



Article

The Impact of Plant Variety Protection Regulations on the Governance of Agri-Food Value Chains

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Abstract: More than 25 years after the 1991 reform of the Union for the Protection of New Plant Varieties (UPOV) treaty, the regulation of Plant Variety Protection (PVP) is still controversial. While the incentives to private innovations are unquestionable, concerns have been raised about farmers' access to resources, the weakening of their bargaining power, their entrepreneurial freedom, and ultimately their welfare. Our paper investigates the effect of PVP regulation on the governance of agri-food value chains (AFVC) with a small-scale survey of kiwi producers in Italy. We found that AFVC trading-protected (club) plant varieties are more likely to exhibit captive governance forms than those trading the free varieties. Nevertheless, the producers of club kiwis achieve higher returns from their investments and bear less risk than others. Because of the high demand for the club fruits, the breeders must give farmers highly profitable contract terms in order to elicit the production and to promote the adoption of the new cultivar. As a consequence, farmers are capturing a share of the value of innovation, even if the breeders have a strong protection. The long-run sustainability of this win-win agreement between breeders and farmers might be jeopardized should the demand for the new varieties fall.

Keywords: plant variety protection; agri-food value chains; agri-food governance; kiwifruits club-varietal

1. Introduction

This paper investigates the impact of the regulation of plant variety protection on the governance of the agri-food value chain. Since the Convention on the Union for the Protection of New Plant Varieties (UPOV) in 1961, the intellectual property rights of breeders of new vegetable varieties have benefited from increasing legal protection. In particular, the 1991 revision of UPOV extended the protection from the traded material only (the seeds, in the majority of cases) to all materials, including the harvested product. The 1991 UPOV system proved to be extremely efficient in motivating large companies and small breeders alike to engage in breeding work (Ghijzen 1998). As a result, the development and marketing of new vegetable varieties is a growing trend in the global food system (Plant Variety Database 2018). The large number of vegetal “club varieties” is a clear example of the marketing potential that can offspring from the new regulation (for example, Brown and Maloney 2009).

The increase in the protection of the breeders' rights is raising concerns about the welfare of farmers, especially in developing countries (e.g., Tripp et al. 2007; Lombard and Leakey 2010). The current system resulted in a stronger protection of the breeders' rights, while limiting farmers' access to genetic resources and their entrepreneurial freedom (Campi and Nuvolari 2015; Moore and Tymowski 2005).

Our paper contributes to the debate about the implications of the PVP regulation, focusing on the implications for the organization of the agri-food system. Our objective is to assess whether the current

regime of plant variety protection (PVP) may have an impact on the governance of the agri-food value chains.

We support our analysis with an empirical investigation of the Kiwifruit sector in the Lazio region in Italy. The case is of particular interest because it allows us to compare value chains that are similar in many respects (same location, land quality, weather conditions, and infrastructures) but differ with respect to PVP. The green kiwi (mostly Hayward cultivar) is a free variety, with no PVP, whilst the production of yellow flesh kiwi (mostly the Sungold, Dorì, Soreli, and Jingold varieties) is protected with PVP. The empirical analysis conducted on a small sample of producers suggests that the governance of the value chain is different for the two varieties.

In order to investigate the issue further, we ran four in-depth interviews with producers and we found that yellow kiwi was perceived as a less risky and more profitable business. As a consequence, several green kiwi producers were considering applying for the club varieties. We concluded that growers of the club varieties had less entrepreneurial freedom but better financial performances than the ones farming free varieties. The monopsony power of breeders is constrained and limited by the necessity of eliciting enough production to meet the increasing consumer demand for the new varieties. Because of the high consumer demand, the kiwi club varieties seem to be a win-win deal between breeders and growers, at least in the short run.

The remainder of the paper is organized as follows. In Section 2, we provide a brief overview of the regulation about PVP. Section 3 illustrates our empirical strategy to measure the differences in the governance of value chains. Section 4 presents the results of the survey and of the in-depth interviews. Section 5 summarizes the results and presents conclusions.

2. The Protection of Intellectual Property Rights on Plant Varieties

The current system of regulation of the protection of intellectual property rights for plant varieties (PVP) is the result of a complex process of historical development that has taken place at different paces in different legislations (Blakeney 2005). Appendix A reports a brief summary of the history of PVP regulation for interested readers.

For the purpose of this study, the distinctive characteristic of the current regulatory system is the ability of a breeder to influence (and control) the downstream segments of the value chain. After the 1991 reform of the *Union pour la Protection des Obtentions Vegetales* (UPOV, see Appendix A), the breeder can set the quantity of the final product arbitrarily, gaining a decisive advantage. By limiting the multiplication rights and banning the reuse of seeds, the breeders can prevent farmers from expanding production to the perfectly competitive level, inducing scarcity in the final market. As a consequence, breeders can exert market power at several stages of the value chain. They are at the same time monopolists of the genetic material and monopsonists of the harvest products with respect to the farmers/adopters. They are monopolists of the harvest product with respect to the downstream traders and consumers.

