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# Analysis of price transmission in the wheat sector

## Does a sophisticated border protection policy improve the protection performance? The case of wheat market in Switzerland

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## Zusammenfassung

Die im Auftrag des Bundesamts für Landwirtschaft (BLW) durchgeführte Studie untersucht für Weichweizen die horizontale Preistransmission von den internationalen Märkten (Amerika und Europa) zum inländischen (Schweiz) Markt. Weizen ist ein typischer Agrarrohstoff, gut lagerbar und mit einer limitierten Qualitätsdifferenzierung, für den die grundlegenden Mecha-nismen der Preistransmission erforscht werden können. Im internationalen Kontext kann die Schweiz als kleines Nettoimportland bezeichnet werden, dessen inländischer Markt nicht gross genug ist, um internationale Marktauswirkungen zu haben. Es ist aber zu erwarten, dass inländische Marktänderungen durch den internationalen Markt beeinflusst sind. Der Schwei-zer Weizenmarkt stellt daher einen idealen Untersuchungsgegenstand für eine Preistransmis-sionsanalyse dar, deren Zielsetzung es ist, zu verstehen und zu messen in welchem Ausmass der inländische Preis auf internationale Preisausschläge reagiert.

Diese Art von Analysen, stellen eine umso grössere Herausforderung dar, wenn Grenz-schutzmassnahmen bestehen, die den inländischen Markt vor internationalen Marktpreis-schwankungen schützen sollen. Auf der einen Seite sind Preistransmissions-Analysen im Um-feld dieser politischen Rahmenbedingungen aus methodologischer Sicht schwierig, bieten jedoch die Chance, die Wirkung respektive die Effektivität der politischen Interventionen zu untersuchen.

Der schweizerische Weichweizenmarkt hat ein besonderes Merkmal. Es sind zwei eigenstän-dige inländische Weizenmärkte mit unterschiedlicher Nutzung vorhanden: für die menschliche Ernährung und für die Fütterung. Für diese beiden Märkte bestehen zwei unterschiedliche Grenzschutzsysteme. Aus diesem Grund könnte die Analyse der Preistransmission prinzipiell in zwei voneinander unabhängigen Analysen durchgeführt werden. Diese Modellierung der beiden Märkte in total separaten Studiengegenständen würde zwei wichtige Aspekte ausser Acht lassen, welche diese Märkte verbindet. Erstens sind beide inländischen Märkte von den-selben internationalen Preisen beeinflusst. Zweitens, da Substitution zwischen den beiden Nutzungen möglich ist, kann eine gewisse Preistransmission zwischen den beiden inländischen Märkten nicht ausgeschlossen werden.

Preistransmission in diesen zwei separaten Märkten, mit jeweils unterschiedlichen Grenz-schutzsystemen, zu untersuchen und trotzdem eine mögliche Verbindung zwischen den bei-den zu akzeptieren ist die Hauptzielsetzung der vorliegenden Studie. Diese Zielsetzung führt zu den relevanten methodologischen Aspekten und zu den Forschungsfragen:

1. Welches ist der langfristige Verlauf der untersuchten Preise?
2. Bewegen sich diese Preise zusammen oder reagieren die beiden inländischen Märkte unter-schiedlich auf gleiche internationale Marktschwankungen?
3. Welches ist die Rolle der unterschiedlichen Grenzschutzsysteme in diesen Bewegungen und Reaktionen?
4. Basierend auf der empirischen Beweislage der vorhergehenden Fragen: Was kann über die Effektivität dieser politischen Massnahmen gesagt werden? Können die gleichen Resultate mit einfacheren politischen Rahmenbedingungen erreicht werden?

Um diese Fragen zu beantworten wird ein sauberer methodologischer Ansatz benötigt, der die Anzahl und die Eigenschaften der verfügbaren Daten miteinbezieht. Aus diesem Grund wurde eine Forschungsstrategie mit vier Schritten gewählt. Erstens, geeignete und konsistente Preisserien werden ausgewählt, um die wichtigsten Koppelungen zwischen den untersuchten Preisen zu bestimmen, sowie deren Koppelung an die grundlegenden inländischen Marktgrundlagen. Zweitens, die stochastischen Eigenschaften der einzelnen Preisserien werden beurteilt, um gemeinsame Eigenschaften in ihren langfristigen Bewegungen und in

den kurzfristigen Anpassungen zu finden. Drittens, gemeinsame stochastische Trends (Kointegration) zwischen den Preisserien werden formal getestet um die entsprechenden Preistransmissions- Gleichungen zu definieren und zu schätzen (VEC models, or VECMs).
Die Spezifikation dieser Preistransmissions- Gleichungen verlangen eine "theoretische" Struktur durch welche die wichtigsten Beziehungen zwischen den Preisen und die preisbildenden Mechanismen abgebildet werden, wie auch die zentralen Preise innerhalb dieser Mechanismen. In der vorliegenden Studie wurde angenommen, dass der inländische Brotweizenpreis die Schlüsselvariable des Modells ist. Ausserdem erlaubt die Schätzung von VECMs die langfristige Dynamik von kurzfristigen Anpassungen zu unterscheiden und ist ein geeignetes Instrument, um den Einfluss von Politikmassnahmen in diesem Zusammenhang zu schätzen. Innerhalb des VECM Rahmens ist es möglich, formal zu testen, ob und wie Preise sich zu-sammen bewegen, aber auch welches die treibenden Preise sind, d.h. die Preise deren Bewe-gungen die Bewegungen anderer Preise verursachen.
Innerhalb der dargestellten ökonometrischen Strategie werden im vierten Schritt die Politikmassnahmen als Variablen eingefügt um deren Rolle in den Preisbewegungen und bezüglich der Beziehungen zwischen den Preisserien zu untersuchen. Aus diesem Grund wurden die relevanten Politikmassnahmen, die auf die Preisbildung und Preistransmission einwirken identi-fiziert und zwar für Brot- und Futterweizen. Im schweizerischen Weizenmarkt werden fol-gende Politikmassnahmen angewendet: Eintrittspreis (Referenzpreis), Grenzabgaben und Zollkontingent (TRQ) für Brotweizen; Eintrittspreis (Schwellenpreis) und Grenzabgaben für Futterweizen. Als weitere Politikmassnahmen für die Preisbildung ist im Weizenmarkt der Schweiz die Deklassierung von Brot- zu Futterweizen zu sehen, auch wenn die Massnahme nicht durch eine öffentliche Behörde beschlossen und angewendet wird.
Ökonometrische Studien belegen, dass sich Preise gemeinsam bewegen und dass sie auf Ausschläge reagieren. Aus den Studien geht hervor, dass die Elastizität der langfristigen Preistransmission zwischen internationalen Weizenpreisen und im Speziellen zwischen nordamerikanischen und europäischen Preisen nahe bei 1 liegt, was aufzeigt, dass Preisausschläge fast ganz zwischen den Märkten übertragen werden. Für die vorliegende Studie kann daraus gefolgert werden, dass eine Preisserie aus Deutschland für die internationale Marktpreisentwick-lung repräsentativ ist um den Grad an Integration oder Protektion des schweizerischen Mark-tes zu analysieren. Trotzdem wurden auch ein kanadischer und europäische Preise in die Schätzungen einbezogen.
Der Schweizer Brotweizenpreis zeigt eine limitierte Integration in die internationalen Preise, was andeutet, dass der inländische Markt nicht davor geschützt ist, auf internationale Marktsignale zu reagieren, obwohl der Schutz des inländischen Markts erheblich ist. Im Falle des inländischen Futterweizenpreises zeigen die Resultate keine langfristige Koppelung zu den internationalen Preisen. Verglichen mit dem Brotweizen scheint dieses Ergebnis überraschend, da Futterweizen in grosser Menge importiert wird und die Nachfrage von Futtergetreide elastischer reagiert als die Nachfrage nach Brotweizen.
Die unterschiedliche Reaktion der inländischen Preise auf internationale Preisausschläge ist durch die unterschiedlichen Politikmassnahmen begründet. Die Resultate deuten an, dass im Falle von Brotweizen die Anwendung eines Zolls einen Abstand zwischen dem inländischen und internationalen Preisen schafft, aber Ersteren nicht davor schützt zumindest teilweise auf Letztere zu reagieren. Die langfristige Transmissionselastizität des deutschen Weizenpreises ist etwa 0.2. Diese stieg auf etwa 0.6 nachdem der Zoll zu den Preisen hinzugerechnet wurde, wobei dieser seit 2008 auf Basis eines Referenzpreises festgelegt wird. Beim Futterweizenpreis ist die langfristige Transmissionselastizität zum deutschen Preis wieder hergestellt und liegt sehr nahe bei 1, wenn der Zoll zu den Preisen hinzugerechnet wird. Dies würde vermuten lassen, dass jeder Preisausschlag in internationalen Preisen zuzüglich Grenzabgaben vollstän-dig in den inländischen Markt übertragen wird. Da die Grenzabgabe

im Gegenzug von einem Schwellenpreis abhängt, kann gefolgert werden, dass der Schwellenpreis der wichtigste Trei-ber für den inländischen Futterweizenpreis ist.
Werden Brotweizen- und Futterweizenpreise miteinander verglichen, kann gefolgert werden, dass beim Futterweizen der Eintrittspreis (Schwellenpreis) eine sehr stark stabilisierende Rolle spielt. Beim Brotweizen kann dies weniger klar beobachtet werden, weil der Eintrittspreis (Referenzpreis) erst vor relativ kurzer Zeit eingeführt wurde, als eine Krise im Markt herrschte. Zusätzlich wirkt er in Kombination mit dem Zollkontingent, das normalerweise ausgenützt wird und weitere Komplexität in die Preisbewegungen bringt. Daneben wird die Grenzbelas-tung beim Brotweizen weniger häufig angepasst als beim Futterweizen und der maximal an-wendbare Zollansatz wird regelmässig ausgeschöpft.
Ob diese verschiedenen Politikmassnahmen auch einen Effekt zwischen den beiden Märkten haben ist eine andere Frage, auf die aufgrund der Schätzresultate nur vorsichtig geantwortet werden kann. Die Koppelung zwischen den beiden inländischen Preisen ist in der Tat ein Ergebnis der Analyse. Die Erklärung ist nicht einfach, da Kointegrationstests nur schwer eine langfristige Beziehung zwischen diesen Preisen identifizieren konnten. Das kann teilweise da-rauf zurückgeführt werden, dass die Brotweizenpreise Perioden mit höherer Volatilität zeigen, die beim inländischen Futterweizen nicht zu beobachten sind. Wenn aber Koppelung stattfin-det, ist die Preisübertragungselastizität bemerkenswert und nicht weit entfernt von 1. In die-sem Zusammenhang ist auch belegt, dass die Deklassierung von Brotweizen zu Futterweizen im inländischen Markt eine Rolle spielen könnte, obwohl der Effekt sehr limitiert ist in Höhe und Dauer der Wirkung.
Trotz der erwähnten Koppelung scheinen die beiden Politikbereiche unabhängig voneinander einen unterschiedlichen Grad an Schutz für die jeweiligen inländischen Märkte zu gewährleis-ten. Im Falle des Brotweizens besitzt das Grenzschutzsystem die Fähigkeit, den inländischen Markt zu schützen und ihn, im Prinzip, vom internationalen Markt abzukoppeln. Dieser "pro-tektionistische" Effekt ist auf zwei wichtige Politikmassnahmen zurückzuführen, das Zollkon-tingent (mit einer möglichen temporären Ausweitung) kombiniert mit einem Grenzschutz und der Einführung des Referenzpreises. Das System mit Referenzpreis ist weniger abschottend als der zuvor existierende fixe Grenzschutz, da es durch die Beschränkung des maximal an-wendbaren Zollansatzes tendenziell den Abstand zwischen inländischen und internationalen Preisen verringert. Tatsächlich scheint das Grenzschutzsystem mit Eintrittspreis (Referenzpreis oder Schwellenpreis) in diesem Zusammenhang effektiver und beständiger zu sein als die temporäre Ausdehnung des Zollkontingents. Im Falle des Brotweizens kann eine solche Schlussfolgerung nicht abschliessend gezogen werden, da nur eine limitierte Anzahl an Be-obachtungen unter dem neuen System des Referenzpreises verfügbar ist, die zusätzlich in eine Zeit mit grossen Marktturbulenzen fallen. Im Falle des Futterweizens ist das System mit Schwellenpreis der einzige robuste und beständige Rahmen des inländischen Preises. Die Re-duktion des Eintrittspreises über die Zeit bewirkte aus diesem Grund eine Preisentwicklung die Stabilität mit einem kontinuierlich sinkenden Trend verbindet und bewirkt, dass der Marktpreis näher an das internationale Niveau heranrückt.
Die politischen Ziele sind immer multidimensional, weshalb eine umfassende Evaluation nicht dadurch erreicht wird, dass der Einfluss der politischen Massnahmen auf die Preistransmission und -bildung betrachtet wird. Trotzdem kann aufgrund der vorliegenden Analysen gefolgert werden, dass stabile Futterweizenpreise, die sich den internationalen Preisen annähern und stabile aber nicht (allzu stark) sinkende Brotweizenpreise möglicherweise zwei unabhängige Grenzschutzsysteme rechtfertigen. Diese Feststellung steht in Einklang mit der Entwicklung der Schweizerischen Agrarpolitik, die als wichtiges Element die Angleichung an die in-ternationalen Preise enthält, um die Wettbewerbsfähigkeit des Schweizerischen Agrarsektors zu stärken.

Man könnte sich fragen, ob die gleichen Resultate mit einem einfacheren, einheitlichen Grenzschutzsystem (d.h. nur ein Eintrittspreis für Brot- und Futterweizen und entsprechend ein einheitlicher Grenzschutz) erreicht werden können, wenn nötig kombiniert mit spezifischen Massnahmen für ausserordentliche Zeiten wie zum Beispiel Zollkontingentserhöhungen oder vielleicht Deklassierungen als Puffer-Mechanismen um Imbalancen im Markt zu verhindern. Selbstverständlich können ökonometrische Schätzungen kaum Antworten zu diesen rein politischen Themen geben.
Auf der einen Seite könnten die vorliegenden ökonometrischen Resultate jedoch darauf hinweisen, welche politischen Alternativen folgerichtig sein könnten, unter den beobachteten Preisverhalten, den geschätzten Kopplungen und der Rolle der Politikmassnahmen. Auf der anderen Seite würde eine vertiefte und robustere empirische Untersuchung zur Validierung und zu den Auswirkungen dieser politischen Alternativen einen substantiellen Schritt vorwärts Richtung eines Modellansatzes bedeuten, der jedoch langfristigere und häufigere Daten der Preise und politischen Massnahmen bedingen würde.

## Résumé

Réalisée sur mandat de l'Office fédéral de l'agriculture (OFAG), la présente étude porte sur la transmission horizontale des prix des marchés internationaux (Amérique et Europe) sur le marché indigène (Suisse) pour le blé tendre. Facile à stocker et présentant de faibles différences de qualité, le blé est une matière première agricole typique qui se prête à l'analyse des mécanismes fondamentaux de la transmission des prix. Dans un contexte mondial, la Suisse peut être considérée comme un petit pays importateur net dont le marché n'est pas assez grand pour avoir des effets à l'échelle internationale. Mais il est, par contre, probable que le marché international influe sur le marché suisse. C'est pourquoi le marché suisse du blé est un objet d'étude idéal pour une analyse de la transmission des prix ayant pour but de comprendre et de déterminer dans quelle mesure les prix pratiqués en Suisse réagissent aux fluctuations mondiales.

Ce type d'analyses représente un défi particulièrement important dans le cas de mesures douanières destinées à protéger le marché indigène des variations de prix des marchés internationaux. Si les analyses de transmission des prix sont difficiles dans un tel contexte d'un point de vue méthodologique, elles donnent néanmoins la possibilité d'examiner l'impact et donc l'efficacité des interventions politiques sur les mécanismes de transmission des prix.

Le marché suisse du blé présente néanmoins une caractéristique particulière. Il comprend deux marchés séparés selon l'utilisation : l'un est destiné à l'alimentation humaine et l'autre à l'alimentation des animaux. Ces marchés étant dotés chacun d'un système de protection douanière, il serait en principe possible de procéder à deux analyses indépendantes de la transmission des prix. Mais la modélisation de ces deux marchés sous la forme de deux objets d'étude totalement distincts reviendrait à négliger deux aspects importants qui relient ces marchés. Ainsi, les deux marchés intérieurs sont influencés par les mêmes prix internationaux. Par ailleurs, les deux utilisations pouvant être substituées l'une à l'autre, la possibilité d'une transmission des prix entre ces deux marchés domestiques ne peut être exclue.

La présente étude entend principalement examiner la transmission des prix sur ces deux marchés séparés et dotés de systèmes de protection douanière différents tout en envisageant la possibilité de liens entre ceux-ci. Cet objectif met en évidence des aspects méthodologiques essentiels et soulève les questions de recherche suivantes:

1. Quelle est la tendance des prix analysés sur le long terme?
2. Ces prix évoluent-ils parallèlement ou les deux marchés intérieurs réagissent-ils différemment aux mêmes fluctuations internationales?
3. Quel rôle jouent les différents systèmes de protection douanière dans ces tendances et ces réactions?
4. Que peut-on déduire des données empiriques aux questions précédentes pour l'efficacité des mesures politiques? Est-il possible de parvenir aux mêmes résultats en simplifiant les conditions-cadre politiques?

La réponse à ces questions requiert une approche méthodique précise tenant compte du nombre et des caractéristiques des données disponibles. C'est pour cette raison qu'il a été décidé de procéder à une stratégie de recherche en quatre étapes. Il s'agit, dans un premier temps, de sélectionner des séries de prix appropriées et cohérentes pour identifier les principaux liens entre les prix examinés et leurs relations avec les fondamentaux de marché. La deuxième étape consiste à évaluer les propriétés stochastisques des différentes séries de prix pour trouver des caractéristiques communes dans leur évolution sur le long terme et dans les ajustements à court terme. Dans un troisième temps, les tendances stochastiques

communes (cointégration) entre les séries de prix sont testées de façon formelle pour définir et évaluer les équations correspondantes de transmission des prix (modèles vectoriels à correction d'erreurs ou «VEC models» ou «VECM»).
La spécification de ces équations des transmissions des prix requière une structure «théorique» permettant de reproduire les principaux rapports de prix et les mécanismes de formation des prix, tout comme les prix pivots à l'intérieur de ces mécanismes. La présente étude part du principe que le prix du blé panifiable pratiqué dans le pays est la variable clé du modèle. En outre, l'évaluation de VECM permet d'établir une distinction entre la dynamique sur le long terme et les ajustements à court terme tout en constituant un instrument approprié pour mesurer l'impact des mesures politiques dans ce contexte. Il est possible, dans le cadre des VECM, de vérifier de façon formelle si les prix évoluent simultanément et de quelle manière, mais aussi d'identifier les prix dont les fluctuations sont à l'origine de celles des autres prix.
La quatrième étape consiste à introduire les mesures politiques comme variable dans l'approche économétrique décrite pour déterminer leur rôle dans les fluctuations des prix et dans les relations entre les séries de prix. Pour ce faire, il a été procédé à l'identification des principales mesures politiques influant sur la formation et la transmission des prix pour le blé panifiable et le blé fourrager. Les mesures politiques suivantes ont été appliquées au marché du blé suisse: prix d'entrée (prix de référence), taxes douanières et contingent tarifaire (CT) pour le blé panifiable; prix d'entrée (prix-seuil) et taxes douanières pour le blé fourrager. Le déclassement du blé panifiable en blé fourrager peut être considéré comme une autre mesure politique qui influence la formation des prix sur le marché du blé de la Suisse, même s'il n'est pas décidé et appliqué par une autorité publique.
Les études économétriques démontrent que les prix évoluent simultanément et qu'ils réagissent aux chocs. Il ressort de ces études que l'élasticité de la transmission des prix sur le long terme entre les prix du blé internationaux et, spécialement entre les prix nord-américains et les prix européens, est très proche de 1, ce qui indique que les fluctuations des prix se transmettent presque entièrement entre les marchés. On peut en conclure pour la présente étude que la série de prix d'Allemagne est représentative de l'évolution des prix du marché à l'échelle internationale pour l'analyse du degré d'intégration ou de protection du marché suisse. Un prix canadien et un prix européen ont quand même été intégrés à ces analyses.
L'intégration limitée du prix du blé panifiable suisse avec les prix internationaux semble indiquer que le marché intérieur n'est pas à l'abri d'une réaction aux signaux des marchés internationaux malgré l'importante protection dont il bénéficie. Il ne ressort pas des résultats un lien à long terme entre le prix du blé fourrager suisse et les prix internationaux. Ce résultat paraît d'autant plus étonnant que le blé fourrager est importé en grandes quantités et que sa demande est plus élastique que celle du blé panifiable.
Les différentes réactions des prix suisses aux fluctuations internationales sont dues aux diverses mesures politiques. Les résultats indiquent que, dans le cas du blé panifiable, l'application d'un droit de douane provoque un écart entre les prix nationaux et les prix internationaux mais qu'elle n'empêche pas les premiers de réagir, du moins en partie, aux seconds. L'élasticité de la transmission des prix à long terme avec le prix du blé allemand se situe autour de 0,2. Ce chiffre est passé à environ 0,6 lorsque on additionne aux prix le droit de douane, qui est lui-même fixé sur la base d'un prix de référence depuis 2008. L'élasticité à long terme de la transmission des prix avec le prix allemand est rétablie pour le prix du blé fourrager et est très proche de 1 lorsque le droit de douane est ajouté aux prix. Ce phénomène laisse supposer que chaque fluctuation des prix internationaux avec en plus les taxes douanières, se répercute complètement sur le marché intérieur. Comme la taxe douanière dépend à son tour d'un prix-seuil, on peut en déduire que le prix-seuil est le principal facteur déterminant le prix du blé fourrager suisse.

La comparaison des prix du blé panifiable et du blé fourrager permet de conclure que le prix d'entrée (prix-seuil) du blé fourrager a un effet très fortement stabilisant, qui est moins manifeste pour le blé panifiable en raison de l'introduction plus récente du prix d'entrée (prix de référence), et à une époque de crise de marché. Qui plus est, ce prix est combiné au contingent tarifaire, qui est habituellement exploité et qui complique la dynamique des prix. A cela s'ajoute le fait que le prélèvement à la frontière pour le blé panifiable est ajusté moins fréquemment que pour le blé fourrager et que le droit de douane applicable maximal est régulièrement atteint.

On peut aussi essayer de répondre, sur la base des résultats de l'évaluation, à la question de savoir si ces diverses mesures politiques ont également des effets croisés sur les deux marchés. La relation entre les deux prix pratiqués dans le pays est en fait un autre résultat clé de l'analyse. Les tests de cointégration permettant difficilement d'identifier une relation sur le long terme entre ces deux prix, ce phénomène n'est pas facile à expliquer. Cette situation peut être en partie due au fait que les prix du blé panifiable connaissent des périodes de grande volatilité, que l'on n'observe pas pour les prix du blé fourrager pratiqués en Suisse. Mais lorsqu'il existe un lien, l'élasticité de la transmission des prix est remarquable et n'est pas très éloignée de 1. Il s'avère, à cet égard, que le déclassement du blé panifiable en blé fourrager sur le marché intérieur pourrait jouer un rôle, bien que l'effet soit très limité en ampleur et dans la durée.

Malgré ce lien, les deux politiques semblent accorder, indépendamment l'une de l'autre, un degré de protection différent à chacun des marchés intérieurs. Dans le cas du blé panifiable, le système de protection douanière a la capacité de protéger le marché indigène et, en principe, de le séparer du marché international. Cet effet «protectionniste» provient de deux mesures politiques importantes: le contingent tarifaire (avec la possibilité d'une extension temporaire) en combinaison avec une protection douanière et l'introduction du prix de référence. Ayant tendance à réduire l'écart entre les prix suisses et les prix internationaux par la limitation du droit de douane applicable maximal, le système avec le prix de référence est moins protecteur que la protection douanière fixe préexistante. En fait, le système de protection douanière avec le prix d'entrée (prix de référence ou prix-seuil) semble être, dans ce contexte, plus efficace et plus stable qu'une extension temporaire du contingent tarifaire. Mais il n'est pas possible, dans le cas du blé panifiable, de tirer une telle conclusion avec certitude en raison du nombre limité d'observations faites dans le nouveau système et, qui plus est, à une période de fortes turbulences sur le marché. En ce qui concerne le blé fourrager, le système avec le prix-seuil est le seul élément solide et stable déterminant pour la fixation du prix intérieur. C'est pour cette raison que la réduction du prix d'entrée dans le temps a entraîné une évolution des prix alliant la stabilité à une tendance continue à la baisse, ce qui a eu pour effet de rapprocher le prix du marché du niveau international.

Comme les objectifs politiques sont toujours multidimensionnels, il n'est pas possible d'effectuer une évaluation complète en considérant simplement l'influence des mesures politiques sur la transmission et la formation des prix. On peut néanmoins déduire des analyses réalisées que les prix stables du blé fourrager qui se rapprochent des prix internationaux et les prix stables du blé panifiable qui ne baissent toutefois pas (trop fortement) peuvent justifier l'existence de deux systèmes de protection douanière distincts. Cette constatation correspond à l'évolution de la politique agricole suisse, dont l'un des principaux éléments est un rapprochement progressif des prix internationaux destiné à renforcer la compétitivité du secteur agricole suisse.

La question se pose de savoir si les mêmes résultats pourraient être atteints avec un système de protection douanière plus simple et uniforme (un seul prix d'entrée pour le blé panifiable et le blé fourrager et donc un seul droit de douane), combiné, si nécessaire, avec des mesures spéciales pour les périodes exceptionnelles, comme des augmentations de contingents

tarifaires ou peut-être des déclassements à titre de mécanismes d'amortissement pour empêcher des déséquilibres sur le marché. Il va sans dire que des évaluations économétriques ne peuvent pas donner de réponse à ces questions d'ordre purement politique.

D'un côté, les présents résultats économétriques pourraient indiquer les alternatives politiques logiquement envisageables, compte tenu des fluctuations de prix observées, des liens évalués et du rôle des mesures politiques. D'un autre côté, un examen empirique plus poussé et plus solide de la validité et des effets de ces alternatives politiques permettrait de franchir un pas important dans l'approche de la modélisation, qui nécessiterait à son tour que les données relatives aux prix et aux mesures politiques soient prélevées sur une plus longue période et plus fréquemment.

## Executive summary

This study is mandated by the Swiss Federal Office for Agriculture (FOAG) and constitutes the first part of the evaluation of cereal markets. It investigates horizontal soft wheat price transmission from the international (North-American and European) markets to the domestic (Swiss) market. Wheat is a typical agricultural commodity, storable and with a limited quality differentiation, for which the basic mechanisms of price transmission (arbitrage) can be investigated. Within the international context, Switzerland can be considered as a small net importer country, whose domestic market is not large enough to influence international markets but whose changes, on the contrary, are expected to be driven by the international markets. The Swiss wheat market thus represents an ideal case for price transmission analysis, the objective being to understand and measure to what extent the domestic price reacts to international shocks.

This kind of analysis, however, becomes more challenging whenever border trade policies are implemented to protect the domestic market from international markets fluctuations. Analyzing price transmission under these policy regimes may be difficult from a methodological point of view but also represents an opportunity to assess the impact, thus the effectiveness, of these policy interventions on price transmission mechanisms. From this perspective, the present study may thus seem a pretty conventional empirical investigation on price transmission and market integration under policy intervention following the most recent developments in this stream of literature.

The Swiss case, however, presents a specific feature that makes it relatively different and unconventional. The peculiarity consists in the presence of two segregated domestic markets according to the use: food use and feed use. For these two markets two different border policies are implemented. Therefore, at least in principle, the price transmission analysis could be performed as two distinct analyses carried out in parallel and independently. Modeling these two markets as totally separated cases, nevertheless, neglects two major aspects that link them together. First of all, both domestic markets are driven by the same international prices. Secondly, as substitution between the two uses is still possible, some degree of price transmission between the domestic markets cannot be excluded.

Investigating price transmission in these separated markets and under the respective different border policies, but still acknowledging possible linkages among them, is the key objective of the present study. Not only this objective raises relevant methodological issues but also make the key research questions surface:

1. Which is the long-term price pattern of the prices under study?
2. Do these prices move together and, in particular, do the two domestic markets respond differently to the same international market shocks?
3. Which is the role of the different border policies in these movements and response?
4. According to the empirical evidence on the previous questions, what can be said about the effectiveness of these policy measures? Can the same outcome be obtained with a simplified policy regime?

Answering these questions implies a proper methodological approach also taking into account the amount and the properties of available data. The adopted research strategy is thus made of four steps. Firstly, an appropriate and consistent set of key price series is selected in order to identify the key price-linkages under study, as well as their linkages with the domestic price fundamentals. Secondly, the stochastic properties of individual price series are assessed trying to find some common features in their long-run movements and short-run adjustments. Thirdly, common stochastic trends (cointegration) are formally tested to finally specify and estimate the proper price linkage equations (the VEC models, or VECMs).

The specification of these price-linkage equations requires a "theoretical" structure to envisage the main price relationships and price formation mechanisms, as well as the pivotal prices within these mechanisms. Here, the domestic food price is assumed to be the key variable of the model. Moreover, estimating VECMs allows distinguishing long-run dynamics from short-run adjustments and provides an appropriate framework to investigate the impact of policy measures in this respect. Within the VECM framework it is possible to formally test if and how prices move together but also which are the driving prices, that is, the prices whose movements "cause" the movements of the others.

Within this econometric strategy the fourth step consists in introducing policy variables to assess the role of policies in these price movements and linkages. To achieve this, the relevant policies interfering with price formation and transmission are identified for both food and feed cases. In the Swiss wheat market case, the relevant trade policy measures applied in the two cases are: *entry prices*, *tariffs* and *tariff-rate quotas* (TRQ) for the food use; *entry prices* and *tariffs* for the feed use. However, other "policy measures" can be relevant, though not applied at the borders and not decided and managed by public authority, as in the case of the *declassification* of wheat for food use into feed use.

Econometric results firstly provide evidence on prices' common movements and on price response to shocks. It emerges that the long run transmission elasticity among international prices and, in particular, between the North-American and the European prices is very close to 1, which apparently implies that price shocks are almost entirely transmitted across markets. The implication for the present study is that, though the Canadian and the European prices are both considered in our estimates, the latter (i.e., German) price alone would fully represent the international market evolution in analyzing the degree of integration, or protection, of the Swiss domestic market.

The domestic Swiss food price shows a limited integration with the international price, therefore suggesting that, although the degree of protection of the domestic market is relevant, this still does not prevent it from responding to international market signals. In the case of the domestic feed price, results indicate no long-run linkage between the domestic feed price and any international prices. Compared to the food case, this seems somehow surprising since the wheat used for feed is largely imported, and its demand is more elastic than the demand for food.

The different response of domestic prices to international price shocks has to do with the different role of policies. In this respect, results suggest that in the food case the application of the tariff creates a gap between domestic and international prices but does not prevent the former from at least partially responding to the latter. The long run transmission elasticity with the German price is around 0.2 but it increases to around 0.6 after the application of the tariff which in turn depends, since 2008, on the established entry price. Also for the feed price, once the tariff is added, the long run transmission elasticity with the German price is restored and is almost frictionless, i.e., very close to 1, which would imply that any shock in the international price plus the tariff is entirely transmitted into the domestic market. As the tariff depends, in turn, on the entry price, it can be concluded that the main driver of the domestic feed price is the entry price.

