	0.0402*** (0.00966)	0.604*** (0.0624)
Aquitaine	-0.172*** (0.0111)	0.212*** (0.0690)
Midi_Pyrenies	-0.186*** (0.0114)	0.175*** (0.0651)
Languedoc_Roussillon	-0.191*** (0.0114)	0.189*** (0.0662)
Corse	0.0911** (0.0421)	-0.644 (0.973)
Provence_Alpes_Ctte_Azur	-0.180*** (0.0103)	0.418*** (0.0656)
Rhone_Alpes	-0.235*** (0.0102)	0.304*** (0.0639)
Franche_Comte	-0.406*** (0.0138)	-0.0939 (0.0959)
Bourgogne	-0.310*** (0.0134)	0.0504 (0.0785)
Poitou_Charentes	-0.311*** (0.0125)	0.0552 (0.0743)
Pays_de_la_Loire	-0.316*** (0.0105)	0.278*** (0.0677)
Bretagne	-0.250*** (0.0109)	0.344*** (0.0692)
Basse_Normandie	-0.261*** (0.0105)	0.275*** (0.0664)
Haute_Normandie	-0.246*** (0.0113)	0.112* (0.0656)

VARIABLES	[1]	[3]
	Full sample (All cheeses and all regions)	Auvergne PDO sample (All regions)
	Price	Price
Picardie	-0.146*** (0.0119)	0.137* (0.0774)
Nord_Pas_de_Calais	-0.153*** (0.0105)	0.0751 (0.0705)
Champagne_Ardenne	-0.175*** (0.0128)	0.0320 (0.0819)
Lorraine	-0.204*** (0.0113)	-0.0275 (0.0755)
<i>Presentation variables of cheeses : benchmark being "Other presentation"</i>		
Present_Piece	0.424*** (0.0109)	1.520*** (0.204)
Present_Whole	-0.232*** (0.0145)	1.883*** (0.213)
Present_grated	-0.0335*** (0.0115)	3.695*** (0.353)
<i>Packaging variables : benchmark being "Other packaging"</i>		
packaging_BARQUET	-0.831*** (0.0112)	-1.498*** (0.205)
packaging_BOX	-0.833*** (0.0126)	
packaging_SACHET	-0.252*** (0.0117)	-1.581*** (0.207)
packaging_PAPER	-0.767*** (0.0189)	-2.177*** (0.225)
packaging_FILM	-0.819*** (0.0123)	-1.548*** (0.204)
<i>Variables of seasons : benchmark being "Winter season"</i>		
Summer	-0.0173*** (0.00399)	0.0685*** (0.0195)
Spring	-0.0163*** (0.00401)	0.0396** (0.0196)
autumn	-0.0106*** (0.00386)	0.119*** (0.0188)
<i>Other attributs of product</i>		
GI (PDO/PGI)	1.503*** (0.0106)	
sale_promo	0.100*** (0.00347)	-0.350*** (0.0347)
Constant	12.00*** (0.0690)	17.03*** (0.315)
Observations	1,265,106	58,199
R-squared	0.712	0.553

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

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Chapter 6: Consumer's choices and willingness to pay for Auvergne cheeses under PDO label. An empirical analysis⁴³

⁴³ - A version of this chapter has been submitted for publication.

- A version of this chapter was presented at the "*15th Congress of European Association of Agricultural Economists (EAAE)*". Parma (Italy), August 29th – September 1st 2017.

- A version of this chapter was presented at the "*Symposium on the Competitiveness, agriculture and food*", organized by the French society of rural economy (SFER). Reims (France), 22-23 June 2017.

- A version of this chapter was presented at the "*154th Seminar of European Association of Agricultural Economists (EAAE)*", Beauvais (France), June 30–July 1, 2016.

Abstract

This Chapter aims to estimate the willingness to pay (WTP) of French consumers for the 5 Auvergne PDO cheeses, namely “Cantal”, “Saint Nectaire”, “Bleu d'Auvergne”, “Fourme d'Ambert” and “Salers”. To do this, firstly, we compare the consumers' choice between Auvergne's cheeses under PDO label with a mixed logit model (MXL). Secondly and based on these estimates, we deduce the WTP of consumers for attributes of each product. Finally, we add in our sample PDO cheeses from other regions like “Roquefort”, “Comté” and “Reblochon”, and non-PDO cheeses like “Camembert”, “Coulommiers” and “Other blue cheese”, this allows us to compare the consumer's choice for Auvergne PDO cheeses with regard to other French PDO and non-PDO cheeses from other regions. As main results, we found that attributes of product influence more purchases of products compared to individual characteristics of consumers. Moreover, among Auvergne PDO cheeses, consumer's willingness to pay is on average +2.681 €/kg, +3.207 €/kg and +3.233 €/kg for the PDO “Cantal”, the PDO “Bleu Auvergne” and the PDO “Fourme Ambert” respectively, relative to their initial price. While, they willingness to pay is on average -0.013 €/kg and -4.619 €/kg for the PDO “St Nectaire” and the PDO “Salers” respectively, relative to their initial price. We also found that, on average Auvergne PDO cheeses are better sold in their region of origin than non-PDO and PDO cheeses from other regions. Finally, the calculation of utilities shows that consumers prefer in first choice non-PDO cheeses, then PDO cheeses from other regions, and finally Auvergne PDO cheeses. We conclude that Auvergne PDO cheeses and PDO cheeses from other regions should review their strategy of promotion in order to better compete with non-PDO cheeses. In addition, Auvergne PDO cheeses must practise an average price about 12 €/kg in order to attract consumers. The major contribution of this chapter is to be the first empirical paper to assess determinants of choice and a WTP of consumers for the 5 Auvergne PDO cheeses with original data from Kantar WorldPanel.

Keywords: Protected Designated of Origin, cheese, product quality, willingness to pay, nested logit, mixed multinomial logit, consumers

JEL classification: D12, L66, C19, Q1, L15, D12

6.1. Introduction

In recent years, Auvergne⁴⁴ PDO (Protected Designated of Origin) cheeses have faced many difficulties in terms of price and volumes sold compared to PDO and non-PDO cheeses from other regions. To explain this downward trend, multiple causes were underlined by professionals, among them: the exacerbation of the competition, the global economic crisis, the restructuring of actors of the sector, the ageing of the clientele and finally difficulties answering quickly evolving modes of consumption of dairy and cheese products.

These difficulties, which can be qualified as the “*curse of the Auvergne PDO cheeses*” have led professionals in the cheese sector of Massif Central in general and Auvergne in particular to review their code of practice and specifications strategies in order to offer consumers products of high qualities and recover their willingness to pay (WTP). Despite these efforts Auvergne PDO cheeses still has mixed results. In addition, it seems that a consumer forsakes these Auvergne PDO cheeses for other PDO or non-PDO cheeses from other regions. Professionals of sector are wondering today whether there is not a hidden willingness to pay of consumers for these products, that it would be important to reveals. Which leads us to ask, what are determinants of choice of consumption (knowing that these determinants of choice are linked to the determinants of prices) and what is the willingness to pay of consumers for each product?

In order to answer these questions, we focus on attributes of products that may affect preferences and the WTP of consumers. To do this and based on a random utility model (RUM), we calculate probabilities of consumer to choose each Auvergne PDO cheese between them, in order to evaluate what makes a consumers choose to buy one Auvergne PDO cheese compared to other Auvergne PDO cheeses. The calculation of these probabilities allows us to deduce the WTP of different attributes of products. Finally, we calculate probabilities of consumer to choose Auvergne PDO cheeses relative to PDO and non-PDO cheeses from other regions in France, in order to evaluate what makes a consumer choose to buy PDO cheeses from Auvergne region compared to other PDO cheeses like “Roquefort” and “Comté” from other regions and non-PDO cheese like “Camembert”, “Coulommiers” and “Other Blue cheese”.

⁴⁴ The region of Auvergne merged on January 1st, 2016 with the Rhône-Alpes region to form a large administrative region now called "Auvergne-Rhône-Alpes Region".

The chapter is organized as follows. Section 2 gives an empirical literature review on the geographical indications (GI) products. Section 3 describes data and descriptive statistics. Section 4 develops the random utility model (RUM) that we use. Section 5 presents econometric specifications. Section 6 presents results and interpretations. Finally, we conclude in section 7.

6.2. Literature review

Auvergne is a French region located in the Massif Central. This region has five cheeses benefiting from PDO protection: “Cantal”, “Saint Nectaire”, “Bleu d'Auvergne”, “Fourme d'Ambert” and “Salers”. These regional products make the pride of the Auvergne region. Many authors consider that the image of a region linked to a product plays favorably in the minds of consumers during the purchase. [Unterschultz, Quagraine et al. \(1998\)](#) show that consumers with high attitudes have a willingness to make a high sacrifice in the form of a price premium for regional products. Consumer attitudes are calculated here by the scaling method, by taking into account the knowledge or the not knowledge of prices. In the same vein, [Van Ittersum, Candel et al. \(2003\)](#) also point out that regional products are more effective when their relevant characteristics correspond to the region's image in terms of physical environment or human factors.

The PDO label is a special case of Geographical Indication which indicates a product whose main stages of production are carried out according to a know-how recognized in a given geographical area, which gives its characteristics to the product. It is necessary to note that in Europe, a significant part of the overall quantity of quality food is produced in traditional farms, using traditional methods [Gilg and Battershill \(1998\)](#). In February 2011, there were 970 products registered under PDO or PGI (465 PGI and 505 PDO) by the European Commission. These products are divided into ten main groups: 1) Fresh meat; 2) Meat products; 3) Cheeses; 4) Other products of animal origin; 5) oils and fats; 6) Fruits, vegetables and cereals; 7) Beers; 8) Water; 9) Bread, pastry and confectionery products; and 10) Essential oils (European Commission 2011). It shows that the development and the promotion of quality products represent a big challenge for the common agricultural policy. Hence the conclusion of [Henson and Northen \(2000\)](#) that extrinsic quality indices such as the country of origin and the organic label are among the most important indicators of the safety for a variety of EU countries.

Many studies showed that regional labels can be important in choices of consumption (Landon and Smith (1998); Loureiro and McCluskey (2000)). Moschini, Menapace et al. (2008) found that GI can provide products of competitive quality and lead to clear welfare gains in competitive markets with free entry and exit. Scarpa and Del Giudice (2004) also found that consumers are more generally concerned about GI produced in their own region ("home-bias"). The purpose of the GI label is to inform consumers about the level of quality, which cannot be measured in its absence (Marette, Crespi et al. (1999); Marette and Crespi (2003); Zago and Pick (2004)). Thus, it plays the role of signal of information. GI label have also been examined by many authors as a tool capable of communicating not only the specific characteristics of a product linked to a specific domain but also the technical requirements of production (Réquillart (2007)). In addition, GI reduce the confusion and search costs for information about the quality (Dimara, Petrou et al. 2004).

Researchers who address the issue of food labeling and expected effects agree that it has a significant effect on decisions of choice of consumptions of individuals. McCluskey and Loureiro (2003) show that food labeling plays an important role in the food marketing system, as consumer demand for agricultural products becomes increasingly complex and dynamic. Labels are a part of the set of information used by consumers to make decisions of purchase of products (Verbeke and Viaene (1999); Salaün and Flores (2001)). In this way, quality label can differentiate products by widening the attractiveness of products or by ensuring consumers a certain level of quality (Bernués, Olaizola et al. (2003); Caswell and Mojduszka (1996)). Trognon, Bousset et al. (2000) argue that socio-demographic factors, perception, knowledge and attitudes interact to influence in fine consumers behavior. Brouwer (1991) shows that the success of protective measures of regional products depends to a large extent on the consumers' appreciation of regional certification labels, which informs them that the name of the regional product is protected and that it is authentic product, and not an imitator version, which is sold. Peri and Gaeta (1999) show that PDO/PGI systems aim to increase the value of the product given that these systems impose strict regulation. The PDO label makes that consumers accept more easily the product. It supports the idea of Caswell and Mojduszka (1996) who argue that signaling quality through the label promotes market incentives with a limited implication of the government.