Summarizing, the global system of protection has the following three key characteristics:

- i. *Branding*: the variety can be associated with a unique name. The protection is extended to the final product (for example, *pink lady* apples or *sungold* kiwis)
- ii. *Production control*. The breeder can plan the production of the final product by controlling the license agreement.
- iii. *Marketing control*. The breeder may claim ownership rights on the final product. This means that farmers may be subjected to a delivery obligation. Consequently, the breeder maintains an influence on the marketing decision.

The breeder can choose to modulate the intensity of the protection arbitrarily. As a consequence, different combinations of the three elements can be found in the actual organization of the value chains. The club variety is a specific combination of PVP rights that is of particular interest for this study. A club variety is a protected plant variety that can be grown only by licensed farmers. The license is

conditional to the adoption of well-defined production standards to ensure a consistent high quality of the final product. The standardization of the final product facilitates strategies based on branding and consumer loyalty. Marketing rights may or may not be claimed by the breeder as long as the brand identity of the product is preserved (Brown and Maloney 2009; Asioli et al. 2016; Canavari 2018).

Our hypothesis is that the change in the intensity of protection is associated with a change in the form of governance of the agri-food value chain. To test the hypothesis empirically, we compare club-varieties value chains with value chains of unprotected varieties and we assess the change in the characteristics of the governance.

3. The Empirical Strategy

3.1. Defining Governance

Governance is an elusive concept to measure or define. The term “governance” encompasses both the authority and the power relationships that determine how financial, material, and human resources are allocated and flow within a chain (e.g., Gereffi and Korzeniewicz 1994). Humphrey and Schmitz (2001) suggested to “use the term to express that some firms in the chain set and/or enforce the parameters under which others in the chain operate”. Similarly, Ménard and Egizio (2005) relate governance with the notion of *authority*. More recently, Ménard (2018) suggested that “Governance [. . .] is intended as the set of devices implemented within organizations, or among networks of organizations, to allocate and monitor assets and rights, providing the backbone to economic activities.”

For the purpose of this paper, we follow Ménard (2018) approach and we consider governance as the set of modalities of the organization of transactions in a value chain. This practical definition has no pretense to be exhaustive, yet it gives us the possibility to run an empirical investigation. In fact, it relates to an extensive literature aiming at defining a taxonomy of governance forms (Gereffi et al. 2005; Carbone 2017; Vurro et al. 2009; Gellynck and Molnár 2009). Based on this definition, the objective of our empirical analysis is to test whether the governance of club-variety value chains exhibit different forms of governance compared to similar, non-club value chains.

Gereffi et al. (2005) proposes a taxonomy of governance forms including five types: market, modular, relational, captive, and hierarchy. As the Author mentioned, “These are analytical, not empirical, types, although they have been in part derived from empirical observation” (Gereffi et al. 2005, p. 83). The purpose of the classification is to provide a general framework to explain the key characteristics of different governance forms.

The most important characteristic of the *market* governance form is the low cost of switching to new parties. This does not necessarily require spot transactions. It may involve repeated trade as long as the traders are free to pursue new opportunities, if available. In *modular* value chains the supplier must be able to deliver a product following the buyer’s specifications. The suppliers take full responsibility for the production process, and they have the skills and the resources to fulfill the buyers’ demand (“turn-key services”). The asset specificity is low. In *relational* value chains, there are complex interactions between buyers and sellers, with mutual dependence and investments in specific assets. Trust and reputation play an important role in these value chains. *Captive* suppliers are dependent on the buyers and face significant switching costs. In these value chains, buyers often rely on monitoring and control. The *hierarchy* governance form refers to vertical integration, where buyers and sellers are owned by the same property.

According to Gereffi et al. (2005), the governance forms are associated with three key drivers: the *complexity* of the transaction, the extent to which information and knowledge can be *codified* and transmitted from one party to another, and the *capabilities* of actual and potential suppliers (in relation to the complexity of the transaction). The five types of governance are associated with different intensity levels of the three factors. In *market* value chains, complexity is low, product specifications are simple and easily codified, and suppliers are fully capable of delivering the product or service. In *modular* value chains, complexity is high, but specifications are easily codified (for example, with standards),

and suppliers have the skills and the knowledge that are necessary for production. *Relational* value chains may emerge when the information that is necessary to complete a complex transaction is difficult to codify and when the buyer must exchange relevant tacit knowledge with highly capable suppliers. When transactions are complex, information is difficult to codify, and suppliers have limited capabilities, *captive* value chains are expected. *Hierarchy* is used when the skill level of suppliers is not sufficient to ensure that the buyer’s demand is met.

3.2. Empirical Investigation of Differences in the Governance of Vegetable Value Chains

We use the association between the three drivers and the five forms of governance to test the differences between value chains with club and non-club varieties. Our empirical test is based on the comparison of two value chains that are as similar as possible in all respect but for the PVP rights. We use a short questionnaire to assess the level of the three factors, and we use these results to infer the form of governance.