By comparing the feed and the food case, then, the conclusion is that the entry price plays a very strong stabilizing role that can be less clearly observed in the food case simply because here its introduction is more recent and has been implemented in a period of major market crisis; but also because it acts in combination with the TRQ, which is normally filled, adding complexity to the price dynamics; because the applied tariff is adapted with a lower frequency; and because the maximum applied tariff is reached regularly.

Whether these different policy measures also have some cross-market effect is another question that can be tentatively answered on the basis of the estimated results. The linkage

between the two domestic prices is, in fact, another key result of the analysis. The evidence is puzzling also in this case because cointegration tests hardly identify a long-run relationship between them. This may be in part attributed to the fact that food price shows periods of higher volatility that are not observed in the feed case. Nonetheless, if this linkage occurs, price transmission elasticity is remarkable and not far from one. In this respect, it is also confirmed that the declassification from food to feed use in the domestic market may play a role, though very limited in magnitude and duration.

Eventually, despite this linkage, the two policy regimes seem to autonomously grant a different degree of protection to the two domestic markets. In the food case, the border protection system is able to protect the domestic market and, in principle, to separate it from the international market. This "protectionist" effect is bounded by two main policy measures, the TRQ (with possibly temporary extensions) combined with a tariff and the introduction of an entry price. The entry price regime is less protective than the pre-existing pure tariff since, if sufficiently low, it tends to reduce the gap between the domestic and the international price. Actually, the entry price system seems to be more effective and permanent in this respect than the temporary extension of the TRQ. In the food case, however, such evidence cannot be considered conclusive due to the limited number of observations available under the new regime also including a period of major market turbulence. In the case of feed, the entry price is the only robust and permanent driver of the domestic price. The reduction of the entry price over time, therefore, was able to induce a pattern of the domestic price that combines stability with a gradually declining trend that makes it converge to the international values.

Though policy objectives always are multidimensional and a comprehensive evaluation cannot be achieved by only looking at policies' impact on price transmission and formation, within the present analysis achieving stable and converging feed prices and stable but not (too) declining food prices is what eventually justifies the presence of two different border protection systems. It appears that stability has been pursued together with gradual convergence to the international prices. More in general, this is in compliance with the evolution of the Swiss agricultural policy, whose an important element is the increasing convergence to the world prices to strengthen the competitiveness of the Swiss agricultural sector.

One may wonder, however, whether the same result could be obtained by a simpler and unique border policy (i.e., only one entry price and, therefore, only one tariff) eventually combined with specific measures for the exceptional times, as it is the case for TRQ extension and, perhaps, declassification, behaving as "buffer" mechanisms to tackle market imbalances. Evidently, econometric estimation can hardly provide an answer to this purely policy issue. On the one hand, however, the present econometric results might suggest which policy alternatives seems consistent with the observed price behavior and the estimated linkages and role of policies. On the other hand, a deeper and more robust empirical investigation on the validity and implications of these policy alternatives would imply substantial steps forward in the modeling approach which, in turn, require longer and more frequent price and policy data.

# 1. Introduction

The objective of this study is to analyze the horizontal price transmission across cereal markets in Switzerland and to assess to what extent trade and border policies may have an influence. The notion of "horizontal" price transmission entangles both cross-market (spatial) and cross-commodity price dynamics[1]. On the one hand, the analysis focuses on the transmission across national borders, that is, transmission of price shocks from world and EU markets towards the domestic Swiss market and, at least in principle, the other way round. On the other hand, the specific domestic market structure and institutional settings imply a segmentation of the cereal market according to the final use of the product, that is, the food and feed uses. Therefore, the transmission of price shocks across these segregated domestic markets is relevant, as well, also with respect to the role of trade policy measures.

As a matter of fact, analyzing domestic cereal market in Switzerland essentially means focusing on the soft wheat (henceforth, only wheat) market as this crop represents about half of the overall domestic cereal use (in terms of quantity). The Swiss wheat market consists of two almost completely segmented markets, the market of wheat for food use and the market for feed use. This segmentation is, by itself, the effect of a policy, in the sense that it depends on the institutional settings, i.e., the normative constraints that are imposed on domestic wheat traders and users. This segregation is then reflected at the borders as it also applies to the imported product. In fact, trade policies themselves are differentiated between food and feed use and this evidently conditions how price shocks are transmitted horizontally between the domestic and the international markets as well as between the domestic wheat food and feed markets[2].

Eventually, the combination of different trade policy measures and the domestic market segregation, makes Swiss border protection on wheat a quite sophisticated policy. One may wonder whether this sophistication is needed to achieve the result of "protection" or to improve the protection performance. Answering this question with a proper econometric analysis is not trivial. This segregation not only represents the main peculiarity of the structure of the domestic wheat market in Switzerland, but also constitutes the most challenging issue in properly investigating price transmission in such context.

According to these main research objectives and challenges, the structure of this study is the following. Section 2 illustrates in details the main research questions. Section 3 presents the whole set of price series taken into account, particularly focusing on the respective source, time coverage and position along the supply chain, as well as displaying their behavior over time. Some key facts characterizing the Swiss wheat markets in the last decade are also presented. Section 4 is dedicated to the policies affecting these markets: the explanation of their functioning, and some first evidence on their impact. In Section 5, the research plan is presented. A selection on the set of price variables is operated, trying to identify the key prices and the key price linkages for the objectives of the present study. This research plan implies a step-wise econometric strategy (which is explained in Section 6) starting with the assessment of the stochastic properties of individual series, then moving to testing common stochastic trends (cointegration) and, finally, specifying and estimating the proper price linkage equations (the VEC models, or VECM). The results of the econometric tests are presented in Section 7, while Section 8 presents the VECM estimation results by firstly

[1] On the contrary, usually the notion of "vertical" price transmission refers to the transmission of prices along the food chain, that is, between producers, intermediaries and consumers.

[2] It must be noted that it is prohibited by law to use for food purposes cereals which are intended as feed; on the contrary, it would be possible, at least in theory, to use for feed cereals which are intended for food purposes. However, this has in practice never been the case, since import tariffs, and then prices, for food cereals systematically turn out to be higher than those for feed cereals.

focusing on separate food and feed markets and, then, looking at the food/feed markets linkage.
The policy implications of these results are drawn in Section 9. This final section not only closes the circle since it provides a tentative answer to the research questions underlying this study. It also puts forward some suggestions or indications on the possible directions of reform or correction of the current policy intervention on this market to eventually improve its effectiveness and efficiency.

## 2. Research questions

Any good research work starts with proper and consistent research questions. So, pursuing the abovementioned objectives of the present study primarily means to raise the right questions to be answered. Here, we can order the relevant research issues in this logical and chronological sequence of four questions.
The first question is: which is the long-term price pattern of the prices under study? This means to first identify what is "long-term" in the present case, and then to distinguish the long-term behaviour of international and domestic prices and of domestic food and feed prices.
The second question is a consequence of the former one: do these prices move together? Again, this means to investigate whether there is co-movement between the domestic and international prices and between the domestic food and feed prices. This possible common movement evidently evokes the issue of price linkage which is, in fact, a step forward as it leads to the following question: which is the driving price, that is, the price whose movements "cause" the movements of the other prices?
The third research question introduces the policy issue: which is the role of policies in these price movements? This question contains itself two other relevant research questions. First of all, which are the relevant policies to be considered, that is, those policy that are candidate to interfere with price formation and transmission? In the specific case of the Swiss wheat market, the candidates in this respect are the trade policy measures in the two cases (wheat for food and feed use): *entry prices*, *tariffs* and *tariff-rate quotas* (TRQ). However, other policy measures can be important, though not applied at the borders. This is the case of the *declassification* of wheat for food use into wheat for feed use. Although this measure is not introduced by public institutions but by producers organizations operating on the domestic wheat market, in this analysis still it can be considered as a "domestic policy" as it represents an intervention on the domestic market with the aim of influencing the transmission of price signals, notably avoiding price declines in case of domestic oversupply. A second issue in this respect is how these policy measures are expected to interfere with price formation and transmission; in other words, the research question is: do we have an ex-ante theory or model and, then, an empirical evidence about the impact of these policy measures on price movements?
All these research questions about the role of policies eventually collapse to the last set of questions: what can we conclude about these policies? Are they effective and are they needed? Are there alternatives that can be suggested on the basis of the results obtained? Actually, the possible answers to this question depend on which is the real objective of these measures. Clearly, their objective is to "protect" the domestic market. However, the objective of protection is not so univocal. There can be a wide agreement on the fact that the protection of the domestic market primarily implies to stabilize the domestic price in the medium or long term perspective[3] by reducing price volatility coming from international markets. However, this stabilization can be obtained at high or at low price levels. In the first case,

[3] We can assume that medium – long term has the same order of magnitude as the period under study here.

protection also grants high wheat price levels to domestic producers (wheat producing farmers). In the second case, protection also grants low wheat price levels to domestic buyers (farmers using wheat for feed, but also intermediate and final consumers of wheat for food). There is an evident conflict between these objectives: granting high prices for domestic producers imposes high price to domestic consumers, and the other way around. So, eventually, answering the question about policy effectiveness necessarily requires understanding which are the underlying policy priorities and targets. As will be clarified more in detail in the following sections, in the case of the domestic Swiss market, the apparent main objective resulting when examining policy measures is to protect the domestic market in such a way to have stable and relatively high prices for wheat for food and stable and relatively low prices for wheat for feed. Doing this, both wheat producing and wheat using farmers are somehow "protected".

## 3. Description of series behaviour

Following the sequence of research questions illustrated above, in this section we start analysing in detail the behaviour of individual price series. First of all, it is worth mentioning that a unique "market price of wheat", by itself, does not exist. There is a battery of wheat prices that captures the different market places (country), the different positions along the food chain (price at the farm gate vs. price at the market), the different product quality (for instance, organic vs. non organic product).

Table 1 reports the whole set of wheat prices that have been collected and are, in principle, available[4]. Therefore, it describes the dataset on which the present analysis is based. Table 1 has also the objective of introducing the price acronyms we are going to use all over this study and to explain their meaning. The price series are organized in four groups. The first group concerns prices of wheat for food use. Here, the difference between the series mostly depends on the product quality. In general terms, quality increases moving from Klasse III product to Top class product. Moreover, however, prices may refer to different segments of the food market as in the case of the IP-Suisse prices (in terms of quantities, the most important private label in Switzerland for cereals for food use) and the Bio product. The second group of prices concern the price of wheat for feed use. As expected, here there is no significant quality difference to be captured by alternative prices; the only relevant difference therefore concern different positions along the supply chain, that is, at the farm level or at the mill.

The third group of prices are the international prices that do not actually distinguish between food and feed use (although, naturally, their quality might made them more suitable for the one or the other use) but may still differ for various economic (production and transportation costs) and institutional (market intervention policies) reasons. Several international prices are considered, taking into account the product coming from some relevant bordering EU countries (France and Germany) to express a sort of EU price, and the product coming from North-America (Canada) to express a sort of international-world price. Another set of international prices are actually border prices, expressing the price of wheat entering the domestic Swiss market and, therefore, though coming from other countries where the food-feed use distinction is not explicit, already taking this domestic distinction into account. The final group of prices actually consists of institutional prices, that is, those established in application of some trade policy measures, including tariffs.

Without entering the details of any price series, some general considerations about data collection and elaboration can be driven. First of all, the time period covered by the series significantly differs. It ranges from a maximum of 192 monthly observations covering all

[4] The graphs showing the behavior of all series are reported in the Annex.

years from 1997 to 2012, to a minimum of 51 monthly observations ranging from October 2008 to the end of 2012. Several international prices have a slightly lower number of observations since the series stop in April 2012. Therefore, one problem to be dealt with in the empirical analysis is to select those prices that share a common, and possibly the largest, time coverage.

A second consideration concerns the fact that prices have to be expressed into a common currency and unit of measurement. In particular, for the purposes of this analysis we convert all prices in Swiss Francs per 100 Kg (CHF/100Kg). Clearly, variations in the exchange rates between CHF, US $ and € occurred over time inevitably affect international prices and, consequently, price transmission from the international to the domestic market.

A final consideration has to do with the high number of heterogeneous wheat prices that are available. They represent aspects (for instance quality differences, different position on the supply chain) that are not of specific interest here, as the focus rather concerns the international/domestic and the food/feed price transmission. Therefore, we decide not to consider those prices that have not sufficient time coverage, for obvious reasons, but also to get rid of price differentials that express issues that are not of interest here. This selection of prices will be discussed in detail in Section 5.

Focusing the attention on these selected prices, Figures 1-3 displays their evolution over the whole available time period. Figure 1a and Figure 1b compare the movement over time of the Swiss wheat food price and of the international prices. Normally, the Swiss prices are above the international ones but the gap is apparently shrinking over time. It is also evident how the gap between domestic and international food prices is strongly related to (i.e., covered by) the quite high applied tariff.

The common movement of domestic and "policy" prices is demonstrated in Figure 2a and Figure 2b where the Swiss wheat feed and the respective entry price show a common decreasing trend. Entry prices, in fact, constitute a target price at which the price of the imported product entering the domestic market (the import price) has to be brought to get close to the domestic price. As shown in the Figure, and as expected, import prices are usually below entry prices with the only exception of 2007-2008 price peak. After applying an appropriate tariff to this imported price, which is established according to the mentioned entry price, the prices of the imported product now almost correspond to the entry prices and, therefore, to the domestic prices. All these prices show a decreasing trend, as well.

Figure 3 finally provides evidence of the common movement of the wheat food and feed prices. The domestic feed prices systematically lie below the domestic food prices. As this distinction between food and feed use only exists in Swiss domestic market up to the borders, this permanent price gap seems to strongly depend on the different (higher in the latter case) entry price level for feed and food. A further aspect that could be stressed in this respect is the role of the already mentioned domestic declassification of wheat for food use into feed use. This possibility is temporary: it is only introduced in some occasions and for limited periods of time, but it may still be helpful in stopping or inverting the convergence of the food and feed prices.

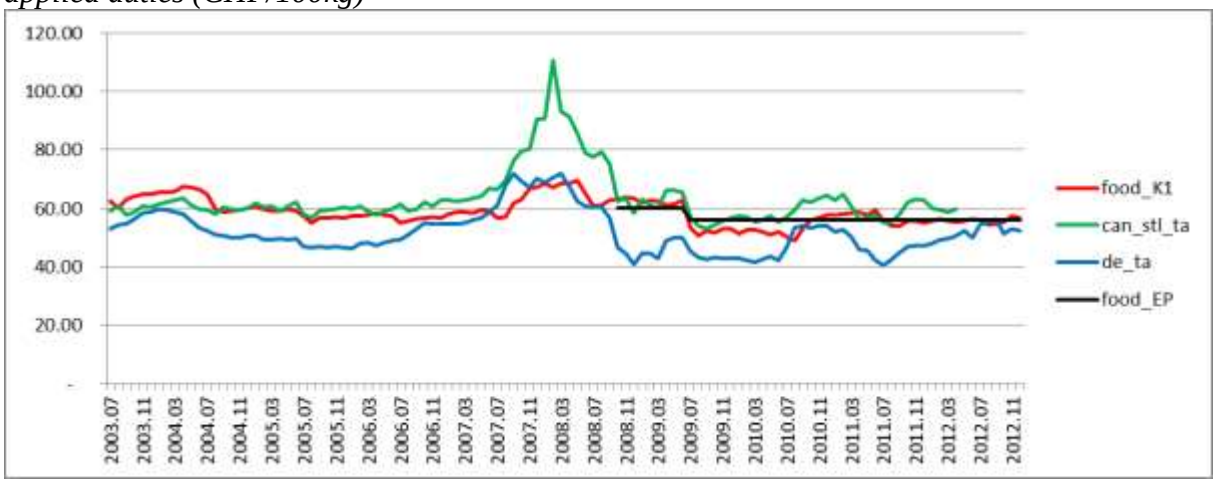
According to this very initial evidence about respective price movements, we can conclude that, over the last decade, the Swiss domestic prices apparently followed a slightly downward/converging trend; this is especially evident for feed prices. Moreover, domestic prices are more stable than the international ones (again, this is true especially for feed prices) and less responsive to world prices. As will be shown more in details in next sections, the price peaks observed during the 2007-2008 and 2010-2011 periods of market turmoil was actually more intense in the international prices (up to +85% in the Canadian price), though it was still remarkable also for the Swiss domestic price (up to +65%).

Along with this relatively smooth evolutionary pattern of domestic wheat prices, we can notice some significant changes in the market fundamentals. Firstly, we can observe an increasing trend of domestic demand (use) over the latest years while domestic production (supply) remains roughly constant. In both cases, the feed use increases its relevance with respect to the food use (Figure 4 and 5). As a consequence of this evolution in the domestic supply and use balance, we observe an increasing role of imports to satisfy the domestic demand: in 2010 almost 50% of the supply balancing the domestic demand is satisfied by imported products (Figure 6). This major and increasing role of imports seems particularly relevant for feed use where in 2010 we observe almost 70% of domestic use satisfied by imported product (Figure 7). Declassification from food to feed use provides another temporary contribution to satisfy the domestic demand of wheat for feed.
Despite this specific intervention through declassification, however, it is also worth noticing that domestic food and feed prices tend to move in parallel, that is, in practice, tend to express the same market information, eventually being expression of the same international price and market fundamentals. In this respect, a final consideration on such price dynamics concerns the evident role of policies (declassification included) in generating or just orienting and affecting this behaviour of prices over time. Therefore, it now necessary to better and more deeply analyse which are the relevant policy measures in place and how they interfere with price formation and transmission.

*Figure 1a – Price series behaviour over time: food domestic and international prices (CHF/100kg)*

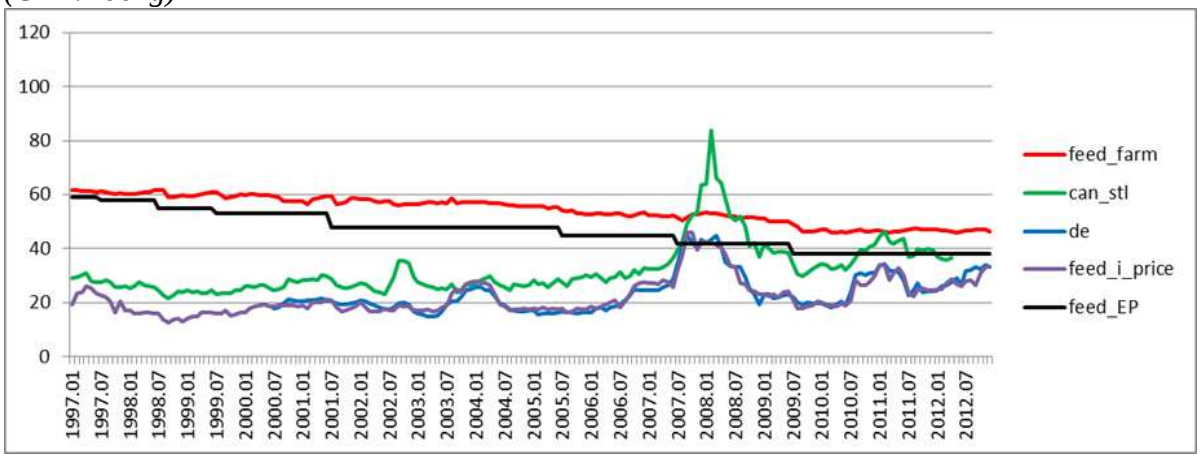

Source: See Table 1

*Figure 1b – Price series behaviour over time: food domestic and international prices plus applied duties (CHF/100kg)*




Source: See Table 1

*Figure 2a – Price series behaviour over time: feed domestic and international prices (CHF/100kg)*




Source: See Table 1

*Figure 2b – Price series behaviour over time: feed domestic and international prices plus applied duties (CHF/100kg)*

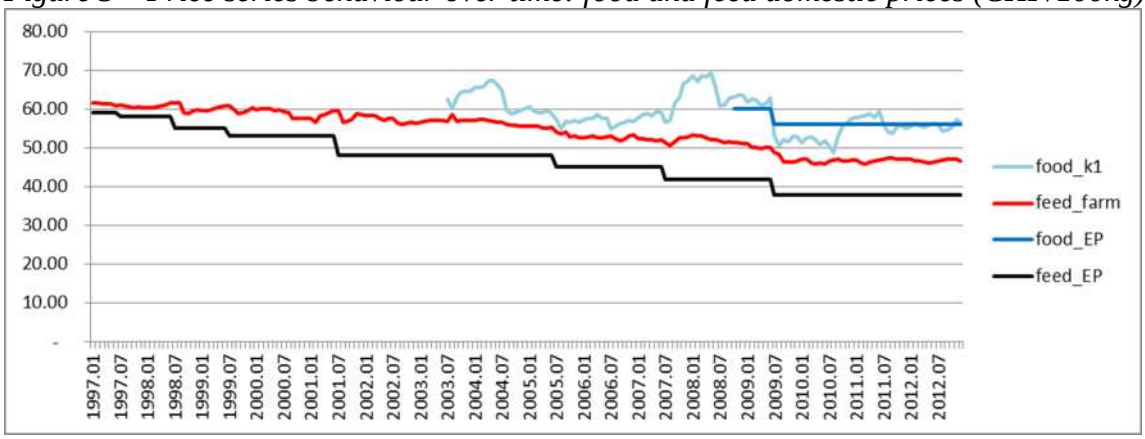
CHF/100kg


Source: See Table 1

*Table 1 – The dataset: group of wheat price series available for the analysis (all price are expressed in CHF/100kg)*

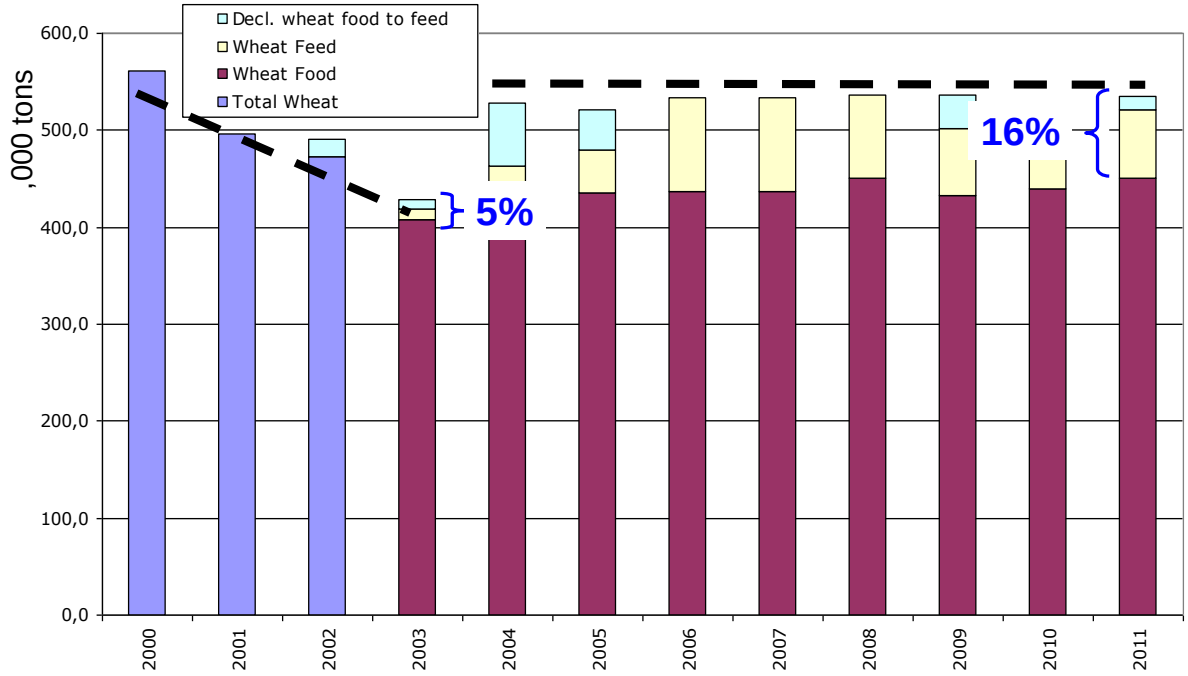
| | Abbreviation | Price | Description | Source | n.obs | Time span | Additional information |
|---|---|---|---|---|---|---|---|
| FOOD | food_top | Swiss price | Inlandweizen, Klasse Top | FOAG | 114 | 2003.07- 2012.12 | "At the mill"; include transport costs. |
| | food_k1 | Swiss price | Inlandweizen, Klasse I | FOAG | 114 | 2003.07- 2012.12 | "At the mill"; include transport costs. |
| | food_k2 | Swiss price | Inlandweizen, Klasse II | FOAG | 114 | 2003.07- 2012.12 | "At the mill"; include transport costs. |
| | food_k3 | Swiss price | Inlandweizen, Klasse III | FOAG | 114 | 2003.07- 2012.12 | "At the mill"; include transport costs. |
| | food_IPS_top | Swiss price | IPS Weizen, Klasse Top | FOAG | 114 | 2003.07- 2012.12 | "At the mill"; include transport costs. |
| | food_IPS_k1 | Swiss price | IPS Weizen, Klasse I | FOAG | 114 | 2003.07- 2012.12 | "At the mill"; include transport costs. |
| | food_IPS_k2 | Swiss price | IPS Weizen, Klasse II | FOAG | 114 | 2003.07- 2012.12 | "At the mill"; include transport costs. |
| | food_bio | Swiss price | Bio Weizen, Inland | FOAG | 114 | 2003.07- 2012.12 | "At the mill"; include transport costs. |
| FEED | feed_mill | Swiss price | Price at the mill | FOAG | 78 | 2006.07- 2012.12 | Purchasing price at the mill |
| | feed_farm | Swiss price | Price at the farm level | SBV | 192 | 1997.01- 2012.02 | Purchasing prices for farmers |
| INTERNATIONAL | can_atl | International price | Canada CWRS Wheat - Atlantic | IGC | 184 | 1997.01- 2012.04 | cif price (fob + freight rates) |
| | can_stl | International price | Canada CWRS Wheat - St Lawrence | IGC | 184 | 1997.01- 2012.04 | cif price (fob + freight rates) |
| | can_van | International price | Canada CWRS Wheat - Vancouver | IGC | 184 | 1997.01- 2012.04 | cif price (fob + freight rates) |
| | fr | International price | France Grade 1 Wheat - Rouen | IGC | 159 | 2002.09- 2012.12 | cif price (fob + freight rates) |
| | de | International price | Germany Grade B Wheat - Hamburg | IGC | 124 | 2000.07- 2012.12 | cif price (fob + freight rates) |
| | food_trad_overs | International price | Bio Weizen, Übersee | FOAG | 114 | 2003.07- 2012.12 | Traded price "at the mill"; include transport costs and duties. |
| | food_trad_EU | International price | Bio Weizen, Europa | FOAG | 114 | 2003.07- 2012.12 | Traded price "at the mill"; include transport costs and duties. |
| | food_bio_trad_overs | International price | Brotweizen, Übersee (CWRS) | FOAG | 114 | 2003.07- 2012.12 | Traded price "at the mill"; include transport costs and duties. |
| | food_bio_trad_EU | International price | Brotweizen, Europa | FOAG | 114 | 2003.07- 2012.12 | Traded price "at the mill"; include transport costs and duties. |
| POLICY | feed_i_price | International price | Eu feed quality | FOAG | 192 | 1997.01- 2012.12 | cif price used for fixing the applied tariff |
| | food_i_price | International price | EU food quality | FOAG | 14 | 2008.10- 2012.12 | cif price used for fixing the applied tariff. |
| | food_ta | Applied tariff | 1001.9932, reviewed every three months | FOAG | 114 | 2003.07- 2012.12 | |
| | food_tb | Maximum applied tariff | 1001.9032 | FOAG | 51 | 2008.10- 2012.12 | Binding tariff (acts as a cap on the applied tariff) |
| | food_EP | Entry price | 1001.9932, introduced in 2008 | FOAG | 51 | 2008.10- 2012.12 | |
| | feed_EP | Entry price | decided by law (tariff code 1001.9939) | FOAG | 192 | 1997.01- 2012.12 | |
| | feed_ta | Applied tariff | decided by law (tariff code 1001.9939) | FOAG | 192 | 1997.01- 2012.12 | |

*Figure 3 – Price series behaviour over time: food and feed domestic prices (CHF/100kg)*



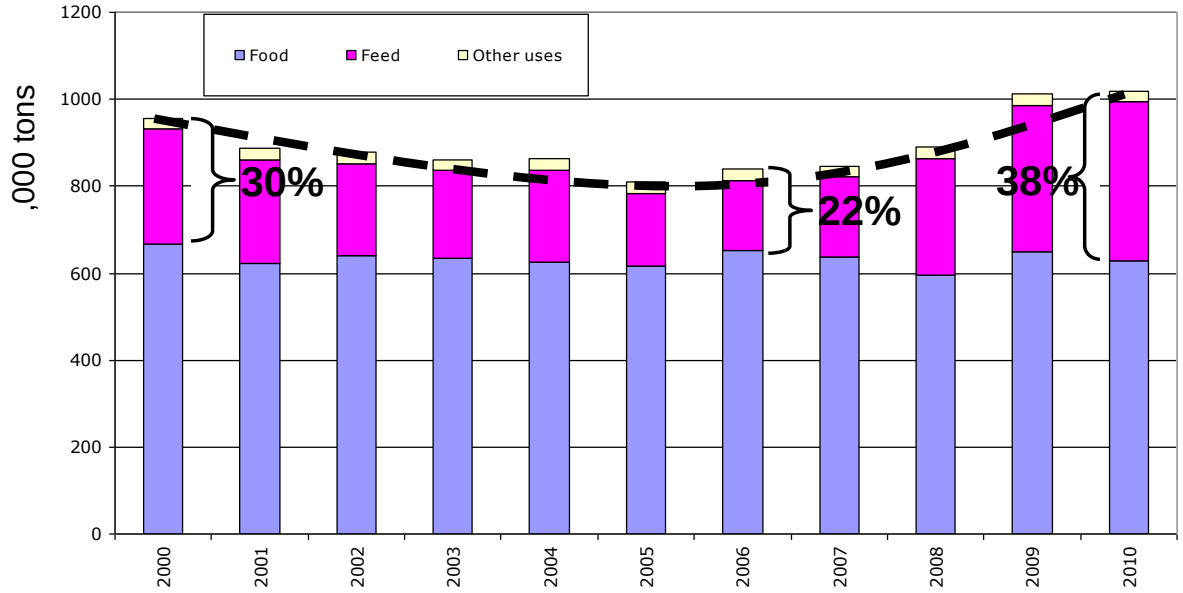

Source: See Table 1

*Figure 4 – Wheat domestic supply over the last decade*



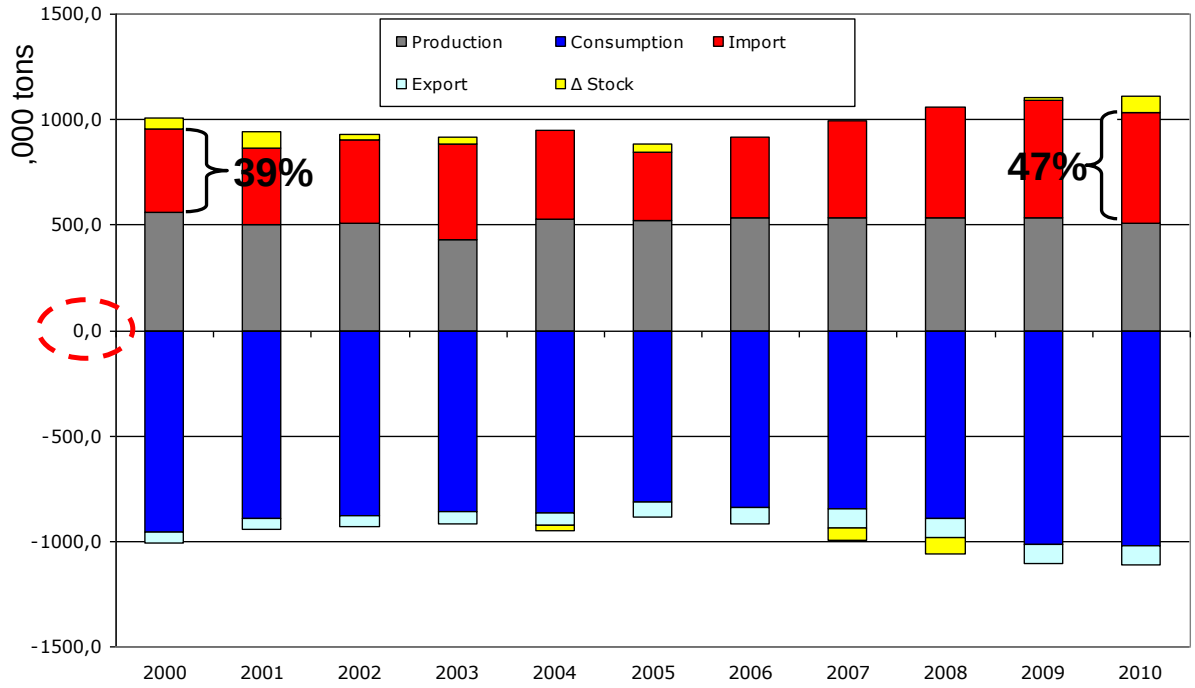

Source: Swiss Farmers' Union.