More and more empirical work is focusing on preferences of consumers and their willingness to pay for products under geographical indications, and find positive results.

Since the 1970s, [Jacoby and Chestnut \(1978\)](#) showed that consumers with strong favorable attitudes towards the protected regional products have a greater willingness to buy for these products than consumers with low attitudes. [Van der Lans, Van Ittersum et al. \(2001\)](#) analyze preferences of consumers for the extra virgin olive oil, using a conjoint analysis on the data of the Lazio region in Italy, they find that the region of origin and GI have a positive effect on preferences of some consumers' segments. [Krystallis and Ness \(2005\)](#) apply a conjoint analysis to describe and analyze urban consumer preferences for quality attributes (organic label and PDO) of olive oil in Greece. Their results indicate that preferences of consumers are influenced by factors such as the age, the education and the income. Specifically, younger people and those with higher levels of education and income attach a great importance to organic and PDO labels when buying high quality olive oil. [Scarpa and Del Giudice \(2004\)](#), use an ordered choice experiment to analyze preferences of urban consumers for specific attributes with regard to extra virgin olive oil in Italy. They describe extra virgin olive oil using a series of attributes that include appearance, price, geographical origin and certifications related to organic production, PDO and PGI. They find that olive oil from southern Italy is most often preferred in the south than in northern Italy. Their results also suggest that PDO and PGI labels are more valued than the organic attribute. In a meta-analysis, [Ngoulma 2015](#) found that on average geographical indications (PGI and PDO) are important signals in studies of his sample, because they increase the consumer's WTP for dairy products when they are affixed to them.

But, on the other hand, some results of other studies reveal the more or less mitigated effects of these geographical indications.

[Fotopoulos and Krystallis \(2003\)](#) estimates by means of a questionnaire, the reputation of the PDO apples of Zagora in the Greek market. They found that 5.8% of respondents to the questionnaire know the PDO label. Although they found that consumers are more motivated once they have informations on the label, but given the limited consumer awareness they conclude that the PDO label can be problematic, as a marketing strategy. Because the conjoint and cluster analyses indicate that the PDO label does not seem to be really important for more than a third of the buyers. [Van der Lans, Van Ittersum et al. \(2001\)](#) carried out a study to verify if the certification designations of origin, such as the PDO label, are perceived by consumers as an indicator of the quality of extra virgin olive oil. They found that the PDO label affects only preferences of consumers indirectly through their perception of the quality

of extra virgin olive oil without direct effect. Thus, PDO labels have no direct effect on preference of products, and consumers without a specific appreciation of the regional nature of the product focus more on the other indications of products such as the price, the color and the appearance. [Loureiro and Umberger \(2004\)](#) used the experimental auction method to obtain information on the WTP of the US consumers for the beef labeled COOL. They found that this label is a less important determinant compared to food safety inspection labels, product quality labels or the traceability of beef. Using another method (hedonic approach) to calculate the WTP of consumers for products of fresh meat which carry a PGI label, [Loureiro and McCluskey \(2000\)](#) studied the effect of PGI on the WTP for a product that is already vertically differentiated, namely beef. This vertical differentiation concerns pieces of meat, from which the authors distinguish three quality levels. They show that for consumers of the PGI label, their consumption is significant for pieces of meat of average quality. For high-quality pieces the value of the PGI is not significant. Therefore consumers are willing to pay a price premium only if the stamp PGI is displayed on the average-quality pieces of the meat, indicating that the label PGI is not a good signal if it is combined with other indicators like a high quality of product.

Since the 2000s, more and more research has focused on preferences of consumers and their WTP for cheese products.

[Bonnet and Simioni \(2001\)](#) studied how consumers with different income and ages respond to the presence or absence of quality signals as a label PDO. They use a mixed multinomial logit (MXL) model to estimate the distribution of WTP for PDO Camembert cheeses and non-PDO Camembert cheeses (or brand) with scanned data from Kantar WorldPanel. Their results suggest that the brand is valued by consumers more than the PDO label on Camembert cheeses. According to them, on the basis of the same price, consumers will prefer to buy a non-PDO Camembert compared to a PDO Camembert. [Monjardino de Souza Monteiro & Raquel Ventura Lucas \(2001\)](#) studied the impact of PDO certification on the consumer preferences for traditional Lisbon cheeses and found that only 56% of respondents consider the PDO as the most important attribute of the product. [Tendero and Bernabéu \(2005\)](#), studied the market of Spanish cheese, and show that labels of origin reassure consumers on the place of production and so serve as guarantees and as food safety. [Hassan, Monier-Dilhan et al. \(2011\)](#) computed elasticities from a demand model distinguishing PDO cheeses from non-PDO cheeses with scanned data from Kantar WorldPanel, they found counterintuitive results:

PDO cheeses are more price elastic than non-PDO cheeses. This finding thus challenges the widespread idea that PDO systematically correspond to high quality. An experimental analysis led by [Cavicchi, Bailetti et al. \(2010\)](#) showed that the value which consumers give to the cheese “Pecorino di Fossa” is higher if this cheese carries the label PDO; the same cheese presented exclusively with a trademark is considered less good. More recently, [Almli, Øvrum et al. \(2015\)](#) used a ranking conjoint experiments to investigate Norwegian consumers’ choices among healthier and organically produced semi-hard cheeses, they found that consumers on average prefer cheeses of new (healthier) fat composition, organic production and lower price to cheeses of regular fat composition, conventional production and higher price. Two consumer segments are investigated. Consumers in the new fat segment are health-conscious, whereas consumers in the regular fat segment are attracted by conventional cheese and lower prices. Self-explicated ratings of cheese attributes corroborate these findings. [Gracia and de-Magistris \(2016\)](#) used an experimental auction approach to assess consumers’ willingness to pay (WTP) for three different food claims on semi-cured, pasteurized sheep milk cheese in Spain. They found that consumers were willing to pay more for PDO cheese, followed by organic and light cheese. Moreover, respondents who were female, older and with a university-level education showed some environmental concerns, influencing their WTP for different cheeses. [Gracia and de-Magistris \(2016\)](#) used experimental auctions for artisan cheese to estimate the value of pasteurization and age as food safety attributes, which is the rationale for the policy in the USA. They also look at consumers’ perception of the tradeoff between safety and quality. They found that there is no evidence of positive demand for pasteurization and there is no evidence of a tradeoff between safety and quality. On average artisan cheese consumers make purchasing decisions based on taste, not their attitude toward food safety. [de-Magistris and Lopéz-Galán \(2016\)](#) used the choice experiment to investigate consumers' willingness to pay (WTP) for cheeses bearing reduced-fat and low salt claims in Spain. They found that consumers are willing to pay a price premium for a package of cheese with a reduced-fat claim or cheese with reduced-fat and low salt claims appearing together; however, they are not willing to pay for a package of cheese with only a low salt claim. In comparison with overweight people, normal weight consumers would prefer to pay more for conventional cheese than low salt cheese.

We observe that the empirical literature on preferences and the WTP of cheese products under geographical indications is more and more developed, but remains however very limited in France, which has nearly 45 PDO cheeses. To fill this gap, we evaluate the determinants of

choice of consumptions and the consumers' WTP for the 5 PDO cheeses of the Auvergne region.

6.3. Data and Descriptive statistics

The data used are data from Kantar Worldpanel. The Kantar Worldpanel data are food purchase data of households in metropolitan France. This database contains nearly 20,000 households. Our data cover the period 2008-2010. These data include the 5 PDO cheeses from Auvergne (“Cantal”, “Saint Nectaire”, “Bleu d'Auvergne”, “Fourme d'Ambert” and “Salers”). This data set contains information on 58,199 acts of purchases of these cheeses by 20,000 French households over the period 2008-2010 (close to 324,035 observations). We consider each act of purchase as an observation and not the household or the individual. For each purchase made by a given household, we know the trademark chosen, its actual price, if this mark is labeled PDO, and the name of the store chain where the purchase took place. As in [Bonnet and Simioni \(2001\)](#) these data represent choices really made by individuals. To build the other choices that would have been able to make the individual at the same moment as him chosen to buy any cheese, we choose the approach of [Bonnet and Simioni \(2001\)](#). Thus, like them, we use the knowledge (the name) of the chain of stores where all the products of our sample were sold during the same week. Prices of unselected products are recovered by making the average of prices of these products on all purchases in the same stores chain for the same week. Our sample are 23 central purchasing offices, see the list in Appendix B.

Table 19: Descriptive statistics of the sample for Auvergne PDO cheeses

Variable	Obs	Mean	Std. Dev.	Min	Max
price	58199	10.25	2.51	6.59	23.08
CDI	58199	0.37	0.48	0	1
CDD	58199	0.07	0.26	0	1
Without Activity	58199	0.55	0.49	0	1
Primary_Education	58199	0.09	0.29	0	1
Secondary_Education	58199	0.56	0.49	0	1
Superior_Education	58199	0.31	0.46	0	1
NoEducation	58199	0.01	0.13	0	1
Single	58199	0.21	0.40	0	1
Couple	58199	0.47	0.49	0	1
Big Family	58199	0.30	0.46	0	1
age	58199	56.10	14.56	15	93
income	58199	2741.75	1326.33	300	7000
gender	58199	0.91	0.28	0	1
nberind	58199	2.42	1.19	1	9
Auvergne	58199	0.09	0.29	0	1
MDD	58199	0.28	0.45	0	1
Supermarket	58199	0.31	0.46	0	1
Hypermarket	58199	0.38	0.48	0	1
Creamer	58199	0.10	0.30	0	1
Hard_discount	58199	0.19	0.39	0	1
OtherMarket	58199	0.01	0.02	0	1
Mat_Grasse	58199	56.78	7.69	45	80
sale_promo	58199	0.09	0.28	0	1

Table 19 shows that the age of the person who buys Auvergne PDO cheeses varies between 15 and 93 years. Similarly, the average monthly income of households consuming Auvergne PDO cheeses in our sample is 2741.75 €, the minimum being 300 € and maximum being 7000 €. This shows that consumers of Auvergne PDO cheeses are recruited in all social classes. We also observe that the size of household (*nberind*) in our sample is 1 (single) to 9 individuals (big family).

Table 20: Evolution of acts of purchase on the period 2008-2010

Auvergne PDO cheeses	Year 2008	Year 2009	Year 2010	Total
Cantal	6987	7567	7347	21901
St Nectaire	4167	4354	4421	12942
Bleu Auvergne	3874	4455	3912	12241
Fourme Ambert	2972	3293	3271	9536
Salers	520	558	501	1579
Total	18520	20227	19454	58199

In table 20 above, we see that in our sample the “Cantal” cheese is the one which registered most acts of purchase (21,901) over the period 2008-2010, followed by “St Nectaire” (12,942), by the “Bleu d’Auvergne” (12,241), “Fourme d’Ambert” (9,536) and finally “Salers” (1,579). Appendix D shows that the department of “Puy de Dôme⁴⁵” is the one where most acts of purchase of PDO cheeses from Auvergne were made. Knowing that this department is a department of the region of Auvergne, we can say that over the period 2008-2010, cheeses of Auvergne registered most acts of purchase in their region of origin. The correlation matrix of variables is presented in appendix C.