The questionnaire has five sections; each section has one or more items. The first section refers to *General items*: questions that are not directly related to the three drivers but might help identifying the form of governance. The item regarding the ownership of the firm is used to identify the vertical integration. If the farm is owned by the buyer (or the breeder), we have a clear reference to *hierarchy*. Free sales are associated with a *market governance*, while long-term contracts refer to other forms. The item regarding the negotiation of the terms of sales was added under the assumption that *captive* suppliers are in no position to negotiate, while other forms of governance may have more negotiation space.

We assessed the complexity of the transaction by asking the grower ‘*how complex are the buyer’s requirements?*’ As mentioned by Gereffi et al. (2005), increasing levels of complexity are associated to different forms of governance (Table 1). The difficulties in codifying information and knowledge are addressed with one item asking ‘*are you free to organize production?*’ The possible answers referred to the increasingly complex standards. The growers are asked whether they have to follow standards or directions and how clear, complex, and exhaustive the instructions are. They are also asked whether the standards concern the final product or the production process. The suppliers’ capability is assessed using replaceability as a proxy. The growers are asked ‘*how easily can they be replaced by the buyer*’ and ‘*how easy is to find another buyer*’ and “Why?” The basic assumption is that capable suppliers are difficult to replace and have more trade opportunities.

Table 1. Detecting the governance form.

	Items	Type of Governance				
		Market	Modular	Relational	Captive	Hierarchy
General	Ownership	Own	Own	Own	Own	Employee
Items	Sales	Free	Contract	Contract	Contract	
	Negotiation of terms of sale	Everything is negotiated	Standard contracts that are equal for all growers	The grower can negotiate some terms (others are imposed)	Terms are dictated by the buyer	
Complexity	Complexity of production	Easy	Difficult for unexperienced growers only	Difficult requires high skills	Must use buyer’s tech support	
Codify info	Production specifications	None/custom rules	Simple standards	Complex standards	Follow directions	
Capabilities	Replaceability	Easy	Easy	Difficult	Easy	
	Termination cost (growers)	Very low	High	High	Impossible/very costly	
Other	Type of PVP					
Items	Farm size(ha)					
	Years of farming					
	Producer Association					

Other items in the questionnaire collect information about the vegetable variety and the PVP rights (in order to tell club from non-club value chains), farm size (proxy for the value of the investments), years of farming (also used as a proxy for capability), and the membership to producer associations. These items have no direct link to the drivers but can be used to obtain complementary information and to test whether the form of governance depends on factors other than PVP rights.

Because the questionnaire is administered via phone interviews, we had to limit the number of questions and we could not ask for sensitive information, such as income or specific contract terms. Also, we had to frame the questions in order to minimize the self-representation bias in the responses. Questions referring to capabilities and the ability to organize production are especially vulnerable to bias because respondents are naturally inclined to portray themselves as skilled and independent growers. For this reason, we used proxies instead of direct questions.

4. The Agro Pontino Kiwifruit Value Chain

We applied our empirical methodology to the Agro Pontino Kiwifruit value chain. The choice was motivated by the specific characteristics of the chain. In particular, we selected a case with a coexistence of club and unprotected varieties in the same area. In this way, we could compare the value chains that differ for the PVP regime only. In Section 4.1, we provide a brief description of the value chain.

4.1. Description of the Agro Pontino Kiwifruit Chain

Italy is the second world producer of Kiwi fruit after China (Table 2). Kiwi production was introduced in Italy in 1970, and it has been growing steadily since. The major production areas in Italy are Agro Pontino (31% of Italian acreage in 2017), Piemonte (18%), Emilia Romagna (15%), Calabria (11%), and Veneto (10%). In 2016, the kiwi output in the Agro Pontino area was 144,395 tons, that is, 3.3% of world production.¹ The production level is achieved on a relatively small area because of the remarkable specialization of the farms (Figure 1).

Table 2. Kiwi fruit production by Country in 2016 (Source Faostat).

Country	Tonnes	%
China	2,390,287	55.9
Italy	523,595	12.2
New Zealand	434,048	10.2
Iran	294,413	6.9
Chile	225,797	5.3
Greece	182,589	4.3
Others	224,141	5.2
Total	4,274,870	100.0

Italian Kiwifruit is mostly consumed as a fresh fruit. The share of national production that is given to the processing industry is approximately 7% (fruit drinks, confectionery, or baking industries). Most of the production is sold abroad. Domestic consumption is approximately 20% of the total production.

At the producer level, the Agro Pontino Kiwifruit system involves approximately 2650 farmers (2010 census data), several producer organizations (Apofruit, KiwiSole, Zeoli, and others), and a protected geographical indication (PGI) consortium. Products are highly differentiated. The traditional variety is Hayward (a green fruit), which is cultivated as conventional PGI, or organic varieties. In the last decade, club varieties were introduced, mostly yellow kiwi. Zespri, Jingold, and Dorì are the major

¹ The 2016 yield suffered a sharp loss (−31% compared to 2015) due to severe pest problems. In 2015, the share of global production reached 5.1%. Data source: CSO (Latina production) and FaoStat (world production).

players in this regard. In particular, Zespri invested large resources in the area with the objective of building a reliable, long-run supply with counter-seasonal production with respect to New Zealand.



