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What Regional Economic Factors Drive Feedstock Cost for Cannabinoid Hemp Processors in the United States?

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Introduction

The 2018 Farm Bill reclassified the federal status of industrial hemp (*Cannabis Sativa L.*) from a controlled substance to an agricultural commodity. Hemp's new legal status combined with growing consumer demand for hemp-derived products offers the potential for the development of new and lucrative agricultural supply chains. Consumers, growers, and processors are especially interested in products derived from cannabinoids (e.g. cannabidiol, or CBD) present within the hemp floral material. CBD is a non-inebriating cannabis molecule used in numerous high value therapeutic and cosmetic products. A one-year prescription of Epidiolex, the FDA approved CBD-based epilepsy medication, is priced at $32,500 (Tinker, 2018). In 2018, the U.S. market for CBD containing products was valued between $0.6-$2 billion, and is predicted to reach $15 billion by 2025 (Azer et al., 2019).

History shows that a new agricultural supply chain is not automatically a catalyst for prosperity. Bankruptcies in the cellulosic biofuel industry highlight the resources wasted when processors build plants and cannot subsequently acquire sufficiently cheap biomass to maintain profitability when biofuel prices decrease. In light of this, CBD processors' ability to locate in regions that produce low-cost, high-quality hemp is crucial for creating and maintaining a stable hemp supply chain. The problem is that there is limited information on which region of the U.S. would produce the lowest-cost floral hemp. This study quantifies the effect of various regional characteristics on a grower's decision to produce floral hemp, in the face of uncertainty and irreversibility. It subsequently maps that effect onto regional feedstock costs for CBD processors.

Agricultural processors tend to locate near their feedstock. Examples include corn ethanol plants located in the Midwest and citrus processors located in Florida. Processors choose these locations to decrease their transportation cost of acquiring feedstock and/or ensure a higher quality input. Location is especially important for CBD processors since the concentrations of CBD within the harvested floral material falls over time post-harvest (Trofin et al., 2012). The longer harvested hemp floral material spends in transportation, the less valuable it is. Hemp has also been legally difficult to transport across state lines. Although industrial hemp is federally legal, each state enacts its own policy. Police seizure of legally produced hemp occurred in both Idaho and Oklahoma following the 2018 Farm Bill (Hemp Industry Daily, 2019). The USDA passed more rulings in October 2019 to address this issue. They clarified that states can govern hemp growth within their own borders, but cannot interfere with the interstate transportation of hemp (Agricultural Marketing Service, 2019), although there was yet another seizure in New York soon after this ruling (Fonrouge & DeGregory, 2019). This stresses the importance of processors locating in a low-cost hemp area.

While existing enterprise budgets help explain a farmer's expected regional production costs for floral hemp (Cui & Smith, 2019; Mark & Shepard, 2019), they do not account for the effect of regional risk and sunk cost inherent in hemp growing decisions. This matters because investment projects containing both sunk costs and uncertainty in future returns create an option value of waiting to enter production. This option value of waiting creates a premium on entry (Dixit & Pindyck, 1994). Growers experience uncertainty in hemp prices, hemp yields, hemp CBD concentration levels, and opportunity cost crop returns. They are also subject to large, irreversible investment costs (e.g. drying structures) (Sterns 2019). Sources of CBD uncertainty and sunk cost vary regionally, thus the feedstock price of floral hemp will also vary. This means a grower considering CBD hemp production may require a price considerably higher than their long run average cost of production to justify entry. This higher price then gets passed onto processors.

Using a real options framework to study grower land use decisions is well established in the economics literature. Previous studies using real options analysis to explore investment decisions behind grower's willingness to adopt various specialty crops consistently find non-trivial premiums on entry for those crops (Luong & Tauer, 2006; Musshoff, 2012; Price & Wetzstein, 1999; Regan et al., 2015; Richards & Green, 2003; Schatzki, 2003; Song et al., 2011; Wolbert-Haverkamp & Musshoff, 2013). These studies found growers only switch to specialty crops once price premiums become between 10-80% above the long run average total cost of production.