*Figure 5 – Wheat domestic use over the last decade*



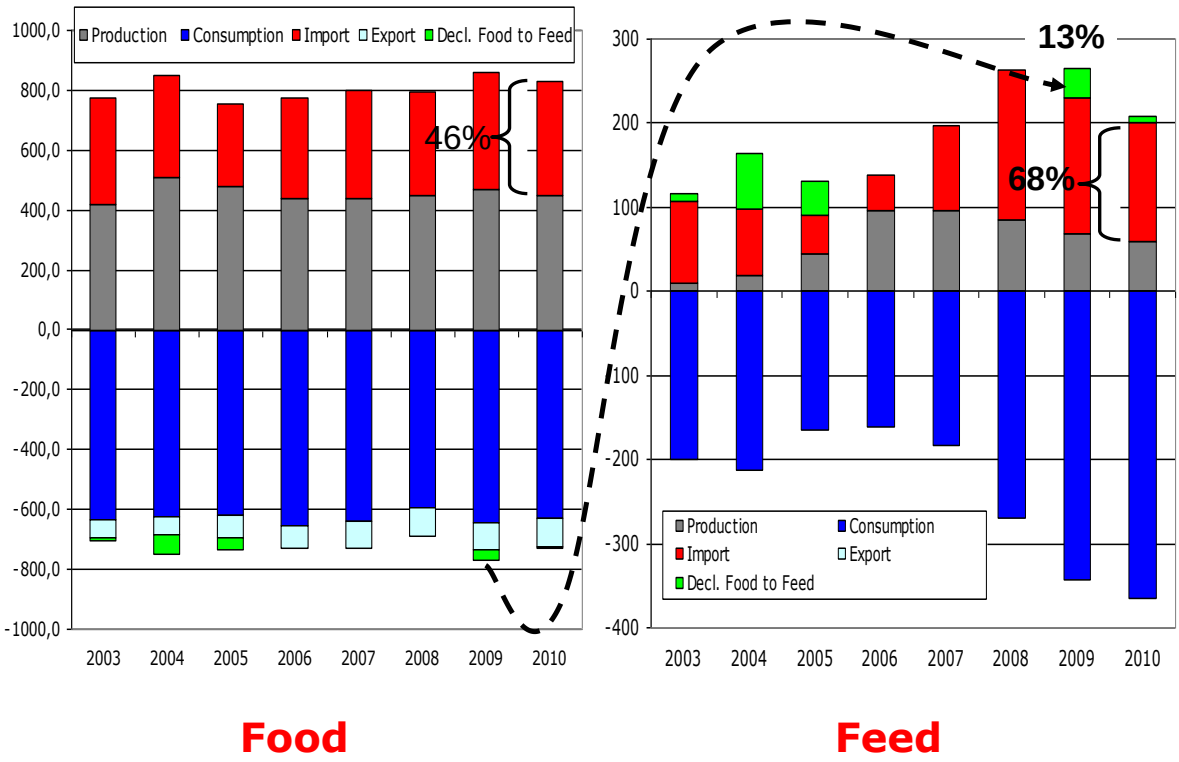

Source: Swiss Farmers' Union.

*Figure 6 – Wheat and wheat products domestic supply and use balance over the last decade*




Source: Swiss Farmers' Union.

*Figure 7 – Wheat and wheat products domestic supply and use balance over the last decade: food and feed use*[5]




Source: Swiss Farmers' Union.

## 4. Policy and prices

This section focuses on the policy measures in place in the wheat market. After a description of the most important instruments (4.1), some first evidence about their possible influence on the price transmission dynamics is presented (4.2).

### 4.1 The relevant policy measures

Tables 2 and 3 describe in details the border policies affecting the Swiss domestic market distinguishing between wheat for food use (Table 2) and wheat for feed use (Table 3). Here, we only want to discuss the main features of this set of policy measures (see 916.01, *Ordonnance sur les importations agricoles, OIAgr*, for further references). .

As far as wheat for food use is concerned, in principle, the border policy is based on a quite conventional system: an import tariff[6] is applied to the imported product to make its price converge to (and even exceed) the higher domestic price. In practice, however, the impact of the application of the tariff on the domestic price is more complex for two basic reasons. First of all, as mentioned, Switzerland is clearly a net importer for wheat (independently from its use), therefore it severely depends on the imported product. Border protection must therefore satisfy two different, and somehow contrasting, objectives: to protect domestic producers but also to satisfy the domestic excess demand by importing wheat at a reasonable (not too high) price.

[5] Due to the use of a different calculation methodology, the shares of food and feed used in consumption are not directly comparable with those of production.

[6] Throughout the text, the term applied tariffs always includes the contributions to the guarantee funds (531.215.17, *Ordonnance sur le stockage obligatoire de cereals*).

Therefore, the import volumes are segmented according to the Tariff Rate Quota (TRQ), that is, by fixing a given amount of imported product on which the applied tariff is maintained relatively low. Above the quota, a higher tariff is charged. Imports above the TRQ are, in fact, exceptional. The TRQ volume is fixed by the law but can also be temporarily augmented due to specific market conditions, especially to stabilize and lower the domestic price during periods of market turmoil (it happened during the 2007-2008 price peak).[7]

The second reason for which the border protection system is, in fact, more complex than what could seem is the introduction of a measure whose aim is to maintain the import price at a reasonable level while inducing a progressive convergence of the external and domestic prices, but in compliance with the international (WTO) commitments in the respect. The mechanism to achieve this restraint is the introduction of an entry price that applies since October 2008 to imports within the TRQ. The entry price represents the target price for the imported product: therefore, the applied tariff is defined (since July 2010, every three months, as explained in Table 2) on the basis of the gap between the import price (before the application of the tariff) and this entry price. Since there is a limit on the maximum applicable tariff[8] this system implies that in some market circumstances the gap between the international market and the domestic market may remain even after the application of the tariff. When the amount of the imported product exceeds the TRQ, however, the applied tariff (over quota tariff) is higher. Therefore, the entry price system fixes the level of the tariff given the international price and, consequently, the import price unless the gap between the international price and the entry price is too high given the maximum applicable tariff (or the import levels are particularly high and the TRQ is exceeded, so the overquota tariff applies).

[7] No TRQ applies to processed cereals for human consumption. Since the applied tariffs for processed products are fixed in line with those for the base cereals, we can safely assume that they do not affect the functioning of the markets of the base products.

[8] Applied tariffs have to be below the tariffs notified at the World Trade Organization (WTO). These are fixed at 35 CHF/100 kg for food wheat and 39 CHF/100 kg for feed wheat. In the case of food wheat, the maximum in quota tariff has been defined at a lower level (see Table 2).

*Table 2 – Summary of the policy measures in place – wheat for food use*

| Policy instruments | Description | Expected Impact | Changes over time (2003-2012) | Relationships with other policy instruments | Main issues |
|---|---|---|---|---|---|
| **Tariff rate quota (TRQ)** | A fixed amount of imports are allowed at a lower tariff; imports above the quota are charged a higher duty. | TRQ not filled<br>equilibrium price = import price + in quota tariff<br><br>TRQ filled and no overquota imports<br>equilibrium price = import price + in quota import tariff + rent. The rent is at most equal to the overquota tariff<br><br>TRQ filled and overquota imports<br>equilibrium price = import price + over quota tariff. | For bread grains, since 1998 there is an annual TRQ of 70'000 t.<br><br>The TRQ was administered every six months in 2002 and 2003, and then every quarter. | The volume *de facto* imported at the in quota tariff is equal to the sum of the TRQ plus the autonomous extension. | Impact on international price transmission |
| **Autonomous extension of the TRQ** | The volume of the TRQ can be increased. | Could lower domestic prices. | In 2007 and 2008 the TRQ has been increased up to 100.000 t. | | Impact on international price transmission<br>Note: it has, de facto, the same impact of an entry price system. |
| **Applied in quota tariff** | Starting from 10.2008, the in quota tariff is calculated according to an entry price system. The maximum applied in quota tariff cannot raise above the bound in-quota tariff. | TRQ not filled<br>the applied tariff determines the height of the import price.<br><br>TRQ filled<br>The applied tariff only affects the distribution of the rent.<br><br>If the in quota tariff is fixed according to an entry price system, all the characteristics of this import system hold. | Fixed at 33.80 CHF/100 kg, lowered up to 27 CHF/100 kg in 07.007.<br>Since 10.2008 entry price system: applied tariff fixed every six months and, since 07.2010, every quarter.<br>Maximum in-quota tariff fixed by the Federal Department in 10.2008 at 27 CHF/100 kg, then lowered to 23 CHF/100 kg in 07.2009. | The level of the entry prices determines the height of the applied tariffs. | Impact on international price transmission |

*Table 2 (continues)*

| Policy instruments | Description | Expected Impact | Changes over time | Relationships with other policy instruments | Main issues |
|---|---|---|---|---|---|
| **Entry price** | Reference price for fixing the in quota applied tariff. | import price ≥ entry price<br>applied in quota tariff = 0 ; the entry price system is de facto not effective<br><br>import price < entry price *and* calculated in quota applied tariff ≤ notified tariff<br>import price =entry price<br><br>import price < entry price *and* calculated *in quota* applied tariff > notified tariff<br>the difference between entry price and import price cannot be fully compensated<br><br>If the quota is filled, the entry price system can only have an effect on the distribution of the rent. | In place since 10.2008.<br>Originally fixed at 60 CHF/100 kg ; in 07.2009, lowered to 56 CHF/100kg. | The level of the entry prices, together with the international price, determines the height of the applied tariffs. | Impact on international price transmission. |
| **Applied over quota tariff** | Imports exceeding the TRQ can occur only at a higher duty (exception: duty free imports, see below). | Normally, no over quota imports occur (exception: technical purposes). If the quota is perfectly filled, it corresponds to the maximum value of the rent. | Fixed at 76 CHF / 100 kg. | | |
| **Declassification to feed uses** | To avoid oversupply, cereals for food uses can be "declassified" into cereals for feed uses by the farmers' organization. | Upward pressure on food prices, possibly downward pressure on feed prices. | Occurred in 2002 - 2005 and 2009 - 2011. | | Impact on the development of domestic prices<br>Note: monthly data are not available for the analysis. |
| **Duty free imports** | Cereals can be imported duty free from Haute Savoy and Gex; these imports may account up to 10% of the total. | Duty free imports ensure international price transmission. | | | Impact on international price transmission? |

Figure 8 and 9 provides schematic representations on how the entry price and TRQ systems operate under different market conditions and, consequently, on how they affect the level of

import prices (and then the gap between the international and the domestic price) of wheat for food use.

Figure 8 shows how, according to the level of the international prices (that is, the import price before the application of the tariff), three cases can occur: the international price is above the entry price and, therefore, no tariff is applied because the external price is already close, if not above, the domestic price; the international price is below the entry price but the difference between the two is lower than the maximum applicable tariff, therefore the tariff is able to bring the imported price at the level of the entry price, i.e., close to the domestic price; the international price is much lower than the entry price, the maximum tariff is applied but this is not enough to fill the gap, therefore the import price will remain below the entry and the domestic price.

Figure 9 concentrates on the volume of imports and, therefore, on the functioning of the TRQ system. Also in this representation, three cases can occur depending on the level of the Swiss domestic demand not satisfied by the domestic supply (Swiss net import demand curve) and on the level of the in quota and over quota tariffs, which affect the shape of the export supply curve. In the first case, the net import demand is relatively low and fully satisfied by the current TRQ; in such case the in quota tariff applies (which, since October 2008, is fixed according to an entry price system). In the second case, the net import demand increases up to the TRQ limit but not so much to induce imports exceeding the TRQ itself. These imports, in fact, would imply a much higher tariff, therefore a much higher import price. Though the level of imports remains in the TRQ bound and, therefore, the in quota tariff is still applied, the import price increases due to the higher import demand. This can generate the so called TRQ rent. The final case occurs when the net import demand is so high that it induces imports above the TRQ level, and this triggers the much higher over quota tariff (unless, of course, a decision to extend the TRQ is taken).

*Figure 8 – Schematic representation of the functioning of the entry price system*

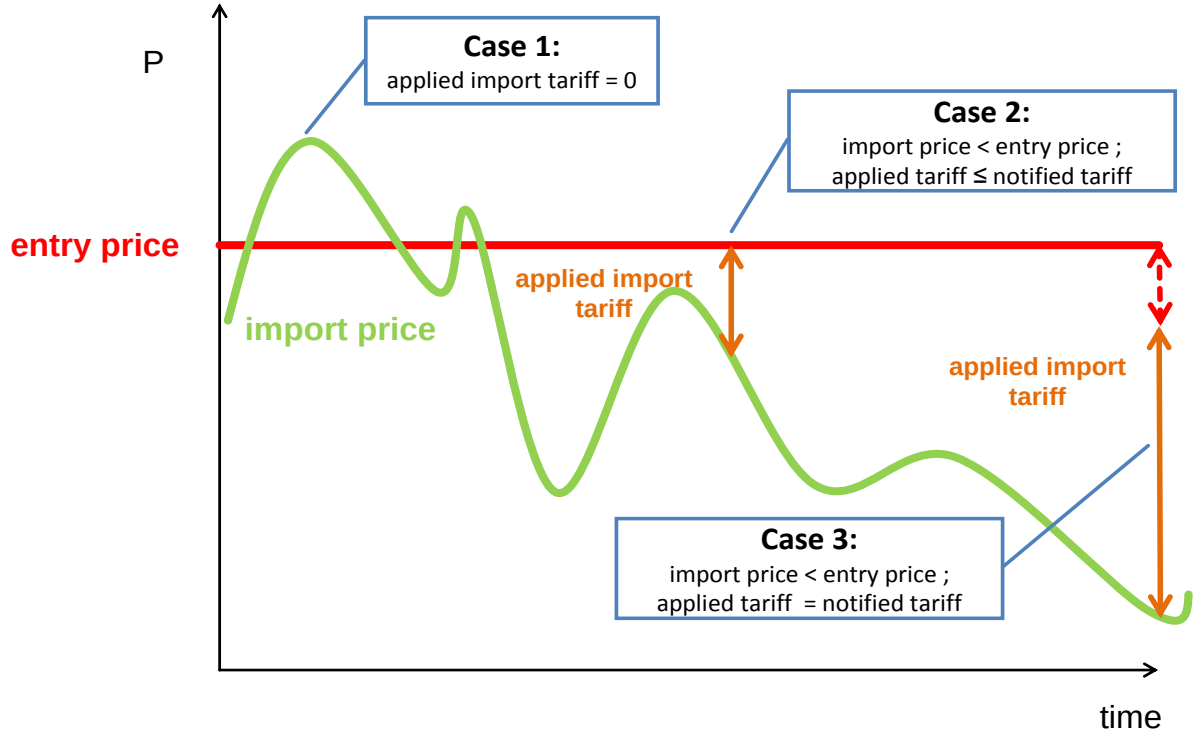
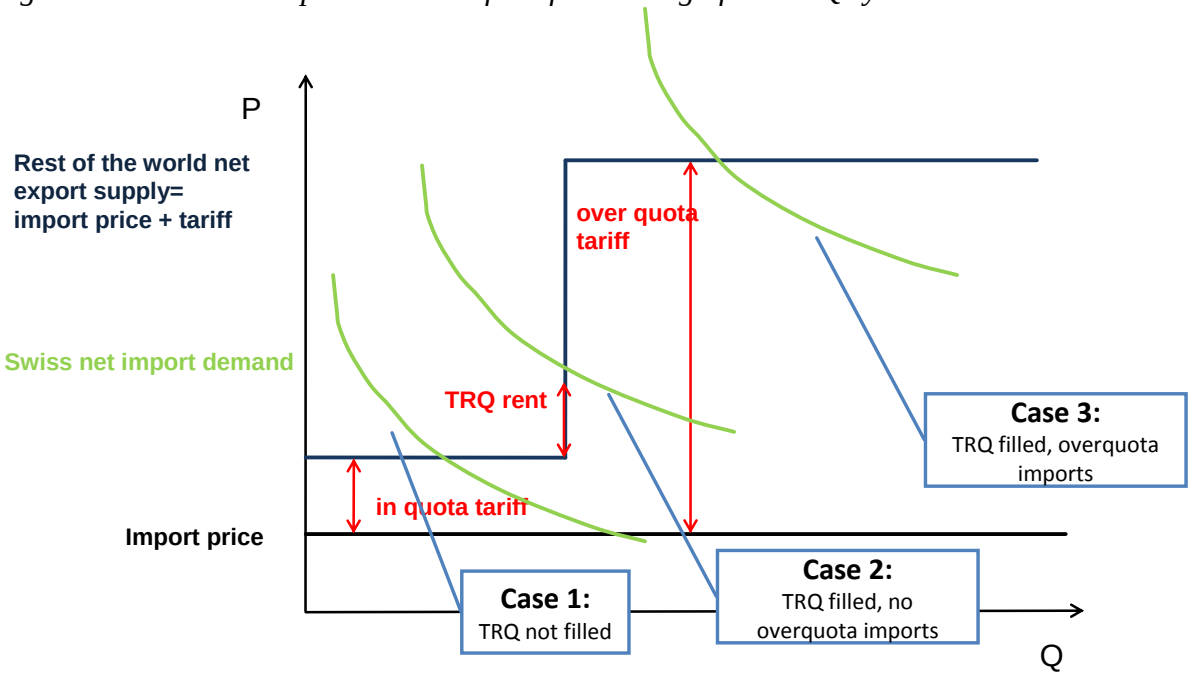


*Figure 9 – Schematic representation of the functioning of the TRQ system*




As far as wheat for feed use is concerned, the border protection system is somehow simpler than for the food case (Table 3). There is no TRQ and the entry price system is in place since 1995, so over the whole period under consideration in the present analysis. The applied tariff is established on a monthly basis as the difference between the international price (the before-tariff import price) and the entry price, unless this difference exceeds the maximum applicable tariff. In this latter case, the difference between the entry and the import price cannot be entirely compensated and, therefore, a gap will remain between the import and the domestic prices.

Both for food and feed uses, however, another mechanism may play a role in affecting the gap between the import and the domestic price. It is the possibility of declassifying wheat originally intended for food use towards the feed use. This declassification is temporary and is established by farmers' organizations when there is (an expectation of) oversupply for food use. Although this measure is not introduced by public institutions but by private agents, it is here considered as a "domestic policy" since it represents an intervention on the domestic market with the aim of influencing the transmission of price signals. In such circumstances, declassification aims at moving the downward pressure away from the wheat food price possibly to the wheat feed price thus contributing to restore or to maintain the gap occurring between these two domestic prices[9]. Declassification is at most effective if quantitative restrictions apply to food imports (otherwise it would be profitable to import up to re-establishing the pre-existing price equilibrium), which is indeed the case since a TRQ is in place.

[9] Note that declassification does not automatically apply to wheat of insufficient quality.

*Table 3 - Summary of the policy measures in place – wheat for feed use*

| Policy instruments | Description | Expected impact on price transmission | Changes over time (1997 – 2012) | Relationships with other policy instruments | Main issues |
|---|---|---|---|---|---|
| **Entry price** | Reference price for fixing the applied tariff | import price ≥ entry price<br>applied import tariff = 0 ; the entry price system is *de facto* not effective<br><br>import price < entry price *and* calculated applied tariff ≤ notified tariff<br>import price =entry price<br><br>import price < entry price *and* calculated applied tariff > notified tariff | In place since 1995.<br><br>Progressively lowered: 01.1997, 59 CHF/100 kg … 07.2009, 38 CHF/100kg. | Determines the height of the applied tariffs. | Impact on international price transmission. |
| **Applied tariff*** | Applied tariff = entry price - import price<br><br>Applied tariff ≤ notified tariff | the difference between entry price and import price cannot be fully compensated | Calculated on a monthly basis. | | |
| **Declassification to feed uses** | To avoid oversupply, cereals for food uses can be "declassified" into cereals for feed uses by the farmers' organization. | Upward pressure on food prices, possibly downward pressure on feed prices. | Occurred in 2002 -2005 and 2009 -2011. | | Impact on the development of domestic prices<br>Note: monthly data are not available for the analysis. |

### 4.2 Policy measures and price patterns

On the basis of the discussion above, we can expect an impact of these policy measures on domestic price formation and on price transmission. However, the interplay among these measures and the changing market conditions may substantially affect how policy interferes with price formation and transmission mechanisms. Therefore, what we observe may in practice be different from what we expect.

In terms of ex-ante expectation, we can distinguish the feed and food case. In the former, the obvious expectation is that the entry price system reduces the transmission of shocks from the international to the domestic market and maintains a variable gap between international and domestic prices. This is true even in the case of food where, however, the separation between the international and the domestic markets is reinforced and at the same time made more flexible by the TRQ system: the over quota intervention (very high tariff) makes this separation almost complete above a given import level but, at the same time, the autonomous temporary extension of the TRQ allows greater flexibility in this respect, especially when the domestic market is experiencing supply shortage and, therefore, high prices.

A further option to grant a flexible protection of the internal food market is represented by the declassification, whose expected outcome is to increase the gap between the domestic wheat food and feed price by increasing, or reducing the decline, of the former, due to a lower supply, and possibly lowering the latter, due to the increase of supply. Therefore, declassification might reinforce the stability of the domestic wheat food price possibly at the expense of an higher volatility of the domestic wheat feed price. However, one should not forget that the volumes involved are normally rather small if compared to the size of the market (see Figure 4 and Figure 7), and that the demand of wheat for feed uses is very elastic since many substitutes are available. All these factors might actually reduce the resulting impact on the feed price.

Assessing these ex-ante expectations of the impact of policy measures on price formation and transmission by just looking at the data is not easy. In fact, data about these policy measures are not necessarily available with the same time coverage and frequency of the price series they are expected to affect. For some policy measure, observations are available for a limited period of time, even because they have been only recently introduced (this is the case of the

entry price for food use). In other cases, available data are discontinuous because these policy measures are fixed or communicated only periodically (as in the case of the applied in quota tariff and of the TRQ). This makes difficult to assess the timing of the events, that is whether a policy intervention may be associated to a given movement of prices or not.

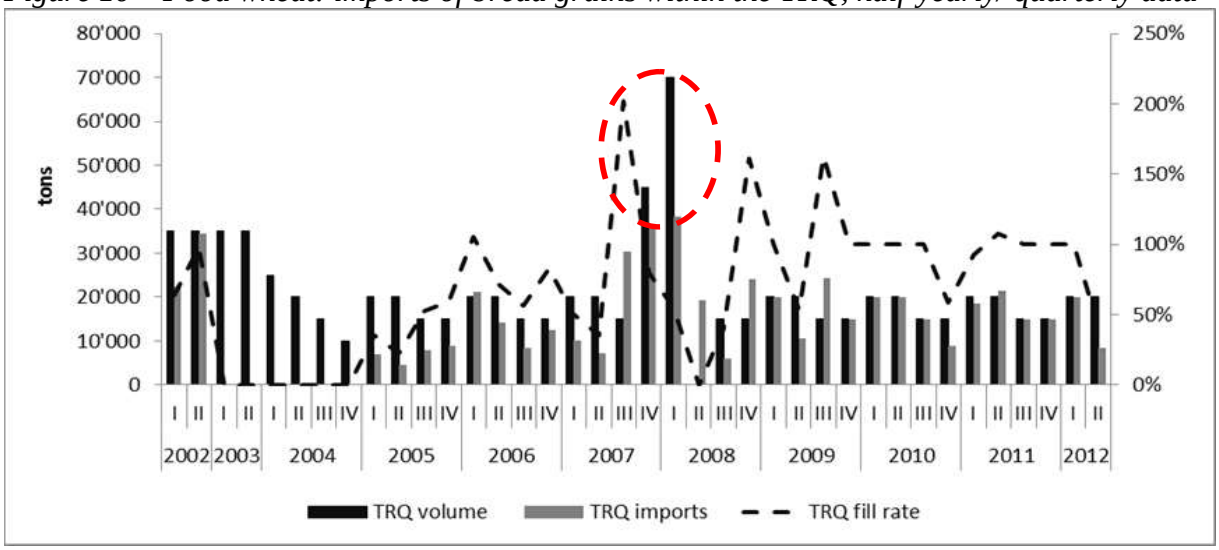
Figure 10 shows the evolution over time of the TRQ volume, which is established every six months and, since 2004, every four months[10]. Evidently, imports can be observed, at least in principle, on a continuous base, but to assess whether and to what extent the TRQ is filled the analysis must be necessarily based on half-yearly/quarterly observations (that is, when the TRQ is opened). If we just observe the data, what emerges is that until the 2007-2008 price peak, the TRQ imports always remained below the TRQ level with only one exception in the first quarter of 2006. As a consequence, the TRQ fill remained quite far from 100%. From mid-2007 onwards, we observe much more frequent cases where the imports entirely fill the TRQ and even exceed it, presumably due to the subsequent autonomous extension of the TRQ itself[11]. From mid-2007 onwards the TRQ fill rate is generally higher than in the period before, with the notable exception of some months in 2008, when the rising price peak on international markets discouraged imports. The fact that the TRQ is normally under filled or filled but that no overquota imports occur suggests that it is the in quota, rather than the over quota tariff that is relevant for the actual functioning of domestic markets.

How this dynamics may have affected the domestic food price is difficult to say. First of all, since these observed TRQ data are quarterly while the observed price series are monthly. Moreover, import prices used to calculate the applied tariff according to the entry price system are collected only every 6 or 3 months. Given this different frequency it is difficult to assess the timing of the effects of the policy on prices, also because policy decision is transmitted into markets, therefore prices, with some lag. For instance, up to 2005 the TRQ was totally or partially filled by allocating (by auctioning) licenses to importers, that may decide to exploit those licenses in the following weeks or months, or in general within the year of emission. Unfortunately, this effect is unobservable. Since 2005, the TRQs are allocated on a first come first served basis. Also in this case, importers decide when to use the TRQ after it has been released according to market conditions. This unknown lag between the policy decision and the impact on prices is even more true in the case of the TRQ extension. This was actually concentrated in last quarter of 2007 and first quarter of 2008 (when a period of high prices on international markets was followed by a low domestic harvest, then in an attempt to ease domestic markets) but the behavior of traders may have been affected even before and after this period due to the formation of expectations in this respect by traders themselves. Finally, it should be mentioned that when a quota applies duty free warehouses can be used to temporarily store goods on which no tax or duty has been paid yet. This allows to carefully select the appropriate timing at which imports will occur.

[10] The TRQs applies to bread grains (including wheat, rye, spelt, einkorn, emmer and others; Table 2). The share of wheat imports on the total imports of bread grains is usually very high (around 90%).

[11] This might also be due to duty free imports from Haute Savoy and Gex.

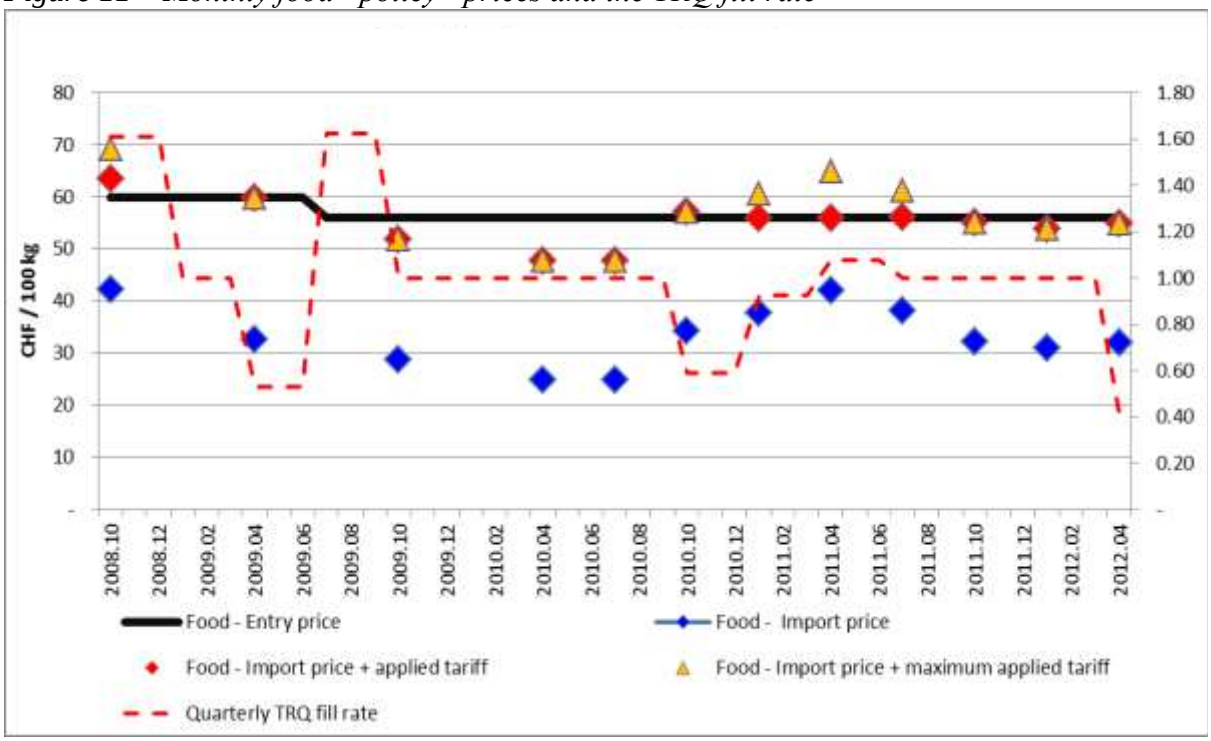
*Figure 10 – Food wheat: imports of bread grains within the TRQ, half-yearly/ quarterly data*




Source: FOAG. Only annual data are available for 2003 and 2004, which are then not shown in the picture.