Figure 1. The production area of the Agro Pontino Kiwifruit netchain (orange area) compared to Italy.

The Agro Pontino system has a distinctive structure, with a sharp distinction between club and non-club varieties. The non-club chain is centered around producer organizations (PO) or private traders. They collect farmers’ production and sell it to supermarket chains, processors, and other traders. POs provide agronomic support to members on voluntary bases. Farmers who are not members of a PO may hire professional agronomists, if needed.

In club varieties, license holders (the breeders) are key players Figure 2 shows that they act both upstream and downstream the production layer. They act as input providers, giving genetic inputs to farmers under a contract with strict production rules and marketing exclusives. The breeders take the production of the club variety and sell it to large retailers, traders, and manufacturers both domestically and internationally. Breeders provide mandatory agronomic support to farmers in order to ensure that the final quality of the output complies with the consumer expectation and to preserve the value of the brand.

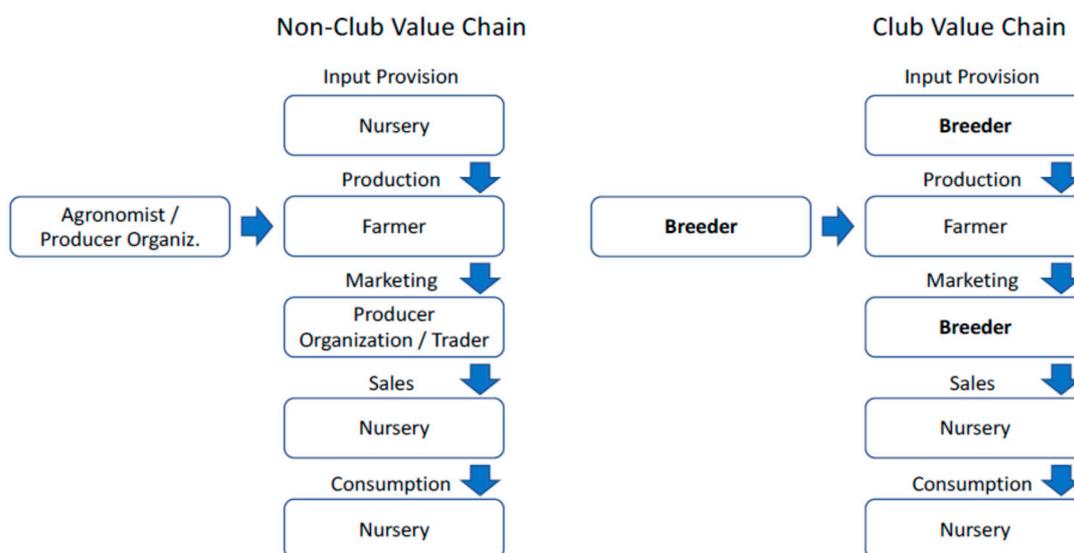


Figure 2. A stylized representation of the Agro Pontino Kiwifruit value chains.

The coordination mechanisms of the two chains is different. In non-club varieties, a typical membership agreement regulates the interactions between farmers and the POs. Transactions with traders are usually organized with informal contracts. The interaction between POs or traders and

large retailers is governed by procurement contracts. Quality is determined ex post with product standards that are based on the PGI product specification and on the standards that are required by the large retailers' buying desks. In a club chain, the breeders provide implants and agronomic support to farmers. Quality is determined ex-ante through the adoption of detailed production standards. Such standards are designed by the breeder in order to achieve a high and homogeneous quality of production. Breeders use their monopoly on the variety and the high quality as negotiation advantages in the negotiation with buyers (large retailers, traders, and manufacturers).

4.2. A Comparison of the Forms of Governance

We administered the questionnaire for a rapid analysis of the forms of governance to 27 randomly selected growers in the Agro Pontino area. Because the 13 farmers who grew club varieties had unprotected varieties as well, we collected 40 observations of governance forms. Although the number of interviews is quite small, we have enough observations to run a basic inference. Table 3 reports the results of the survey.

Table 3. Results of the quick assessment of the governance forms in the Agro Pontino Kiwifruit value chains.

Governance Forms	PVP		
	Free	Club	Total
Market	4	1	5
Modular	17	3	20
Relational	1	0	1
Captive	4	10	14
Hierarchy	0	0	0
Total	27	13	40

A χ^2 association test allowed us to reject the null hypothesis of independence between the PVP and the governance form at a 99% confidence level.² The test statistic is $\chi^2_{(3)} = 13.301$, which is larger than the critical value $\chi^2_{(0.01,3)} = 11.345$.³ The data supports the conclusion of an association between the type of protection and the form of governance.