This study utilizes a real options framework to quantify the impact regional risk level, sunk cost, opportunity cost, and growing conditions each individually has on a farmer's decision to produce floral hemp. The presence of uncertainty and irreversibility inherent within floral hemp production makes real options the ideal choice to study the problem. Such an analysis allows for the characterization of regional economic/agronomic factors that are most important in determining the feedstock cost of floral hemp. The anticipated findings aid both farmers and processors by identifying regional attributes that are most important for a stable CBD supply chain. The regionally-relevant parameter values under consideration herein are from the current 5 largest hemp producing states: Colorado, Kentucky, Oregon, Montana, and Tennessee (Drotleff, 2019).

Sources of Uncertainty and Irreversibility

Hemp grower's future floral material price, floral yield, and CBD concentration are stochastic. Floral material price depends upon volatile consumer tastes and preferences for CBD-containing products. Reported prices of dried hemp floral material in 2019 ranged from $150 to $1,100 per pound (Drotleff, 2019). Opportunity cost crops and their associated volatility vary regionally. The historical standard deviation as a percentage of yearly revenue over the last 20 years is 20% for corn, 16.9% for wheat, 16.3% for soybeans, and 11.8% for hay (NASS, 2019).

Rainfall, insects, fungus, extreme temperatures, and weed pressures all affect floral yield. However, hemp has no approved pesticides within the U.S., which complicates pest management (Purdue, 2019). Additionally, weather and climate influence tetrahydrocannabinol (THC) levels within hemp plants. THC is a mind-altering compound found in varying levels in all cannabis plants; fields containing THC concentrations above 0.3% are federally illegal and must be destroyed by drug enforcement agencies (Gerlach, 2019; Place, 2019). In years this occurs, farmers effectively experience zero floral yields (Place, 2019).

CBD concentration dictates grower's selling price measured in dollars per percentage point per dry pound of harvested floral material. CBD itself is extracted from floral material harvested from unpollinated female hemp plants. However, cross-pollination from non-feminized cannabis crops has become an increasingly common problem, degrading CBD levels by over 50% (Meier & Mediavilla, 1998; Small & Antle, 2003). Floral hemp production sometimes requires investments in drying sheds to combat mold (Cui & Smith, 2019; Place, 2019). This sunk cost ranges from \$0 in drier climates to \$4,641 in wetter ones.[1] Specialized machinery could reduce high labor costs but would require more sunk investment.

Model for Optimal Land Use

I construct the grower's problem in the same real options framework as Song et al. (2011) and McCarty and Sesmero (2019). A risk-neutral grower currently produces one of two crops, $i \epsilon \{c, h\}$ on an acre, where c denotes the local commodity crop and h denotes a hemp crop. The grower can convert from land use i to j if they pay fixed cost C_{ij}, $j \epsilon \{c, h\}$. The revenue of growing crop i at time t is $R_i(t)$. These revenues evolve over time, following a Geometric Brownian Motion:

$$dR_i = \mu_i(R_i, t)dt + \sigma_i(R_i, t)dz_i \quad ; \quad i = c, h \tag{1}$$

The drift rate for crop i's revenue is μ_i and volatility is σ_i. The symbol dz_i denotes a Weiner Process increment. The grower chooses land use to maximize the expected present value of the payment stream they acquire, V, net any switching costs for an infinite time horizon (Fackler, 2004). The V that a grower receives from growing crop i and converting land use when optimal to do so is V^i. This decision of a grower currently growing crop i is displayed in equation (2):

$$V^i(R_c(t), R_h(t), w_c, w_h) = \max\{R_i(t)dt - w_i + e^{-rdt}EV^i(R_c(t+dt), R_h(t+dt), w_c, w_h), V^j(R_c(t+dt), R_m(t+dt), w_c, w_h) - C_{ij}\} \quad (2)$$

The operating cost for a crop i is w_i, and the discount rate is r. A grower in land use i earns a stream of returns for growing crop i that change over time. Growing crop i gives the option to convert land to crop j in the future by paying fixed cost C_{ij}. They convert if returns for growing crop j becomes sufficiently larger than growing crop i. The inverse is true for crop j. Brekke and Oskendal (1994) proved an optimal solution for equation two occurs when two conditions hold:

$$rV^i(R_c, R_h, w_c, w_h) - R_i(t) + w_i - \sum_{k=c,h} \mu_k (R_k, t) V^i{}_{R_k} - \sum_{k=c,h} \frac{\sigma_k{}^2(R_i)\, V^i{}_{R_k R_k}}{2} \geq 0, \quad i = c, h \quad (3)$$

$$V^i(R_i, R_j, w_c, w_h) \geq V^j(R_i, R_j, w_c, w_h) - C_{ij} \;; \quad i, j \in (c, h) \text{ and } i \neq j \quad (4)$$