6.4. Theoretical background

Following [McFadden \(1974\)](#), [Aprile, Caputo et al. \(2012\)](#) we use the RUM-model. Then in accordance with [Train \(2003\)](#), we use a mixed logit to estimate.

The mixed logit model is a form of random utility model (RUM) wherein it is assumed that the functional form of utility is common to all individuals, but parameters vary between individuals. This approach is considered by many researchers as the most reasonable analytical model among discrete choice models available and represents a different approach to heterogeneous modeling as used in several logit models with fixed parameters where the approach is to segment the sample, attributes or both ([Hensher and Greene, 2003](#)).

Therefore, the mixed logit model solves limits assigned to the conditional logit model used by ([Burton, Rigby et al. 2001](#)). The mixed logit model does not take into account the Independence of Irrelevant Alternatives (IIA) assumption, it explicitly authorize a distribution of preferences among the population rather than identifying only average preferences.

Let an individual faces a choice among alternatives of choice in a set j . The utility that individual n obtains with alternative j in choice situation t is:

$$U_{njt} = \beta'_n x_{njt} + \vartheta_{njt} \quad (1)$$

Where x_{njt} is a vector of variables observed and β'_n tastes of individuals, which are unobserved and vary in the population with a density $f(\beta|\theta^*)$ where θ^* is the true parameter

⁴⁵ Puy de Dôme is a department of the central France located in the administrative region of Auvergne

of the distribution. ϑ_{njt} is unobserved error term, which is *iid* in function of a distribution of extreme values. This is a standard logit specification. Nevertheless, but instead of being fixed, we consider that the coefficient β'_n vary across the population. Therefore, tastes vary across those who make consumption choices, but not in choices made by an individual.

The vector of coefficients β'_n can be expressed as an average (b) and individual specific gap is η_n . Hence, the corresponding utility that individual n obtained to the alternative choice j at the time t is rewritten like this:

$$U_{njt} = b'_n x_{njt} + \eta'_n x_{njt} + \vartheta_{njt} \quad (2)$$

If tastes of individuals are known, for example if β'_n take the value β , the researcher could conditional β and the choice of probability would be a simple logit formulation for the probability that an individual n choose the alternative i in the choice situation t:

$$P_{nit} = \frac{\exp(\beta' x_{nit})}{\sum_j \exp(\beta' x_{njt})} \quad (3)$$

The estimation of equation (3) is known as being the conditional logit model. The limitation of this model is: it assumes that individuals have same preferences. Consequently, there is equal proportional substitution between the alternatives:

$$\frac{\partial P_{nit}}{\partial x^*_{njt}} \frac{x^*_{njt}}{P_{nit}} = -x^*_{njt} P_{njt} \beta^* \quad (3a)$$

Note that the expression (3a) does not depend on i, this is due to the assumption that error terms are independent. Another consequence is the Independence of Irrelevant Alternatives (IIA⁴⁶) property.

⁴⁶ Suppose that the logit model holds; and consider the odds that individual i will selected mode j over mode k. With logit choice probabilities, this is a routine calculation: the denominators cancel and we have.

$$\frac{P_{ni}}{P_{nk}} = \frac{\frac{\exp(V_{ni})}{\sum_{j=1}^J \exp(V_{nj})}}{\frac{\exp(V_{nk})}{\sum_{j=1}^J \exp(V_{nj})}} = \frac{\exp(V_{ni})}{\sum_{j=1}^J \exp(V_{nj})} \times \frac{\sum_{j=1}^J \exp(V_{nj})}{\exp(V_{nk})} = \frac{\exp(V_{ni})}{\exp(V_{nk})} \quad (3b)$$

We see that the odds depends only on the systematic (observable) utility of the two modes in question. Put another way, the odds do not depend on (are independent of) the characteristics of any other (irrelevant) alternatives, only the two alternatives (j and k) in question. This is the Independence of Irrelevant Alternatives (IIA) property of the logit model.

Since values of β'_n are unknown, the probability to choose the option i at time t is the integral of the conditional probability (3) over all possible values of β .

This model is known as being the mixed logit model, in which limitations of the conditional logit are, overcomes by allowing coefficients in the model to vary across decision makers.

The mixed logit choice probability is given by:

$$Q_{nit}\theta^* = \int P_{nit}(\beta)f(\beta|\theta^*)d\beta \quad (4)$$

Where $f(\beta|\theta^*)$ is the density function of β . Allowing coefficients to vary implies that we allow for the fact that different decision makers may have different preferences. Thus, it can also be seen that the IIA property no longer holds.

Let $i(n,t)$, the alternative that individual n chosen at the time t , and assume that $\beta'_n = \beta$, the probability of the individual n to observe the sequence of choice is given by:

$$S_n(\beta) = \prod_t P_{ni(n,t)t}\beta \quad (5)$$

Considering β'_n is unobserved, the probability for the sequence of choice is the integral of (5) evaluated over all possible values of β , which depends on the distribution of β :

$$P_n(\theta^*) = \int S_n(\beta)f(\beta|\theta^*)d\beta \quad (6)$$

The purpose of the estimation procedure is to estimate θ^* , more precisely parameters of the population that describe the distribution of different parameters. The log-likelihood function is:

$$LL(\theta) = \sum_n \ln[P_n(\theta)] \quad (7)$$

Which is maximized by simulation⁴⁷ in which $P_n(\theta)$ may be approximated by simulation and an estimation of θ^* can be found by maximizing the simulated log likelihood function. More

⁴⁷ In the formula of mixed logit, the integral cannot be solved analytically and is therefore approached by simulation [Brownstone, D. and K. Train \(1998\)](#). "Forecasting new product penetration with flexible substitution patterns." *Journal of econometrics* 89(1): 109-129.

precisely, $P_n(\theta)$ is approximated by summation of the random choice of values β . using this β , $S_n(\beta)$ can thus be calculated. This process is repeated several times, and average values $S_n(\beta)$ are interpreted as the estimate of the probability of choice, i.e.

$$SP_n(\theta) = \left(\frac{1}{M}\right) \sum_{m=1}^M S_n [\beta_{nr}(\theta)] \quad (8)$$

Where M is the number of draws, $\beta_{nr}(\theta)$ is the r^{th} draw from $f(\beta_n|\theta)$, and $SP_n(\theta)$ is the simulated probability of consumer n 's sequence of choices.

As in [Bonnet and Simioni \(2001\)](#), the model can somewhat heuristically be described as follows:

- (i) Set starting values θ_0 for the distribution of the coefficient of interest, that is to say $f(\beta_n|\theta)$;
- (ii) Simulate M values $\beta_{nr}(\theta_0)$ from $f(\beta_n|\theta_0)$ for each consumer n ;
- (iii) Use data and these M values $\beta_{nr}(\theta_0)$ to evaluate $SP_n(\theta_0)$ using equations (3), (5) and (8);
- (iv) Evaluate the log-likelihood using $LL(\theta_0) = \sum_n \ln[SP_n(\theta_0)]$;
- (v) Change θ_0 and repeat steps (ii)-(iv) until a maximum is reached. The values obtained for θ^* are then our simulated maximum likelihood estimates.

To go further, we choose to compare PDO from Auvergne with PDO from other French regions and non-PDO cheeses. To do this, we add in our sample, PDO ‘‘Roquefort’’ which is similar to the Auvergne PDO ‘Fourme Ambert’ and ‘Bleu Auvergne’; PDO ‘‘Comt  ’’ which is similar to the Auvergne PDO ‘Cantal’; PDO ‘‘Reblochon’’ which is similar to the Auvergne PDO ‘St Nectaire’; and non-PDO ‘‘Camembert’’, non-PDO ‘‘Coulommier’’ and other non-PDO ‘‘blue cheese’’, which are the most sold in the market. Then we choose to implement the nested logit model. This model is most attractive because it relaxes the strong assumptions of the multinomial (or conditional) logit model as the mixed logit model, but in addition it is computationally straightforward and fast compared to, mixed logit, or other even more flexible models due to the existence of a closed-form expression for the likelihood function.

Let us describe briefly the general approach. Let G subsets ('nests') $C_g, g=1, \dots, G$, so that each alternative belongs to exactly to one nest. Denote the nest to which alternative $j = 1, \dots, J$ belongs as B_j :

$$C(j) = \{C_g : j \in C_g ; g = 1, \dots, G\}$$

For the cheese choice example, one possible nesting structure is depicted in figure 36 below. The number of nests is $G = 3$. Auvergne PDO cheeses choices (Cantal, St Nectaire, Bleu Auvergne, Fourme Ambert and Salers) share the nest $C_{PDO} = \{Cantal, St Nectaire, Bleu Auvergne, Fourme Ambert, Salers\}$, other-PDO cheeses choices (Roquefort, Comte and Reblochon) share the nest $C_{otherPDO} = \{Roquefort, Reblochon and Comte\}$, Finally non-PDO cheeses choices {Camembert, Coulommier and Other Blue Cheese} share the nest $C_{nonPDO} = \{Camembert, Coulommier and Other Blue Cheese\}$. Cameron and Trivedi (2005) claim that, the nested logit (NL) model requires that a nesting structure be specified that splits alternatives into groups, where errors in the RUM are correlated within group but are uncorrelated across groups. Following this, we specify a two level NL model, though additional level of nesting can be accommodated, and assume a fundamental distinction between PDO, other-PDO and non-PDO cheeses. The tree is depicts in figure 36.

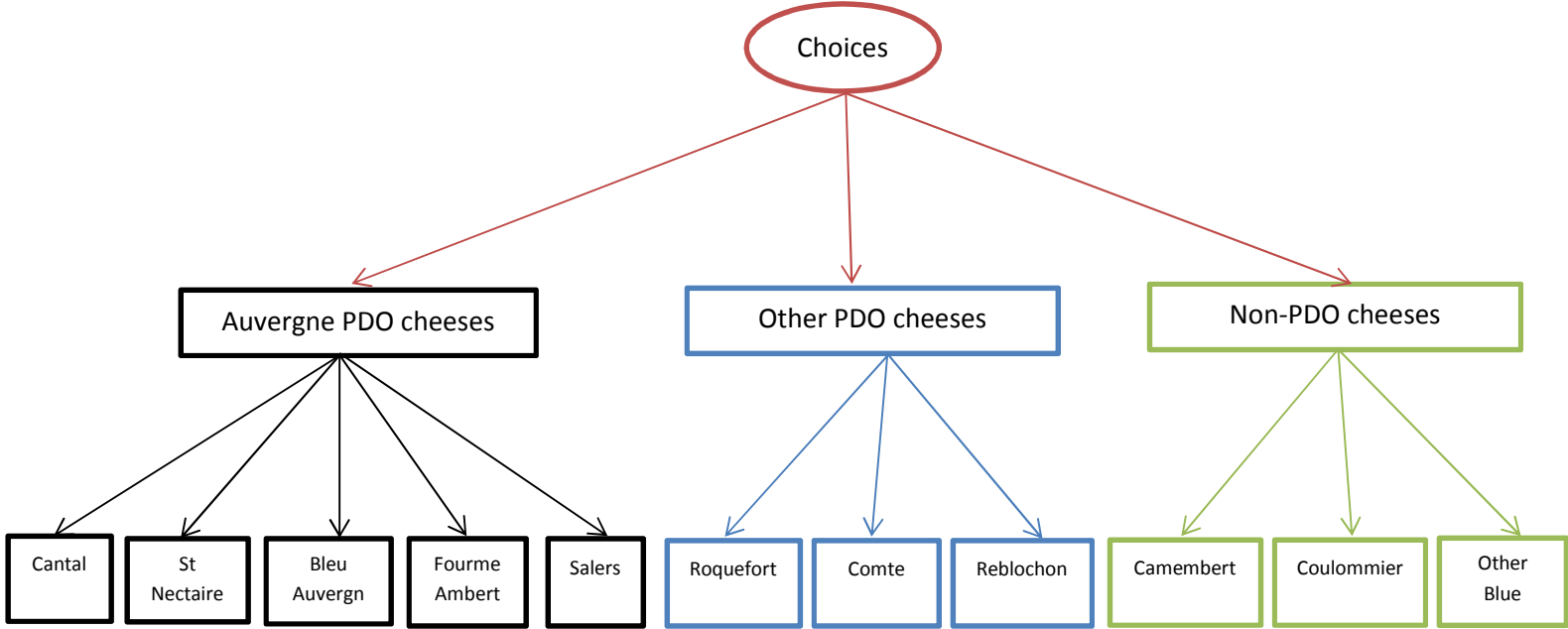


Figure 36 : Nesting structure for the choice of cheese

The probability of individual i choosing alternative j , $\Pr(y_i = j)$, is equal to the product of the probability to choose some alternative in nest C_j , $\Pr\{y_i \in C_{(j)}\}$, and the conditional probability to choose exactly alternative j given some alternative in the same nest C_j is chosen $\Pr\{y_i = j | y_i \in C_{(j)}\}$; that is:

$$P_j = \Pr(y = j) = \Pr\{y = j | y \in C_{(j)}\} \times \Pr\{y_i \in C_{(j)}\} \quad (8)$$