The modal governance form for the unprotected varieties is *modular*. Noticeably, the four captive farmers are producing club varieties as well. Of the producers of the unprotected varieties, 59% stated that they can easily find alternative buyers with very low switching costs; 33% said that they can easily change at the expiration of the contract. Only 7% admitted that finding new buyers can be costly. The complexity of transaction is low for 51% of respondents, and production can be difficult for unexperienced farmers only for 44% of the sample. The information are coded in simple production standards for 67% of respondents. The standards are considered complex in 26% of cases. Only one producer said that the buyer does not require standards. Another one answered that he is following directions.

The most common governance form for the club varieties is *captive*. Of the club farmers, 70% said that the costs for changing buyers were very high, while only 15% answered that switching costs

² In the computation of the test statistics, we excluded the case of the *hierarchical* governance form because of the zero frequency. The degrees of freedom of the test were adjusted accordingly.

³ The χ^2 test requires a large sample. Usually, it is considered inappropriate for a sample size smaller than 30 or 40 observations. Because our sample size is just sufficient, we computed a Fisher's exact test in order to support our conclusion. The test returns the exact probability of observing the actual data if the null hypothesis was true. The downside of the test is that it requires a 2×2 table. For this reason, we aggregated the governance forms into two groups: *Market* and *Modular* on the one side and *Relational* and *Captive* on the other one. Fisher's exact probability is $p_1 = 0.0016$, which allows us to reject the null hypothesis of equal distribution in the two groups. The test confirms that the observed differences in the distributions are unlikely to be due to chance alone.

were low. Of the club producers, 62% found the production complex, even for experienced producers and/or those who used technical support. The information are coded into difficult standards requiring detailed instructions for 54% of respondents, while 23% found the standards complex, but they feel that they were independent in their decisions.

Our empirical survey supports the conclusion that the club varieties are associated to captive governance forms. In the following section, we use semi-structured interviews to a small group of farmers to understand why they are willing to adopt the new varieties.

4.3. The Role of Governance in the Adoption of New Varieties

The survey supports the conclusion that adopting a club variety implies a possible switch from a *modular* to a *captive* value chain. In order to investigate the incentives to such a decision, we ran a set of semi-structured interviews of producers of yellow kiwi. We randomly selected four growers of the *sungold* variety who were not involved in the phone survey.

The intellectual property rights of *sungold* are held by Zespri, a New Zealand corporation that is investing in the Agro Pontino. With the production in Italy being counter-seasonal with respect to New Zealand, the Italian investment gives Zespri a stable, year-round supply of the product. This is a decisive advantage in Zespri's strategy of building a well-defined product identity and consumer loyalty (Zespri Annual Report 2017–18). We focus our analysis on Zespri because of the tight control they exert on production. They plan the production by controlling the implants, requiring rigid process and product standards, imposing technical assistance, providing the genetics of the implants, collecting the entire production, having absolute discretion over the grading of the final products, and being in charge of all marketing activities including brand management. The organization of Zespri's value chain is very close to the archetype of the *captive* governance form as described by Gereffi et al. 2005.⁴ By adopting the *sungold* variety, farmers are not just choosing the product but also selecting a *captive* governance form and giving up part of their entrepreneurial freedom. We investigate the motivations for such a choice.

The four semi-structured interviews were designed to assess the incentives that farmers have to join the captive value chains. In particular, we consulted a panel of 4 farmers that have experimented the reconversion of the actinidia plants into the production of *Zespri sungold*. The respondents were asked to answer a set of questions related to their club and non-club (if any) varieties alike. The interview covered four topics: contract structure and business practices, negotiation process, financial performances, and risk management. The interviews gave us a more detailed insight into the differences between club and non-club variety value chains and provided us suggestions of possible changes in the kiwifruit sector if the transition towards the production of club-varieties becomes massive.

The transaction between Zespri and a farmer is regulated with long term (from 10 to 20 years), standardized production contracts. The contracts are offered by Zespri to selected farmers on a takeit or leave it basis. The agreement regulates quantities, pricing rules, quality standards (product and process), mandatory technical assistance, and marketing activities. There is a mutual marketing obligation, meaning that the farmers must sell their entire production to Zespri, who is committed to buying it.

The delivery of high-quality yellow-flesh kiwi requires complex on-farm operations, including dedicated investments and the adoption of new agronomic practices. Zespri's mandatory technical assistance provides farmers the necessary support to ensure the required quality. The quality standards are established by Zespri exclusively, who controls compliance and rejects products that do not comply.

⁴ Gereffi et al. (2005, p. 84) define the captive governance form these words: "Captive value chains. In these networks, small suppliers are transactionally dependent on much larger buyers. Suppliers face significant switching costs and are, therefore, 'captive'. Such networks are frequently characterized by a high degree of monitoring and control by lead firms.