Figure 11 reports the monthly food "policy" prices and the abovementioned TRQ fill rate just to provide further evidence of the difficulty in finding a consistent explanation, when only discontinuous observations, of the timing of the events are available. While the entry prices, following the long-term trend of the domestic price, have been lowered from 60 to 56 CHF/100kg in mid-2009, the movement of the before-tariff import prices and, consequently, of the associated policy measure is much less smooth and regular. The TRQ fill rate should consistently accommodate these movements but this is not necessarily the case. In most of the observations the applied tariff is "capped" by the maximum allowed one, i.e., the applied tariff has reached the maximum admitted level but this is enough to cover the gap between the before-tariff import price and the entry price, thus making the imported product entering the domestic market at a price equal to the entry price (the after-tariff import price).
For almost an entire year between 2009 and 2010, international prices have been so low that the after-tariff import price remained below the entry price and, therefore, the domestic price. Under such circumstances a major incentive to import may be argued and, indeed, the fill rate of the TRQ was 1. But the TRQ remained completely filled also in the subsequent months (with the notable exception of the last quarter of 2010), when international prices went up and the after-tax import prices returned to the level of the entry price. In this case a lower incentive to import could be assumed.
The timing of the events, the frequency of the observation of data as well as the formation of expectations especially in periods of market turbulence and uncertainty may make the linkage between market prices and policy measures diverge from the ex-ante expectations.

*Figure 11 – Monthly food "policy" prices and the TRQ fill rate*

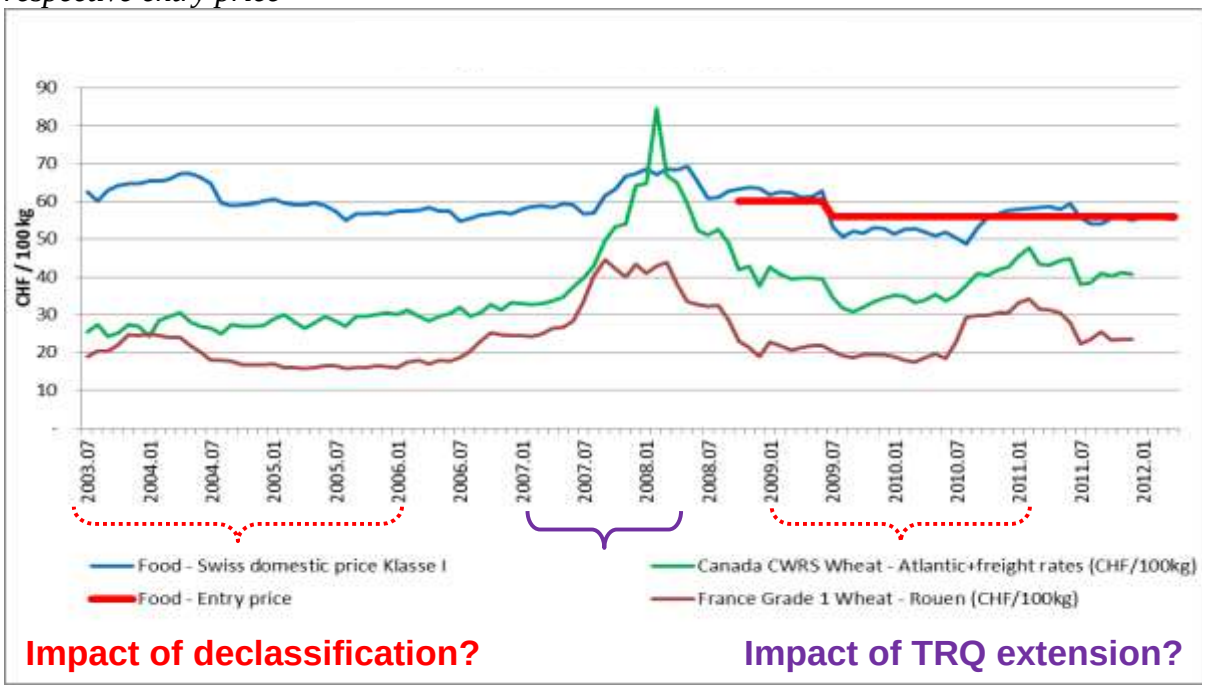



Source: FOAG, Swiss Customs Administration.

In general terms, however, the role played by these policy measures, as well as their complex interplay, did not affect what appears to be the already mentioned prevalent long-term tendency of both the wheat food and feed domestic prices, that is, their gradual decline and convergence towards the international prices. Figure 12 shows that, if we exclude the 2007-2008 price peak, the gap between the domestic food and the international (both European and North-American) prices is slightly and gradually shrinking. This is evidently accompanied and, presumably, caused by the abovementioned reduction of the respective entry price in mid-2009. However, this convergence process, facilitated by the decline of the entry price and, therefore, of the in quota tariffs, not necessarily implies higher price transmission especially during periods of market turmoil. In fact, during this convergence process, other temporary policy interventions, namely TRQ extension and declassification, may have had a role, though is difficult to state, on a purely descriptive base, in which direction and with which magnitude. They could have had only a temporary effect during turbulent times, for instance by shifting and reducing the price "bubble" but without affecting the long-term tendencies.

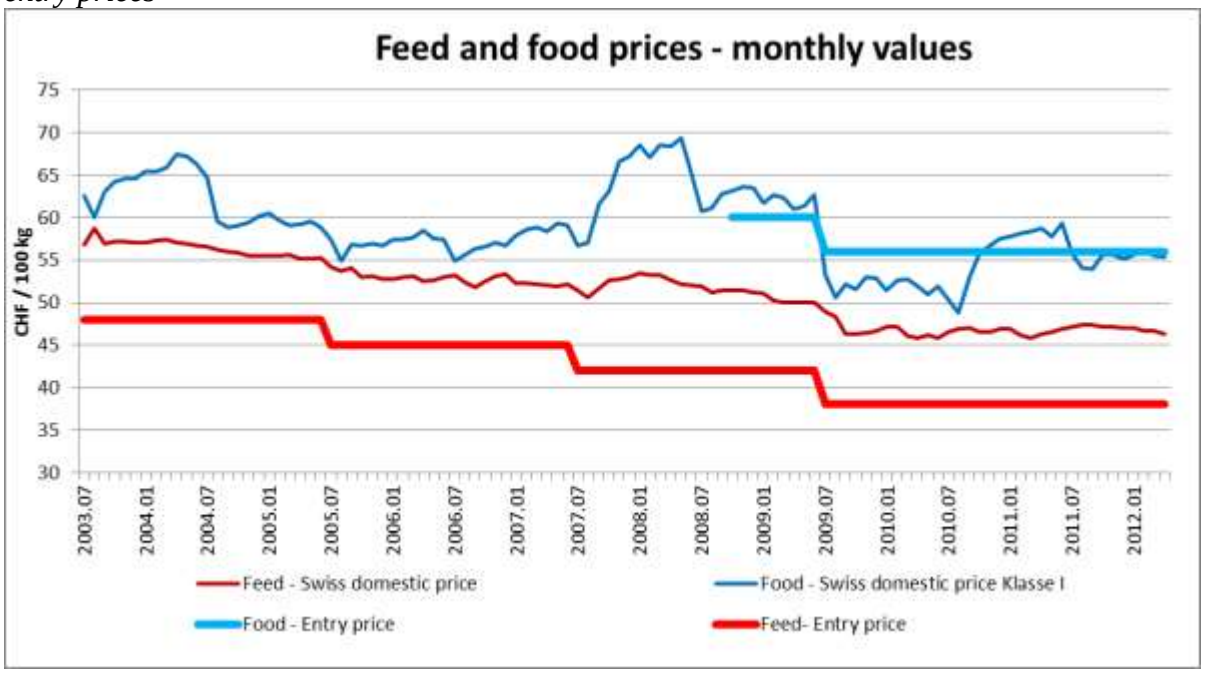
Figure 13 further illustrates this declining and converging pattern for the domestic price of wheat for feed use. It also clarifies that, more regularly than the case of wheat for food use, this decline strictly follows the decline of the respective entry price. Moreover, the entry prices of the food and feed uses remain constantly separated with the former above the latter by more than 15 CHF/100kg. Evidently, this difference in the entry prices may explain why the wheat feed price is closer to the international price and, therefore, why there is a constant gap between the two domestic prices. Fixing two different entry prices, together with admitting declassification in specific market conditions, can represent the key policy variable forcing the wheat feed prices to lie below the wheat food prices.

*Figure 12 – Long-term evolution of international and domestic wheat food prices and of the respective entry price*




Source: FOAG

*Figure 13 – Long-term evolution of domestic wheat food and prices and of the respective entry prices*




Source: FOAG

## 5. Variables selection and the research plan

In this section, the general research scheme is presented (5.1), followed by a description of its application to the available data (5.2).

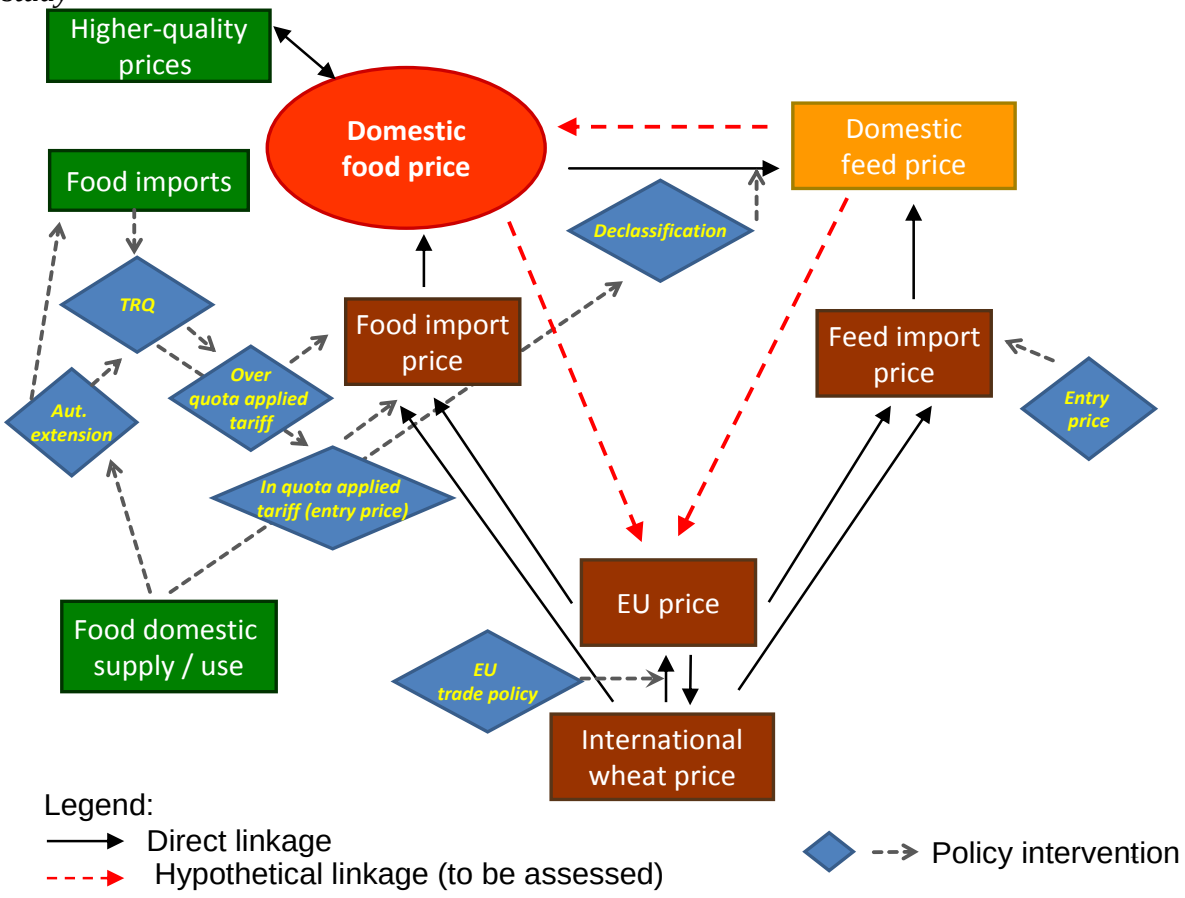
### 5.1 The model: a flow-diagram representation

Moving from the descriptive analysis of the price evolution and of the role of policy measures to the rigorous assessment of this role, as implied by the objective of this study, requires a methodological step forward. First of all, a selection among the available variables (i.e., price series) is needed. As shown in the previous sections, many different wheat price series are observed but with a heterogeneous time coverage. Moreover, they contain a largely redundant information with differences that are either negligible or not clearly or easily motivated.

An econometric assessment of the role of policy measures must be based on a quite limited number of price series with a long enough time coverage and a robust linkage with market fundamentals and, possibly, policy measures. The objective, here, is to identify few price series that: contain parsimonious (not redundant) information, therefore with a limited variability to be explained; with an homogeneous and long-time coverage; with a clear interpretation of their drivers and of the relationship among them, that is, allowing for a synthetic econometric model of price formation and transmission.

Therefore, in looking for such a synthetic econometric model, our first research objective is to identify the key prices for the analysis, the key transmission relationships among them, the key policy variables and the key policy mechanisms affecting these relationships. Finding this synthetic model represents our logical and methodological approach to the present research problem. It is visually represented in the flow diagram shown in Figure 14.

*Figure 14 - The logical diagram representing the synthetic model adopted in the present study*



According to such representation, the domestic food price is the key variable of the model. The main reason for this is that it constitutes the main target (i.e. variable) of the whole policy intervention depicted in the previous section. As the main policy objective is eventually to support and stabilize the income of Swiss farmers, the support and stabilization of the wheat price is the shortest way to achieve this target. Therefore, the domestic food price also drives trade policy decision like, for example, the declassification, whenever the domestic food price becomes too low. Evidently, beside the international price, the main drivers of the food price in the domestic market are the domestic wheat demand and the domestic wheat supply for food use. A proper policy must therefore take into consideration these aspects when trying to stabilize the domestic price, and this drives other policy interventions like, for instance, the TRQ extension whenever the domestic demand largely exceeds the domestic supply and the international price may be helpful to stabilize the domestic market.

Though the domestic food price is considered as the key variable of the present analysis, it must still explicitly take into account that what is really specific to the Swiss case is, again, the market segregation of wheat for food and feed use and, therefore, the presence of two distinct prices for the two cases. As discussed, this segregation is possible, or at least is facilitated, by the different regulation between food and feed uses. In this respect, a different border protection and the possibility of declassification play a critical role.

Nonetheless, the feed use of wheat within the domestic market remains ancillary with respect to the food and so its price as well. This occurs because feed is only a small part of the domestic market and it is mostly imported, and because the wheat demand for feed use is much more elastic with respect to price than the demand for food use since the former can be used in various combinations with other cereals, so its price changes can be easily adjusted by moving to or from other cereals' use. The secondary position of the feed use within the domestic market is actually demonstrated by the fact that that declassification is only admitted in one direction (from food to feed use and not *vice versa* though technically possible and without significant implication for consumption) and it is not activated because of what happens to domestic feed demand, but it is only driven by what happens to domestic food prices.

The other variables included in the synthetic representation of Figure 14 and the respective linkages or relationships summarize the analysis presented in the previous sections. Empirically assessing, i.e. estimating, these linkages is eventually the objective of the econometric strategy and results put forward in the next sections. Both the black continuous arrows (representing the key price linkages) as well as the dashed red arrows (representing possible feedbacks among prices) and the grey dashed arrows (representing the influence of policy variables on these linkages) are of interest of this econometric work. Moreover, this challenging econometric estimation requires a clear, univocal and parsimonious identification of the series representing the various price and non-price variables of the model represented in Figure 14.

### 5.2 From the diagram to the data

To further reduce the minor (at least with respect to the present objectives) aspects in the adopted model, other simplifying assumptions are needed to further reduce the number of variables and linkages to be modelled, identified and estimated. First of all, quality differentials are neglected. This particularly concerns the food use for which several different prices, expressing such differentials, are available. The economic relationships under study are relatively independent on quality differentials as they hold true for all different qualities though, reasonably, with a different intensity as any of these different qualities may constitute a different segment of the food market. Such exclusion of quality differentials is evidently

much less relevant in the case of the feed use. The consequence of this is that only one price for the food use is considered, which somehow represents a sort of basic quality level (*food_k1*); all the other food prices are excluded from the analysis (Table 4).
As far as feed domestic prices are concerned, we have to choose the price at the farm level (*feed_farm*) rather than at the mill (*feed_mill*), due to the very limited number of observations available for the latter. It should nonetheless remembered that *feed_farm* is the purchasing price for the farmers (it is then measured at the end of the food chain, differently from all other prices used in this analysis, which are producer prices) and that it represent a smaller share of the market than *feed_mill*.
The diagram in Figure 14 acknowledges the presence of high quality products (such as those represented by prices *food_top* and *food_bio*) as well as of market fundamentals like the import levels and the domestic supply and use. However, all these variables represented as green boxes will not be explicitly included in the econometric analysis. After all, market fundamentals are evidently structural determinants of market prices but, just for this reason, prices themselves already include all the information contained in these fundamentals. Looking directly at the linkage across prices, therefore, allows taking into account also the role of market fundamentals on these prices.
In the jargon of econometrics, this implies focusing the analysis on the reduced-form representation of the price linkages rather than on their structural form, which would also include the role played by market fundamentals, therefore also representing how prices are formed. Here, however, the interest is on how price shocks are transmitted and the role of policy variables in this respect, as this is the critical influence of trade policies. Given this objective, the reduced-form representation of the price linkages (or price transmission equations) is fully suitable.
All these considerations allow to strongly reducing the number of variables to be considered in the analysis. These are summarised in Table 4 also explaining which model variables these series are expected to capture. On this selected variables, the objective is to firstly identify the main price linkages represented by the black arrows in Figure 4 together with the possible feedbacks (the dashed red arrows). These linkages are those among the domestic food and feed prices (*food_k1* and *feed_farm*, respectively), and among the domestic and external prices (*feed_i_price*, *can_stl*, *de*). Only one Canadian price is selected (*can_stl*) the other being very similar, while the German price (*de*) is preferred to the French one as the former seems more relevant for the Swiss domestic market. While, given the characteristics of the underlying product, the German price can be used as a reference price for both the food and the feed case, the higher quality of the Canadian wheat makes it relevant for price transmission in the food market only. The reference import price for feed (*feed_i_price*) is also included, though quite close to the German case, since this is the one which is in practice used in combination with the entry price to fix the applied tariff. On the contrary, we prefer to focus on the international prices at the border and we not consider, at least at this stage, the "traded prices", which would add further elements of complexity that are beyond the scope of the present analysis.
Secondly, the policy variables are included in the analysis. As discussed, the relevant policy variable eventually affecting the domestic price is the applied tariff; therefore, the international prices augmented by the applied tariffs are included in the analysis (*can_stl_ta*, *de_stl_ta*). Actually other policy variables are included in the econometric estimation but not in Table 4 as they are not continuous variables, therefore time series, but are just measures activated temporarily (often for a very limited period of time) and, in any case, whose observations are, as mentioned, not available with monthly frequency. Therefore, they will enter the econometric models as time dummies (taking value 0 when they are not active, 1

when they are activated). This is the case for the TRQ extension and for declassification from feed to food use.
The same treatment is actually applied to another non-policy variable, that is, the 2007-2008 price bubble. If we carefully look at the Swiss domestic food prices we notice that some periods of rapid growth and rapid decline can be observed. These price bubbles, for instance, appears in late 2003 and in mid-2011 but the most relevant one occurred in 2007-2008 when the prices increased by 45-65% in very few months and then quickly returned to their initial values. These peaks correspond to analogous "bubbles" appeared in the international markets through the period even if their intensity is not fully correspondent. It may also surprise that while the domestic food price is evidently affected by the "bubbles" this occurs only very marginally in the case of the feed price (Figure 15). Evidently the price linkage operates in these periods but with forms that may differ with respect to the "normal" times, also for the specific role played by the policies during these "turbulent" times.

*Table 4 – List of the variables adopted in the econometric analysis*

| ***Prices*** | ***In the model*** | ***Details*** |
|---|---|---|
| *food_k1* | Domestic food price(1) | Klasse I; "At the mill"; include transport costs. |
| *feed_farm* | Domestic feed price | Feed use; Purchasing prices for farmers |
| *feed_i_price* | International feed price | Eu feed quality |
| *can_stl* | International wheat price | Canada CWRS Wheat – St Lawrence |
| *de* | EU price | Germany Grade B Wheat – Hamburg |
| *can_stl_ta* | International wheat price entering the domestic market | Canada CWRS Wheat – St Lawrence plus the food/feed tariff (ta) |
| *de_ta* | EU price entering the domestic market | Germany Grade B Wheat - Hamburg plus the food/feed tariff (ta) |

Therefore, in the present estimation strategy the final objective is to estimate the direction and magnitude of the impact of policy measures, but also of the price bubbles, in the price transmission under analysis, that is, of the grey dashed lines in Figure 14. The key price linkages under considerations are those among the prices represented in brown boxes in Figure 14, that can be in turn divided in two groups of relationships, those concerning the domestic linkages between feed and food prices, and the linkages between domestic and external prices.

*Figure 15 - Price bubbles in the domestic and the international markets (CHF/100kg)*

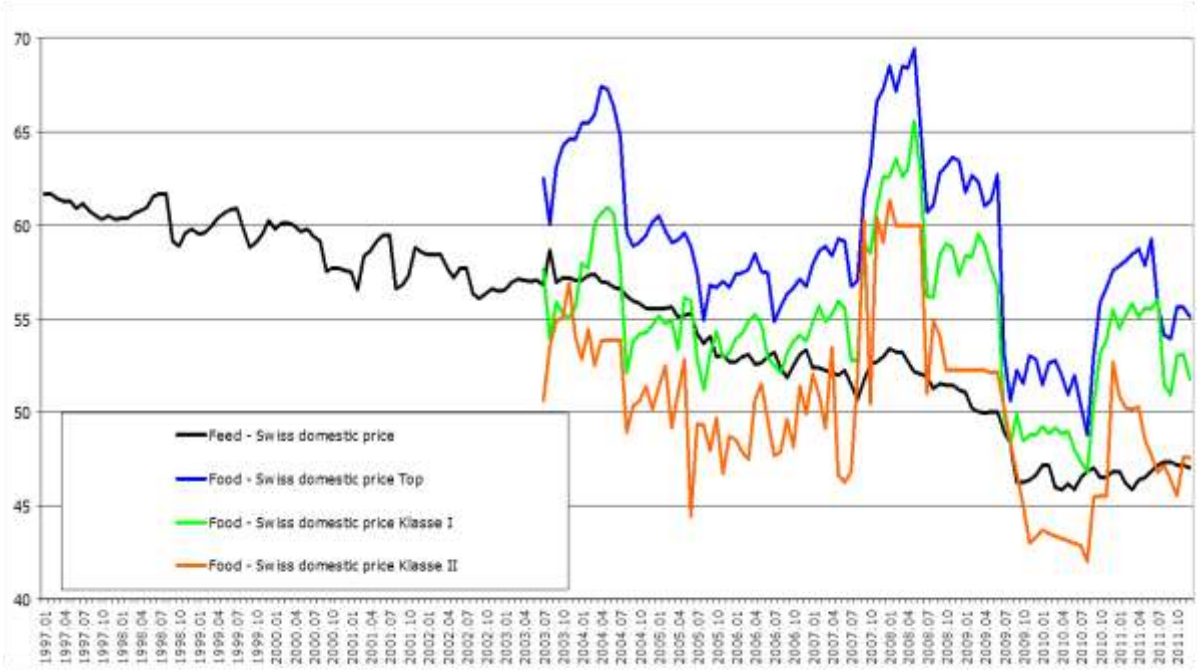
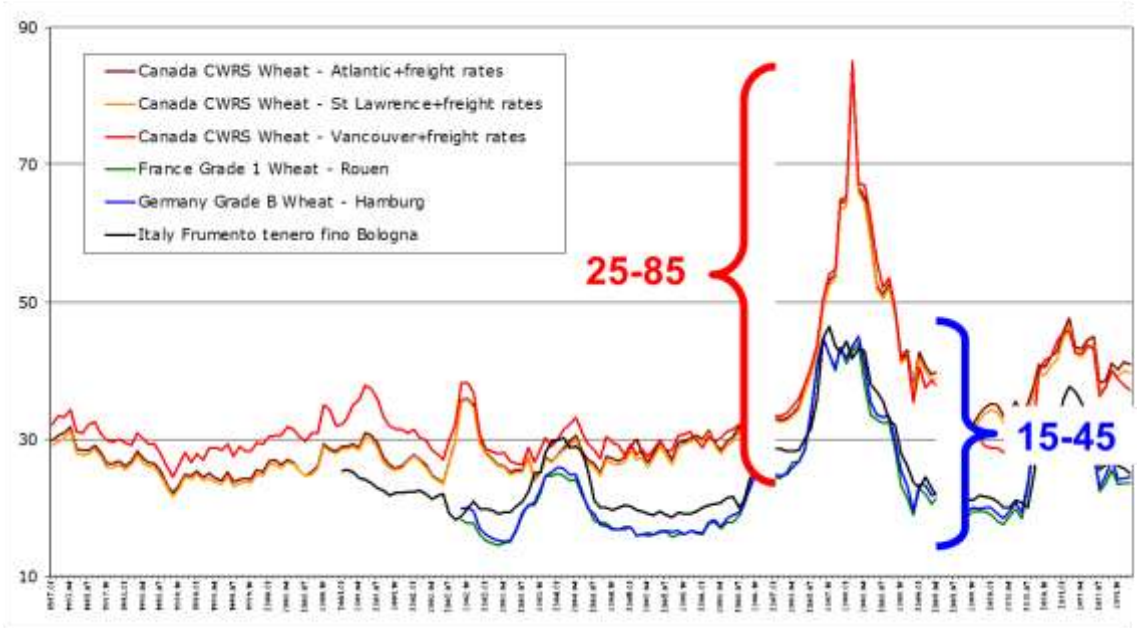



*Figure 15 - (continues)*




Source: FOAG

## 6. Econometric strategy

The objective of this section is to identify an econometric strategy to convert the description and conjectures made in the previous sections into testable hypothesis.

In particular, three general hypotheses can be formulated, as follows. *Hypothesis 1* is that prices move together. In this respect, we want to test if there are price linkages between the series analyzed and, if yes, which are their characteristics. *Hypothesis 2* is that something changed over time in these price linkages. We here want to test if endogenous and exogenous factors had an impact on the distance and/ or the price transmission elasticity between the

prices. *Hypothesis 3* is that policies acted as some of these factors. Here, we want to further study how they might have influenced the price transmission mechanisms.
In order to test these three hypotheses, a stepwise approach is followed. First of all, the stochastic properties of each of the individual series are analyzed (section 6.1). Indeed, this exam is a fundamental prerequisite to study the price transmission mechanisms between the series. Then, we test for the presence of common stochastic properties, or common stochastic trends between them (section 6.2). At this point, we can proceed estimating the price transmission relations both without and by accounting for the factors which might have had an impact on them, namely the policy measures (section 6.3). The econometric procedure which will be implemented in described in section 6.4.
Throughout our analysis, the logarithmic transformation of prices is considered rather than the price levels, as this allows referring to price linkages as elasticities. Therefore, $\mathbf{p}_i$ henceforth will identify the series of the price logarithms of the *i-th* time series.

### 6.1 Tests on the individual price series

To explore in depth the stochastic properties of the price series under study, we test in sequence for the presence of unit roots, of AutoRegressive Conditional Heteroskedasticity (ARCH) effects, for persistence (long memory or fractional integration) and for explosiveness.
A fundamental characteristic of a price series is the persistence of its shocks as indicated by its autocorrelation coefficients. If the autocorrelation coefficients are equal to 1, shocks will never vanish over time. In this case the series is said to contain a «unit root» or, alternatively, to be integrated of order 1, or I(1), since it needs to be differentiated to become stationary, I(0), i.e. with time invariant mean and variance. As a matter of fact, empirical tests often find evidence of unit roots in commodity prices. In this work, we run both the ADF (Adjusted Dickey-Fuller) and the PP (Phillips-Perron) tests (Enders, 1995), since the latter is more robust under heteroskedasticity. In addition, a KPSS test (Kwiatkowski, Phillips, Schmidt and Shin) is performed. Unlike the ADF and the PP tests, in the KPSS test the null hypothesis is that the series is I(0), while in the alternative hypothesis it is I(1). Therefore, the KPSS test is expected to reveal those series that the conventional ADF test tend to accept as I(1) while, in fact, they are only near unit-root processes.
ARCH effects refer to variations over time of the variance of the price series. The variance can be considered as a measure of volatility. For example, one possible reconciliation of I(1) series with the nonlinearities implied by explosive bubbles can be found in the presence of ARCH effects, that is, in a dramatic increase in volatility during the bubble. Testing for the presence of an ARCH effect can be done by an LM test on the heteroskedastic structure of the error term of ADF regressions.
In addition to non stationarity and heteroskedasticity, agricultural prices are often characterised by long memory (Wei and Leuthold, 1998). In such cases, price series are neither I(0) nor I(1) but rather I(d) processes, with $0<d<1$. This is also called fractional integration, and can be tested following the approach proposed by Geweke and Porter-Hudak (1983) and then modified by Phillips (1999a,b; see Esposti and Listorti, 2013, for further details). The procedure proposed by Phillips (1999a, b) tests the value of parameter d. If $0<d<1$, then fractional integration is accepted.
Finally, we want to test for the presence of an explosive root in addition to a unitary one. Intuitively, a temporary explosive root in price series in addition to a unit root might explain the behaviour of "bubbles" that inflate and deflate within a relatively limited period of time. This issue has gained particular relevance in recent years, mostly due to the price rallies occurring on international markets. Phillips and Yu (2012) propose a test for the presence of bubbles which allow assessing period-by-period the presence of an explosive root within

processes that would be otherwise ruled as I(1). In this test, forward recursive ADF tests are run on the price series. The forward recursive test is based on a conventional ADF regression computed on a fraction of the sample; in subsequent regressions, the initial data set is supplemented by successive observations. Of all these forward recursive ADF tests, the test of explosiveness considers the maximum observed value (SADF) under the null hypothesis of unit root and against the right-tailed alternative hypothesis of an explosive root. The SADF test then allows assessing period-by-period the possible nonstationarity of the price series against an explosive alternative. This kind of test may be particularly helpful also to locate over time the origin and the conclusion of the exuberance, by simply displaying the series of the abovementioned forward recursive ADF test and checking if and when exceeds the right-tailed critical values of the asymptotic distribution of the standard Dickey–Fuller t-statistic.