The subscripts on V^iexpress partial derivatives of V^i with respect to R. Equation (3) states the current period return from selling a project today and investing that income rV^i must be greater than or equal to the current period profit stream $(R_i(t) - w_i)$ plus the appreciation for project i in this period. Equation (4) states that the value of land use i must be greater than or equal to the value of land use j minus the cost of switching to j. Either (3) or (4) must hold with equality. If equation (3) holds, the grower maintains their current land use. If equation (4) holds, the grower converts from land use i to j. If both equations hold, the grower is indifferent between the two uses. The R_h that makes a grower indifferent between continuing to grow a commodity and switching to hemp at a given R_c level is the R_h that triggers hemp production, ${R_h}^*$. We divide ${R_h}^*$ by the expected hemp yield to recover the hemp trigger price, ${P_h}^*$, that initiates a switch to hemp.[2,3]

Results and Discussion

Table 1 compares hemp trigger prices under real options criteria, ${P_h}^*$, and long run average cost (Marshallian) criteria, ${M_h}^*$. Comparing trigger prices shows how large farmer premium on entry $({P_h}^* - {M_h}^*)$ is across different economic/agronomic situations. I display trigger prices for the minimum possible ${P_h}^*$, the maximum ${P_h}^*$, and the most likely "base" ${P_h}^*$ situations. Grower ${P_h}^*$ is the processor's feedstock cost. This establishes the range of possible feedstock costs and shows in what conditions Marshallian criteria is inaccurate. The parameters C_{ch}, σ_h, σ_c , Y_h, and π_c denote the sunk fixed cost of hemp production per acre, the yearly standard deviation of revenue as a percent for hemp and commodities, the expected pound per acre yield of floral material, and the forgone commodity return. We see that under minimum feedstock cost assumptions the difference between estimates is minor. This premium increases dramatically for maximum feedstock cost assumptions. Regional economic and agronomic attributes greatly affect feedstock cost.

Table 1
Comparison Between Trigger Price for Floral Hemp Under Various Conditions

Cost level	Parameter level	Marsh M_h^*	R.O. P_h^*	% Price Premium
Min	$C_{ch} = \$2{,}000$, $Y_h = 2{,}000$, $\pi_c = \$100$, $\sigma_h = 10\%$, $\sigma_c = 10\%$	\$6.99	\$7.60	8.70%
Base	$C_{ch} = \$4{,}000$, $Y_h = 1{,}500$, $\pi_c = \$250$, $\sigma_h = 30\%$, $\sigma_c = 15\%$	\$9.60	\$12.33	28.40%
Max	$C_{ch} = \$6{,}000$, $Y_h = 1{,}000$, $\pi_c = \$400$, $\sigma_h = 50\%$, $\sigma_c = 20\%$	\$14.82	\$22.30	52.50%

Note. The minimum and maximum P_h^* are calculated based upon a range of parameters deemed plausible for this analysis. The range of these values and their justification is found in appendix B

Table 2 shows the effect of changing one parameter on P_h^* while holding all other parameters at the baseline level ($C_{ch} = \$4{,}000$, $Y_h = 1{,}500$, $\pi_c = \$250$, $\sigma_h = 30\%$, $\sigma_c = 15\%$). I compare trigger prices across various combinations of $C_{ch}, Y_S, \pi_c, \sigma_h$, and σ_c to see which parameter affects P_h^* the most.

Table 2
Comparative Statics on Parameters of Interest Effect on Real Options Trigger Price

Comparative Static	Decrease Baseline to	Increase Baseline to	P_h^* for Decrease	P_h^* for Increase	ΔP_h^*
C_{ch}	\$2,000	\$6,000	\$11.46	\$13.06	\$1.60
σ_h	10%	50%	\$10.65	\$13.89	\$3.24
σ_c	10%	20%	\$12.26	\$12.33	\$0.07
Y_h	1,000 lbs.	2,000 lbs.	\$18.49	\$9.25	-\$9.24
π_c	\$100	\$400	\$12.21	\$12.44	\$0.23