The farmers take a price-penalty for below-standard products. Zespri can consider defective kiwis as second-choice products (offering a lower price) or even zero-value “waste”. For this reason, the mandatory technical assistance is well-received by farmers, as it lowers the probability of incurring a serious price reduction. However, the constant technical support and the strict quality standards limit farmer’s production choices, making his/her skills less important compared to the ability to follow Zepri’s directives.

The distribution of bargaining power is clearly unbalanced in the favor of Zespri. Farmers cannot negotiate the contract terms, must accept Zespri’s assessment of product quality, have no marketing alternatives, and face sizable switch costs in case they want to exit the agreement. Zespri, instead, can dictate the terms of the transaction, can change the quality standards unilaterally, and can easily replace the growers in the case of contract termination. Nevertheless, the farmers consider Zespri as a fair and caring business partner who is interested in mutual success.

The farmers state that their main incentives to enter the *sungold* production are mainly financial. Zespri offers a higher price compared to non-club kiwifruit. Furthermore, if farmers produce both club and non-club varieties, they have the option to market both through Zespri. Even for non-club kiwifruit, Zespri provide a higher price than other buyers, thus capturing the entire kiwifruit production of the farms (and increasing the dependence of the farmers).

A consistent and reliable supply of high-quality *sungold* kiwifruit generates enough cash flow to cover the initial investment (higher than non-club varietal kiwifruit), a necessary condition for long-run sustainability. The production is profitable because farmers are paid a higher price than the one for non-club varieties. Such a high price is possible because Zespri is willing to share part of their monopoly rent with farmers. This requires that Zespri has total control over the marketing activities of *sungold* kiwis. The farmers’ total delivery obligation plays a key role in this respect. At the same time, it implies a long-term commitment because a grower willing to withdraw from the transaction incurs prohibitive switching costs in the form of contractual penalties and plant-dismantling costs.

Farmers perceive the mutual marketing obligation as an important tool to transfer commercial risk onto Zespri. In fact, Zespri’s commitment is independent of the market conditions. Compared to the non-club varieties, the production of *sungold* kiwifruits is less risky because farmers are not exposed to demand fluctuations. Furthermore, Zespri’s technical assistance is perceived as an important tool to reduce production risk. Farmers are concerned about the yield loss (due to pests or adverse weather conditions) and low quality (due to the complexity of production). Zespri’s support is effective in mitigating both factors.

Summarizing, by adopting the *sungold* variety, farmers enter a value chain as captive suppliers with limited bargaining power (if any). Despite the lock-in problem and the relative weakness, farmers achieve higher returns and lower risk for the investment, compared to what they obtain from non-club varieties. Zespri is willing to share part of the monopoly profits with farmers in order to have a steady and reliable supply of high-quality kiwifruits. The outcome is a win-win situation such that farmers have high profits and Zespri can pursue the branding strategy successfully. The result is consistent with the theoretical findings by Merél and Sexton (2017) who argued that the effects of monopsony power might be mitigated by the buyers’ concerns about the sustainability of production in the long-run.

The cornerstone of the agreement is the consumers’ strong and increasing demand for the *sungold* variety. In order to meet the demand, Zespri must expand the production base, contracting new farmers. In order to elicit participation, Zespri must offer farmers (i) higher returns compared to risk than the existing alternatives and (ii) a credible commitment to refrain from renegotiation once the farmer has become captive. The interviews confirmed the existence of concrete financial benefits (higher prices and lower risk than the free varieties). The credibility of the commitment to refrain from renegotiation is associated to Zespri’s reputation as a fair business partner. If Zespri renegotiated existing agreements, the loss in reputation would make contracting new farmers difficult (and costlier).

In our interpretation, Zespri's commitment, based on reputation, is credible only as long as new producers must be contracted in order to meet the increasing demand for *sungold* kiwifruits. Once the steady stage in production is achieved, the cost of a loss in reputation decreases while the benefits of renegotiation increase. This raises concerns for the sustainability of the win-win agreement in the long run, especially if consumer demands for the non-club varieties should fall.

5. Summary and Conclusions

The 1991 revision of the UPOV agreement and the following Trade Related aspect of Intellectual Property Right (TRIPs) agreement have changed the regulation of plant variety protection. As a result, the intellectual property rights of the breeders are now more protected than ever before. The new regulation was a radical change in the institutional context, and as a consequence, new forms of governance of transactions in the agri-food system emerged. In particular, the use of the so-called club varieties became increasingly popular for managing varietal innovation in agriculture.

The new regulation raised concerns regarding the welfare of growers because the strength of the breeder protection might determine unbalances in the bargaining power along the agri-food chains. Our paper investigates this issue empirically, with a study of the Kiwifruit chains in Agro Pontino (Italy). The area experienced an important shift of production from free varieties to club varieties (in particular, yellow flesh fruit). We examined the changes in the governance of the value chains that were associated with this transition.