### 6.2 Identification of common stochastic properties

After the properties of the individual time series have been explored, we can proceed to test for the presence of interdependence relations between them. We do it by testing for cointegration between the price variables. As it will be explained more extensively in the next section, the presence of cointegration implies that observable variables exhibiting nonstationary behaviour will nonetheless maintain long-run relationships.

In this work, we assess the existence of cointegration in two ways. Firstly, we test for cointegration by using the conventional Johansen cointegrating rank test (the trace test; Johansen, 1995) between the series. Secondly, we also test for cointegration "ex post" by checking in the econometric models that we estimate the stationarity of the residuals from the long run relation. This is particularly useful when policy breaks are to be accounted for, as in these cases the use of the standard Johansen test is not straightforward.

### 6.3 Estimating price transmission: VEC models (VECM)

Once cointegration has been tested, we can proceed to the study of empirical models. The study of price transmission mechanisms basically implies referring to the so called *Law of One Price* (LOP): in markets linked by trade and arbitrage, prices expressed in the same currency will be equalized, net of transport costs. Although the very designation as a "law" reflects the faith placed in its adherence, in reality a number of factors can actually prevent prices from convergence, such as transaction costs, product homogeneity and differentiation, market power, border and domestic policies, and so on (for further details see Listorti, 2009).

As already mentioned, the investigation of price linkages is usually carried out within reduced-form models, i.e., based only on price data. Fackler and Goodwin (2001) provide a common template based on linear excess demand functions and embracing all dynamic regression models from which an estimable reduced-form model can be derived.

Since the seminal work of Ardeni (1989), cointegration techniques have been extensively used for the study of agricultural price transmission mechanisms. They presuppose that observable variables exhibiting nonstationary behaviour will maintain long-run relationships, despite they can deviate from them in the short run. In this case the long-run relationship is nothing but the LOP, which is assumed to be valid in the long run even if prices are allowed to diverge from it in the short run.

Besides allowing for the distinction between short and long run dynamics, cointegration models gained a prominent role in price transmission analyses since all prices can be assumed to be endogenous to the system (there is no need of an a priori hypothesis on which price is leader and which follower), and since they provide a flexible framework for the insertion of structural breaks.

The basic structure of a Vectorial Error Correction Models (VECM) can be represented as (Johansen, 1995):

$$\Delta \mathbf{p_t} = \boldsymbol{\alpha}\boldsymbol{\beta}' \mathbf{p_{t-1}} + \sum_{i=1}^{k-1} \Gamma_i \Delta \mathbf{p_{t-i}} + \boldsymbol{\varepsilon_t} \quad (1)$$

where $\mathbf{p}_t$ is a vector containing the prices, $\boldsymbol{\beta}$ is the cointegration matrix which contains the long-run coefficients (the degree of price transmission), $\boldsymbol{\alpha}$ is the loading matrix which contains the adjustments parameters (a measure of the speed of price transmission), $\boldsymbol{\Gamma}$ are matrixes containing coefficients that account for short-run relations, and $\boldsymbol{\varepsilon_t}$ are white noise errors. Being prices written in logarithmic form, an implicit assumption is that price spreads (that is, all components which account for price spreads) are a stationary proportion of prices. The coefficients in the cointegration vector will provide information on the long run (LR) gap and price transmission elasticity between the prices (an indication on the LOP). The adjustment coefficients will give indications on the presence and the speed of the short run (SR) response to the deviations from the LR linkage.

Two further considerations are worth mentioning. First of all, interestingly, it has been shown that the standard Johansen estimation procedure remains a valid and appropriate empirical strategy even in presence of a possible temporary explosive behaviour (see Engsted, 2006, and Nielsen, 2010). This means that the VECM described in equation (1) can be applied also if any of the series displays an explosive root.

Secondly, as mentioned before, VECM can also be adapted to the introduction of structural breaks. Johansen et al. (2000) propose a model where breaks in the deterministic terms occur in known points in time, generalizing the standard Johansen cointegration test by admitting up to two predetermined breaks in the cointegration space. As shown in equation 2, the general VECM becomes:

$$\Delta_1 \mathbf{p}_t = \boldsymbol{\alpha}\begin{bmatrix}\boldsymbol{\beta}\\ \boldsymbol{\mu}\end{bmatrix}' \begin{bmatrix}\mathbf{p}_{t-1}\\ t\mathbf{E}_{t-1}\end{bmatrix} + \boldsymbol{\gamma}\mathbf{E}_t + \sum_{i=1}^{S-1} \boldsymbol{\Gamma}_i \Delta_1 \mathbf{p}_{t-i} + \sum_{i=1}^{S}\sum_{j=2}^{q} \mathbf{k}_{i,j}\mathbf{D}_{j,t+k-i} + \sum_{m=1}^{M} \boldsymbol{\Theta}_m \mathbf{w}_{m,t} + \boldsymbol{\varepsilon}_t \quad (2)$$

The time series is divided in *q* sub-periods, separated by the occurrence of the structural breaks, where *j* denotes any generic sub-period. $\mathbf{E_t}$ is a vector of q dummy variables that take the value 1 if the observation belongs to the $j_{th}$ period (j = 1, …, q), and 0 otherwise. $\mathbf{D_{j,t+k-i}}$ is a so-called impulse dummy; $\mathbf{w_t}$ are the so-called intervention dummies (up to M). The short run parameters are included in matrices $\boldsymbol{\gamma}$, $\boldsymbol{\Gamma}$, $\mathbf{k}$, and $\boldsymbol{\Theta}$ (VxV). $\boldsymbol{\mu}$ is the vector containing the long run drift parameters and $\boldsymbol{\beta}$ contains the usual long run coefficients in the cointegrating vector. Within this framework it is possible to allow the parameters of the cointegration vector to vary according to the introduction of structural breaks.

The breaks induced by the policy regime changes can indeed act in combination with other breaks, like the 2007-2011 price bubbles. Based on this theoretical background, it is thus possible to include in our price transmission analysis the policy measures which are expected to have had an impact on the wheat markets as well as the explosive behaviour which might have occurred in some of the series.

These factors might have had an impact in the magnitude and direction of the price transmission and can be assumed to affect both the LR price linkage and the SR adjustment mechanisms, introducing elements of non linearities in the relations. Consequently, a "bubble" and the "policy" dummies can be included in the cointegration space, if they are assumed to have had an impact con the long run relation between the prices. They can be represented as policy regime changes, that is, structural breaks (dummies), or exogenous variables (for continuous variables: e.g. EP). Alternatively, if they are expected to have influenced only the short run dynamics, they can be accounted for in the short run terms of the model.

### 6.4 Econometric procedure

Based on the theoretical framework introduced in the previous section, an appropriate estimation procedure is implemented. First of all, in order to provide a structured answer to the policy questions identified above, the price series are assigned to different sub groups identified as follows:

- International prices;
- Wheat for food uses: domestic and international prices;;
- Wheat for feed uses: domestic and international prices
- Wheat for food and feed uses: domestic prices.

In the next sections, following the tests on the individual properties of the series (section 7.1), cointegration among the prices belonging to the same sub group is assessed using the conventional Johansen (trace) test (section 7.2). If cointegration is found, then the respective VECM is estimated following specifications (1) and (2) (section 8).

The optimal number of lags is selected according to the conventional information criteria (Akaike information criterion, AIC; Bayesian information criterion, BIC; Hannan-Quinn criterion, HQC), up to a maximum of 6.

In all cointegration tests and VECM estimates a constant term is included in the cointegration space. Indeed, both theory and visual inspection of the data imply the presence of a constant in the long-run relationship, accounting for all elements contributing to price differentials not explicitly modelled in the price transmission equation. This means that the cointegrating relation has a constant mean, but there are no linear time trends in the level of the data.

Each model is estimated both without and with the policy and bubble structural breaks relevant to each specific case. These are assumed to have an impact on the constant and eventually on the price transmission elasticity term inside the cointegration space. In equation (2), the coefficients of the policy dummies and exogenous policy variables have to be interpreted as relative to the constant or price transmission term valid over the whole period. According to the nature of the policy measure analyzed, its impact on the short run mechanisms will also be tested.

Conventional ADF tests are run on the residuals of the cointegration relation to check if the rank selected without the breaks with the conventional Johansen cointegration test can be confirmed after their introduction (as explained before, this means checking cointegration "ex post"). At the same time, this post-estimation allows assessing the presence of a residual explosive component in the estimated relationship.

Weak exogeneity tests (i.e., conventional t-tests on the coefficients of vector $\boldsymbol{\alpha}$) for the estimated VECM are eventually performed to assess the direction of horizontal transmission of price shocks. Through these tests, for any group of prices we can identify which causal relationships emerge, that is, which are the "central" (i.e., leader in price formation) and "follower" markets (Verga and Zuppiroli, 2003).

## 7. Stochastic properties of the series (the tests)

According to the stepwise evaluation proposed in the previous section, here the stochastic properties of the individual series are described (7.1), followed by the tests on the identification of common stochastic trends between them (7.2).

### 7.1 Tests on the individual series

As anticipated in section 6.1, we here test in sequence for the presence of unit roots, for explosiveness, for AutoRegressive Conditional Heteroskedasticity (ARCH) effects and for persistence (long memory or fractional integration).

Before proceeding with these tests, we want to check for normality and analyse the structure of autocorrelation of the price series.

With the exception of some of the Swiss domestic prices for food, the null hypothesis of normality can be rejected in most of the cases (Table 5).
As far as the structure of autocorrelations is concerned (Table 6), for most prices only the first lag (or the first two lags) are significant. Given the monthly nature of the data, it is also not surprising that the observations of the previous year are significant ($11^{th}$ to $14^{th}$ lag), which is an indication of behaviour affected by seasonality. Visual evidence of seasonal behaviour is intuitively represented in Graphs 16 and 17.

*Table 5 – Normality tests on price series (p-values in parenthesis) – in bold cases for which we reject the null of normal distribution (5% confidence level)*

| Price | Skewness/Kurtosis tests for Normality | Shapiro-Wilk W test |
|---|---|---|
| food_top | 0.85 (0.65) | 0.98 (0.17) |
| food_k1 | 1.91 (0.38) | 0.98 (0.13) |
| food_k2 | 1.17 (0.56) | 0.98 (0.16) |
| food_k3 | 0.86 (0.65) | 0.98 (0.13) |
| food_IPS_top | 4.23 (0.12) | **0.97 (0.02)** |
| food_IPS_k1 | 4.39 (0.11) | **0.96 (0.00)** |
| food_IPS_k2 | 4.51 (0.10) | **0.96 (0.00)** |
| food_bio | 5.18 (0.07) | **0.97 (0.05)** |
| food_trad_overs | **36.02 (0.00)** | **0.86 (0.00)** |
| food_trad_EU | **10.56 (0.01)** | **0.93 (0.00)** |
| food_bio_trad_overs | 15.75 (0.00) | **0.91 (0.00)** |
| food_bio_trad_EU | **5.96 (0.05)** | **0.95 (0.00)** |
| food_ta | **9.22 (0.01)** | **0.93 (0.00)** |
| food_tb | **15.52 (0.00)** | **0.88 (0.00)** |
| food_EP | **15.52 (0.00)** | **0.88 (0.00)** |
| food_i_price | 0.33 (0.85) | 0.94 (0.46) |
| can_atl | **33.37 (0.00)** | **0.89 (0.00)** |
| can_stl | **35.15 (0.00)** | **0.89 (0.00)** |
| can_van | **55.72 (0.00)** | **0.82 (0.00)** |
| fr | **8.08 (0.02)** | **0.95 (0.00)** |
| de | **9.56 (0.01)** | **0.94 (0.00)** |
| feed_mill | **11.77 (0.00)** | **0.94 (0.00)** |
| feed_farm | **53.06 (0.00)** | **0.91 (0.00)** |
| feed_EP | **37.80 (0.00)** | **0.97 (0.00)** |
| feed_ta | **66.05 (0.00)** | **0.83 (0.00)** |
| feed_i_price | **13.58 (0.00)** | **0.94 (0.00)** |

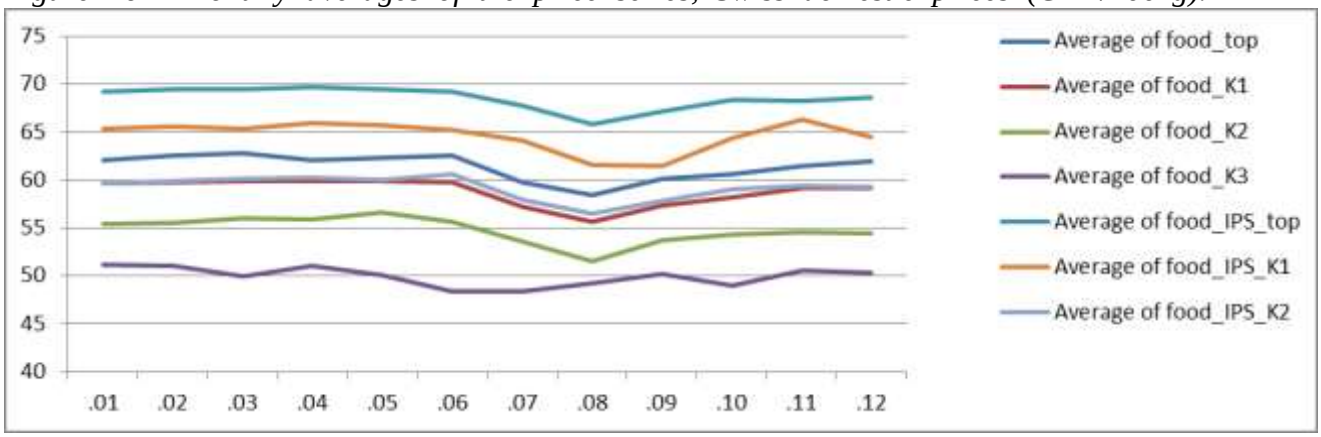
Table 6 – Structure of autocorrelations: evidence from partial autocorrelogram (PAC) (max 18 lags)

| Price | Highest PAC term | At lag | Latest consecutive lag with significant PC[a] | Other significant lags[a,b] |
|---|---|---|---|---|
| food_top | 0.928 | 1 | 1 | 4, 13 (-) |
| food_k1 | 0.924 | 1 | 1 | 13, 14 (-) |
| food_k2 | 0.887 | 1 | 1 | 13 (-) |
| food_k3 | 0.829 | 1 | 2 | |
| food_IPS_top | 0.915 | 1 | 1 | 13, 14 (-) |
| food_IPS_k1 | 0.809 | 1 | 2 | 13, 14 (-) |
| food_IPS_k2 | 0.915 | 1 | 1 | 13 (-) |
| food_bio | 0.599 | 1 | 2 | 14, 16 (-) |
| food_trad_overs | 0.829 | 1 | 1 | |
| food_trad_EU | 0.797 | 1 | 2 | 8 (-) |
| food_bio_trad_overs | 0.870 | 1 | 2 | 12 (-) |
| food_bio_trad_EU | 0.732 | 1 | 1 | 16 (-) |
| food_ta | 0.959 | 1 | 1 | 7, 13 (+) |
| food_tb | 0.889 | 1 | 1 | |
| food_EP | 0.889 | 1 | 1 | |
| food_i_price | | | | |
| can_atl | 0.969 | 1 | 1 | |
| can_stl | 0.968 | 1 | 1 | 3 (-), 11 (+) |
| can_van | 0.953 | 1 | 1 | 3 (-), 11 (+) |
| fr | 0.969 | 1 | 2 | |
| de | 0.971 | 1 | 2 | 4 (-) |
| feed_mill | 0.951 | 1 | 1 | 9 (+) |
| feed_farm | 0.996 | 1 | 1 | 4, 11 (+) |
| feed_EP | 0.993 | 1 | 1 | |
| feed_ta | 1.005 | 1 | 1 | 7, 17, 18 (+) |
| feed_i_price | 0.960 | 1 | 1 | |

[a] 95% confidence bands

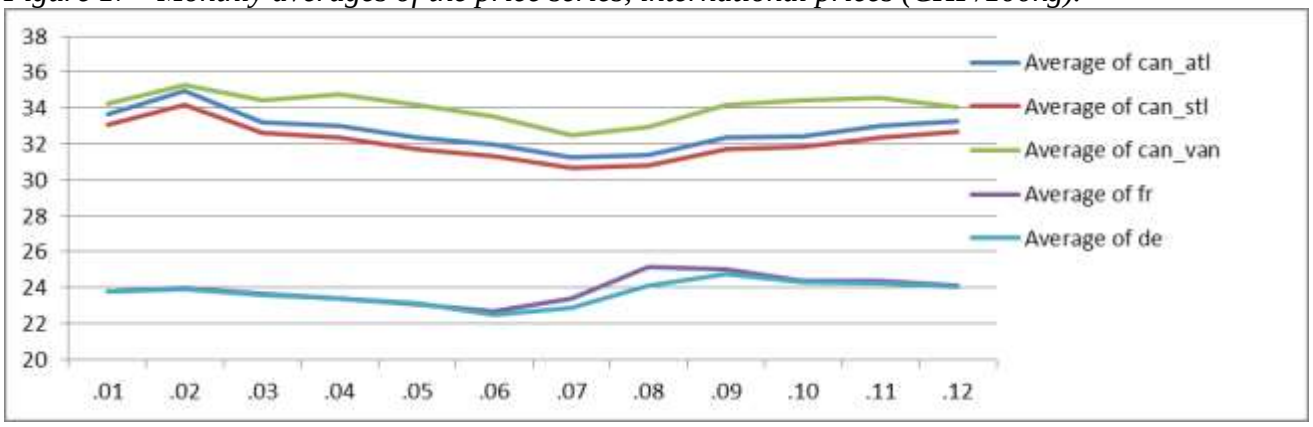
[b] In parenthesis the sign of the significant partial correlation term

*Figure 16 - Monthly averages of the price series, Swiss domestic prices (CHF/100kg).*




Source: FOAG

*Figure 17 - Monthly averages of the price series, international prices (CHF/100kg).*




Source: FOAG

### 7.1.1 Unit root tests

Table 7 reports unit root tests on the logarithms of the price series, $\mathbf{p}_i$ and on the respective first differences, $\mathbf{\Delta}_1\mathbf{p}_i$. Although only some of them will be included in the econometric analysis which will follow, for the sake of completeness we here run the tests on all the series at our disposal.

As far as the domestic prices for food are concerned, *food_top*, *food_k1*, *food_ips_top* unambiguously display evidence of a unit root. For the other prices, the outcomes of the three unit root tests considered are not always concordant. In particular, for *food_bio* all tests suggest a stationary behaviour; for *food_k2* and *food_ips_k1* both the PP and the KPSS test suggest a I(0) behaviour; for *food_k3*, the PP test suggests a I(0) behaviour; for *food_ips_k2*, the KPSS suggests a I(0) behaviour.

This somehow mixed results for the domestic prices strongly contrast with what we see for international prices: here all series (*fr*, *de* and the three Canadian prices) are clearly I(1). For the traded prices, while the ADF tests (with the exception of *food_trad_eu*) indicate the presence of a unit root, the PP and KPSS tests always suggests that the series are instead I(0). Remembering that the traded prices account for transport costs and import taxes, one could speculate that the absence of a clear-cut evidence of unit root behaviour, despite the non-stationary behaviour in the international ones, could be explained by the stabilising effect of Swiss policies for soft wheat.

Both domestic and import prices for feed (*feed_mill*, *feed_farm*, *feed_i*) show a unit root.

The tests are also repeated on *de* and *can_stl* after having added the applied import tariff for food (*ta_fo*) and the one for feed (*ta_fe*), since these composite series will be used in the econometric analysis which will follow. According to the ADF test, the series are I(1). However, when the tariff for food is added, the series are I(0) according to the KPSS test; when the tariff for feed is added, they are I(0) according to the PP test. This could be taken as an indication that adding the import tariffs accounts for a sort of stabilising effect which waters down the non stationarity of the original price series.

### 7.1.2 Explosiveness

Concerning the possible presence of explosive behaviour in the price series, according to the SADF test, we can conclude that a temporary explosive behaviour is manifest in only and all the international prices. Once the applied tariffs are added to them, this evidence however disappears, with the exception of the series *can_stl_ta_fo*. As explained before, the SADF test may be particularly helpful also to locate the origin and the conclusion of the exuberance. Figure 18 reports this evidence and shows that the price bubble is limited to the months of

August – October 2007 for the EU prices, and December 2007 to February 2008 for the Canadian ones.

*Table 7 – Unit-root and explosive-root tests on $\mathbf{p}_{ik}$ and on $\Delta_1\mathbf{p}_{ik}$: Adjusted Dickey-Fuller (ADF)[a], Phillips-Perron (PP) [b], and Kwiatkowski, Phillips, Schmidt e Shin (KPSS)[c] tests (p-values in parenthesis; the values for which the null is rejected are in bold - 10% critical values); Phillips et al.(2009) SADF tests of explosive roots on $\mathbf{p}_{ik}$ [d] (the values for which the null is rejected are in bold: values greater than asymptotic 1% critical values).*

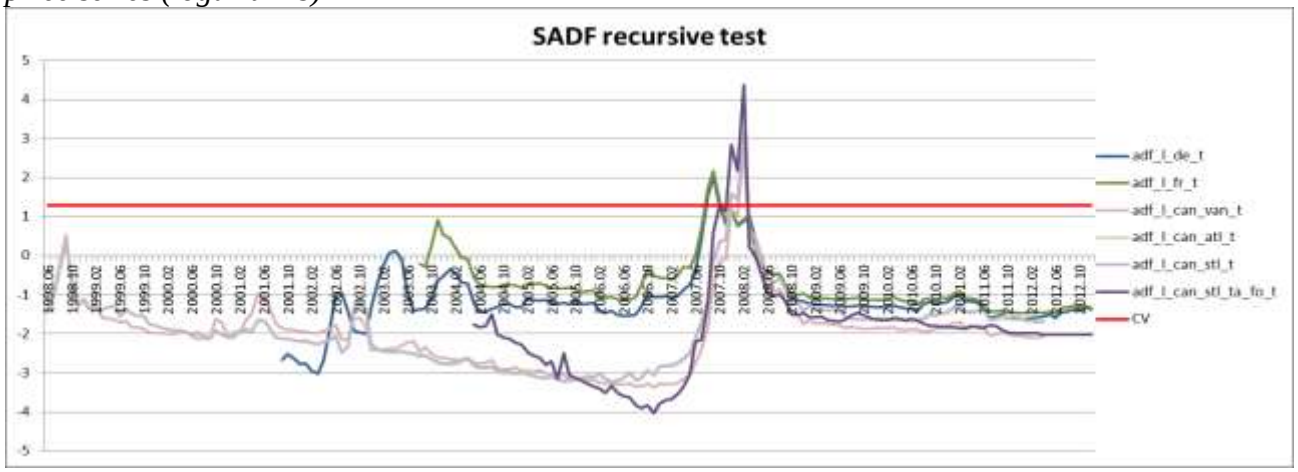
| Price | $\mathbf{p}_i$ | | | $\Delta_1\mathbf{p}_i$ | | | SADF test (Forward Recursive Regressions) | |
|---|---|---|---|---|---|---|---|---|
| | ADF | PP | KPSS | ADF | PP | KPSS | (r=0.1) | (r=0.2) |
| food_top | -2.026 (0.276) | -2.183 (0.212) | **0.361** | **-4.630 (0.0001)** | **-10.280 (0)** | 0.054 | -0.377 | -0.377 |
| food_k1 | -2.524 (0.110) | -2.208 (0.203) | **0.365** | -2.233 (0.195) | **-9.220 (0)** | 0.062 | -0.105 | -0.105 |
| food_k2 | -2.174 (0.216) | **-2.631 (0.087)** | 0.243 | **-4.758 (0)** | **-10.042 (0)** | 0.057 | -0.653 | -1.230 |
| food_k3 | -2.472 (0.123) | **-3.218 (0.019)** | **0.354** | **-14.341 (0)** | **-16.016 (0)** | 0.063 | -1.181 | -1.627 |
| food_ips_top | -1.823 (0.370) | -2.313 (0.197) | **0.372** | **-4.190 (0.001)** | **-11.818 (0)** | 0.051 | -0.832 | -1.063 |
| food_ips_k1 | -1.986 (0.293) | **-3.542 (0.007)** | 0.304 | **-14.993 (0)** | **-13.803 (0)** | 0.050 | -0.265 | -0.265 |
| food_ips_k2 | -1.727 (0.415) | -2.517 (0.111) | 0.106 | **-9.510 (0)** | **-9.570 (0)** | 0.049 | -0.339 | -0.488 |
| food_bio | **-2.687 (0.076)** | **-5.984 (0)** | 0.109 | **-10.983 (0)** | **-22.032 (0)** | 0.054 | -1.602 | -1.602 |
| food_trad_overs | -2.222 (0.198) | **-3.275 (0.016)** | 0.118 | **-10.687 (0)** | **-12.044 (0)** | 0.074 | 0.264 | 0.264 |
| food_trad_eu | **-2.678 (0.078)** | **-3.861 (0.002)** | 0.115 | **-3.698 (0.004)** | **-17.814 (0)** | 0.067 | -0.965 | -1.676 |
| food_bio_trad_overs | -1.990 (0.292) | **-2.795 (0.059)** | 0.186 | **-16.018 (0)** | **-17.279 (0)** | 0.133 | 0.322 | 0.322 |
| food_bio_trad_eu | -2.210 (0.203) | **-4.548 (0.0002)** | 0.136 | **-8.920 (0)** | **-15.060 (0)** | 0.067 | -1.558 | -1.558 |
| can_atl | -1.417 (0.576) | -1.882 (0.341) | **0.956** | **4.584 (0.0001)** | **-12.769 (0)** | 0.052 | **3.135** | **3.135** |
| can_stl | -1.484 (0.542) | -1.917 (0.324) | **0.935** | **-4.520 (0.0001)** | **-12.948 (0)** | 0.051 | **3.126** | **3.126** |
| can_van | -2.249 (0.189) | -2.515 (0.112) | **0.516** | **-4.663 (0)** | **-13.207 (0)** | 0.040 | **2.835** | **2.835** |
| fr | -1.593 (0.486) | -1.961 (0.304) | **0.416** | **-3.874 (0.002)** | **-8.123 (0)** | 0.047 | **2.171** | **2.171** |
| de | -1.523 (0.522) | -2.063 (0.260) | **0.540** | **4.322 (0.0004)** | **-8.833 (0)** | 0.045 | **2.037** | **2.037** |
| feed_mill | -1.214 (0.665) | -1.246 (0.654) | **0.623** | **-6.846 (0)** | **-7.850 (0)** | 0.148 | 0.260 | 0.260 |
| feed_farm | -0.085 (0.949) | -0.295 (0.926) | **1.500** | **7.366 (0)** | **-14.063 (0)** | 0.073 | 0.642 | 0.642 |
| feed_i_price | -1.849 (0.357) | -2.184 (0.212) | **0.789** | **-4.333 (0.0004)** | **-13.021 (0)** | 0.048 | 0.058 | 0.058 |
| de_ta_fo | -1.840 (0.361) | -2.226 (0.197) | 0.168 | **-3.498 (0.008)** | **-8.067 (0)** | 0.059 | 1.893 | 1.893 |
| de_ta_fe | -1.987 (0.293) | **-3.867 (0.002)** | **1.090** | **-7.863 (0)** | **-19.247 (0)** | 0.043 | -0.837 | -1.041 |
| can_stl_ta_fo | -2.368 (0.151) | -2.272 (0.181) | 0.120 | **-3.237 (0.018)** | **-10.420 (0)** | 0.070 | **4.369** | **4.369** |
| can_stl_ta_fe | -2.235 (0.194) | **-3.411 (0.011)** | **0.725** | **-4.785 (0)** | **-17.811 (0)** | 0.043 | -0.665 | -0.665 |

| Asymptotic ritical values (Phillips et al., 2009): | r(0) = 0.1 | r(0) = 0.2 |
|---|---|---|
| 1% confidence level | 2.01 | 1.91 |

*Table 7 (continues)*

[a] $H_0$: unit root. The test specification includes a constant term, seasonal dummies and all significant lags "testing down" up to a maximum of 12. The tests have been repeated also by not including seasonal dummies. Results differs only in a few cases: notably, they indicate I(0) behaviour for *food_k1*, *food_k2*, *food_ips_k2*, *food_bio* and *fr*. For *food_top*, *food_k3*, *food_ips_top*, *food_ips_k1*, *food_trad_eu* the null of stationarity is accepted only at 5% significance. On price differences, they indicate I(1) behaviour for *food_top*, *food_k2*, *food_ips_top* and *food_ips_k2*. These results are available upon requests.
[b] $H_0$: no unit root; tests are performed including a constant term and assuming 12 lags. The tests were repeated also by using 4 lags, the only difference being an I(0) behaviour of *food_trad_overs*. Results are available upon request.
[c] $H_0$: no unit root. The test specification includes 12 lags, seasonal dummies and a constant term. The tests have been run also without seasonal dummies. These tests show no difference and are available upon request. The 10% critical value is 0.348.
[d] $H_0$: no explosive root; tests are performed including a constant term and no lags. The rolling window is differentiated according to time series (0.1 * *n* and 0.2 * *n* , where *n* is the size of the sample).

*Figure 18 - Dating the bubble: time series of the forward recursive ADF t- international price series (logarithms)*




Source: FOAG

### 7.1.3 ARCH effects

As far as ARCH effects are concerned, while they clearly appear for *food_k3* and *food_ips_k1*, some weak evidence of volatility clustering also emerges for the international prices (*can_atl*, *can_stl*, *can_van*, *de*; Table 8). In other words, for the international prices there is some evidence that their variance, which is an indication of volatility, varied over time. It is interesting to notice that this is not the case for the most relevant Swiss domestic prices.

### 7.1.4 Long memory tests

As far as long memory is concerned, it seems to emerge for *food_k2*, *food_k3*, *feed_farm* (Table 9). For *food_top*, *food_k1*, *food_IPS_k2*, *food_bio* and most of the international and traded prices the presence of a unit root would seem confirmed, while the behaviour of the other series is much less clear cut.