When I constrain the problem to a range of plausible parameters, floral yield impacts trigger price the most. The difference between the lowest and highest plausible yield Y_h affects P_h^* by \$9.24/lb. The next largest impact comes from σ_h; as hemp floral material revenue becomes more volatile from either price of floral material, floral yield, or CBD concentrations, the grower requires up to \$3.24/lb. more to grow floral hemp. The sunk cost of converting from commodity crops to floral hemp changes cost up to \$1.60/lb. At present, π_c and σ_c have only modest effects on ${P_h}^*$. Recall, floral hemp has both a biomass yield and a CBD concentration yield. To simplify the problem, CBD levels were treated as fixed, but the effect of changes in Y_h approximates the effect changes in concentration levels would have; CBD yields also matter for trigger price.

Industrial hemp is expected to grow best on high quality agricultural land (Russel et al., 2015). Cherney and Small (2016) argue "soils ideally suited to hemp production are comparable to corn-growing soils: they are well-aerated loams with high fertility and high organic matter" (p. 11). This means processors face a tradeoff in their location decisions. Productive land for floral hemp is associated with higher valued commodity crops and higher levels of volatility in commodity crop returns than marginal land. The effect of floral hemp yields trump everything else in this analysis. This means the current commodity crop being grown on land is less important than the characteristics of the ground beneath it. All else equal, this supports processors locating in the generally more productive agricultural land of the South. In addition, defining the highest yielding cultivar for any region is paramount. Schluttenhofer and Juan (2017) argue genetic improvements are needed to enhance the economics of CBD. Working with local researchers could help identify and develop the best cultivar for an area and boost yields.

The volatility of hemp returns also affects ${P_h}^*$ in a meaningful way. This reinforces the importance of high quality land. Consistent rainfall or irrigation combined with proper drainage will make floral yields and THC levels more predictable, both of which reduce σ_h. The local political climate also affects σ_h. States measure and enforce the 0.3% THC limit differently. States that are stricter will increase the likelihood of crop destruction, which simultaneously decreases the expected yield of hemp and increases the risk for growing it. Stricter enforcement policies will affect ${P_h}^*$ and ultimately the cost of acquiring hemp floral material. The sunk cost required to grow floral hemp also has a moderate effect on ${P_h}^*$. Drying sheds make up a large component of C_{ch}. Since yearly precipitation and humidity dictate how large C_{ch} needs to be, all else equal, the model favors processors locating in the generally drier climate of the West.

It is important to consider the impact of future shifts in industrial hemp policy. Malone and Gomez (2019) argue that policies supporting hemp are more politically viable now than they were in the past. This argument appears to have explanatory power, particularly with the passage of the USDA's Interim Final Ruling in October 2019. Industrial hemp qualifies for Whole Farm Revenue Protection Insurance starting in 2020 (Agricultural Marketing Service, 2019). Hemp rulings like this reduce hemp revenue volatility in all regions, which lowers feedstock cost.

Another important consideration is that processors have the ability to shape growers' C_{ch} and σ_h through contracting. The processor could reduce farmer C_{ch} through an establishment subsidy, and the effect of σ_h on growers through lump sum payments. Processors would benefit from a lower feedstock cost; growers would benefit from being exposed to less sunk cost or uncertainty. This topic requires future research to measure how contractual arrangements shape grower risk and uncertainty and the impact that has on floral hemp feedstock cost.

Conclusions

The most important factors influencing the cost of acquiring floral hemp are final floral yield and/or CBD concentration within the plant. Land quality, local climate, production practices and cultivar adaptation to the region all influence yield. Because of this, it appears likely the Southern U.S. will be the most cost competitive for CBD processors for the immediate future. This could change with the new state regulations currently being crafted across the country. Favorable state policy through insurance, subsidies, research, or regulation could change low-cost locations.

As important as the factors that matter for industrial hemp growing decisions are those that do not. Contrary to conventional wisdom for other crops, the alternative use of the land is not much of a factor for hemp. If one acre's worth of floral hemp sells for $20,000, then the grower doesn't care much if the relevant commodity crop return is $100 or $400 per acre. The grower is more concerned with achieving a highly predictable yield of floral hemp and CBD concentration that does not get destroyed by enforcement or cross-pollinated. Yields levels and risk involve gaining or losing tens of thousands of dollars per acre; opportunity cost and risk involve only hundreds.