Although the limited scope of the empirical analysis does not allow us to draw general conclusions, we found that—in the case of study—the concerns regarding the post-1991 regulation are supported only partially. We found that the adoption of a club variety is associated with a shift in the governance form from *modular* to *captive*. This result supports the concerns about the new regulation because captive governance forms are linked to a reduction in the suppliers' entrepreneurial freedom and to holdup conditions. However, an in-depth analysis of a panel of four producers found that the change in the governance form may result in higher profits for farmers compared to non-club varieties. Because of the PVP regulation, the breeder can achieve monopolist profits on the final product. The need for a consistent supply brings the breeder to share such profits with the growers in order to elicit production.

The extension of the rights of the breeders over the harvest does not necessarily harm farmers. The monopsonistic power of the breeders is limited by the farmers' participation constraint. In order to satisfy the demand for the new variety, the breeder must offer farmers a more profitable trade compared to the production of the free varieties. However, there are concerns for the long run sustainability of the win-win agreement. A deterioration of the terms of trade for farmers is possible in the long run if the demand for the given club variety decreases or if the farmers' option to produce free varieties becomes less profitable.

Author Contributions: The article is common responsibility of the Authors. However the individual contributions can be defined as follows: A.D.F. is responsible for Section 4 and defined the general idea of the paper, V.N. was responsible for Section 2, the Appendix A, contributed to the definition of the questionnaire and collected data, C.R. is responsible for Section 3. N.F. was responsible for data handling. Introduction and Conclusions are a collective effort.

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Appendix A. A Short History on the Regulation of PVP

In the XX century, the burst of innovation in *commercial* vegetable varieties challenged the traditional system based on seed and knowledge sharing among farmers (Dutfield 2017). The problem of adequate ex ante incentives to innovation was particularly complex in the case of vegetable varieties because of plant innovation. Because the discovery is embodied in seeds, the natural process (in the absence of termination devices) determined the possibility of uncontrolled imitation. A market

failure could emerge, and the innovator cannot recover the high costs of innovation. In the absence of adequate protection against imitation, firms had no incentive to breed new varieties and the market underprovided innovation. The application of the standard patent regulation was considered insufficient to overcome the problem as it did not consider the aspects related to seed replication. The very notion of a self-replicating (and therefore freely imitable) innovation was a compelling case for public intervention on intellectual property rights (Janis and Kesan 2002). As a consequence, we observed more than one hundred years of regulations on Plant Variety Protection (PVP).

The current system of regulation of the protection of intellectual property rights for plant varieties was the result of a complex process of historical development that had taken place at different paces in different legislations (e.g., Blakeney 2005). The brief review in this section has the objective to highlight the aspects of regulation that—in our opinion—have a direct impact with the governance of agri-food value chains, with no pretense of exhaustivity. Interested readers can refer to the extensive literature on the topic (for example, Raustiala and Victor 2004; Dutfield 2011, 2017).

Period 1: National Regulation (from ~1906 to 1961)	
<p>Regulation Sources (Examples)</p> <ul style="list-style-type: none"> • US Plant Patents Act of 130 (USA 1906) • Register for newly-bred plants (France 1922) • seed certification system (Netherland 1932) • Other national regulation: e.g. Cuba (1937) South Africa (1952) 	<p>Key Objectives/Provisions</p> <ul style="list-style-type: none"> • Protection against unfair imitation by competing breeders in domestic markets • Granting exclusive use of the name of the seed, as an extension of the trademark discipline
Period 2: multilateral agreements (from 1961 to 1991)	
<p>Regulation Sources</p> <ul style="list-style-type: none"> • UPOV convention 1961 • UPOV Convention 1972 	<p>Key Objectives / Provisions</p> <ul style="list-style-type: none"> • Favor international trade and innovation <ul style="list-style-type: none"> • Harmonization of regulation • International patent scheme over traded material
Period 3: Global protection (from 1991 on)	
<p>Regulation Sources (Examples)</p> <p>UPOV convention 1991</p> <p>TRIP agreement 1993 art 27 (b)</p> <p>ITpgrfa (2004)</p>	<p>Key Objectives / Provisions</p> <ul style="list-style-type: none"> • Creating a global market and promoting innovation • Extending breeders' rights over harvested material • Regulating research and farmers' exemptions

For the purpose of this paper, we break down the history of PVP into three periods: (i) national regulations (roughly from 1906 to 1961), (ii) multilateral agreements (from 1961 to 1991), and (iii) global protection (from 1991 to present day). The summary of PVP regulation summarizes the main characteristics of the three periods.

In the first period, national governments were in charge of the regulatory initiatives on PVP. To the best of our knowledge, the first modern regulation about PVP was the 1906 US Plant Patents Act of 130, amending the US laws of patents in order to consider the interests of the “originators of horticultural products”.⁵ We consider the 1906 Act as the first attempt to create a sui generis protection of intellectual property rights on plant varieties, with distinctive characteristics with respect to the general patent rules.⁶ Later on, a similar legislation was adopted in other countries such as Cuba

⁵ Sanderson (2017) found an 1833 Papal State Edict about the ownership of new inventions and discoveries in the fields of agriculture and technical arts. However, this Edict was not specifically designed to protect new plant varieties. For a more detailed discussion of the application of standard patent laws to plant varieties before the sui generis regulation, see Van Overwalle, G. (Van Overwalle 1998).