So, for example the probability to choose the cheese ‘‘Cantal’’ $\Pr(y_i = Cantal)$ is equal to the probability of choosing Auvergne PDO cheese $\Pr\{y_i \in C_{(Cantal)}\}$, times the conditional probability of choosing the Cantal cheese given an Auvergne PDO cheese is chosen $\Pr\{y = Cantal | y \in C_{(Cantal)}\}$.

In the equation (8) the conditional choice probability of choosing alternative j given some alternative in its nest chosen is $\Pr\{y = j | y \in C_{(j)}\}$, which corresponds to a simple conditional logit (CL) model for the choice between alternatives in nest C_j . Utilities are rescaled by the inverse of the dissimilarity parameter $\tau_{(i)}$ for this nest:

$$\Pr\{y = j | y \in C_{(j)}\} = \frac{\exp\left(\frac{V_j}{\tau_{(j)}}\right)}{\sum_{k \in C_{(j)}} \exp\left(\frac{V_k}{\tau_{(j)}}\right)} \quad (9)$$

Following Heiss (2002), we note that the denominator in equation (9) represents a (rescaled) measure of the attractiveness of the nest C_j . The log of this expression for each nest g is called inclusive value IV_g . It corresponds to the expected value of the utility individual i obtains from alternatives in nest g :

$$IV_g = \ln \sum_{k \in C_g} \exp\left(\frac{V_k}{\tau_g}\right) \quad (10)$$

In equation (8), the probability $\Pr\{y_i \in C_{(j)}\}$ of choosing some alternative from nest k is again a conditional logit probability for the choice between nests. The scaled back inclusive values take the role of the deterministic parts of utilities:

$$\Pr\{y \in C_{(j)}\} = \frac{\exp(\tau_{(j)} IV_j)}{\sum_{g=1}^G \exp(\tau_{(g)} IV_g)} \quad (11)$$

Because of the way the dissimilarity parameters enter this equation, they are also called IV parameters. According to Heiss (2002), nested logit models can be fit sequentially. First, fit a

sub-model for each nest according to equation (9). Then, calculate inclusive values defined in equation (10) and fit a model for the choice of a nest shown in equation (11). Alternatively, all these equations can be plugged into equation (8). In this way, we obtain the marginal choice probability for alternative j as:

$$P_j = \frac{\exp\left(\frac{V_j}{\tau_{(j)}}\right)}{\exp(IV_j)} \times \frac{\exp(\tau_{(j)}IV_j)}{\sum_{g=1}^G \exp(\tau_{(g)}IV_g)} \quad (12)$$

This probability is the full information likelihood contribution.

6.5. Econometric specification

We estimate the probability to choose the 5 Auvergne PDO cheeses. [McFadden and Train \(2000\)](#), indicate that a random utility model can be approximated accurately by the mixed logit model if we choose perfectly explanatory variables and distribution settings. [Train \(2003\)](#) shows that the mixed logit avoids three limits of standard logit model allowing for random variation of tastes, a substitution pattern without restriction, and a correlation unobserved factors over time. In the mixed logit formula, the integral cannot be solved analytically and is therefore approximated by simulation ([Brownstone and Train 1998](#)). The estimation equation of this specification is depicts in the model 1 below.

Model 1: Mixed logit equation

$$\mathbf{Choice}_{Mixed(nit)} = \alpha_i + \beta_{price} \mathbf{Price} + \beta_{nit} \mathbf{X} + \beta_{nit} \mathbf{Z} + \epsilon_{nit}$$

Where \mathbf{Choice}_{Mixed} represents the dummy variable of indirect utility, which takes 1 if the consumer chooses one cheese among the five Auvergne PDO cheese (Cantal, St Nectaire, Bleu Auvergne, Fourme Ambert or Salers) and 0 if he chooses the other Auvergne PDO cheeses among these 5 cheeses, in the estimation of each cheese equation. ϵ represents error terms which are *iid* with extreme values distributions ([Greene 1998](#)). It captures in the case of mixed logit variations in preferences across consumers and correlation of attributes of products ([Hensher, Rose et al. 2005](#)). To estimate this model 1, we follow the approach of [Cameron and Trivedi \(2005\)](#) and [Hole \(2007\)](#).

This estimation allows us to deduct the willingness to pay (*WTP*) for attributes k of product. Indeed, as the price is assumed to be a fixed parameter, we have the convenient result that:

$$WTP^k = - \frac{\beta^k}{\beta^{price}}$$

Then, we implement the nested logit model by adding data of PDO cheeses (Roquefort, Reblochon and Comte) and non-PDO cheeses (Camembert, Coulommier and Other Blue cheese). Cameron and Trivedi (2005) explain that there are two variants of nested logit model (NL). The first variant is based on the RUM developed in the ‘section 6.4’ and the second variant is called by Heiss (2002) non-normalized nested logit (NNNL) model. Both variants have a multinomial logit and a conditional logit as special cases, and both ensure that multinomial probabilities lie between 0 and 1 and sum to 1. But as recommended by Cameron and Trivedi (2005) we use prefer the variant based on the RUM, because it is consistent with utility maximization. The equation of estimation of the nested logit is depicts in the Model 2 below. In this equation, we estimate the probability to choose Auvergne PDO cheeses and other PDO cheeses from other regions compared to non-PDO cheeses.

Model 2: nested logit equation

$$Choice_{Nested(nit)} = \alpha_i + \beta_{price} Price + \beta_{nit} X + \beta_{nit} Z + \epsilon_{nit}$$

Where *Choice_{Nested}* represents the dummy variable of indirect utility. *Price* represents the price of the chosen cheese, which is assumed to be a fixed parameter in all of our models. X^{48} represents a vector of household variables. Z^{49} represents a vector of product variables and ϵ are error terms which are independent and identically distributed (*iid*). To estimate the two models, we use the software Stata 13. Results are presented in the next section.

6.6. Results and discussion

6.6.1. Mixed logit estimations

Table 21 below represents results of mixed logit (Let us recall that our mixed logit is only based on the data of purchases of 5 Auvergne PDO cheeses). For the market distribution variables like “*Supermarket*”, “*Hypermarket*”, “*Hard-discount*” and “*Creamer*”, the benchmark is “*Other market*”. While, for employment variables like “*CDI*” and “*CDD*”, the

⁴⁸ **X**: income, age, nberind, CDI, CDD, gender, Single, Couple, Primary_Educ, Secondary_Educ, Superior_Educ,

⁴⁹ **Z**: Supermarket, Hypermarket, Hard discount, Creamer, MDD, sale_promo, Mat_Grasse, Auvergne

benchmark is “*Without activity*”. Then, for education variables like “*Primary education*”, “*Secondary education*” and “*Superior education*”, the benchmark is “*No education*”. Finally, for family variables like “*Couple*” and “*Single*”, the benchmark is “*Big family*”.

The coefficient of price is specified to be fixed. Ruud (1996) and Train (2000) explain that the mixed logit model tends to be unstable when all coefficients vary. Fixing the price coefficient will solve this instability. In addition, if the coefficient of price is allowed to vary, the distribution of calculated WTP is often inconvenient to evaluate. With a fixed price coefficient, WTP for an attribute is distributed the same way that the coefficient of the attribute.

Results in Table 21 show that individual characteristics of consumers do not greatly influence the purchasing decisions of Auvergne PDO cheeses. Whereas attributes of products are those on which the consumer bases its behaviour. These results are in line with those of Scarpa and Del Giudice (2004); Van der Lans, Van Ittersum et al. (2001) for the case of extra virgin olive oil GI. Therefore, we interpret only variables of products.

Results show that the “store brand” (*MDD*) on the PDO ‘Cantal’ and PDO ‘Salers’ reduce the WTP of consumers on average of -0.268 €/kg⁵⁰ and -1.127€/kg respectively. So, ‘Cantal’ and ‘Salers’ cheeses sold without store brands are more attractive for consumers. While, for the PDO ‘St Nectaire’, the PDO ‘Bleu Auvergne’ and the PDO ‘Fourme Ambert’ the presence of store brand (*MDD*) on these cheeses during the purchasing increases the WTP of consumers on average of +0.993 €/kg, +0.840 €/kg and +0.638 €/kg respectively. This implies that, these cheeses are better valued in the eyes of consumers when it is sold with a distribution mark affixed to it compared to those sold without a distribution mark. Thus, it would be interesting to increase the presence of distribution marks affixed to these cheeses on the market in order to increase the WTP of consumers for this cheese.

The sale of Auvergne PDO cheeses in a “supermarket” (*Supermarket*) decrease the WTP of consumers on average of -1.561 €/kg and -3.261 €/kg for the PDO ‘St Nectaire’ and the PDO ‘Salers’ respectively. These cheeses must instead rely on traditional retailers to be better valued and attract more consumers. While, the sale of Auvergne PDO cheeses in a

⁵⁰ See the calculated WTP in table 22

“supermarket” increases the WTP of consumers on average of +0.810 €/kg and +0.741 €/kg for the PDO ‘Bleu Auvergne’ and the PDO ‘Fourme Ambert’ respectively. These results imply that these cheeses are highly valued when it is sold in large distributions shops compared to other traditional retailers.

The sale of Auvergne PDO cheeses in a “hypermarket” (*Hypermarket*) decrease also the WTP of consumers on average of -1.442 €/kg and -1.904 €/kg for the PDO ‘St Nectaire’ and the PDO ‘Salers’ respectively. These results, such as those found on ‘supermarkets’, show that, on average, large-scale distribution is not a productive distribution channel for these cheeses. While, the sale of Auvergne PDO cheeses in a “hypermarket” increases the WTP of consumers on average of +0.513 €/kg and 0.588 €/kg for the PDO ‘Bleu Auvergne’ and the PDO ‘Fourme Ambert’ respectively. These results imply that these cheeses are highly valued when it is sold in large distributions shops compared to other traditional retailers.

The sale of Auvergne PDO cheeses in a “creamer” (*Creamer*) decrease the WTP of consumers on average of -0.574 €/kg compared to whether it was sold in another traditional distribution channel. Coefficients are not significant for other Auvergne PDO cheeses. It shows that the fact of buying at the creamer does not influence purchases, given that purchases in dairy shops represent only 3.76% (*see Chapter 4*).