*Table 8 – ARCH(p) tests on ADF unit-root test equations ($H_0$: no ARCH effects; p-values in parenthesis)* [a] *– in bold cases for which the null is rejected (5% confidence level)*

| **Price** | **Price Logarithms** | |
|---|---|---|
| food_top | 7.574 | (0.816) |
| food_k1 | 2.225 | (0.999) |
| food_k2 | 6.717 | (0.876) |
| food_k3 | **29.180** | **(0.003)** |
| food_IPS_top | 10.798 | (0.546) |
| food_IPS_k1 | **28.740** | **(0.004)** |
| food_IPS_k2 | 12.883 | (0.378) |
| food_bio | 11.448 | (0.491) |
| food_trad_overs | 7.916 | (0.792) |
| food_trad_EU | 9.161 | (0.689) |
| food_bio_trad_overs | 15.003 | (0.241) |
| food_bio_trad_EU | 10.598 | (0.564) |
| can_atl | 18.687 | (0.096) |
| can_stl | 18.017 | (0.115) |
| can_van | 20.426 | (0.059) |
| fr | 13.059 | (0.365) |
| de | 18.863 | (0.092) |
| feed_mill | 8.371 | (0.756) |
| feed_farm | 5.691 | (0.931) |
| feed_i_price | 10.914 | (0.536) |

[a] ARCH test is an LM test, thus is distributed as a $\chi^2(p)$. The adopted specification includes 12 lags (p=12) and a constant

*Table 9 – Long-memory (fractional integration) tests p-values of the price series according to Phillips (1999a,b). If d=0 the series is I(1); if d=1 it is I(1); if 0<d<1 it is I(d)(long memory process)* [a] *– in bold cases for which the null is accepted (5% confidence level)*

| | **Price Logarithms** | | **Δ Price Logarithms** | |
|---|---|---|---|---|
| **Price** | t ($H_0$: d=0) | z ($H_0$: d=1) | t ($H_0$: d=0) | z ($H_0$: d=1) |
| food_top | **0.015** | 0.093 | 0.674 | **0.000** |
| food_k1 | **0.026** | 0.116 | 0.737 | **0.000** |
| food_k2 | **0.018** | **0.036** | 0.649 | **0.000** |
| food_k3 | **0.022** | **0.030** | **0.035** | **0.000** |
| food_IPS_top | 0.054 | 0.322 | 0.453 | **0.000** |
| food_IPS_k1 | 0.215 | **0.001** | **0.001** | 0.202 |
| food_IPS_k2 | **0.034** | 0.106 | 0.281 | **0.000** |
| food_bio | **0.006** | 0.065 | **0.048** | **0.000** |
| food_trad_overs | **0.012** | 0.200 | 0.315 | **0.000** |
| food_trad_EU | **0.000** | 0.652 | 0.207 | **0.000** |
| food_bio_trad_overs | **0.000** | 0.418 | 0.518 | **0.000** |
| food_bio_trad_EU | 0.618 | **0.000** | **0.000** | 0.212 |
| can_atl | **0.000** | 0.151 | 0.522 | **0.000** |
| can_stl | **0.000** | 0.171 | 0.475 | **0.000** |
| can_van | **0.001** | 0.440 | 0.091 | **0.000** |
| fr | **0.000** | 0.903 | 0.814 | **0.000** |
| de | 0.093 | **0.022** | 0.416 | **0.000** |
| feed_mill | 0.197 | **0.012** | 0.118 | **0.000** |
| feed_farm | **0.003** | **0.025** | 0.316 | **0.000** |
| feed_i_price | 0.173 | **0.001** | 0.161 | **0.000** |

[a] The original test has not been detrended. The test's arbitrary power parameter is here assumed equal to 0.55[12]

[12] Test robustness is often assessed using a set of values of the power parameter (see Phillips, 1999a,b) ranging from 0.4 to 0.75. Here, a value in the middle of this range has been adopted. Nonetheless, test results for

### 7.2 Common stochastic trends

Since we can safely assume that all the price series that we intend to use for the econometric analysis are I(1), in order to understand if they are linked together by a long run relation we can proceed with the standard Johansen cointegration test.

As shown in Table 10, the domestic prices of wheat for feed and food uses turn out not to be cointegrated. When the relations between the domestic and the international prices (German, Canadian) are studied, no cointegration emerges for wheat for feed uses, while the domestic price of wheat for food is cointegrated with the German one. The international prices are cointegrated between them.

In the case of wheat for food uses, adding the import duty to the international price series does not alter the results: there is always cointegration in the case of the German price, but not for the Canadian one. In the case of wheat for feed uses, the German price series plus the import duties is cointegrated with the domestic price, while it was not the case without the tariff. This appears as a first strong evidence of the relevance of the entry price mechanism for the feed wheat. The domestic price series is not linked to the German one, whereas import duties are calculated so as to bring the international prices close to the entry and, consequently, the domestic prices. This is however not the case for the Canadian price.

The feed price is not cointegrated with the reference import price for feed. The latter is however cointegrated with the Canadian and German prices.

*Table 10 –Johansen cointegrating rank test (Johansen, 1995). The cases for which the null is accepted are in bold (p-values are reported in parenthesis; 10% confidence level)*[a]

| Prices | | n. of lags | Rank | |
|---|---|---|---|---|
| | | | 0 | 1 |
| food_k1 | feed_farm | 1 | 13.055† | 3.838 |
| food_k1 | can_stl | 4 | 15.490† | 5.721 |
| food_k1 | de | 1 | 22.157 | 7.600† |
| food_k1 | can_stl_ta_fo | 1 | 15.601† | 2.486 |
| food_k1 | de_ta_fo | 1 | 33.218 | 6.385† |
| feed_farm | feed_i_price | 1 | 13.691† | 3.657 |
| feed_farm | can_stl | 1 | 12.395† | 4.128 |
| feed_farm | de | 1 | 10.207† | 2.653 |
| feed_i_price | can_stl | 1 | 22.003 | 3.062† |
| feed_i_price | de | 1 | 32.916 | 2.064† |
| feed_farm | can_stl_ta_fe | 1 | 7.983† | 3.106 |
| feed_farm | de_ta_fe | 1 | 43.758 | 3.759† |
| can_stl | de | 4 | 27.810 | 4.862† |

[a] Trace test. The test is run in the "restricted constant" case and a number of lags identified according to the conventional information criteria (AIC, BIC, SBIC). Seasonal dummies have been included. When seasonal dummies are not included in the regressions, results do not vary.

† Accepted rank: lowest rank whose test result is lower than 10% critical values.

## 8. VECM estimation: results

Based on the empirical tests run in the previous sections, here the VECM are estimated. Following the division of the price series into the various sub groups presented before, first the dynamics on the international markets are explored (section 8.1); then, the relations between domestic and international prices for wheat for food uses are studied (section 8.2),

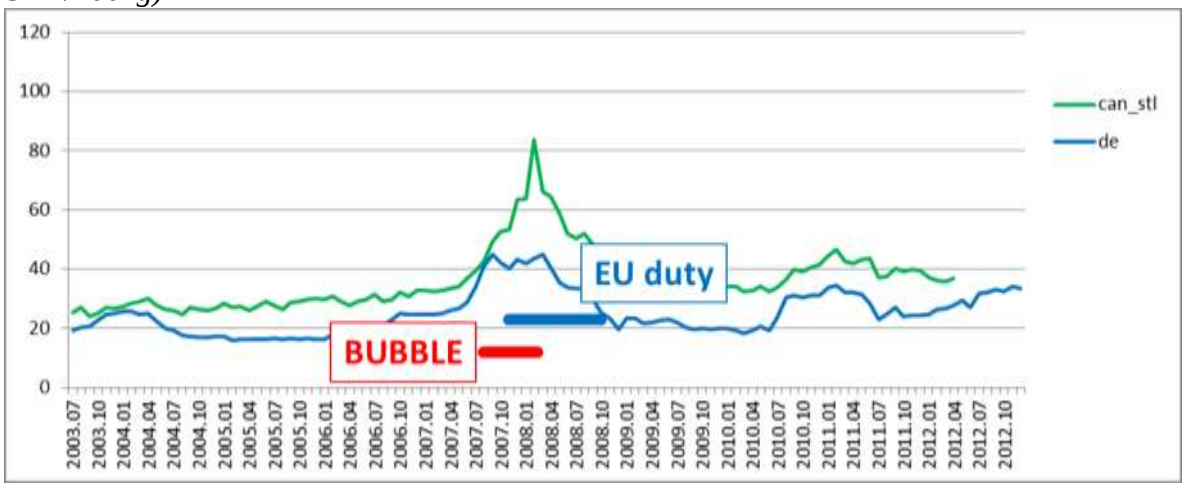
alternative values of the power parameter have been also obtained and are available on request. They do not significantly differ, however, from those here presented.

followed by those related to wheat for feed uses (section 8.3). Finally, the relations existing between the prices for food and feed uses on domestic markets are analyzed (section 8.4)[13].

### 8.1 International prices

In order to understand the price transmission mechanisms on international markets, we examine a VECM for a system constituted only by the European and American prices. Figure 19 reports the price series under study, together with the relevant structural breaks that will be analysed afterwards.

*Figure 19 – Time pattern of the variables considered in the VECM for international prices (CHF/100kg)*




Source: FOAG

The two series are cointegrated according to the Johansen test. The price transmission elasticity reported in the cointegration vector turns out to be almost equal to one and highly significant. As far as the short run dynamics are concerned, it is interesting to notice that it is the German price that behaves as weakly exogenous, while the adjustment coefficient of the Canadian price is significant. This means that it is the Canadian price which adjusts to the disequilibria from the cointegration relationship.

In addition, we want to test if the long run price transmission relation has been influenced by two factors: the presence of explosive behaviour (bubble), which, as seen in section 7.1, is present in both price series, and the suspension of EU import duties on cereals implemented by the European Commission to confront the price spikes on international markets. Both factors are assumed to affect the distance between the prices; the corresponding dummies are then inserted in the cointegration vector. The presence of explosive behaviour is mimicked by a dummy variable (*bubble*) which is equal to 1 for all months between August 2007 and February 2008, and 0 otherwise. The suspension of EU import duties is represented with a dummy variable (*duty*) which takes the value 1 for all months between January 2008 and October 2008, and zero otherwise[14] (Figure 19).

We let the structural breaks affect only the constant term of the cointegration relationship. In this case, we are interested in knowing if the presence of the bubble on international markets and the removal of EU import duties had an impact on the distance between the price series. The estimations indicate that while the bubble seems to have increased the distance between the two prices, the suspension of EU import duties had a counter effect. However, this latter

[13] The econometric estimates are obtained using the Gretl (http://gretl.sourceforge.net/) and STATA® softwares.

[14] See Reg. CE 1/2008, Reg. CE 608/ 2008 and Reg. CE 1039/2008. The suspension was originally extended until June 2009, but then, the reintroduction of duties was anticipated at the end of October 2008.

variable is not significant. The long run price transmission elasticity becomes equal to 0.8; the German price always behaves as weakly exogenous.

*Table 11– Price transmission relations for food: VECM estimates (standard errors in parenthesis) – Canadian and German prices* [a]

| *Cointegrating vector (β)* | **Without breaks** | **With breaks** |
|---|---|---|
| can_stl | 1*** | 1*** |
| de | -1.060(0.111)*** | -0.824 (0.185)*** |
| constant | -0.205(0.347) | -0.923(0.562) |
| bubble | | -1.209(0.419)*** |
| duty | | 0.214(0.205) |
| *Adjustment vector (α)* | | |
| can_stl | -0.115(0.043)*** | -0.131(0.032)*** |
| de | 0.045(0.042) | -0.036(0.033) |
| *ADF test on residuals of long-run relation* [b] | -3.562*** | -2.907*** |

[a] The optimal lag of the VECM has been selected according to the conventional information criteria by introducing a constant and seasonal dummies in the regressions. The optimal lags identified by the BIC criterion was 2, while the AIC and BIC indicated 4 lags. The Johansen test and the VECM were run in the restricted constant case and introducing seasonal dummies by using 4 lags. Autocorrelation was tested with a LM test up to the 6$^{th}$ lag at 10%. The series turned out not to be cointegrated when 2 lags were used.

[b] The ADF test specification includes all significant lags up to a maximum of 12. In models with structural breaks, the test was repeated also on the residuals from the short run relation. The null hypothesis was always rejected at 5% significance.

[c] The VECM specification imposes unit root modulus, not reported here.

† Accepted rank: lowest rank whose test result is lower than 10% critical values.

*Statistically significant at 10% confidence level.

**Statistically significant at 5% confidence level.

***Statistically significant at 1% confidence level.

## 8.2 Food prices

In this section, the relations between the domestic prices for food wheat and the international ones are analysed (Figure 20). At first, the VECM are estimated first without accounting for structural breaks (sub section 8.2.1); then, structural breaks accounting for the policy measures and the turbulence on international markets are inserted in the cointegration relation (sub section 8.2.2).

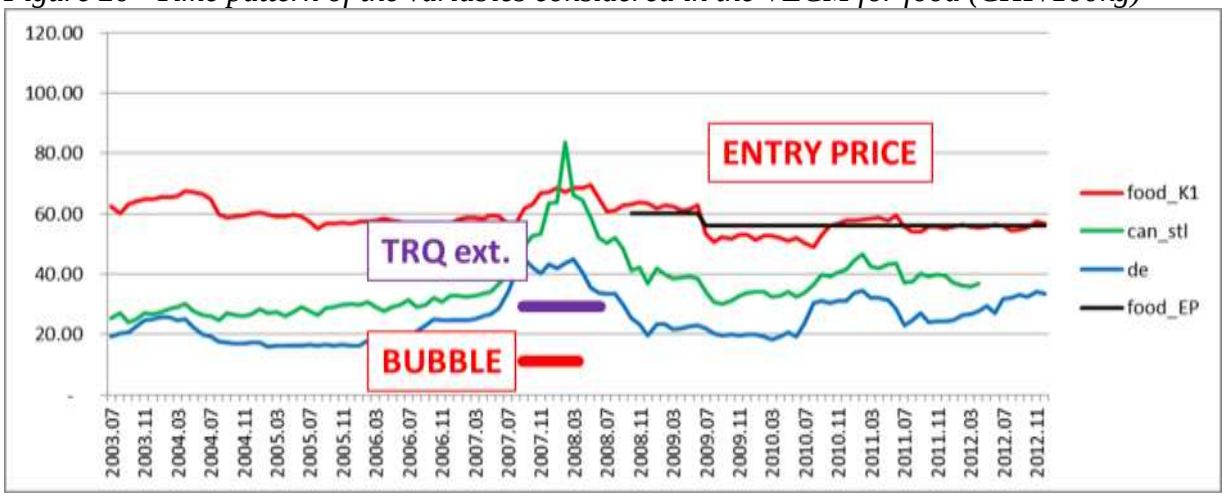
### 8.2.1 Models without structural breaks

We start by examining the relation between the European price and the Swiss price. According to the Johansen test, *food_k1* and *de* are cointegrated. The long run transmission elasticity is equal to 0.19 and significant (Table 12). Although none of the two prices can be identified as weakly exogenous, we note that the significance of the short run adjustment coefficient of *de* is lower than *food_k1* and the sign is not correct, suggesting that the Swiss price adjusts more quickly than the German one to the disequilibrium.

When we test for cointegration between the Swiss price and the Canadian one, we do not find evidence supporting it[15]. As a consequence, we cannot proceed with the estimation of the VECM.

[15] The optimal lag of the VECM has been selected according to the conventional information criteria by introducing a constant and seasonal dummies in the regressions. AIC indicated 4 lags, BIC 1 and HQC 2 lags. The Johansen test was run in the restricted constant case and introducing seasonal dummies. In all cases, no cointegration was found.

*Figure 20– Time pattern of the variables considered in the VECM for food (CHF/100kg)*




Source: FOAG

In order to understand the relevance of the applied duties on price transmission mechanisms on domestic markets, we add to the international price series the applied import tariff which is charged at the border (the resulting series are *de_ta_fo* and *can_stl_ta_fo*). Even after this modification, we still find that the Canadian price is not cointegrated with the Swiss one according to the Johansen test. On the contrary, the series including the German price is once again cointegrated with the Swiss price.

It is interesting to notice that, once the applied tariffs are added to the German price, the price transmission becomes higher and equal to 0.55 (Table 12). Also its statistical significance increases in respect to the previous case. As far as the short run dynamics are concerned, in this case the series including the German price clearly behaves as weakly exogenous, since its adjustment coefficient has not the correct sign and is not statistically significant, meaning that it doesn't respond to the disequilibria from the cointegration relationship.

Summing up, when the applied import tariffs are accounted for, the relation between the Swiss price and the German price becomes stronger and the leading role of the latter appears more clearly. This can be taken as a confirmation of the impact of import duties on price transmission mechanisms.

As far as the Canadian price is concerned, its relation with the Swiss price cannot be defined at this stage yet. This might be due to disregarding some important structural changes that have influenced this price transmission relation, which will indeed be examined in the next section.

*Table 12 – Price transmission relations for food: VECM estimates (standard errors in parenthesis) – Swiss price, German price, German price plus applied duties* [a]

| | | |
|---|---|---|
| *Cointegrating vector (β)* | | |
| food_k1 | 1** | 1*** |
| de | -0.191*(0.075) | |
| de_ta_fo | | -0.550(0.089)*** |
| constant | -3.458**(0.239) | -1.896(0.351)** |
| *Adjustment vector (α)* | | |
| food_k1 | -0.090***(0.027) | -0.162***(0.31) |
| de | -0.170*(0.091) | |
| de_ta_fo | | -0.077(0.069) |
| *ADF test on residuals of long-run relation* [b] | -2.043** | -3.305*** |

[a] *food_k1* and *de*: The optimal lag of the VECM has been selected according to the conventional information criteria by introducing a constant and seasonal dummies in the regressions. While AIC indicated 3 lags, BIC and HQC indicated 1 lag. The Johansen test and the VECM were then run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to the 6th lag. The null of no-autocorrelation was accepted with a statistical significance of 5%.
*food_k1* and *de_ta_fo*: The optimal lag of the VECM has been selected according to the conventional information criteria by introducing a constant and seasonal dummies in the regressions. All criteria indicated 1 lag. The Johansen test and the VECM were then run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to the 6th lag. The null of no-autocorrelation was accepted with a statistical significance of 10%.
[b] The ADF test specification includes all significant lags up to a maximum of 12. In models with structural breaks, the test was repeated also on the residuals from the short run relation. The null hypothesis was always rejected at 5% significance.
[c] The VECM specification imposes unit root modulus, not reported here.
† Accepted rank: lowest rank whose test result is lower than 10% critical values.
*Statistically significant at 10% confidence level.
**Statistically significant at 5% confidence level.
***Statistically significant at 1% confidence level.

### 8.2.2 Models with structural breaks

We here aim at analyzing whether the price transmission relations that we have estimated so far have been influenced by structural breaks. As far as the policy measures are concerned, two important changes which have occurred in the market regulation of wheat for food uses, deviating from what could be regarded as the standard (albeit complex) set of policies, are the autonomous extension of the TRQ and the introduction of an entry price system (Figure 20).
In the first case, the aim of the legislator was to prevent the transmission of the price spike occurring on the international markets to the domestic ones, especially since it happen to follow a year of very low domestic supply. This policy measure is represented with a dummy variable (*TRQ_ext*) assuming the value of 1 for all the months between November 2007 and June 2008, and 0 otherwise. On the contrary, and despite the fact that an entry price system is more protective than a simple tariff, its definition at levels which would de facto reduce the pre-existing applied protection was made with the aim of increasing the transmission of international price signals on domestic markets. This regime change is represented by a dummy variable (*EP*) which takes the value 1 for all months after October 2008[16]. In addition to these, also the presence of explosive behaviour in the international prices might have been responsible for changes in the price transmission mechanisms. For this reason, a *bubble* dummy variable is also introduced in the model. This variable accounts for the explosive behaviour that could eventually be present in some of the international price series[17].

[16] Although the entry price could also be inserted as such in the cointegration vector, since its value is in practce constant and a limited number of observations are available, for the sake of simplicity we treat it as a dummy variable.
[17] The dummy bubble is defined differently according to the price series showing the explosive behavior.

At first, all structural breaks are considered together in the VECM (subsection 8.2.2.1); then, we focus on the EP and on the extension of the TRQ separately (subsection 8.2.2.2 and 8.2.2.3).

### 8.2.2.1 All structural breaks

At a first stage, all policy dummies are simply assumed to affect the constant of the cointegration space. In other words, they are assumed to have an impact only on the distance between the prices. Indeed, to study if they also have an impact on the long run price transmission elasticity, we should introduce in the cointegration space all the interaction terms between the dummies and the prices. Although technically possible, this would substantially increase the number of parameters to be estimated, which is not advisable given the low number of observations at our disposal, and would make more complex the interpretation of the results.

Like in the section 8.2.1, the models will be estimated also by adding to the international price series the tariffs which are charged at the border.

When the structural breaks are accounted for, the long price transmission elasticity between *food_k1* and *de* is 0.21 (Table 13). This value is indeed very close to the one found when policy breaks were not considered. None of the two prices behaves as weakly exogenous: both respond to the disequilibria from the cointegration relation, although the coefficient of the German price has not the correct sign. The only dummy which is significant is *EP*. The introduction of an entry price system would then seem to have contributed to a decrease of the distance between the domestic and the international prices. Neither *bubble* nor *TRQ_ext* are significant. However, their sign suggests that the first corresponds to an increase in the distance between the two prices, and the second one to a decrease.

As shown in the previous section, the Canadian price is not cointegrated with the Swiss price when cointegration is tested "ex ante" with the standard Johansen test. However, residuals of the long run relation of the VECM estimated by introducing structural breaks are stationary, indicating that some evidence of cointegration could emerge "ex post" when structural breaks are appropriately accounted for.

The long run transmission elasticity is equal to 0.33, then even higher than the one between the Swiss price and the German one. Moreover, here all dummies are significant. The signs are the same as those resulting from the same model estimated with the German price: the bubble increased the distance between the prices (although the fact that the Canadian price went even above the Swiss price during the price peak further complicates the interpretation), while the extension of the TRQ and the introduction of the EP reduced it. Both the Swiss and the Canadian prices respond to the disequilibria from the long run relation, although the adjustment coefficient of the Canadian price has not the correct sign.

The same models are estimated by adding the applied tariffs for wheat for food uses to the international prices (Table 13). For the series *de_ta_fo*, the price transmission elasticity is equal to 0.627, then much higher than for *de*. The German price now behaves as weakly exogenous. The increase in the price transmission elasticity as well as the clear emergence of an exogenous behaviour for the German price are in line with what seen in section 8.2.1, when structural breaks were not accounted for. However, in this model none of the dummies is significant, although their signs are coherent with what seen in the other estimates. The fact that the structural breaks are not significant when the applied tariff is added to the German one might indicate that most of the policy effects are actually captured by this latter variable. In this case, we note that the *bubble* dummy has not been inserted since there is no evidence of explosive behaviour in the German price after the addition of the applied duties.

The model estimated with the Canadian price is much less intuitive. The long run transmission elasticity is above one. Both prices respond to the disequilibria from the long

run relation. Both the constant and all structural breaks dummies have a positive sign, and none of them is significant. As seen in subsection 8.2.1, also here the addition of the applied tariff to the Canadian price doesn't seem to improve the estimates. A possible explanation could be that the German price is much closer to the one which used in practice as a reference price for fixing the tariffs.

*Table 13 – Price transmission relations for food: VECM estimates (standard errors in parenthesis) – Swiss price, German price, Canadian price* [a]

| | | | | |
|---|---|---|---|---|
| *Cointegrating vector (β)* | | | | |
| food_k1 | 1*** | 1*** | 1*** | 1 |
| de | -0.215 (0.062)*** | | | |
| de_ta_fo | | | -0.627(0.140)*** | |
| can_stl | | -0.333(0.128)** | | |
| can_stl_ta_fo | | | | -1.698(0.438)** |
| constant | -3.442(0.187)*** | -2.983(0.437)** | -1.605(0.556) | 2.919(1.806) |
| bubble | -0.056 (0.103) | -0.444(0.176)* | | 0.739(0.251) |
| TRQ_ext | 0.081(0.070) | 0.414(0.149)*** | 0.088(0.067) | 0.365(0.233) |
| EP | 0.122(0.028)*** | 0.197(0.048)*** | 0.016(0.031) | 0.018(0.056) |
| *Adjustment vector (α)* | | | | |
| food_k1 | -0.156(0.031)*** | -0.097(0.025)*** | -0.153(0.030)*** | -0.051(0.018)*** |
| de | -0.225(0.110)** | | | |
| de_ta_fo | | | -0.051(0.061) | |
| can_stl | | -0.204(0.072)*** | | |
| can_stl_ta_fo | | | | 0.103(0.032)*** |
| *ADF test on residuals of long-run relation* [b] | -2.780*** | -2.501** | -3.072*** | -5.315*** |

[a] *food_k1*, *de*: The VECM was run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to the 6th lag. The null of no-autocorrelation was accepted with a statistical significance of 10%.
*food_k1*, *can_stl*: The VECM was run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to the 6th lag and could be accepted at 10%.
*food_k1*, *de_ta_fo*: The VECM was run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to the 6th lag. The null of no-autocorrelation was accepted with a statistical significance of 10%.
*food_k1*, *can_stl_ta_fo* : The VECM was run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to the 6th lag and could be accepted at 5%.
[b] The ADF test specification includes all significant lags up to a maximum of 12. In models with structural breaks, the test was repeated also on the residuals from the short run relation. The null hypothesis was always rejected at 5% significance.
[c] The VECM specification imposes unit root modulus, not reported here.
† Accepted rank: lowest rank whose test result is lower than 10% critical values.
*Statistically significant at 10% confidence level.
**Statistically significant at 5% confidence level.
***Statistically significant at 1% confidence level.

### 8.2.2.2 Entry price

After having estimated the models by including all structural breaks which may be assumed to have had an impact on the domestic market of wheat for food uses, we here want to focus on each of them more in particular.
We start with the introduction of an entry price system. Indeed, this represents a substantial, long term structural change in the policy regime affecting the import regulation for wheat for feed uses. In fact, this dummy variable is significant in the first two models estimated in Table 13. Since we are concentrating only on one policy measure, the number of parameters to be estimated is lower. For this reason, we can allow this policy variable to have an impact both on the distance and on the long price transmission elasticity between the prices. In other words, the dummy accounting for the exogenous structural break "introduction of the EP

system" can in principle allow for a shift both in the constant and in the elasticity of the long run relation linking the endogenous variables. The results of the estimates are reported in Table 14.

When the EP is assumed to affect only the constant of the long run price transmission relation, the price run transmission elasticity of the German price is 0.17. The EP dummy is statistically significant, suggesting that the introduction of the EP system actually reduced the distance between the prices. This is in line with what estimated when also the other structural breaks were considered (Table 13). In the model where the EP is allowed to influence also the long run price transmission elasticity, we find that the value of the price transmission elasticity valid in the overall sample is slightly lower (0.13), but that it increased substantially (by 0.17, up to a value of 0.30) after the introduction of the EP system. While it could seem counterintuitive that the replacement of an applied tariff by an entry price system actually increased the price transmission elasticity, one possible explanation is that indeed the level of the entry price was fixed so as to reduce the level of the applied tariffs which had been applied insofar. Furthermore, the applied tariffs resulted often capped at the maximum allowed level, *de* facto acting as single tariffs. What we see here is that in addition to lowering the distance between the domestic and the international price, the introduction of an entry price system might also have allowed for a better transmission of price signals. In both models, both the Swiss and the German price respond to disequilibria from the long run relation, although the coefficient of the German price has not the correct sign.

What said for the German price is valid also for the Canadian one. In this case, when the introduction of the entry price system is assumed to have an impact only on the constant of the cointegration space, the price transmission elasticity is 0.2 and the introduction of the entry price lowers the distance between the prices (in analogy with what seen when all structural breaks were considered). In the second model, the price transmission elasticity is 0.13 but it increases by 0.57 (up to a value of 0.70) after the introduction of the entry price system, which has also keeps having the effect of lowering the distance between the two prices. Once again, the adjustment coefficients of the international prices have not the correct sign, suggesting that only the Swiss price properly adjusts to the deviations from the long run relations.

Summing up, if we were to consider the introduction of the EP system purely as a mean to divide our subsample in two (before and after the change of a given policy regime; or in two consequent periods over time), these estimates can then be taken as simple evidence that over the years the domestic price became closer to the international one, and more respondent to its changes. This can be explained by the abovementioned characteristics of the EP system, but other factors might also have played a role. In particular, it should not be forgotten that the data availability for this policy regime includes periods of major market turbulences, which might have significantly influenced the behaviour of market operators, but is also limited, which prevents us from further investigations in this respect.

In respect to Table 14, in Table 15 we add to the international price series the applied import duties. Like what observed when all structural breaks were accounted for, the structural breaks dummies loose part or all of their significance. Indeed, the applied tariffs reflect by their own nature the functioning of the EP system.

For the German price, the long run price transmission elasticity to the price series of the German price plus the applied import duties in is 0.5 and 0.44 when the entry price is allowed to have an influence also on this parameter (this is in line with what seen in Tables 12 and 13). In the latter case, the price transmission elasticity increases by 0.14 after the introduction of the entry price, but this coefficient is not significant. In a way, it is like if the higher transmission elasticity is already captured by considering the import duties in the German price. Although not significant, in both models the introduction of the EP would seem to have

lowered the distance between the prices. Like already observed in all models in which the applied tariffs have been added to the German price, its short run adjustment coefficient is non-significant, which suggests weak exogeneity.
The same considerations hold for the models including the Canadian price. In this case, however, the dummy variables representing the introduction of the entry price system are significant. The long price transmission elasticity is 0.46 in the first model and 0.27 in the second one, where it is found to increase by almost 1 after the introduction of the entry price system. This once again problematic result could be explained by the fact that the applied duty is actually calculated based on the German price. In both cases, the introduction of the EP has lowered the distance between the domestic and the international prices. The Canadian price behaves as weakly exogenous.

*Table 14 – Price transmission relations for food: VECM estimates (standard errors in parenthesis) – Swiss price, German price, Canadian price* [a]

| | | | | |
|---|---|---|---|---|
| *Cointegrating vector (β)* | | | | |
| food_k1 | 1*** | 1*** | 1*** | 1*** |
| de | -0.171(0.037)*** | -0.126(0.042)** | | |
| can_stl | | | -0.202(0.068)*** | -0.131(0.055)** |
| constant | -3.572(0.118) *** | -3.717(0.132)*** | -3.400(0.240)*** | -3.656(0.193)*** |
| EP | 0.110(0.021) *** | 0.642(0.289)** | 0.141(0.034)*** | 2.196(0.716)*** |
| EP * de | | -0.166(0.089)* | | |
| EP * can_stl | | | | -0.57(0.198)*** |
| *Adjustment vector (α)* | | | | |
| food_k1 | -0.173(0.035)*** | -0.155(0.033)*** | -0.131(0.034)*** | -0.153(0.035)*** |
| de | -0.301(0.120)** | -0.367(0.110)*** | -0.071(0.108) | -0.193(0.111)* |
| can_stl | | | | |
| *ADF test on residuals of long-run relation* [b] | -3.076*** | -2.540** | -2.966*** | -2.634*** |

[a] food_k1, de, EP: The VECM was run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to the 6th lag. The null of no-autocorrelation was accepted with a statistical significance of 10%.
food_k1, can_stl, EP : The VECM was run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to the 6th lag. The null of no-autocorrelation was accepted with a statistical significance of 10%.
food_k1, de, EP, EP * de: The VECM was run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to 6th lag. The null of no-autocorrelation was accepted with a statistical significance of 10%.
food_k1, can_stl, EP * can_stl: The VECM was run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to 6th lag. The null of no-autocorrelation was accepted with a statistical significance of 10%.
[b] The ADF test specification includes all significant lags up to a maximum of 12. In models with structural breaks, the test was repeated also on the residuals from the short run relation. The null hypothesis was always rejected at 5% significance.
[c] The VECM specification imposes unit root modulus, not reported here.
† Accepted rank: lowest rank whose test result is lower than 10% critical values.
*Statistically significant at 10% confidence level.
**Statistically significant at 5% confidence level.
***Statistically significant at 1% confidence level.