⁶ The 1883 Paris Convention for the Protection of Industrial Property considered agriculture as one of the areas in respect to which property rights can be granted. However, this provision was just an extension of the standard regulation. Furthermore, its applicability to new plant varieties was questioned by Blakeney 2010.

(1937) and South Africa (1952). In Europe, the first attempts to regulate the matter were the Register for newly bred plants in France (established in 1922) and the Netherland seed certification system (1932) (Blakeney 2005).

The core of the regulation was the protection of the innovator against unfair imitation by competing breeders. The key tool was the right to the exclusive use of the name of the seed, as an extension of the trademark discipline (see Janis and Kesan 2002 for a critical assessment).

For the purpose of our studies, the key concepts that were established in this period were the notions of “distinct variety” and “reproducibility”. In fact, in the US 1930 act, the protection was awarded to “any person who invented or discovered and asexually reproduced a new and distinct plant variety”. Although national regulations differed in the specific definition of a “distinct variety”, they all agreed that only entrepreneurs who introduced an innovation and were able to reproduce it with stable characteristics were entitled to the protection (e.g., Rossman 1935).

The international scope of the market for new varieties called for international coordination and multilateral agreements among nations because a spatially heterogeneous protection system harmed trade. In 1961, an initiative of the French government led to the adoption of the International Convention of New Varieties of Plants or *Union pour la Protection des Obtentions Vegetales* (UPOV). The agreement defines a supranational sui generis system of protection of the intellectual property rights on new vegetal varieties.

One of the objectives of UPOV was the harmonization of the requisites for protection. Vegetal varieties (defined as a plant grouping within a single botanical tax on of the lowest known rank) were protected if four conditions were met: the variety must be new, distinct, uniform, and stable. Unlike the general patent law, in this context, novelty means that the variety was not commercialized before. This provision allowed for the protection of existing species that were not used already for commercial purposes. The distinction requisite required that variety was clearly distinguishable from any other variety, the existence of which was publicly known or a matter of common knowledge at the time of the filing of the application.⁷ Stability and uniformity refer to the capability of the breeder to provide a consistent product over time.

The system designed by the 1961 agreements was a typical patent scheme, where the innovator was allowed to sell the embodied innovation at a monopoly price and the adopter was entitled to dispose of the harvest.⁸ The monopoly profits over the sale of seeds or other genetic material allowed the breeder to recover the cost of producing the innovation and to reinvest in research and development activities.

Two features of UPOV 1961 (and of the later revision in 1972) are of particular interest for our purposes. Firstly, the protection had a limited scope. It covered the traded material only (i.e., seeds or other genetic material), and the purchaser of the technology was free to dispose of the harvest. Secondly, several limitations (exemptions) were introduced to the rights of the breeders. In particular, farmers were free to save and use seeds produced on-farm, even when the saved variety was protected under a plant breeder’s certificate (the so-called farmers’ privilege). Also, breeders were free to use protected varieties in the development of new protectable varieties (the so-called breeder exemption).

This scheme was revised in the following UPOV reform in 1991 that started the third period of PVP protection: global protection. The main regulatory references originating the change were the 1991 UPOV reform, the Trade Related aspect of Intellectual Property Right agreement (TRIPs) in 1993.

The 1991 UPOV reform was a deep revision of the agreement. Several changes were applied in order to extend the scope of the treaty. For the purpose of this paper, three key changes must be mentioned. The scope of the protection was extended to cover not only the traded material (as in UPOV 1961 and 1972) but also all materials, including the harvest. This allowed the breeder to claim

⁷ Janis and Kesan (2002) noted that this requisite approximates the “novelty” requisite of the general patent law.

⁸ For an analysis of the economic principles of this scheme in the agri-food system, see Moschini and Lapan 1997.

the entire production that was obtained from the traded material. Also, the farmer's privilege was included under the scope of the protection, meaning that breeders gained the faculty of limiting the right of farmers to the use of seeds. Finally, the breeder exemption was redefined, and the notion of *essential derivation* was introduced. These provisions extended the scope of protection for a variety over the material of a newly developed cultivar that is derived from the original variety.

The TRIPs agreement was of paramount importance for the diffusion of PVP regulation worldwide. Article 27(b) of the treaty requires that Members shall provide for the protection of plant varieties either by patents or by an effective sui generis system or by any combination thereof. As a consequence, the number of countries adopting the PVP regulation (mostly UPOV 1991) increased significantly (Campi and Nuvolari 2015). As a consequence, the system of protection changed from a multilateral agreement among a limited number of countries to a truly global system.

As mentioned in the text, the 1991 UPOV reform allowed for a new organization of the fruit and vegetable supply chain, namely the "club". The breeder's rights to limit the access to the genetic resource and to the control of the marketing activities determines a fundamental change in the vertical relationship along the value chains.

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