The distribution of “percentage of fat content” (*Mat_Grasse*) for the PDO ‘Cantal’ is normally distributed with a mean of -0.139, and standard deviation of 0.004. With the estimated parameters, 99%⁵¹ of the distribution is less than 0. This implies that all consumers in the sample prefer the PDO ‘Cantal’ with little fat content, because the cheese is considered as cheese with hard paste. To add the fat to this cheese will lower its quality. The presence of fat content in the ‘Cantal’ cheese decreases the WTP on average of -0.175 €/kg for all consumers. Similarly, the distribution of “percentage of fat content” (*Mat_Grasse*) for the PDO ‘Salers’ is normally distributed with a mean of -0.468 and a standard deviation of 0.027. With the estimated parameters, 99% of the distribution is less than 0. So, for consumers the presence of fat content in this cheese decreases the WTP on average of -0.580 €/kg. It should

⁵¹ These figures are given by $100 \times \Phi\left(\frac{-b_k}{s_k}\right)$ where Φ is the cumulative standard normal distribution and b_k and s_k are the mean and standard deviation, respectively, of the k^{th} coefficient

be noted that, as the “Cantal” cheese, the “Salers” cheese is considered as cheese with hard paste. To add the fat to this cheese will decrease its quality.

But, in the other hand, the distribution of “percentage of fat content” (*Mat_Grasse*) for the PDO ‘St Nectaire’ is normally distributed with a mean of 0.134 and a standard deviation of 0.004. With the estimated parameters, 99% of the distribution is greater than 0. So, for almost all consumers the fat content of this cheese increase the WTP of consumers on average of +0.143 €/kg. This result can be explained by the fact that this cheese is considered as a cheese with soft paste. Increase fat will make the product even more attractive. In the same way, the distribution of “percentage of fat content” (*Mat_Grasse*) for the PDO ‘Bleu Auvergne’ is normally distributed with a mean of 0.859 and a standard deviation of 0.004. With the estimated parameters, 99% of the distribution is greater than 0. Thus, for consumers the fat content of this cheese increase their WTP on average of +1.029 €/kg. Similarly, the distribution of “percentage of fat content” (*Mat_Grasse*) for the PDO ‘Fourme Ambert’ is normally distributed with a mean of 0.917 and a standard deviation of 0.004. With the estimated parameters, 99% of the distribution is greater than 0. So, for the consumers the presence of fat content in this cheese increase the WTP on average of +1.130 €/kg. So, the blue PDO cheeses are cheeses with very typical taste and need a little of innovation, to increase the percentage of fat will allow to be at the same level as industrial blue cheeses more creamy. This will allow to attract young consumers.

The “advertising or promotion” (*sale_promo*) increases the WTP of the PDO ‘Cantal’, the PDO ‘Bleu Auvergne’ and the PDO ‘Fourme Ambert’ on average of +2.341 €/kg, +0.696 €/kg and +0.879 €/kg respectively. These results are very interesting; it shows that advertising impact largely the perception of consumers to the product and encourages them to put an extra premium to acquire it. The coefficient is higher for the PDO ‘Cantal’ because the professionals of sector have invested a lot for the promotion of this product since the 2009s.

The “region” where the product is sold (*Auvergne*) increases the WTP of Auvergne PDO cheeses if this latter is sold in Auvergne on average of +0.783 €/kg, +0.822 €/kg, +0.642 €/kg, 0.586 €/kg, +0.914 €/kg for the PDO ‘Cantal’, the PDO ‘St Nectaire’, the PDO ‘Bleu Auvergne’, the PDO ‘Fourme Ambert’ and the PDO ‘Salers’ respectively, compared to if it is sold elsewhere in France. This result shows that the ‘Cantal’ cheese which is the largest Appellation of Auvergne has a high premium when it is sold in its production region compared

if it is sold elsewhere in France. For the PDO ‘Salers’ for example, professionals must maximize sales in Auvergne, because this Appellation is little known to consumers. Overall, professionals of Auvergne PDO cheeses must concentrate a large part of its sales of Auvergne PDO cheeses in its region of origin.

Table 21: Mixed logit estimation for the Auvergne PDO cheeses

VARIABLES	MXL	MXL	MXL	MXL	MXL
	Prob(Cantal)	Prob(St Neactaire)	Prob(Bleu Auvergne)	Prob(Fourme Ambert)	Prob(Salers)
	[1]	[2]	[3]	[4]	[5]
Product Variables					
Price	-0.793*** (0.005)	-0.934*** (0.008)	-0.834*** (0.006)	-0.811 *** (0.005)	-0.806*** (0.005)
MDD (mean)	-0.213* (0.115)	0.928* (0.214)	0.701*** (0.113)	0.518*** (0.119)	-0.909** (0.854)
MDD (SD)	0.003 (0.118)	0.466 (0.286)	0.466 (0.286)	0.013 (0.107)	0.266 (0.137)
Supermarket (mean)	-0.089 (0.201)	-1.458*** (0.240)	0.676*** (0.230)	0.601** (0.234)	-2.629*** (0.468)
Supermarket (SD)	0.045 (0.110)	0.160 (0.188)	0.001 (0.094)	0.003 (0.099)	0.091 (0.349)
Hypermarket (mean)	-0.033 (0.198)	-1.347*** (0.237)	0.428*** (0.231)	0.477** (0.233)	-1.535*** (0.459)
Hypermarket (SD)	0.058 (0.098)	0.647*** (0.158)	0.005 (0.133)	0.026 (0.108)	0.114 (0.246)
Hard_discount (mean)	-0.797 (0.512)	-0.238 (0.866)	0.857 (0.587)	-0.249 (0.980)	0.688 (0.401)
Hard_discount (SD)	0.003 (0.204)	0.284 (0.335)	0.008 (0.158)	0.003 (0.167)	0.190 (0.019)
Creamer (mean)	-0.095 (0.206)	-0.537*** (0.231)	0.092 (0.244)	-0.737 (0.241)	0.009 (0.452)
Creamer (SD)	0.704*** (0.133)	1.109*** (0.212)	0.228 (0.214)	0.041 (0.260)	0.443* (0.262)
Mat_Grasse (mean)	-0.139*** (0.007)	0.134*** (0.010)	0.859*** (0.006)	0.917*** (0.006)	-0.468*** (0.027)
Mat_Grasse (SD)	0.004*** (0.001)	0.004** (0.002)	0.004** (0.001)	0.004*** (0.001)	0.002 (0.002)
sale_promo (mean)	1.857*** (0.203)	-1.841*** (0.036)	0.581*** (0.188)	0.713*** (0.179)	-3.084** (0.795)
sale_promo (SD)	0.012 (0.228)	0.032 (0.169)	0.026 (0.202)	0.010 (0.176)	0.736 (0.951)
Auvergne (mean)	0.621*** (0.130)	0.768*** (0.209)	0.536*** (0.127)	0.476*** (0.129)	0.737** (0.331)
Auvergne (SD)	0.788*** (0.157)	2.236*** (0.166)	0.367*** (0.144)	0.334*** (0.171)	0.110 (0.352)
Households Variables					
CDI (mean)	0.060 (0.108)	-0.305 (0.195)	0.113 (0.126)	-0.174 (0.128)	-0.110 (0.284)
CDI (SD)	0.052	0.075	0.050	0.114	0.034

	(0.100)	(0.208)	(0.151)	(0.133)	(0.241)
CDD (mean)	-0.090 (0.179)	-0.491 (0.286)	0.250 (0.205)	-0.031 (0.207)	0.484 (0.446)
CDD (SD)	0.052 (0.222)	0.127 (0.769)	0.331 (0.206)	0.036 (0.253)	0.143 (0.550)
Primary_Educ (mean)	0.122 (0.271)	-1.061** (0.532)	0.531 (0.339)	-0.087 (0.322)	1.383 (0.984)
Primary_Educ (SD)	0.030 (0.193)	0.343 (0.307)	0.438*** (0.162)	0.096 (0.217)	0.448 (0.470)
Secondary_Educ (mean)	0.101 (0.242)	-1.231*** (0.518)	0.354 (0.307)	0.129 (0.291)	0.190 (0.629)
Secondary_Educ (SD)	0.050 (0.093)	0.148 (0.191)	0.018 (0.145)	0.005 (0.102)	0.079 (0.195)
Superior_Educ (mean)	-0.114 (0.255)	-1.014** (0.490)	-0.401 (0.320)	-0.051 (0.306)	-0.377 (0.651)
Superior_Educ (SD)	0.039 (0.120)	0.214 (0.248)	0.111 (0.131)	0.007 (0.135)	0.170 (0.280)
Couple (mean)	0.080 (0.169)	-0.142 (0.261)	0.133 (0.189)	-0.082 (0.189)	-0.067 (0.444)
Couple (SD)	0.010 (0.114)	0.049 (0.156)	0.045 (0.120)	0.032 (0.120)	0.050 (0.271)
Single (mean)	-0.087 (0.268)	-0.365 (0.517)	0.201 (0.279)	-0.153 (0.298)	0.414 (0.644)
Single (SD)	0.024 (0.157)	0.124 (0.241)	0.022 (0.144)	0.009 (0.153)	0.111 (0.333)
Gender (mean)	0.023 (0.191)	-0.166 (0.173)	0.114 (0.211)	-0.047 (0.217)	1.53 (0.366)
Gender (SD)	0.208 (0.087)	0.133 (0.126)	0.025 (0.103)	0.075 (0.095)	0.027 (0.207)
Lincome (mean)	-0.260** (0.101)	0.048 (0.154)	-0.049 (0.112)	-0.018 (0.111)	0.484* (0.278)
Lincome (SD)	0.001 (0.009)	0.097*** (0.015)	0.007 (0.010)	0.010 (0.009)	0.016 (0.021)
Age (mean)	-0.001 (0.004)	-0.008 (0.006)	-0.004 (0.004)	-0.008* (0.004)	0.019* (0.117)
Age (SD)	0.002* (0.001)	0.008*** (0.002)	0.001 (0.001)	0.001 (0.001)	0.003 (0.003)
Nberind (mean)	0.154** (0.071)	-0.206** (0.105)	0.049 (0.075)	-0.050 (0.084)	0.202 (0.342)
Nberind (SD)	0.020 (0.038)	0.045 (0.046)	0.013 (0.032)	0.003 (0.033)	0.041 (0.215)
Constant	11.425*** (1.050)	2.305*** (1.862)	8.277*** (2.795)	6.634*** (2.260)	22.222*** (2.775)
Observations	324035	324035	324035	324035	324035
Log likelihood	-7250.26***	-5373.46***	-5887.80**	-7666.15**	-8090.19**

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

6.6.2. Average willingness to pay

The table 22 below shows the calculated WTP for attributes of cheeses. We approximate the WTP of each Auvergne PDO cheese by summing the WTP of attributes by cheese. We make this summation because we start from the fact that the price of a product depends on the price of each attribute that makes it [Rosen \(1974\)](#). Thus, the total price is equal to the sum of the price of all attributes. By deduction, we also assume that the WTP (which is a price premium) of a product depends on the WTP of each attribute of this product, so the total WTP will be equal to the sum of the WTP of the attributes. Unfortunately we do not have all attributes that composes a price of each product; nevertheless we use attributes drawn from our database. We find that the mean WTP of “Cantal”, “St Nectaire”, “Bleu Auvergne”, Fourme Ambert”, “Salers” are +2.681 €/kg; -0.013 €/kg; +3.207 €/kg; +3.233 €/kg; -4.619 €/kg respectively with respect to the initial price of these products. The command written by [Hole \(2007\)](#), allows to have both a distributed WTP over an interval and an average WTP. We chose to present the average WTP as in [Bonnet and Simioni \(2001\)](#).