*Table 15 – Price transmission relations for food: VECM estimates (standard errors in parenthesis) – Swiss price, German price, Canadian price* [a]

| | | | | |
|---|---|---|---|---|
| *Cointegrating vector (β)* | | | | |
| food_k1 | 1*** | 1*** | 1*** | 1*** |
| de_ta_fo | -0.505(0.104)*** | -0.440(0.120)* | | |
| can_stl_ta_fo | | | -0.463(0.133)*** | -0.277(0.177)* |
| constant | -2.083(0.417)** | -2.345(0.483)** | -2.172(0.555)** | -2.953(0.490)*** |
| EP | 0.022(0.028) | 0.569(0.839) | 0.065(0.034)* | 4.193(1.517)** |
| EP * de_ta_fo | | -0.140(0.215) | | |
| EP * can_stl_ta_fo | | | | -1.007(0.371)** |
| *Adjustment vector (α)* | | | | |
| food_k1 | -0.167(0.033)*** | -0.164(0.033)*** | -0.136(0.036)*** | -0.153(0.035)*** |
| de_ta_fo | -0.062(0.066) | -0.095(0.065) | | |
| can_stl_ta_fo | | | 0.029(0.076) | -0.101(0.075) |
| *ADF test on residuals of long-run relation* [b] | -3.375*** | -3.223 | -3.473*** | -4.493** |

[a] food_k1, de_ta, EP: The VECM was run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to the 6th lag. The null of no-autocorrelation was accepted with a statistical significance of 10%.
food_k1, can_stl, EP : The VECM was run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to the 6th lag. The null of no-autocorrelation was accepted with a statistical significance of 10%.
[a] food_k1, de_ta, EP, EP * de: The VECM was run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to the 6th lag. The null of no-autocorrelation was accepted with a statistical significance of 10%.
food_k1, can_stl, EP * can_stl: The VECM was run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to the 6th lag. The null of no-autocorrelation was accepted with a statistical significance of 10%.
[b] The ADF test specification includes all significant lags up to a maximum of 12. In models with structural breaks, the test was repeated also on the residuals from the short run relation. The null hypothesis was always rejected at 5% significance.
[c] The VECM specification imposes unit root modulus, not reported here.
† Accepted rank: lowest rank whose test result is lower than 10% critical values.
*Statistically significant at 10% confidence level.
**Statistically significant at 5% confidence level.
***Statistically significant at 1% confidence level.

### 8.2.2.3 Autonomous extension of the TRQ

Finally, we focus on the impact of the extension of the TRQ. The character of this measure is inherently different from the one of the introduction of the EP system. While, as discussed, the latter can be regarded as a relevant structural break that can be expected to affect the relation between the domestic and the international prices *in the long run*, the extension of the TRQ is a measure that was applied in order to confront a very particular market situation *only once* over the time period under study. Indeed, its character could rather be regarded as exceptional, and one could actually think that the extension of the TRQ is a measure affecting the short rather than the long run dynamics. The fact that this variable is actually not strongly significant in the models estimated in subsection 8.2.2.1, where it is assumed to affect the long run dynamics, might be an indirect confirmation of this.

This scarce statistical significance in the long run is evident also when we consider a VECM in which only the TRQ and the bubble are assumed to have an impact on the cointegration relation between the Swiss and either the German or the Canadian price. We estimate a VECM in which we introduce only the bubble and the extension of the TRQ which was implemented as a response to it, then disregarding the introduction of the EP system. For the German price, the long run transmission elasticity estimated in Table 16 is consistent with what seen in previous estimates (although it is not significant). For the Canadian price, it has instead the wrong sign. It can be noticed that while the *bubble* dummy is always significantly contributing to an increase in the distance between the prices (which adds some complexities

in the interpretation of the cointegration space), the same cannot be said for *TRQ_ext*, which is not statistically significant.
The estimates repeated by adding to the international price series the applied duties are actually of limited interest, since the series including the German price is not showing any explosive behaviour (and *TRQ_ext* is not significant), and the one including the Canadian price reports results which are rather implausible (the price transmission elasticity is equal to 3).

*Table 16 – Price transmission relations for food: VECM estimates (standard errors in parenthesis) – Swiss price, German price, Canadian price* [a]

| | | | | |
|---|---|---|---|---|
| *Cointegrating vector (β)* | | | | |
| food_k1 | 1** | 1 | 1*** | 1* |
| de | -0.117(0.096) | | | |
| de_ta_fo | | | -0.664(0.122)*** | |
| can_stl | | 0.584(0.332)* | | |
| can_stl_ta_fo | | | | -2.939(0.479)*** |
| constant | -3.685 (0.301)** | -6.150(1.166) | -1.453(0.478)* | 5.776(1.967)*** |
| bubble | -0.291(0.173)* | -2.054(0.588)*** | | 0.943(0.305)*** |
| TRQ_ext | -0.006(0.105) | 0.281(0.431) | 0.094(0.068) | 0.566(0.273)** |
| *Adjustment vector (α)* | | | | |
| food_k1 | -0.088(0.026)*** | -0.001(0.01) | -0.149(0.029)*** | -0.033(0.013)** |
| de | -0.176(0.086)** | | -0.063(0.064) | 0.104(0.025)*** |
| de_ta_fo | | | | |
| can_stl | | -0.102(0.025)*** | | |
| can_stl_ta_fo | | | | |
| *ADF test on residuals of long-run relation* [b] | -2.341** | -3.112*** | -3.032*** | -5.548*** |

[a] *food_k1*, *de*: The VECM was run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to the 6th lag. The null of no-autocorrelation was accepted with a statistical significance of 10%.
*food_k1*, *can_stl*: The VECM was run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to the 6th lag and could be accepted at 10%.
*food_k1*, *de_ta_fo*: The VECM was run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to the 6 th lag. The null of no-autocorrelation was accepted with a statistical significance of 10%.
*food_k1*, *can_stl_ta_fo* : The VECM was run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to the 6th lag and could be accepted at 10%.
[b] The ADF test specification includes all significant lags up to a maximum of 12. In models with structural breaks, the test was repeated also on the residuals from the short run relation. The null hypothesis was always rejected at 5% significance.
[c] The VECM specification imposes unit root modulus, not reported here.
† Accepted rank: lowest rank whose test result is lower than 10% critical values.
*Statistically significant at 10% confidence level.
**Statistically significant at 5% confidence level.
***Statistically significant at 1% confidence level.

Provided that the estimates in which the TRQ extension is assumed to affect the long run relation add limited information to what already found, we try to test if this dummy variable might on the contrary have an impact on the short run dynamics. For this reason, we estimate a VECM in which the bubble is once again assumed to have an impact on the long run dynamics, while the extension of the TRQ is assumed to have an impact on the short run coefficients. Like before, we repeat the estimates adding the applied duties to the international price series.
The estimates reported in Table 17 show long run transmission coefficients which are very close to those of the previous estimates. Concerning the short run coefficients of *TRQ_ext*, while they are not significant in the first two models, they become significant when the applied duties are added to international prices. In these two cases, the coefficient of the

Swiss price is negative, which actually indicates that during the opening of a TRQ the domestic reacted more quickly to the deviations from the disequilibrium. The coefficient of the international price series is three times negative (but not significant) and once positive. The latter case would seem to indicate that also the international responded more quickly to the deviations from the disequilibrium.

*Table 17 – Price transmission relations for food: VECM estimates (standard errors in parenthesis) – Swiss price, German price, Canadian price* [a]

| | | | | |
|---|---|---|---|---|
| *Cointegrating vector (β)* | | | | |
| food_k1 | 1** | 1 | 1*** | 1 |
| de | -0.125(0.098) | | | |
| de_ta_fo | | | -0.671(0.123)*** | |
| can_stl | | 0.559(0.324)* | | |
| can_stl_ta_fo | | | | -2.534(0.517)*** |
| constant | -3.658(0.306)** | -6.062(1.135) | -1.426(0.483) | 6.350(2.122)*** |
| bubble | -0.294(0.175)* | -2.005(0.572)*** | | 1.057(0.328)*** |
| *Adjustment vector (α)* | | | | |
| food_k1 | -0.088(0.026)*** | -0.002(0.010) | -0.148(0.029)*** | -0.027(0.012)** |
| de | -0.165(0.088)* | | | |
| de_ta_fo | | | -0.056(0.064) | |
| can_stl | | -0.105(0.026)*** | | |
| can_stl_ta_fo | | | | 0.101(0.023)*** |
| TRQ_ext 1eq. | 0.001(0.01) | -0.014(0.011) | -0.014(0.010)* | -0.025(0.011)** |
| TRQ_ext 2 eq. | -0.006(0.029) | -0.032(0.030) | -0.016(0.018) | 0.046(0.022)** |
| *ADF test on residuals of long-run relation* [b] | -2.310** | -3.309*** | -3.198*** | -2.557** |

The adjustment coefficients of TRQ_ext refer to the food_k1 equation (1 eq.) and the other price (2 eq.) reported in the VECM.

*food_k1, de*: The VECM was run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to the 6th lag. The null of no-autocorrelation was accepted with a statistical significance of 10%.

*food_k1, can_stl*: The VECM was run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to the 6th lag and could be accepted at 10% (but the p-value for the first equation is 0.049).

*food_k1, de_ta_fo*: The VECM was run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to the 6th lag. The null of no-autocorrelation was accepted with a statistical significance of 10%.

*food_k1, can_stl_ta_fo* : The VECM was run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to the 6th lag and could be accepted at 5%.

[b] The ADF test specification includes all significant lags up to a maximum of 12. In models with structural breaks, the test was repeated also on the residuals from the short run relation. The null hypothesis was always rejected at 5% significance.

[c] The VECM specification imposes unit root modulus, not reported here.

† Accepted rank: lowest rank whose test result is lower than 10% critical values.

*Statistically significant at 10% confidence level.

**Statistically significant at 5% confidence level.

***Statistically significant at 1% confidence level.

Finally, we test what happens if also the entry price is assumed to affect the parameters of the long run price transmission relation. Basically, we re-estimate the models reported in section 8.2.2.1 but this time we allow *TRQ_ext* to influence only the short run dynamics (Table 18).
The long run price transmission elasticity with the German price is 0.22, which increases to 0.63 when the applied duties are added to it. Both prices respond to the disequilibria from the long run relation, but as usual coefficients of the German price have not the correct sign and loose significance when applied duties are added to it. In the long run, the bubble increased the distance between the prices (but is not significant), while the introduction of an entry price system contributed to its reduction. In the model estimated by adding the applied duties,

there is no evidence of explosive behavior and the *EP* dummy is not significant, as seen before. In the short run, the extension of the TRQ increases the response to disequilibrium of the domestic prices, although the coefficients are not significant.
When the models are estimated with the Canadian price, the long run transmission elasticity is 0.3 but becomes implausible when the applied duties are added. Both prices react to the short run equilibrium. The coefficient of the Swiss price are always significant and showing the right sign, while this happens for those of the Canadian price only when the applied duties are added to it. On the long run, the bubble contributed to an increase in the distance between the prices, while the introduction of an entry price system reduced it. The two factors loose significance when applied duties are added to the Canadian price. In the short run, the extension of the TRQ corresponds to an increase in the response to deviations from the long run equilibrium for the Swiss price (the coefficient is significant), while for the Canadian price this is the case only when import duties are added (but not significant).

*Table 18 – Price transmission relations for food: VECM estimates (standard errors in parenthesis) – Swiss price, German price, Canadian price* [a]

| | | | | |
|---|---|---|---|---|
| *Cointegrating vector (β)* | | | | |
| food_k1 | 1*** | 1*** | 1*** | 1 |
| de | -0.217(0.062)*** | | | |
| de_ta_fo | | | -0.635(0.141)*** | |
| can_stl | | -0.313(0.133)* | | |
| can_stl_ta_fo | | | | -2.091(0.597)* |
| constant | -3.435(0.189)*** | -3.054(0.452)** | -1.573(0.560) | 4.547(2.459) |
| bubble | -0.056(0.104) | -0.502(0.182)** | | 1.167(0.341)* |
| EP | 0.123(0.028)*** | 0.195(0.049)*** | 0.015(0.031) | -0.004(0.765) |
| *Adjustment vector (α)* | | | | |
| food_k1 | -0.157(0.032)** | -0.0870.025)*** | -0.152(0.030)*** | -0.028(0.014)** |
| de | -0.217(0.112)* | | | |
| de_ta_fo | | | -0.045(0.061) | |
| can_stl | | -0.222(0.071)*** | | |
| can_stl_ta_fo | | | | 0.089(0.024)*** |
| TRQ_ext 1eq. | -0.012(0.008) | -0.043(0.013)*** | -0.014(0.008) | -0.019(0.011)* |
| TRQ_ext 2 eq. | -0.027(0.029) | -0.072(0.038)* | -0.013(0.017) | 0.022(0.019) |
| *ADF test on residuals of long-run relation* [b] | -2.968*** | -2.504** | -3.224*** | -4.346*** |

[a] The adjustment coefficients of TRQ_ext refer to the food_k1 equation (1 eq.) and the other price (2 eq.) reported in the VECM.

*food_k1*, *de*: The VECM was run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to the 6th lag. The null of no-autocorrelation was accepted with a statistical significance of 10%.

*food_k1*, *can_stl*: The VECM was run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to the 6th lag and could be accepted at 10%.

*food_k1*, *de_ta_fo*: The VECM was run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to the 6th lag. The null of no-autocorrelation was accepted with a statistical significance of 10%.

*food_k1*, *can_stl_ta_fo* : The VECM was run in the restricted constant case and introducing seasonal dummies by using 1 lag. Autocorrelation was tested with a LM test up to the 6th lag and could be accepted at 10%.

[b] The ADF test specification includes all significant lags up to a maximum of 12. In models with structural breaks, the test was repeated also on the residuals from the short run relation. The null hypothesis was always rejected at 5% significance.

[c] The VECM specification imposes unit root modulus, not reported here.

† Accepted rank: lowest rank whose test result is lower than 10% critical values.

*Statistically significant at 10% confidence level.

**Statistically significant at 5% confidence level.

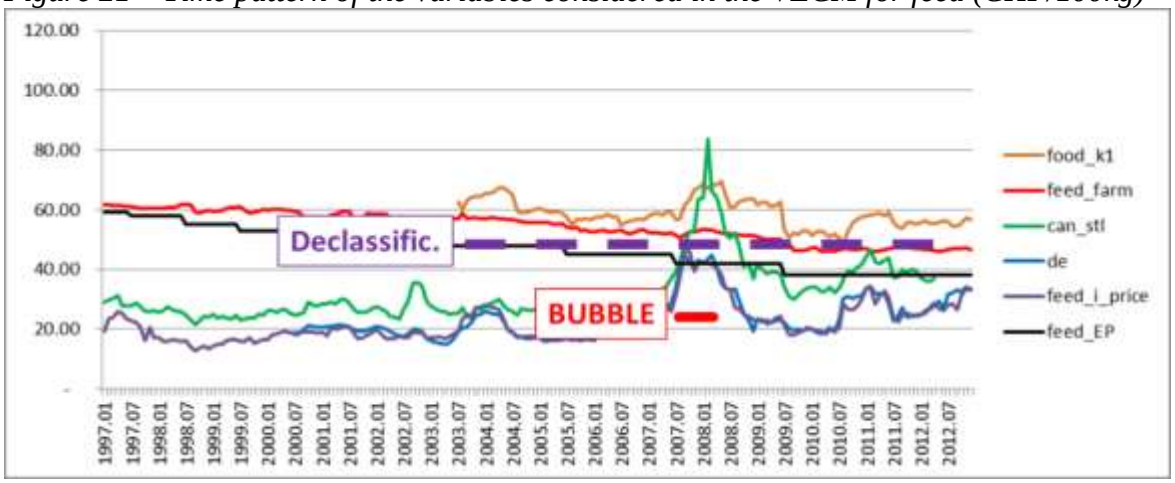
***Statistically significant at 1% confidence level.

### 8.3 Feed prices

Following the same methodological and econometric approach adopted to analyse the linkages among food prices, this section now considers the domestic price of wheat for feed use and its linkages with international prices and the food price itself. Figure 21 displays the prices that are under analysis in this respect and their evolution over time. The domestic feed price (*feed_farm*) regularly declines not showing any particular periods of turbulence that can be observed, on the contrary, both in the domestic food price and in all reference international prices. These latter (the Canadian and the German prices), as repeatedly mentioned, do not distinguish between the food and feed uses. However, considerations on product's quality suggest that the Canadian price can be used a reference price mostly in the case of food uses. Keeping this in mind, and remembering the strong long term linkage between the Canadian and German prices (section 8.1), they will however both be inserted in the models under study. The Figure also includes the reference import price observed at the border that is used to fix the applied tariff (*feed_i_price*) and the main border policy variable in this context, that is the entry price for feed use (*feed_EP*) that regularly declines over time progressively converging towards the international prices. Differently from the case of food, where the limited number of observations and changes in its level didn't allow to do so, this variable here enters the model as a continuous exogenous variable rather than as a structural break (dummy). Furthermore (Figure 21), we notice that the distance between the entry price and the domestic price for feed in the first years of the sample seems smaller than in the following ones. In this respect, one should remember that the domestic price for feed is indeed the purchasing price of feed for farmers (then, at the end of the food chain), while all other prices are producers' prices; market imperfections and frictions in the transmission along the food chain could also play a role. Due to limited data availability, this issue cannot be further explored here.

As the objective here is to identify the long-run linkages among prices, possible temporary variations of these linkages are taken into account in correspondence with events that may have altered them. This is the case of the declassification interventions repeatedly occurring, though for limited periods of time, between 2003 and 2012, and of the 2007-2008 price "bubble" clearly emerging in the international markets. Following the same modelling approach presented above, the impact of these events on price linkages enters the model as structural breaks. In the case of declassification, it behaves as a discontinuous break starting from 2002.08 up to 2012.12; in the case of the "bubble", the structural break takes into account the explosive behaviour in prices observed especially in international prices between 2007.08 and 2008.02.

*Figure 21 – Time pattern of the variables considered in the VECM for feed (CHF/100kg)*




Source: FOAG

### 8.3.1 The linkage between the domestic and the international prices

Table 19 reports the estimates of the VECM between the domestic (*feed_farm*) and the international feed prices (*feed_i_price)*. It must be reminded that the cointegration tests reported in Table 10 do not support the hypothesis that these two prices are cointegrated. Therefore, apparently there is not long-run linkage between domestic and import prices and the results of the VECM estimation confirm this conclusion. If they were cointegrated, in fact, the sign of the parameter in the cointegration vector (though statistically significant) would imply that price transmission apparently move in the "wrong" direction, i.e., the rise of one price would induce a decline in the other price. The parameter of the adjustment vector associated to the domestic price is not statistically significant thus suggesting that it behaves as weakly exogenous.

Even though the ex-post assessment of cointegration (the ADF test on the residuals of the estimated long-run relation) would suggest the presence of a cointegration relationship, results indicate that the domestic price move independently from the import price and this can evidently be the effect of the border protection policy. This conclusion is somehow supported even after the introduction of the structural breaks and of the entry price as exogenous variable. In this case, the cointegration relationship appears even weaker with no significant parameter in the cointegration space and the presence of an unit roots in the residuals of the estimated long-run relationship. Eventually, the only significant variable is the entry price and it moves in the expected direction as its increase amplifies the gap between the domestic and the import prices. An alternative interpretation is that the only relevant relation is the one between the feed price and the entry price.

*Table 19 – Price transmission between domestic and import feed price: VECM estimates (standard errors in parenthesis)* [a]

| *Cointegrating vector (β)* | **Without break** | **With break** |
|---|---|---|
| feed_farm | 1.000 | 1.000 |
| feed_i_price | 0.477**<br>(0.162) | -0.038<br>(0.046) |
| "bubble" dummy | | -0.017<br>(0.030) |
| EP | - | -0.734***<br>(0.089) |
| constant | -5.522*<br>(0.499) | -1.039<br>(0.447) |
| *Adjustment vector (α)* | | |
| feed_farm | 0.005<br>(0.006) | -0.082***<br>(0.024) |
| feed_i_price | -0.114**<br>(0.044) | -0.191<br>(0.200) |
| *ADF test on residuals of long-run relation* [b] | -2.232** | -0.824 |

[a] The optimal lag of the VECM has been selected according to the conventional information criteria. AIC indicated 1 lag, SBIC 1 lag. 1 lag has been selected. All VECM were run in the restricted constant case and introducing seasonal dummies. Lack of autocorrelation was tested with a LM test up to the 4th lag and could be rejected in no cases with a statistical significance of 10%.

[b] The ADF test specification includes 12 lags.

*Statistically significant at 10% confidence level.

**Statistically significant at 5% confidence level.

***Statistically significant at 1% confidence level.

The separation and independence of the domestic feed price with respect to the international wheat prices is confirmed in Table 20. Together with the cointegration test results (Table 10), it emerges that the domestic price is not cointegrated with any alternative international prices and, in any case, the estimated cointegrating price linkage moves in the wrong direction. On the contrary, the import price is strongly cointegrated with alternative international prices (the German and the Canadian), with a long-run linkage that is quite close to a unit elasticity, that is, to the so called law of one price implying that the import price react proportionally to shocks in the German or Canadian price.

On the one hand, this evidence also confirms that the European and the North-American prices are strongly cointegrated and, therefore, the respective markets fully integrated. On the other hand, such result indicates that evidence about feed domestic and international prices is quite robust regardless how the latter are represented. Therefore, in investigating the linkages of the domestic feed price the import, the German and the Canadian price can be used indifferently and, in practice, contain the same information. For this reason, to avoid redundancy and following geographical closeness and quality considerations, in commenting the following estimations only the results with the German price will be considered.

*Table 20 – Price transmission between domestic feed and international prices: VECM estimates (standard errors in parenthesis)* [a]

| *Cointegrating vector (β)* | **(1)** | **(2)** | **(3)** | **(4)** |
|---|---|---|---|---|
| feed_farm | 1.000 | 1.000 | - | - |
| feed_i_price | - | - | 1.000 | 1.000 |
| can_stl | 0.484<br>(0.159) | - | -1.029***<br>(0.134) | - |
| de | - | 0.544*<br>(0.245) | - | -0.935***<br>(0.049) |
| constant | -5.709<br>(0.547) | -5.789<br>(0.768) | 0.486<br>(0.461) | -0.200<br>(0.153) |
| *Adjustment vector (α)* | | | | |
| feed farm | 0.003<br>(0.007) | 0.008<br>(0.005) | | |
| feed_i_price | | | -0.040<br>(0.042) | -0.292***<br>(0,088) |
| can_stl | -0.108**<br>(0.045) | | 0.110***<br>(0.032) | |
| de | | -0.058*<br>(0.031) | | 0.083<br>(0.077) |
| *ADF test on residuals of long-run relation* [b] | -2.819*** | -2.028** | -4.021*** | -2.988*** |

[a] The optimal lag of the VECM has been selected according to the conventional information criteria by introducing a constant and seasonal dummies in the regressions. AIC indicated 1 lag for (1) and 2 lags for (2), (3) and (4); SBIC 1 lag for all cases. 1 lag has been selected. Lack of autocorrelation was tested with a LM test up to the 4th lag and could be rejected in no cases with a statistical significance of 10%.

[b] The ADF test specification includes 12 lags.

*Statistically significant at 10% confidence level.

**Statistically significant at 5% confidence level.

***Statistically significant at 1% confidence level.

Table 21 confirms the non-robust long-run linkage between domestic feed and international prices even if the cointegration space is enriched with the structural breaks and the entry price is introduced. None of these variables is actually able to restore a consistent cointegration relationship and the only significant results concern the role of the bubble and the role of the entry price. In the former case results are not univocal in direction and magnitude, and this can be explained by the fact that, as emerged in Table 7, only the Canadian price clearly shows an explosive root. In the latter case, the entry price increases the gap between the domestic and the external prices, as expected. Though within a weak or even inconsistent cointegration relationship, the entry price seems to be the only variable capable to restore a statistically significant relationship between the two prices and to eventually make the domestic price endogenous. An alternative explanation is that what we see is actually the linkage between the domestic price and the entry price. The next section shows how the inclusion of the entry price, and of the respective border policy, within the VECM model can be achieved in a more consistent and meaningful way.

*Table 21 – Price transmission between domestic feed and international prices with structural breaks and entry price: VECM estimates (standard errors in parenthesis)* [a]

| *Cointegrating vector (β)* | **(1)** | **(2)** | **(3)** | **(4)** |
|---|---|---|---|---|
| feed_farm | 1.000 | 1.000 | - | - |
| feed_i_price | - | | 1.000 | 1.000 |
| can_stl | 0.193*** (0.043) | - | -2.550 (0.432) | - |
| de | - | 0.031 (0.022) | - | -0.924*** (0.067) |
| "bubble" dummy | -0.299*** (0.042) | -0.091*** (0.042) | 2.271*** (0.417) | -0.068 (0.078) |
| EP | -0.466** (0.068) | -0.720*** (0.047) | -1.748** (0.679) | -0.036 (0.143) |
| constant | -2.855 (0.380) | -1.362 (0.047) | 12.377 (3.803) | -0.097 (0.674) |
| *Adjustment vector (α)* | | | | |
| feed_farm | -0.067*** (0.016) | -0.153*** (0.036) | | |
| feed_i_price | | | 0.023 (0.014) | -0.306*** (0.089) |
| can_stl | -0.576*** (0.087) | | 0.064*** (0.001) | |
| de | | -0.882*** (0.031) | | -0.080 (0.079) |
| *ADF test on residuals of long-run relation* [b] | -4.068*** | -3.935*** | -3.498*** | -3.103*** |

[a] The optimal lag of the VECM has been selected according to the conventional information criteria by introducing a constant and seasonal dummies in the regressions. AIC indicated 1 lag for (1) and 2 lags for (2), (3) and (4); SBIC 1 lag for all cases. 1 lag has been selected. Lack of autocorrelation was tested with a LM test up to the 4th lag and could be rejected in no cases with a statistical significance of 10% except the first equation of (1).

[b] The ADF test specification includes 12 lags.

*Statistically significant at 10% confidence level.

**Statistically significant at 5% confidence level.

***Statistically significant at 1% confidence level.

### 8.3.2 The role of the tariff

The easy explanation of the lack of a long-run price linkage between the domestic and the import (or international) prices evidently lies in the protection, thus separation, of the domestic market granted by fixing an entry price and imposing a tariffs covering the gap between this entry price and the international (or before-tariff import) price. Therefore, it is reasonable to assume that shocks are not (or only partially) transmitted from the international to the domestic markets due to this protection system: the tariff absorbs all (or most) of the variations occurring on the international prices. As a consequence, it is reasonable to assume that a long-run relationship occurs between the domestic price and the after-tariff international prices (as already seen in Table 10).

Table 22 reports the VECM estimates linking the domestic feed price and the after-tariff international prices. Limiting the attention to the German prices it emerges that, at least ex-post, cointegration can be observed and the cointegration and the adjustment vectors provide an empirical evidence that is close to the theoretical expectations: the domestic and the after-tariff German prices move together with an elasticity of transmission that is statistically very close to 1; the domestic price is endogenous while the international one is weakly exogenous, that is, the latter drives the former. An indirect confirmation of how the addition of the tariff to the international price substantially changes their behavior and linkages is provided by the cointegration relationship with the import price. It is confirmed by the VECM estimates that the value of the cointegration coefficient is very far from the expected value (that is, the unit elasticity).

Table 22 – Price transmission between domestic feed and after-tariff international prices: VECM estimates (standard errors in parenthesis) [a]

| *Cointegrating vector (β)* | **(1)** | **(2)** | **(3)** | **(4)** |
|---|---|---|---|---|
| feed_farm | 1.000 | 1.000 | - | - |
| feed_i_price | - | - | 1.000 | 1.000 |
| can_stl_ta_fe | -0.065<br>(0.435) | - | 0.434<br>(0.331) | - |
| de_ta_fe | - | -1.151***<br>(0.094) | - | 5.479***<br>(0.929) |
| constant | -4.043<br>(1.728) | 0.385<br>(0.355) | -4.793<br>(1.316) | -23.702***<br>(3.501) |
| *Adjustment vector (α)* | | | | |
| feed_farm | 0.004*<br>(0.002) | -0.040***<br>(0.012) | | |
| feed_i_price | | | -0.051**<br>(0.022) | 0.015<br>(0,013) |
| can_stl_ta_fe | 0.054<br>(0.034) | | 0.040<br>(0.041) | |
| de_ta_fe | | -1.042<br>(0.065) | | -0.045***<br>(0.009) |
| *ADF test on residuals of long-run relation* [b] | -0.139 | -2.028** | -2.797*** | -3.363*** |

[a] The optimal lag of the VECM has been selected according to the conventional information criteria by introducing a constant and seasonal dummies in the regressions. AIC indicated 1 lag for (1) and 2 lags for (2), (3) and (4); SBIC 1 lag for all cases. 1 lag has been selected. Lack of autocorrelation was tested with a LM test up to the 4th lag and could be rejected in no cases with a statistical significance of 10% except the first equation of (4).
[b] The ADF test specification includes 12 lags.
*Statistically significant at 10% confidence level.
**Statistically significant at 5% confidence level.
***Statistically significant at 1% confidence level.

*Tables 23 – Price transmission between domestic feed and after-tariff international prices with structural breaks and entry price: VECM estimates (standard errors in parenthesis)* [a]

| *Cointegrating vector (β)* | **(1)** | **(2)** | **(3)** | **(4)** |
|---|---|---|---|---|
| feed_farm | 1.000 | 1.000 | - | - |
| feed_i_price | - | | 1.000 | 1.000 |
| can_stl_ta_fe | 0.017<br>(0.022) | - | 0.219<br>(0.158) | - |
| de_ta_fe | - | 8.854***<br>(1.018) | - | 343.960***<br>(32.124) |
| "bubble" dummy | -0.135***<br>(0.039) | -0.005<br>(0.293) | -0.919***<br>(0.276) | -14.897<br>(9.234) |
| EP | -0.710***<br>(0.054) | -6.925***<br>(0.891) | 0.703<br>(0.385) | -243.020***<br>(28.143) |
| constant | -1.319***<br>(0.188) | -11.130***<br>(2.2024) | -6.580***<br>(1.324) | -376.560***<br>(69.533) |
| *Adjustment vector (α)* | | | | |
| feed_farm | -0.106***<br>(0.021) | 0.004**<br>(0.002) | | |
| feed_i_price | | | -0.110***<br>(0.029) | 0.001***<br>(0.000) |
| can_stl_ta_fe | -0.365<br>(0.337) | | -0.107*<br>(0.058) | |
| de_ta_fe | | -0.062***<br>(0.009) | | -0.002***<br>(0.000) |
| *ADF test on residuals of long-run relation* [b] | -2.193** | -1.477 | -0.255 | -2.733*** |

[a] The optimal lag of the VECM has been selected according to the conventional information criteria by introducing a constant and seasonal dummies in the regressions. AIC indicated 1 lag for (1) and 2 lags for (2), (3) and (4); SBIC 1 lag for all cases. 1 lag has been selected. Lack of autocorrelation was tested with a LM test up to the 4th lag and could be rejected in no cases with a statistical significance of 10%.
[b] The ADF test specification includes 12 lags.
*Statistically significant at 10% confidence level.
**Statistically significant at 5% confidence level.
***Statistically significant at 1% confidence level.