While regional generalizations are helpful in isolating what is important to feedstock cost, it is important to consider local differences. For instance, Oregon's climate is heterogeneous with an arid east and wet western portion. Yields, relevant opportunity cost crops, and sunk cost will vary within a region. Another important caveat is that while the South is more humid and requires more drying barn infrastructure, certain areas of the South that historically grew tobacco, and already have drying barn infrastructure. This allows farmers to forgo some sunk investment.

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Appendix A: Numerical Estimation of Value Functions

This model allows two-way conversion which means that equation 3 and equation 4 must satisfy two different equalities (i to j) and (j to i), (commodity to hemp) and (hemp to commodity). These value functions are not homogenous of degree one and their mutual dependence of option values complicates the problem and necessitates the use of numerical methods to estimate the form of the value function (Dixit & Pindyck, 1994; Fackler, 2004; Schmit, Luo, & Conrad 2011; Song, Zhao, & Swinton, 2011). I numerically estimate the value functions by using the collocation method and subsequently set up an extended vertical linear complementarity problem. This extended vertical linear complementarity problem is solved using the Newton method. All calculations are done in Matlab. For a detailed description of how to set up and solve regime switching models numerically for multiple stochastic variables see (Fackler, 2004).

The Newton method recovers the trigger revenue of hemp to convert from commodity to hemp production ${R_h}^*$, and the trigger revenue of commodities to covert from hemp to commodity production ${R_c}^*$. I then divide ${R_h}^*$, by Y_h to recover the floral hemp price that triggers investment into hemp production ${P_h}^*$. Note that numerous possible ${R_h}^*$ and ${R_c}^*$ combination values exist as solutions since the level of ${R_h}^*$ is conditional on the level of ${R_c}^*$ and the level of ${R_c}^*$ is conditional on the level of ${R_h}^*$. To retrieve the relevant ${R_h}^*$ I put in the expected value of R_c into the value functions once they have been estimated using collocation. This gives a unique ${R_h}^*$ that occurs under the expected level of R_c. The expected level of R_c is calculated using the average revenue from the past 20 years of whatever commodity crop is the relevant alternative. This means that under the expected revenues we have observed for commodity crops that there will be one unique hemp revenue that causes the shift to hemp production. Calculations in Matlab require the *comp-econ* toolbox add in.

Appendix B: Data and Parameter Estimation

Table 3 lists the baseline parameters held constant across all specifications of the problem and where they were found.

Table 3
Fixed parameter assumptions

Parameter	Definition	Level	Scale	Source
w_c	Commodity crop operating cost	$200	Per acre	(NASS, 2019)
w_h	Hemp operating cost	$13,750	Per acre	(Cui & Smith, 2019)
r	Discount rate	10%	Per year	(McCarty & Sesmero, 2019)
C_{hc}	Hemp to commodity fixed cost	$0	Per acre	Author's Calculation
μ_c	Commodity revenue drift rate	0%	Per year	(McCarty & Sesmero, 2019)
μ_h	Hemp revenue drift rate	0%	Per year	(McCarty & Sesmero, 2019)

Estimates from commodity crop operating cost come from the NASS database; I calculated average operating cost for the last 20 years for corn, soybeans and hay. Average operating cost for corn was just above $300 per acre, soybeans were just above $100, and Hay was right at $200 per acre so yearly operating cost for commodity crops was estimated at $200 per acre.[1] The operating cost for producing hemp was pulled from the Cui and Smith (2019) budget, I added in yearly capital replacement cost to accommodate the infinite time horizon assumption necessary for real options analysis. Current budgets do not discount hemp investments since they only look at the snapshot of one year, with no prior assumption to base floral hemp projects on I adopt the 10% rate used for specialty crops in the McCarty and Sesmero (2019) working paper. The fixed cost of converting the land back from industrial hemp production to commodity crop production was given a value of zero because nothing in the literature suggested that there was a capital

[1] I held operating cost for commodity crops constant and experimented with different levels of commodity crop revenue to model the differences in different opportunity cost returns.

requirement to leave hemp production. I follow the setup of McCarty and Sesmero (2019) and set the drift rate for both crops was to zero to isolate the effect of volatility and fixed cost.

Table 4 lists the comparative statics used in this analysis. I took numbers in the literature and used them to establish a range of values that were tested using real options analysis. I allowed every possible combination of comparative static levels, 5 variables three different ways, (3^5) leading to the recovery of 243 unique trigger price solutions.