Table 22: Estimated average Willingness to pay for the attributes of product

Variables or attributes	Cantal in €/kg	St Nectaire in €/kg	Bleu Auvergne in €/kg	Fourme Ambert in €/kg	Salers in €/kg
MDD	-0.268*	0.993*	0.840*	0.638*	-1.127*
Mat_Grasse	-0.175*	0.143*	1.029*	1.130*	-0.580*
sale_promo	2.341*	-1.971*	0.696*	0.879*	-3.826*
Auvergne	0.783*	0.822*	0.642*	0.586*	0.914*
Total	+2.681 €/kg	-0.013€/kg	+3.207 €/kg	+3.233 €/kg	-4.619 €/kg

Note: In bold starry the significant WTP

Table 23 below allows us to better understand these results found in the table 22 above. This table 23 shows that the “St Nectaire” and the “Salers” are the two cheeses with expensive price at the factory level and consumer’s level. Over the period 2008-2010, the average price of “Salers” was 10.1 €/kg at the factory level, while the average price at consumers was 17.423 €/kg. The average WTP of consumers is -4.619 €/kg, which shows that consumers want to pay the “Salers” at an average price of around 12.804 €/kg.

Table 23: comparaison

Variables	Average⁵² price at the factory level in €/kg	Average PRICE at consumers level in €/kg	Average WTP in €/kg	Expected average PRICE in €/kg
CANTAL	6.7	9.627	+2.681	12.308
SAINT NECTAIRE	8.2	12.235	-0.013	12.222
BLEU AUVERGNE	5.8	9.009	+3.207	12.216
FOURME AMBERT	5.7	9.435	+3.233	12.668
SALERS	10.1	17.423	-4.619	12.804

For the “St Nectaire”, table 23 above shows that, over the period 2008-2010 the average price at factory level was 8.2 €/kg, while the average price at consumers level was 12.235 €/kg. The average WTP of consumers is -0.013 €/kg, which shows that consumers want to pay the “St Nectaire” at an average price about 12.222 €/kg.

For the “Cantal” cheese, the average price at factory level was 6.7 €/kg, while the average price at consumers level was 9.627 €/kg. The average WTP of consumers is +2.681 €/kg, which shows that consumers want to pay the “Cantal” at an average price of around 12.308 €/kg.

Finally, for the two blue cheeses “Bleu Auvergne” and “Fourme Ambert” the average price at factory level was 5.8 €/kg and 5.7 €/kg respectively, while the average price at consumers level was 9.009 €/kg and 9.435 €/kg respectively. The average WTP of consumers is +3.207 €/kg for “Bleu Auvergne” and +3.233 €/kg for “Fourme Ambert”, which shows that consumers want to pay the “Bleu Auvergne” and “Fourme Ambert” at an average price of around 12.216 €/kg and 12.668 €/kg respectively.

The results of this table 23 suggest that there is an expected price by consumers of PDO cheeses from Auvergne, which is about 12 €/kg.

⁵² Data come from France Agrimer

6.6.3. *Nested logit estimation*

We add in our sample of Auvergne PDO cheeses other data of other PDO cheeses from other regions of France namely “Comte”, “Roquefort”, “Reblochon” and non-PDO cheeses like “Camembert”, “Coulommiers” and “Other Blue Cheese”. This allows us to compare Auvergne PDO cheeses with other PDO cheeses compared to non-PDO cheeses. The adding of these data makes that the number of observations increases of 1,743,896 observations. Non-PDO cheeses are our base of comparison (or benchmark); therefore we fix the variable “non-PDO cheeses” which becomes our alternative of comparison. Table 24 below shows results.

As in the mixed logit estimation above, we found that characteristics of product influences more decisions of consumers compared to individual characteristics. Column 1 shows results of Auvergne PDO cheeses and column 2 shows results of other PDO cheeses, the reference being no-PDO cheeses.

PDO Auvergne cheeses

- For Auvergne PDO cheeses, we find that on average the sale of Auvergne cheeses in Large and medium distributions channel such as “hypermarket”s, “supermarkets” and “hard discount” decrease the likelihood of choosing these cheeses compared to non-PDO cheeses. So, PDO cheeses from Auvergne are better valued in other traditionnels shops, compared to non-PDO cheeses.
- The “promotion or advertising” (sale_promo) on Auvergne PDO cheeses decreases their likelihood of choice compared to non-PDO cheeses. This suggests that these cheeses should review their marketing strategy to better compete non-PDO cheeses. Because the PDOlabel as the only signal of quality is not enough, it is also necessary to make itself known by making targeted advertising. Knowing that among the Auvergne PDO cheeses, only the PDO ‘Cantal’ has really invested in various advertising.

- We also find that the sale of Auvergne PDO cheeses in the Auvergne “region” (Auvergne) increases their likelihood of choice compared to non-PDO cheeses and other PDO cheeses from other regions.
- Finally, we find that the increase of “fat content” (Mat_Grasse) in Auvergne PDO cheeses will increase on average their probability of being purchased compared to non-PDO cheeses.

PDO cheeses from other regions

- For PDO cheeses from other regions, we find that, the “store brand” (MDD) increases the likelihood of choice of these cheeses compared to non-PDO cheeses. Therefore, on average, PDO cheeses from other regions are better sold with store brands compared to non-PDO cheeses and Auvergne PDO cheeses.
- The sale of PDO cheeses from other regions in large and medium distribution channel such as “hypermarkets”, “supermarkets” and “hard-discount” increase the likelihood of choosing these cheeses compared to non-PDO cheeses. So, PDO cheeses from other regions are better valued in large distribution shops, compared to non-PDO cheeses.
- As the Auvergne PDO cheeses, PDO cheeses from other regions should review and invest more in the marketing strategy (sale_promo) in order to better compete with non-PDO cheeses. Because their current “promotion” decreases the probability of purchase. This shows that globally, the geographical indication alone as a sign of quality alone is not enough, it is necessary to add the advertising signal.

Table 24: Nested model estimation

VARIABLES	NL	NL
	Prob(PDO Auvergne Cheeses)	Prob(Other PDO cheeses)
	[1]	[2]
Product Variables		
Price (<i>fixed</i>)	-2.020*** (0.057)	-2.020*** (0.057)
Supermarket	-6.632*** (1.325)	4.548*** (1.544)
Hypermarket	-7.506*** (1.320)	4.832*** (1.548)
Creamer	4.146*** (1.367)	4.595*** (1.621)
Hard_discount	-8.218*** (1.345)	2.660* (1.584)
MDD	-1.310*** (0.284)	0.727*** (0.184)
Sale_promo	-4.022*** (0.327)	-0.207*** (0.197)
Mat_Grasse	0.204*** (0.015)	-0.022 (0.010)
Auvergne	3.322*** (0.533)	0.651 (0.623)
Households Variables		
CDI	-0.378 (0.290)	0.543*** (0.210)
CDD	0.473 (0.467)	-0.589* (0.349)
Couple	0.175 (0.389)	-0.383 (0.282)
Single	0.140 (0.563)	0.028 (0.453)
Gender	0.302 (0.452)	0.928** (0.387)
lincome	-0.376** (0.194)	0.277 (0.179)
age	-0.003 (0.010)	-0.031*** (0.008)
Nberind	-0.288** (0.145)	-0.122 (0.107)
Observations	1,743,896	

Log likelihood	-3851.50***
Likelihood Ratio Statistic	1458.02***
Number of cases	158,536
Number of Alternatives	11
Wald test	1344.51***
$\tau_{\text{PDO_Auvergne}}$ (dissimilarity parameters)	2.475
$\tau_{\text{Other_PDO}}$ (dissimilarity parameters)	2.410
$\tau_{\text{non_PDO}}$ (dissimilarity parameters)	1.320
Utility (PDO Auvergne)	0.404
Utility (Other PDO)	0.414
Utility (non-PDO)	0.757

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

We measure the utility of consumers as being the inverse of dissimilarity parameters (Heiss, 2000). Thus, the utility of consumers for Auvergne PDO cheeses is 0.404, while the utility of consumers for PDO cheeses from other regions is 0.414; finally the utility of consumers for non-PDO cheeses is 0.757. These utilities show that, consumers prefer in first choice non-PDO cheeses, then PDO cheeses from other regions, and finally Auvergne PDO cheeses. So, we have $U_{\text{nonPDO}} > U_{\text{otherPDO}} > U_{\text{AuvergnePDO}}$. This can probably be explained by the fact that non-PDO cheeses are more numerous and sometimes less expensive on the market than PDO cheeses in general.

6.7. Conclusion

This chapter aimed to estimate preferences of choice and willingness to pay of French consumers for Auvergne PDO cheeses. To do this, we used a mixed logit based on random utility model (RUM). We found that attributes of the product influence more purchases of products compared to individual characteristics of consumers. Moreover, among Auvergne PDO cheeses, the consumer's willingness to pay is on average -0.013€/kg and -4.619 €/kg for PDO "St Nectaire" and PDO "Salers" respectively, with respect of their initial price. While, they willing to pay on average +3.207 €/kg, +3.233€/kg and +2.681 €/kg for the PDO "Bleu Auvergne", the PDO "Fourme Ambert" and the PDO "Cantal" respectively, with respect to their initial price. In addition, it seems that there is a unique price expected for Auvergne PDO cheeses which is around 12 €/kg. Because, there is a large margin between the factory price and the final consumer price, this margin is generally captured by large and medium distributions channel. This may lead to substitution of these products by other similar products relatively less expensive. So it will be interesting that producers of cheeses and the large and medium distribution agree on an equilibrium price that maximizes the quantities, which will allow the whole sector to win.

Then we choose to add in our sample others PDO cheeses from other regions namely "Comte", "Roquefort", "Reblochon" and non-PDO cheeses like "Camembert", "Coulommier" and "Other Blue cheese" in order to compare Auvergne PDO cheeses with others PDO cheeses with respect to non-PDO cheeses. We found that Auvergne PDO cheeses are better sold in their region of origin than non-PDO cheeses and others PDO cheeses from other regions. We also found that non-PDO cheeses have a better promotion than PDO products generally, perhaps because there are more financial means in the non-PDO sectors which are generally industrial. So it would be important for PDO products to invest in the advertising signal because the PDO signal alone is not enough, there is the competition from other non-PDO products that signal the quality through advertising and thus incites consumers to buy. The innovation is also a way of distinguishing better for some of these PDO cheeses.