A similar result is obtained by adding the structural breaks to this VECM between the domestic and international prices (Table 23). Even in this case the parameter of the cointegrating relationship between *feed_farm* and *de_ta_fe* is statistically significant but it shows the wrong sign. The ex post cointegration itself disappears and the impact of the structural break (the "bubble") and of the exogenous variables (the entry price) assume unreasonably high value. Evidently, once the tariff is added, the new variable (the after-tariff international price) already "incorporates" the entry price and "absorbs" the impact of structural break that, in fact, only concerns the international price, and the Canadian one in particular, and not the domestic prices. This seems a further indirect confirmation of the fact that the border protection though tariffs incorporates the entry price and somehow "sterilizes" the international prices against the impact of major shocks, as the "bubble".

### 8.4 Food and feed prices

A final assessment of the price linkages concerns the long-run relationship between the domestic food and feed prices (Table 24). This linkage is actually central in the present analysis (Figure 14) as also demonstrates possible cross-effects of border policies applied on one of the two domestic markets.

Though the conventional cointegration test (Table 10) is not conclusive in supporting a cointegration relationship between the two domestic prices, VECM estimates seem to suggest a strong linkage. On the one hand, cointegration is always confirmed ex post. On the other hand, whenever structural breaks are not considered, the cointegration parameter is negative and close to unit elasticity, so it is close to theoretical expectation, though statistical significance is weak presumably expressing a weak cointegration relationship. The signs of the parameters within the adjustment vector are correct and the feed price turns out to be endogenous while the food price is weakly exogenous; therefore, the latter drives the former.

*Table 24 – Price transmission between domestic feed and food prices with and without structural breaks (standard errors in parenthesis)* [a]

| *Cointegrating vector (β)* | **Without breaks** | **With breaks(1)** | **With breaks (2)** |
|---|---|---|---|
| food_k1 | 1.000 | 1.000 | 1.000 |
| feed_farm | -0.901(0.376) | -0.755***(0.205) | -2.949***(0.378) |
| "decl" dummy | | 0.136***(0.036) | 0.065**(0.018) |
| EP | - | - | 1.826***(0.308) |
| constant | -0.566(1.477) | -1.133(0.805) | 0.663(0.471) |
| *Adjustment vector (α)* | | | |
| food_k1 | -0.034(0.033) | -0.141(0.097) | -0.184*(0.103) |
| feed_farm | 0.030**(0.014) | 0.025 (0.046) | 0.101**(0.046) |
| *ADF test on residuals of long-run relation* [b] | -1.811* | -3.878*** | -2.273** |

[a] The optimal lag of the VECM has been selected according to the conventional information criteria by introducing a constant and seasonal dummies in the regressions. AIC indicated 3 lags, SBIC 1 lag. 1 lag has been selected. Lack of autocorrelation was tested with a LM test up to the 4th lag and could be rejected at 10% and could be rejected in no cases with a statistical significance of 10%.

[b] The ADF test specification includes 12 lags.

*Statistically significant at 10% confidence level.

**Statistically significant at 5% confidence level.

***Statistically significant at 1% confidence level.

Whenever the structural breaks are included, the quality of the results improves and this seems particularly true when the declassification dummies are considered. The ex post cointegration test confirms a long-run linkage with a cointegration parameter that is correct in sign and statistically significant, although lower (about 0.75). In other words, the introduction

of the dummy declassification reduces the price transmission elasticity. This dummy is significant; however, the interpretation of its sign is not easy, since it corresponds to a reduced gap between the food and the feed prices. Moreover both prices are now weakly exogenous.
When also the entry price is included as an exogenous variable, the declassification maintains its significance; the long run transmission elasticity in the cointegration vector now becomes unreasonably high but this can be attributed to the role played by the entry price that, in turn, enlarges the gap and, therefore, presumably also amplifies the elasticity of transmission of price shocks. More generally, the domestic feed price and the entry price are strongly linked, the former being mostly driven by the latter. Therefore, including the entry price within the analysis absorbs most of the movements of the domestic feed price and substantially resizes the role played by the other potential drivers.

# 9. Policy implications

In this final section, the main findings of this study are presented.
Our empirical analysis aims at answering the research questions introduced in section 2. The first one is: which is the long-term price pattern of the domestic and international prices under study? The resulting second one is: do these prices move together? Is there co-movement between the domestic and international prices and between the domestic food and feed prices, and which is the driving price?
In this respect, in section 9.1 we try to summarize and explain the comprehensive and consistent "story" underlying price behavior as emerging from our empirical estimates.
The third research question concerns the policy issue: which is the role of policies in these price movements? Which are those policies that are candidate to interfere with price formation and transmission, and is there empirical evidence about their impact on price movements?
In section 9.2, we then focus on the impact of the policy measures on the various price transmission mechanisms under study.
All these analyses and reflections lead to a last, comprehensive question: what can we conclude about the efficiency and effectiveness of these policies? Are there alternatives that can be suggested on the basis of our results?
Our econometric estimates, characterized by many challenges and limitations (recalled in section 9.3.1), and sometimes leading to puzzling findings (presented in section 9.3.2), only allow us to draw some very confined impressions on what the adopted methodological approach suggests about the impact of these policies (section 9.3.3). Indeed, the present study is the first part of the FOAG evaluation of cereal markets and our focus is only on the price transmission under current policies.
Keeping all these considerations in mind, we try to draw some final policy considerations, indicating some possible directions of development of the current policy intervention system.

### 9.1 Summing-up and trying to "tell a story"

The evidence and econometric results provided and discussed in the previous sections should now be summarised to outline the main tendencies in price evolution as well as the role of policies in this respect. Finding such synthesis, however, is not easy because this amount of evidence is not necessarily univocal, some results may be ambiguous and contradictory, others may seem unreliable or, at least, not very robust. Therefore, we here want to summarize only what we think emerges as relevant and robust evidence from the analysis above.

First of all, it is worth reminding some results about international wheat prices that are not new in this literature but still are of major interest here. The long run transmission elasticity among international prices and, in particular, between the North-American and the EU prices is very close to 1, which apparently implies that price shocks are almost entirely transmitted across markets. A careful look at the results, however, indicates that the EU market (in particular, the German price is here considered) is relatively "independent" with respect to the North-American one. More technically speaking, within the VECM the respective adjustment coefficient is not significant so the European price appear to be weakly exogenous. Moreover, and surprisingly, the 2007-2008 price peak (the bubble) comes earlier in the EU prices than in the Canadian price, and the EU interventions during the price peak, in particular the suspension of import duties on cereals, seems to have been effective in counteracting the «bubble». This anticipation and the effectiveness of the policy response would further suggest a sort of "centrality" of the EU market in the international context.

The implication for the present study is that, though the Canadian and the EU prices are both considered in our estimates, the latter (i.e., German) price alone would fully represent the international market evolution in analyzing the degree of integration, or protection, of the Swiss domestic market. Of this domestic market what is confirmed to really be the most peculiar character is the separation between the food and feed uses and, therefore, the significantly different behavior of the two prices.

The domestic food price shows a limited integration with the international price, therefore suggesting that, although the degree of protection of the domestic market is relevant, this still does not prevent it from responding to international market signals. As will be summarized in the following section, the different policies in place allow, or might even turn out to improve international price transmission. The long run transmission elasticity with the German price is around 0.2 but it increases to around 0.6 after the application of the tariff which in turn depends, since 2008, on the established entry price. This is fully consistent with the expectations, as the tariff absorbs most of the international price's variations at least within the limit of the maximum admitted tariff. Nonetheless, it remains true that frictions remain between the international and the domestic markets, which make the latter only partially respond to the former. The long-run relationship of the domestic price with the Canadian price, though roughly moving in the same direction, appears to be less stable. This instability may be attributed to the 2007-2008 price "bubble" that significantly increased the distance between the prices, as already observed in previous studies (Esposti and Listorti, 2013). With respect to the food use and price, therefore, we can conclude that the Swiss domestic market is not isolated from the European and the international ones but is still protected in the sense that border policies "artificially" stabilize it with respect to the external variations, as will be explained in the next section.

The case of the "other" domestic market and price, the feed use, actually presents a more puzzling behavior. This is even more surprising if we consider that longer time series are available for this price, which should grant more robust econometric evidence, and that the respective border protection is relatively "simpler" and in place by longer time with respect to the food case. Results indicate that there is no long-run linkage between the domestic feed price and any international prices, either the import price (*feed_i_price*) or German and Canadian prices. Compared to the case of the entry price of food, this is somehow surprising since the wheat used for feed is largely imported, its demand is more elastic than the demand for food, so the expectation is to find a stricter integration with the international market than in the food case.

Nonetheless, for the domestic feed price it hardly emerges a significant, robust and plausible linkage with other prices. What appears to be the main evidence in this respect is that the feed price strongly depends on its own entry price.

Apparently, for the feed price can be repeated what discussed for the food price: once the tariff is added, the long run transmission elasticity with the German price is restored and is very close to 1, which would imply that any shock in the international price plus the tariff is entirely transmitted into the domestic market. As the tariff depends, in turn, on the entry price, it can be concluded that the main driver of the domestic feed price is the entry price.
In the case of feed, however, this seems even more true than for food because the behavior of the feed price very strictly follows the evolution of the entry price over time: it is very smooth and, apparently, it is not affected by short-run market turbulence and does not show significant "bubbles". By comparing the feed and the food case, therefore, the conclusion could be that the entry price plays a very strong stabilizing role that can be hardly observed in the food case simply because here its introduction is more recent and has been implemented in a period of major market crisis; but also because it acts in combination with the TRQ, which is normally filled, adding complexity to the price dynamics; because the maximum applicable tariff is reached regularly; and probably because the applied tariff is adapted only with a lower frequency (biannually and then quarterly, rather than monthly), and is based on the prices observed in the past three months while, in the case of feed, future prices are used.
The regularity of the feed price and its limited, if any, linkage with the other prices compared with the food price, however, is something that remains partially unexplained in the present analysis. Among the measures that are expected to stabilize the food price at the expense of the feed price there is the option of the declassification of the food use into feed use. As this measure turns to be statistically significant and, therefore, a driver of transmission of price shocks between the food and the feed price, it remains difficult to explain why eventually the feed price is visually much more regular and stably declining than the food price. One possible explanation are the low volumes involved, the availability of suitable substitutes for wheat for feed uses, and the fact, being Switzerland a net importer of feed, in case of an increased supply of feed, imports are likely to decrease, but the domestic feed price is likely to be always determined by the entry price.
The linkage between the two domestic prices is, in fact, another key result of the present analysis. The evidence is puzzling also in this case because cointegration tests hardly identify a long-run relationship between them. This may be in part attributed to the fact that food price shows periods of higher volatility that are not observed, as mentioned, in the feed case. While this could depend on the functioning of policies in the two cases, as will be clarified below, it is clear that together with the shorter period of observation in the food case, this different behavior in turbulent times may prevent from correctly separating and identifying the long-run linkage and the short-run responses. Nonetheless, it emerges a significant linkage among the two prices with a quite high price transmission (the elasticity is close to one if the declassification intervention and structural breaks are not considered, although this coefficient is not significant). It is also confirmed that the declassification plays a role, since its introduction in the model reduces the price transmission elasticity. However, the main driver of the feed price remains the entry price.

### 9.2 The role of policies

Along these general evolutionary tendencies of prices ("the story"), we can read and interpret the role of policies as emerging from the estimates. Even in this case, it is useful to distinguish the analysis between the food and feed prices and then look for possible complementary or conflicting effects.
In the food case, the border protection system is able to protect the domestic market and, in principle, to separate it from the international market. This "protectionist" effect is bounded by two main policy measures. On the one hand, the TRQ: the protectionist effect is maximum for over quota levels of imports that are, in fact, rarely observed. However, the possibility to

temporary introduce an extension of the TRQ allows to reduce the gap between the domestic and the international price in periods of major market turbulence, notably when the import demand tends to increase. On the other hand, the same "convergence" effect is eventually determined by the introduction of an entry price that is less protective than the pre-existing pure tariff since, if sufficiently low, it tends to reduce the gap between the domestic and the international price. Indeed, the applied tariff is often "capped" at its maximum allowed level, which makes this entry price system *de facto* work as a tariff set at a lower level.

Actually, the entry price system seems to be more effective and permanent in this respect than the temporary extension of the TRQ. In practice, although in place for limited periods in the period under observation, they both contributed to generate an effect which is, at the same time, of gradual convergence to the international prices but also of protection of the domestic market from market turbulence. This is evident during the 2007-2008 price "bubble" when the combination of an entry price and of the TRQ extension seems to have partially offset the impact of the international price spike in the domestic market. The combination of these policy measures (tariff, entry price and a flexible TRQ) in the food case provides a good example of how the Swiss market is not isolated from the international ones but it is still "artificially" stabilized. The interconnection between all these different policy measures is complex and requires continuous market observation and adjustments. Furthermore, one should not forget that the limited number of observations available in the case of food, which include periods of major market turbulence which might have had an impact also on the behavior of market operators, poses numerous challenges to the interpretation.

Due to the more puzzling evidence concerning the feed price, also the conclusion about the role of policies in this respect could be vague and uncertain, as well. As a matter of fact, as mentioned, the entry price for the feed use seems to be the only robust and permanent driver of the domestic price and, consequently, the major cause of his smoothness. The reduction of the entry price over time, therefore, was able to induce a pattern of the domestic price that combines stability with a gradually declining trend that makes it converge to the international values. In the case of feed, the lack of a TRQ system does not prevent the combination of a declining entry price and a tariff to achieve this twofold result of stabilization and gradual convergence.

However, this should not come as a surprise: the more articulated border protection for the food case (including an extendable TRQ) is justified by the fact that in this case, while the stabilization of the domestic price remains a key purpose of the policy, the same cannot be said for its gradual decline and convergence to the international prices. Since in the food case the policy objective is also to grant the farmers a price which is high enough, the permanence of a TRQ system and the late introduction of a slightly declining entry price can be justified. The temporary but still not rare use of the declassification from food to feed use demonstrates how defending high enough domestic food prices may temporary prevail also on the stabilization of the domestic feed price. However, as explained above the impact on feed prices of declassification is lower as it is mostly driven by its entry price.

Achieving stable and converging feed prices and stable but not (too) declining food prices is what eventually justifies the presence of two different border protection systems and of the domestic measure of the declassification. Going back to the original research questions concerning the objectives and impacts of the policies, it appears that stability has been pursued together with gradual convergence to the international prices. More in general, this is in compliance with the evolution of the Swiss agricultural policy, whose an important element is increasing convergence to the world prices to strengthen the competitiveness of the Swiss agricultural sector (cfr. For example the message of the Federal Council for the new Agricultural Policy in 2006).

One may wonder, however, whether the same result could be obtained by a simpler and unique border policy eventually combined with specific measures for the exceptional times (as it is the case for declassification and TRQ extension).

## 9.3 Main challenges

In this concluding section, we briefly remind the possible limitations to be taken into account in interpreting the results obtained (section 9.3.1), and point at some puzzling evidence which deserves further investigation (section 9.3.2). Finally, remembering that the present work is only the first step of the FOAG evaluation of cereal markets, some first policy considerations are drawn about the appropriateness and effectiveness of the policies in place (section 9.3.3)

### 9.3.1 Data issues

In commenting the estimation results and in trying to draw policy implications and conclusions great caution is, obviously, needed. This is always true when trying to "reconnect" the empirical analysis to the real world, but it is truer in the present case especially for the persistent limits in the adopted dataset. Three major problems can be reminded here.

The first issue concerns the heterogeneous time coverage of the series available. Besides some marginal (and solvable) aspects like the incomplete availability of international IGC prices for year 2012, the key problem here is represented by the shorter food price series compared to the feed prices. Evidently, a shortened period means a much lower number of observations and this, by definition, reduces the statistical robustness of the analysis. But there is more. Food price series focus on a time period characterized by a much higher turbulence: this inevitably affects the identification of the possible long-run relationship. In other words, feed and food prices contain two at least partially different "stories", and we are trying to derive from them a common one; this is not easy.

The second issue concerns time frequency of price observations. Again, this represents a problem on two different grounds. First of all, compared to weekly data often and increasingly adopted in price transmission studies (Esposti and Listorti, 2012), the monthly data used here results in a much lower number of observation with the already mentioned consequence in terms of statistical quality of the analysis. Secondly, and more importantly, monthly data may miss, hide or confound, price transmission linkages operating over a limited amount of time, that is, days and weeks rather than months. This is particularly true in turbulent times where prices (both international and domestic) may react more rapidly to, and even anticipate, market signals. An econometric analysis performed on monthly data, especially over such periods, may encounter problems in separately identifying short-run an long-run relationships among prices.

This leads us to the final issue, that is the amount and quality of information (i.e., data) on policies. While assessing the role of policy measures in price formation and transmission is eventually the main scope of the present study, data about policy measures are inadequate in many respects compared to price data they are expected to influence. This is not necessarily a problem of data collection. Policy data may be poor simply for the nature itself of the policy intervention. Policy data are poor because they are discontinuous, that is, infrequent and irregular (i.e., cover a limited amount of time). Therefore, with a limited number of observations we are trying to derive evidence of general validity though, in fact, it could apply to a very restricted period and very peculiar conditions.

Eventually, these limitations in policy data availability imply that these variables enter the econometrics just as dummies, on/off variables that may only roughly capture the often complex interaction of these policies with price mechanism. But this use of policy variables within our estimated model raise a further and even more complex issue. What we observe

(again, often just as on/off of a policy instrument) is just the moment when a given policy decision is taken and an instrument activated (for instance, the TRQ extension). However, this does not necessarily correspond to when this measure becomes really effective and, therefore, conditions price formation. The timing of the actual implementation of a policy measure may be complex and hardly predictable. Furthermore, once again the limited data coverage at our disposal prevents from the adoption of more sophisticated approaches (for example, allowing for lagged or anticipated responses). Therefore, entering policy variables as dummies within econometric models may not only be rough but also imprecise in representing the real timing of the events and, eventually, in correctly identifying the cause-effect relationships.

A final consideration on data availability and use concerns the conversion of international prices into the national currency (CHF). Evidently this operation is neither neutral nor irrelevant in the analysis of price transmission. Variations in the exchange rates between CHF and € or US$ are clearly reflected in changes of international prices measured in CHF. This implies that shocks in the exchange rate and real shocks in the international wheat market are indistinguishable, in practice, in the present analysis. Though separating these two effects is beyond the scope of the present study, we should still be aware of the fact that months of relatively more volatile exchange rates during the whole period under observation may have had an impact on the estimated results.

### 9.3.2 Puzzling evidence

Having reminded all the possible limitations to be carefully taken into account in interpreting the results obtained here, it remains true that, together with some robust evidence, some results remain unclear and deserve further investigation. Quite surprisingly, these results mostly concern the feed price, which is the longest and apparently more stable price series. Nonetheless, its regularity appears to be one of the key issues. Apparently, the domestic feed price moves along a quite smooth and gradual declining pattern, driven only by the respective entry price and hardly affected by the international prices. The domestic feed price is more independent from the international prices than the domestic food price, although this latter receives, at least in principle, a stronger border protection. Why is this the case? If the stabilising role of the entry price would be so relevant, the same would be observed in the domestic food price after the introduction of its own entry price in 2008. But even after this date, the domestic food price remains more responsive to external variations and price "bubbles" than the domestic feed price. In sections 9.1 and 9.2 we tried to provide some tentative answer in this respects, although one should not forget that the complex price dynamics characterizing the time period[18] further complicate the picture.

Within this context, the role of the declassification itself may be surprising. In principle, when implemented, declassification should transmit price decline from the food to the feed domestic markets. Looking at the behaviour of the series over time, there is no evidence of this transmission. At the same time, the econometric estimation assigns to declassification a significant impact on price transmission even though, in practice, this instrument is activated in limited periods and concerns very small volumes. Furthermore, the demand of wheat for feed uses is very elastic. So, its impact is expected to be limited as well, confined to the immediate and short-run price response and irrelevant for the longer term price linkages. It must be noticed, however, that declassification enters the estimated model as an intermittent dummy usually activated during periods of major market movements[19]. Therefore, it is

[18] And, as well, the fact that the feed price is a consumer's price while all other prices are producer's prices.

[19] The decision to implement declassification normally follows high yields in the domestic production. Normally, high yields in Switzerland coincide with high yields in Europe, that is, periods of major market dynamics.

almost impossible to separately identify the specific impact of the measure implemented and the impact of market turbulence on price transmission, and the two effects can be actually confounded.
Another possible explanation for these puzzling results can be the inadequate adopted specification of the econometric model. On the one hand, we estimate VEC models, therefore we always implicitly assume that the long-term relationship among prices is linear, though the dummies roughly introduce some non linearities in the form of parallel shifters. On the contrary, either the short-run and the long-run price linkages may assume more complex non-linear behaviour as assumed in the non-linear VECM increasingly adopted in the recent literature (Esposti and Listorti, 2012). In addition, in most cases the adopted specification implicitly assumes that policies play a role by affecting the gap between the prices but not affecting the respective price transmission elasticity. We only tentatively explore this issue in the case of the entry price for food. Unfortunately, model specifications admitting more complex non-linearities and time-varying price transmission elasticities are unaffordable here given the already discussed data limitations.
A final and more radical remark in this respect is that the VECM itself could be inappropriate to analyse the complex behaviour and linkage of agricultural commodity prices. First of all, it is well known and studied that the behaviour of agricultural commodity prices may substantially differ from those economic and financial series for which this model has been designed and originally implemented. The movement of agricultural prices over time is largely erratic and this prevents from clearly identifying and separating short-run responses from long-run relationships. The latter, in fact, may not even exist because these prices are neither strictly stationary nor strictly non-stationary as they often show fractional integration, that is, long memory of the shocks without having a unit root. This may also explain why, though a clear linkage among price emerges, it remains difficult to identify the presence of a cointegration relationship.
When we bring all this complexity into the field of policy analysis, it evidently hampers a sound assessment of policy effectiveness. First of all, some policy measures are intended to govern market relationships in "normal" times; other are expected to intervene only in "exceptional" times. However, in agricultural commodity markets, as mentioned, it may not be easy, if not feasible, to distinguish the former from the latter and, therefore, to assess when a given policy is appropriate and effective. Secondly, and more generally, there is always a battery of heterogeneous policy measures simultaneously implemented at a certain point in time. Therefore, assessing the impact of a single measure can be itself unaffordable; the only possible evaluation concerns the whole set of measures. Whether that combination of simultaneous policies is the most efficient one cannot be actually established on an empirical basis but only making careful and cautious conjectures and hypotheses based on that empirical evidence.

### 9.3.3 Some final policy considerations

What can be said, in the conclusion of the present study, about the appropriateness and effectiveness of the policies in place? Evidently, the objectives behind the cereals' trade policy are multiple and complex. Some of these objectives may not be fully clear, at least for the analyst, some others may be inherently in conflict and, therefore, the policy objectives becomes in fact a good compromise between conflicting objectives. Consequently, any policy measures should be implemented and, above all, evaluated only on this multidimensional ground.
This multidimensionality is unaffordable and well beyond the scope of the present analysis. Therefore, there is no intention here to "judge" a policy; the above mentioned complexity necessarily invokes a political evaluation, not some econometric estimates with several data

limitations. Nonetheless, here we can still try to draw some very confined impressions on what the adopted methodological approach suggests about the impact of these policies, still considering that the present study is the first part of the FOAG evaluation of cereal markets and the focus is only put on the price transmission under current policies. Further development of the market regulations and, therefore, possible alternatives will have to be considered more comprehensively, taking into account the whole set of agricultural and border policies and objectives, elsewhere and, presumably, also with other methodologies.

We can state that, roughly speaking, the main objective of the policy measures here considered is to make the domestic price gradually converge and be responsive to international prices but still protecting the domestic market with respect to excessive fluctuations. This protection can be intended in terms of stabilizing both food and feed prices but in a differentiated way in order to grant food price more protection, i.e., to maintain a gap between food and feed prices favoring a stable domestic wheat production. In other words, the apparent main objective underlying policy measures is to protect the domestic market in such a way to have stable and relatively high prices for wheat for food and stable and relatively low prices for wheat for feed.

If this is the objective, we can conclude that such policy targets have been, at least in part, achieved. A key role in this achievement is played by the entry price system. In the case of feed uses, the combination of a declining entry price and a tariff allow to achieve this twofold result of stabilization and gradual convergence. In the food case the introduction of the EP system coincides with a period of higher transmission of price signals across the border. The extension of the TRQ and the intervention through declassification, though not a policy *strictu sensu*, can be considered coherent integrative measures within this context to be adopted in turbulent times.

Still one can wonder whether, despite this positive overall evaluation, these same results can be achieved in a different and possibly more efficient way. In other words, the question becomes what can be possible directions of policy reform in this context. These streams of reform can range from relatively minor incremental adjustments to more radical changes. Evidently, if the objectives remain the same, any alternative policy must guarantee a domestic segregation.

One possible simplification could be the unification of the two systems, that is, only one entry price (therefore, one tariff) for both food and feed uses. As shown, there is at least partial evidence of an existing linkage between food and feed prices, and the entry price system has a strong stabilizing role within the domestic market; indeed, this solution would imply a more or less gradual convergence of the two domestic prices toward the same level, therefore with a gap progressively going to zero. Without forgetting that quality differentials between feed and food wheat could in part still account for price differentiation, this outcome would eventually cancel out the domestic separation of the two markets. If such separation has to be maintained, a common entry price should be accompanied by measures that, at the border or internally, restore the price gap especially during periods of downward price trends. This can be achieved by maintaining or adapting the TRQ system for food and, internally, activating the declassification any time the domestic food price reaches a level that is considered too low. Eventually, both solutions together allow stabilizing the food price (trying to adjust it downwards or upwards) and regulating the price gap with the feed price.

If the entry price is progressively reduced to make it converge to the international prices, one possible further step could be a liberalization of the wheat for feed use, at least within the EU market. A free trade agreement with the EU, only for the feed use, assumed it is politically and technically feasible, could maintain the separation and the gap between the food and feed price by just maintaining an entry price system for the food use. As this may be not sufficient especially during periods of strongly declining international prices, and remembering that

there is evidence of at least some price transmission between food and feed prices, it remains to be evaluated whether this solution still requires the maintenance of the other specific measures designed to stabilize the domestic food price, that is the TRQ and the declassification.

In both cases, the TRQ extension and the declassification allow to adjust the price gap between food and feed prices. In this respect, alternatively, the presence of two different entry prices for food and feed, like it is the case today, but removing the TRQ for food, would render declassification less or not effective (since cheaper imports of food could anyway occur then lowering the domestic prices). In this case, while specific provisions could be implemented in order to render the entry prices systems more effective in preserving the domestic price gap (for example, in the case of food the tariffs could be adjusted every month), there would be no available "buffer" mechanisms to tackle temporary market imbalances.

These are just possible options that appears to be feasible according to our results and that could be further evaluated to achieve a progressive simplification of this policy.

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# Annex

*Figure A1 – Price series behaviour over time: food domestic prices (CHF/100kg)*

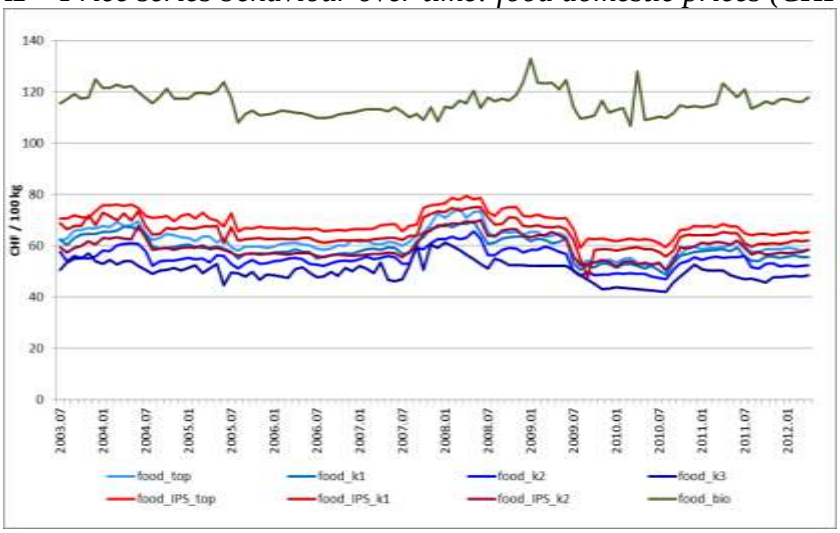


*Figure A2 – Price series behaviour over time: feed domestic prices (CHF/100kg)*

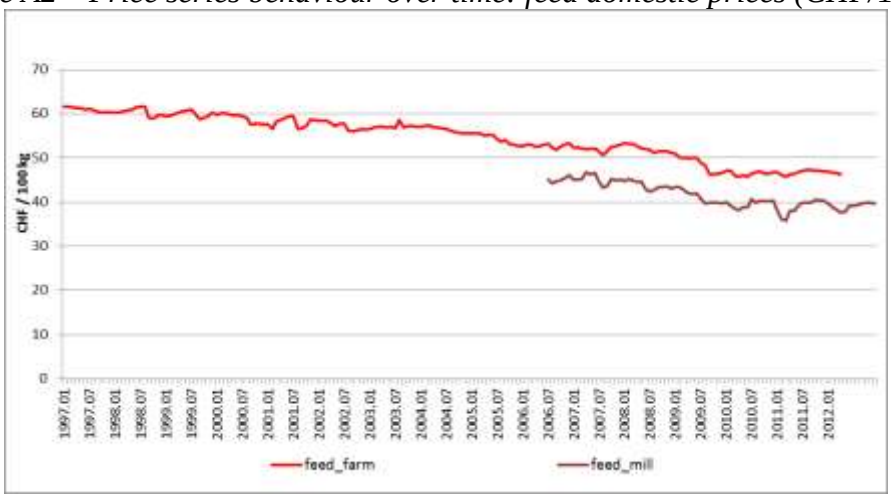


*Figure A3 – Price series behaviour over time: international prices (CHF/100kg)*

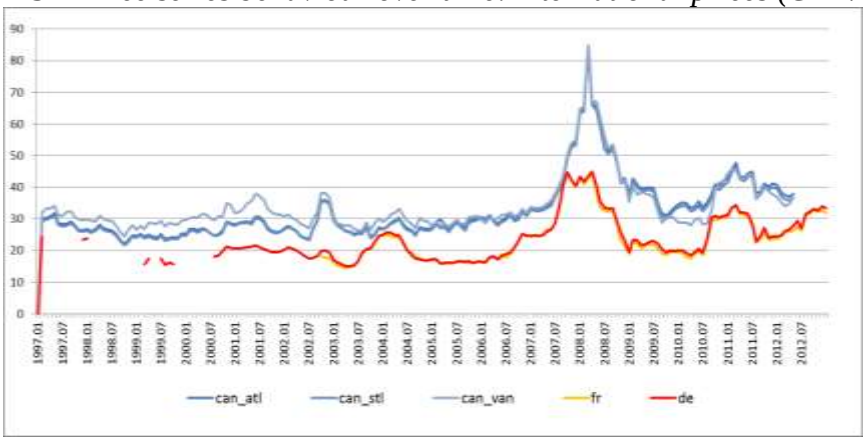

*Figure A4 – Price series behaviour over time: traded prices (CHF/100kg)*