Table 4
Comparative Static Parameters Used in Analysis

Parameter	Definition	Level	Scale	Source
σ_c	Commodity revenue volatility	10, 15, 20	$\frac{\%}{year}$	(NASS, 2019)
σ_h	Hemp revenue volatility	10, 30, 50	$\frac{\%}{year}$	(NASS, 2019)
C_{ch}	Commodity to hemp fixed cost	2000, 4000, 6000	$\frac{\$}{acre}$	(Cui & Smith, 2019)
Y_h	Floral yield	1000, 1500, 2000	$\frac{Lb}{acre}$	(Cui & Smith, 2019)
OC_h	Opportunity cost of hemp	100, 250, 400	$\frac{\$}{acre}$	(NASS, 2019)

The volatility of commodity revenue was tested from the past 20 years of NASS data for corn revenue, soybean revenue, wheat revenue, and hay revenue. The lowest standard deviation from a commodity crop was 11.8% for hay and the highest was 20% for corn, thus the range of values used in the analysis was 10-20% for σ_c. There was little existing data to calculate revenue volatility for floral hemp. To establish a minimum for potential hemp volatility, I looked at 20 years of historical data for an established crop with some similar production practices (tobacco). Yearly standard deviation for tobacco as a percent of tobacco revenue over the past 20 years is just under 12%, it seems unlikely that hemp revenue volatility would be significantly lower than this so I established 10% as the minimum for σ_h. Uncertainties in hemp yield, hemp selling price, and hemp CBD concentrations all contribute to σ_h because of this $\sigma_h = 0.5$, while large, seemed an appropriate maximum on floral hemp volatility longer term. Converting the yearly rental cost of drying barn within Tennessee (a relatively wet state) (Cui and Smith 2019) to one-time capital cost from came out to be \$4,736. I assumed a 10% yearly return on investment over 20 years at a 10% discount rate. When additionally including any potential specialized machinery investment cost that may become necessary as specialized hemp production practices emerge led to a maximum estimate C_{ch} of \$6,000. Drier areas could push more hemp through a drying barn over a given length of time thus reducing barn cost per acre; if the local climate is dry enough they may not require a barn at all. Additionally, practices not using specialized capital equipment would clearly contain less sunk cost so I also considered \$2,000 and \$4,000 for required capital expenditure to start producing hemp. It is interesting to note that with a $C_{ch} = 0$ the real options solution becomes equal to the Marshallian solution for trigger prices. In other words, option value only exists with the combination of sunk cost and uncertainty. The Cui and Smith (2019) budget estimated floral hemp yields at 1,425 pounds of floral material per acre. When accounting for differences in growing conditions, it seemed plausible that hemp yields could range anywhere from 1,000-2,000 pounds per acre. Finally, the return to growing commodity crops varies by the crop. Using NASS data, the highest yearly return (not including the alternative use of land) to be \$314 for corn and \$159 for hay. Individual years or growing conditions could make returns higher or lower than this; I considered opportunity cost levels range from \$100 to \$400 per acre.

Footnotes

Converting the yearly rental cost of drying barn within Tennessee (Cui & Smith, 2019) to one-time capital cost from came out to be $4,736. I assumed a 10% yearly return on investment over 20 years at a 10% discount rate.

[2] Due to the mutual dependence of option values and two-way conversion (we need to add copies of equations (3) and (4) that simultaneously recover R that solve for *j* to *i* conversion, the form of the value function is unknown and needs to be estimated numerically. The estimation of the value functions using collocation, and recovery of ${R_h}^*$ and subsequent ${P_h}^*$ using the newton method is found in Appendix A.

[3] One must be careful in their interpretation of ${R_h}^*$ and ${P_h}^*$. Sterns (2019) points out that the more mature Canadian hemp market went through periods of farmer boom-bust in the late 90's/early 2000's when they legalized hemp production. The real option results in this article should be regarded as the current CBD price required to convince growers to plant CBD hemp not the final sale price. Uncontracted growers would be willing to sell their crop at harvest for much less if prices edge down due to an oversupply of CBD hemp. In 2018 processors fought for a limited amount of floral input. The expanse in processing capacity has not kept pace with farmer investment and 2019 has been more of a case of farmers competing for limited refining capacity (Sterns, 2019).