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Appendix

Appendix A: definition of variables

Variables	Defintion	unit
Choice (nested regression)	Dummy variable of choice	
Choice (mixed regression)	Dummy variable which takes 1 if the purchaser choose one of Auvergne PDO cheese between Auvergne PDO cheeses	
Price	The price of cheese	
CDI	Dummy which takes 1 if the purchaser has permanent contract and 0 otherwise	in euro/kg
CDD	Dummy which takes 1 if the purchaser has fixed-term contract and 0 otherwise	
Without activity	Dummy which takes 1 if the purchaser has not job and 0 otherwise	
Primary_Educ	Dummy which takes 1 if the purchaser has a primary level and 0 otherwise	
Secondary_Educ	Dummy which takes 1 if the purchaser has a secondary level and 0 otherwise	
Superior_Educ	Dummy which takes 1 if the purchaser has a university level and 0 otherwise	
NoEducation	Dummy which takes 1 if the purchaser's is not educated and 0 otherwise	
Single	Dummy which takes 1 if the household is constituted of 1 individual and 0 otherwise	
Couple	Dummy which takes 1 if the household is a couple of 2 individuals and 0 otherwise	
Big_family	Dummy which takes 1 if the household has many individuals and 0 otherwise	
age	the Age of individual which purchase	
income	the income of household which purchase	in Euros
gender	Dummy which takes 1 if the purchaser's is a women and 0 otherwise	
nberind	the number of individual in a household	
Auvergne	Dummy which takes 1 if the product is sale in the Auvergne region and 0 otherwise	
MDD	Dummy which takes 1 if the product is sale with a brand of distribution and 0 otherwise	
Supermarket	Dummy which takes 1 if the product is sale in a supermarket and 0 otherwise	
Hypermarket	Dummy which takes 1 if the product is sale in a hypermarket and 0 otherwise	
Creamer	Dummy which takes 1 if the product is sale in a creamer and 0 otherwise	
Hard_Discount	Dummy which takes 1 if the product is sale in an hard discount and 0 otherwise	
OtherMarket	Dummy which takes 1 if the product is sale in other sales circuit or other distribution channel	
Mat_Grasse	The percentage of fat content of the product	in %
sale_promo	adverting Dummy which takes 1 if the product is sale with a promotion and 0 otherwise	

Appendix B: Purchase center of Auvergne PDO cheeses on the period 2008-2010

Purchase Center	Freq.	Percent	Cum.
Center 1	8,082	13.89	21.16
Center 2	8,334	14.32	35.48
Center 3	5,653	9.71	45.19
Center 4	9,645	16.57	61.76
Center 5	5	0.01	61.77
Center 6	1,154	1.98	63.75
Center 7	2,92	5.02	68.77
Center 8	4,199	7.21	75.99
Center 9	31	0.05	76.04
Center 10	2,816	4.84	80.88
Center 11	127	0.22	81.10
Center 12	1,639	2.82	83.91
Center 13	411	0.71	84.62
Center 14	5	0.01	84.63
Center 15	2,016	3.46	88.09
Center 16	3,401	5.84	93.93
Center 17	2,167	3.72	97.66
Center 18	92	0.16	97.82
Center 19	19	0.03	97.85
Center 20	549	0.94	98.79
Center 21	1	0.00	98.79
Center 22	702	1.21	100.00
Center 23	4,231	7.27	7.27
Total	58,199	100.00	

Appendix C: Correlation Matrix

	price	CDI	CDD	Primary	Seconda	Superior	Single	Couple	age	income	gender	nberind	Auvergne	MDD	Supermar	Hyperma	Creamer	Hard_disc	Mat_Grass	sale_pr
price	1.0000																			
CDI	-0.0316	1.0000																		
CDD	-0.0185	-0.2161	1.0000																	
Without Activity	0.0404	-0.8597	-0.3129																	
Primary_Educ	-0.0373	-0.1775	-0.0179	1.0000																
Secondary_Educ	-0.0666	-0.0961	0.0136	-0.3765	1.0000															
Superior_Educ	0.0905	0.2359	0.0016	-0.2254	-0.7799	1.0000														
Single	0.0551	-0.0167	-0.0567	-0.0168	-0.0612	0.0894	1.0000													
Married	0.0120	-0.1671	-0.0577	0.1251	0.0075	-0.1041	-0.4978	1.0000												
age	0.1036	-0.5417	-0.1318	0.1746	0.0969	-0.2260	0.1835	0.3340	1.0000											
income	0.1128	0.1529	-0.0301	-0.1921	-0.1858	0.3312	-0.3225	0.0686	-0.1609	1.0000										
gender	-0.0332	-0.0814	0.0294	0.0542	0.0696	-0.1155	-0.5173	0.2466	-0.0045	0.1111	1.0000									
nberind	-0.0786	0.1334	0.1031	-0.0681	0.0442	-0.0097	-0.6217	-0.2194	-0.4251	0.3082	0.3383	1.0000								
Auvergne	0.0941	0.0073	-0.0101	0.0223	-0.0017	-0.0097	-0.0212	-0.0068	-0.0111	-0.0424	0.0167	0.0171	1.0000							
MDD	-0.1866	0.0229	0.0011	0.0065	-0.0299	0.0263	0.0029	-0.0123	-0.0708	-0.0124	-0.0138	0.0115	-0.1284	1.0000						
Supermarket	0.0213	-0.0121	0.0156	0.0029	0.0178	-0.0182	0.0146	-0.0135	0.0225	-0.0549	0.0226	-0.0032	-0.0752	0.1083	1.0000					
Hypermarket	0.0734	0.0239	-0.0018	-0.0193	-0.0283	0.0364	-0.0599	0.0202	-0.0596	0.0853	0.0135	0.0460	0.0621	0.0080	-0.5418	1.0000				
Creamer	0.2923	-0.0482	-0.0239	-0.0187	-0.0070	0.0224	0.0802	-0.0015	0.1153	0.0294	-0.0465	-0.0920	0.0835	-0.1388	-0.2309	-0.2661	1.0000			
Hard_discount	-0.3396	0.0220	0.0025	0.0343	0.0193	-0.0404	-0.0049	-0.0082	-0.0424	-0.0627	-0.0082	0.0181	-0.0512	-0.0314	-0.3358	-0.3870	-0.1649	1.0000		
Mat_Grass	0.0341	-0.0415	0.0084	0.0182	0.0201	-0.0395	-0.0135	0.0337	0.0743	0.0014	0.0175	-0.0081	0.1047	-0.1799	-0.0178	0.0153	0.0704	-0.0518	1.0000	
sale_promo	-0.1771	0.0477	0.0029	-0.0125	0.0076	0.0036	-0.0204	-0.0109	-0.0755	-0.0201	-0.0022	0.0254	-0.0841	0.3300	0.0682	0.0189	-0.1012	-0.0259	-0.1490	1.0000

Appendix D: Acts of purchase of Auvergne PDO cheeses on the period 2008-2010

French department of purchase	Acts of purchase of Auvergne PDO cheeses
PUY DE DOME	3706
LOIRE	2109
VILLE DE PARIS	2021
HERAULT	1722
BOUCHES DU RHONE	1471
HAUTE GARONNE	1350
RHONE	1300
ESSONNE	1271
VAL DE MARNE	1259
CORREZE	1259
HAUT DE SEINE	1213
NORD	1206
SEINE SAINT DENIS	1118
SEINE ET MARNE	1157
ALLIER	910
CANTAL	654
HAUTE LOIRE	426
Others	34047
Total	58199

Conclusion Générale

Les récents scandales alimentaires qu'a connus le monde comme celui des œufs contaminés survenu en France en 2017 ont remis en lumière l'importance des indications géographiques comme label de qualité permettant de signaler l'origine et la démarche de production des aliments que nous consommons. Ces indications géographiques (IG) ont initialement été implantées dans les pays européens, la France étant le précurseur dans ce domaine. Ce système de labellisation a plus tard été étendu au niveau mondial étant donné l'Accord sur les aspects des Droits de Propriété Intellectuelle qui sont liés au Commerce (ADPIC). L'Accord a été mis en place par l'Organisation Mondiale du Commerce (OMC) en 1994 (Belletti, Brazzini et al. 2014). Il prévoyait entre autres un ensemble formel de règles communes avec de multiples aspects liés à la qualité et à l'origine. Mais la répartition de l'excédent créée par la mise en place des IG reste influencée par la dynamique du marché, mais aussi par les différents acteurs du système. Chaque acteur fixant son prix sans tenir compte des autres, ce qui entraîne un bénéfice lié au prix du produit final inégalement réparti entre les acteurs des filières. Conséquence, il arrive parfois que les consommateurs trouvent ces produits coûteux, car le prix n'étant pas fixé par la rencontre de l'offre et de la demande, mais plutôt par le pouvoir de marché de la grande distribution, conduisant ainsi les consommateurs vers des produits génériques.

Cette thèse de doctorat en économie appliquée est une contribution à la littérature relative à l'économie de l'information dont les solutions trouvent leur origine dans l'économie industrielle et par ailleurs un approfondissement de l'analyse des déterminants du consentement à payer pour les produits sous indications géographiques. L'objet d'étude est ici les fromages AOP d'Auvergne. Pour ce faire, trois objectifs sont poursuivis. Le premier étant de connaître ce que les études empiriques nous disent sur l'évaluation de ce consentement à payer. Le second étant d'évaluer les déterminants de la dispersion des prix des produits sous IG. Enfin, le troisième objectif quantifie le consentement à payer des consommateurs pour les produits portant ce type de label d'origine et propose un prix d'équilibre des produits permettant une répartition de la valeur ajoutée dans la filière auvergnate.

Afin d'atteindre ces objectifs, cinq hypothèses ont été posées.

Hypothèse 1 : les fromages AOP d’Auvergne sont consommés par toutes les catégories de consommateurs. Mais les attributs du produit influencent plus les décisions d’achats par rapport aux caractéristiques propres aux consommateurs [Scarpa and Del Giudice \(2004\)](#) ; [Van der Lans, Van Ittersum et al. \(2001\)](#).

Hypothèse 2 : les producteurs des fromages AOP d’Auvergne ont des difficultés, car ils s’adressent à un marché dont ils n’ont pas l’œil critique (consommateurs très hétérogènes). Les produits étant traditionnels et patrimoniaux ([Benhamou, 2015](#)), ils ne correspondent pas aux attentes des consommateurs, et du coup sont confrontés à un monde qui veut de l’innovation.

Hypothèse 3 : certains producteurs n’utilisent pas l’AOP comme vecteur d’information, par contre d’autres utilisent seulement le signal AOP ([Laporte, 2000](#)). Mais cela reste insuffisant, car la réputation du produit et le CAP des consommateurs dépendent du signal prix et d’autres signaux comme l’AOP et la promotion.

Hypothèse 4 : les fromages AOP d’Auvergne n’arrivent pas à capter suffisamment des parts de marché ou le CAP des consommateurs, car ils n’arrivent pas à multiplier et à combiner les promotions de leur produit. Ce sont économiquement des petits fromages n’ayant pas les moyens de développer des actes promotionnels ([Ricard, 2014](#)) ; ([Menadier, 2012](#)). On pourrait penser qu’il existe un certain pouvoir de marché.

Hypothèse 5 : Selon la structure du marché (plus ou moins oligopolistique, plus ou moins concurrentiel), le surplus capté par les producteurs sera plus ou moins important, du fait du pouvoir de marché dont dispose la distribution (prix au niveau de la distribution étant parfois le double du prix au sorti d’usine). La concurrence représentant ainsi un outil de limitation de la dispersion des prix ([Gerardi and Shapiro, 2009](#)).

Ainsi, dans le **Chapitre 1** nous présentons l’objet de l’étude à savoir le marché des fromages AOP d’Auvergne. Ce marché s’insère de façon globale à celui des marchés agricoles laitiers. Ce chapitre nous apprend que les produits laitiers sont généralement des produits de consommations locales car ils sont périssables rendant l’exportation difficile dans certains cas. Il en ressort également qu’il n’existe pas de « marché des fromages AOP d’Auvergne » à proprement parler, car chaque fromage passe par des circuits différents et est fabriqué par

différents acteurs pratiquant chacun son prix. Enfin, ce chapitre nous informe que les fromages sous indications géographiques sont en moyenne plus coûteux que les fromages non-IG et cela est lié au cahier de charge des filières des produits sous IG.

Dans le **Chapitre 2** nous présentons une littérature théorique sur les problèmes d'asymétries d'information (qui découlent de l'économie de l'information) existant sur des marchés imparfaits. Il ressort de cette littérature que plusieurs études tirant leur origine dans l'économie industrielle ont suggéré des pistes permettant de résoudre ces problèmes d'asymétries d'information comme la réputation, la certification, les garanties et la publicité (Dewally and Ederington 2006). Cependant, les problèmes d'asymétries d'information demeurent, raison pour laquelle les indications géographiques ont été implémentés afin d'informer les consommateurs sur l'origine de provenance et la démarche de production des aliments qu'ils consomment, d'où la nécessité d'évaluation de l'efficacité économique de ces indications géographiques. Ce chapitre fixe et délimite le cadre théorique sur lequel nous nous inspirons pour répondre aux questions posées dans cette thèse.

Dans le **Chapitre 3**, nous effectuons une méta-analyse portant sur les produits laitiers. L'objectif étant de connaître ce que les études portant sur le consentement à payer de ces produits nous disent en termes de résultats empiriques. Il en ressort qu'en moyenne dans les études l'effet label est important dans l'esprit des consommateurs. Il en ressort également qu'en moyenne les méthodes d'évaluation du CAP dans les études influencent grandement les résultats. Enfin, les consommateurs ont en moyenne un consentement à payer faible pour les fromages par rapport aux autres produits laitiers. Ce qui laisse à se demander ce qu'il en est du CAP des fromages sous IG. Ce chapitre nous aide à avoir une idée sur les grands résultats existants dans la littérature sur l'évaluation du CAP des consommateurs pour les produits laitiers.

Le **Chapitre 4** présente la base de données Kantar WorldPanel que nous utilisons dans le cadre de cette thèse. Cette base de données regroupe les actes d'achats d'environ 20 000 ménages français depuis 1998. Nous travaillons sur la période 2008-2010 qui représente la période de réforme des filières fromagères AOP d'Auvergne. Il ressort de l'analyse de la base de données que les fromages sont plus coûteux dans la région d'Auvergne. De plus, nous

trouvons qu'il existe une certaine dispersion des prix des fromages AOP d'Auvergne et cela d'une région française à une autre. Ce chapitre nous aide à révéler et à comprendre certains faits stylisés existants.

Le **Chapitre 5** analyse les déterminants et la dispersion des prix des fromages AOP d'Auvergne. En nous basant sur les articles de [Harvey \(1976\)](#) et [Cardebat, Gergaud et al. \(2015\)](#), nous trouvons que les déterminants du prix des fromages sont majoritairement : les circuits de distributions, la région d'achat, la saison d'achat, la présence d'une marque de distribution, la méthode de conditionnement, le type de présentation et le label IG. Les indications géographiques comme l'appellation d'origine protégée (AOP) et l'indication géographique protégée (IGP) ont un impact positif et significatif sur le prix des fromages en moyenne de +2.329 €/kg par rapport aux fromages sans IG. Ensuite, nous trouvons que les agrégats expliquant la dispersion des prix des fromages AOP d'Auvergne sont : les promotions, l'inflation, la période d'hiver et la présence d'une marque de distribution apposée sur ces fromages. Enfin, les agrégats permettant une limitation de cette dispersion des prix observés sur les fromages AOP d'Auvergne sont : l'augmentation des parts de marchés, la concurrence, le nombre de présentation par fromage, les achats dans les grandes et moyennes distributions (Hypermarché, Supermarché, Hard-Discount). Ces différents constats vont dans le même sens que les hypothèses *H4* et *H5* de notre thèse.

Le **Chapitre 6** a pour ambition d'évaluer le consentement à payer des 5 fromages AOP d'Auvergne. En s'inspirant des études tels que celles de [Bonnet et Simioni \(2001\)](#) ou encore [Bergès-Sennou, Hassan, Monier & al. \(2007\)](#), nous trouvons qu'en moyenne les caractéristiques des consommateurs n'influencent pas leur décision de choix de consommation, mais plutôt les attributs des produits. Nous trouvons également que les consommateurs sont attirés par des caractéristiques intrinsèques du produit, mais également par celles liées à la distribution et ainsi sont prêts à consommer des produits qui proposent plus d'innovations. Nous trouvons ensuite que les consommateurs sont prêts à payer environ +2.681 €/kg pour l'AOP Cantal par rapport au prix de base, -0.013 €/kg pour l'AOP St Nectaire par rapport au prix de base, +3.207 €/kg pour l'AOP Bleu d'Auvergne par rapport au prix de base, +3.233 €/kg pour l'AOP Fourme d'Ambet par rapport au prix de base environ et enfin -4.619 €/kg pour l'AOP Salers par rapport au prix de base. Enfin, nous trouvons que

les fromages non-AOP sont mieux valorisés en termes de stratégies promotionnelles, par rapport aux fromages AOP en générale. Ce résultat invite ces derniers à investir dans les promotions, car l'AOP comme seul signal de qualité ne suffit plus aujourd'hui, il faut également se faire connaître et cela passe par des promotions diverses et variées. Les résultats de ce chapitre, vont dans le même sens que les hypothèses *H1*, *H2* et *H3* émises dans cette thèse de doctorat.

L'originalité de notre démarche vient du fait qu'en plus d'utiliser des méthodes d'évaluation économique du consentement à payer jamais utilisé dans le cas des 5 fromages AOP d'Auvergne. Nous analysons la dispersion des prix région par région pour des produits alimentaires sous indications géographiques, ce qui est une première. Enfin notre analyse montre que le signal IG vient de l'amont (au niveau des producteurs), il a pour objectif d'informer les consommateurs de la qualité des produits, mais n'incite pas pour autant à passer directement à l'acte d'achat. Car le consommateur se trouve en aval de la filière et est plus sensible aux diverses actes promotionnels et c'est dans ce dernier signal d'information que les produits non-IG investissent par contre afin de signaler leur qualité. Il apparaît donc nécessaire aujourd'hui que les produits sous indications géographiques investissent également dans la promotion de ce signal de qualité afin d'informer les consommateurs sur l'origine, la démarche de production et ainsi favoriser ces derniers à passer à l'acte d'achat.

Implications de politique économique

Cette thèse propose plusieurs implications. Premièrement nous montrons que les politiques économiques de labellisation et de valorisation des aliments liés à leur origine géographique et à leur méthode de production sont à l'ordre du jour. Il est important pour les professionnels du secteur des produits sous indications géographiques en général et pour ceux des AOP d'Auvergne en particulier d'améliorer la stratégie promotionnelle de leur produit de terroir, afin de faire face aux fromages sans label et aux fromages provenant d'autres pays. Améliorer la stratégie de promotion serait un atout en termes d'image et de signal de qualité pour ces indications géographiques.

Deuxièmement, les politiques industrielles de différenciation sont un atout important, permettant aux produits sous IG de mieux se distinguer. Les professionnels des produits sous indications géographiques doivent introduire de l'innovation dans leur méthode de production afin de s'adapter aux demandes des consommateurs. Par exemple pour le cas des fromages à "pâtes persillées", l'augmentation de la matière grasse rendra ces produits moins 'typés' et plus 'onctueux' les aidant ainsi à concurrencer les fromages sans label de même gamme tel que le « St Agur » par exemple. Cela permettra d'attirer une clientèle plus jeune et ainsi s'adapter aux besoins actuels des consommateurs en termes de goût du produit.

Troisièmement, il ressort de l'analyse du consentement à payer qu'il existe une certaine convergence des prix des fromages AOP d'Auvergne autour de 12 €/kg. Ce qui suggère qu'il existe un prix moyen souhaité par les consommateurs de ces fromages qui est d'environ 12 €/kg. En effet, l'implémentation des indications géographiques par les décideurs politiques a pour objectif de rendre cet outil efficace en termes de signal d'information crédible. Mais le grand écart existant entre le prix des produits au sorti d'usine et le prix au niveau du consommateur final a tendance à rendre le label inefficace. D'où l'utilité d'avoir un prix proche des attentes des consommateurs, permettant de maximiser non plus au niveau des prix, mais plutôt au niveau des quantités. Pour ce faire, il faut aussi un ajustement des politiques sectorielles afin de contrôler les dérapages de la grande distribution. Cela nécessite une implication des pouvoirs publics, car la main invisible prônée par Adam Smith ne fonctionne pas équitablement dans ce cas de figure. Nous constatons que dans ces marchés de produit de qualité d'origine, le prix d'équilibre n'est pas toujours fixé par la rencontre de l'offre et la demande.

Limites

La base de données Kantar WorldPanel que nous utilisons est représentative des ménages sur l'ensemble du territoire français. Mais, elle n'est pas réalisée dans l'optique de recueillir les données sur les fromages français en général et des fromages sous indications géographiques en particulier. Ce qui peut conduire à l'absence de certaines variables utiles relatives aux attributs des produits permettant d'avoir des résultats plus affinés sur le consentement à payer des consommateurs, mais également sur les déterminants de la dispersion des prix.

Néanmoins, cette base de données reste meilleure qu'une enquête terrain basée sur les préférences déclarées des consommateurs (où on peut rencontrer un problème de 'biais de réponse'), car elle repose sur des actes d'achats réellement effectués et sur les données scannées de ces actes d'achats.

Prolongement possibles

Il y a deux grandes pistes que nous n'avons pas explorées dans cette thèse.

Premièrement l'influence des interactions sociales dans les décisions de choix des consommateurs pour les produits sous IG. En effet, l'idée que les préférences d'un consommateur dépendent des choix d'un autre consommateur est connue depuis [Leibenstein \(1950\)](#), qui explore le désir de certains consommateurs d'être dans le «style», à la «mode» ou d'avoir «l'exclusivité». [Manski \(1993\)](#) soutient que ces effets, d'après le contexte, peuvent s'appeler «normes sociales», «influence des pairs», «effets du voisinage», «effets de la conformité», «effets d'imitation», «effets de contagion», «interactions sociales», ou «préférences interdépendantes». La littérature sur les interactions sociales dans la prise de décision des individus est de plus en plus développée. [Brock et Durlauf \(2001\)](#) et [Manski \(2000\)](#) ont étudié un ensemble de contextes dans lesquels les interactions sociales ont été avancées pour expliquer les résultats individuels et globaux. Les modèles d'interaction sociale peuvent également être compris comme les conséquences des individus sur leur emplacement dans l'espace social [Akerlof \(1997\)](#). Sachant donc que les choix d'un individu peuvent influencer les décisions d'autres individus, certaines études empiriques ont exploré les aspects de cette dépendance dans l'espace, tels que [Conley & Topa \(2002\)](#) et [Topa \(2001\)](#) qui analysent les interactions sociales en matière d'emploi, [Bayer, Hjalmarrsson & al. \(2007\)](#), [Glaeser, Sacerdote & al. \(1995\)](#) et [Sirakaya \(2006\)](#) qui estiment le rôle des interactions sociales dans le comportement criminel des individus.

Malgré tous ces développements, la littérature sur l'influence des interactions sociales dans la consommation de produits sous indications géographiques reste encore limitée. L'influence de l'effet label dans la traduction du signal d'information provenant d'un tiers en actes d'achats

reste encore peu développée. Des futurs travaux pourront tenter de combler ce vide, car nos analyses font ressortir certaines différences marquantes entre régions.

Un deuxième prolongement pourra être fait sur les pays en développement (PED). En effet, l'agriculture est un secteur important dans la majorité des PED. Les IG apparaissent comme une opportunité permettant le développement des filières agricoles et agro-alimentaires dans ces pays. De plus en plus de PED enregistrent leur produit de terroir auprès de l'UE afin de mieux valoriser et favoriser l'exportation de ces derniers. Ce type d'étude peut ainsi s'appliquer aux produits originaire de ces pays qui sont enregistrés dans l'UE, comme par exemple, le « café de Colombie » enregistré en 2007 (première IG hors UE) ; le « poivre de Penja » et le « miel d'Okou » au Cameroun ; ou encore le « café Ziama » en Guinée, tous trois étant les premières IG d'Afrique Subsaharienne enregistrées en 2013 auprès de l'UE. Il serait intéressant d'évaluer le consentement à payer de ces nouvelles IG afin de connaître l'appréciation des consommateurs pour ces produits.

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