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IS TAJIKISTAN A POTENTIAL MARKET FOR GENETICALLY MODIFIED POTATOES? [1]

Consumer perception and willingness to pay for genetically modified foods have been extensively studied in recent years. However, until so far there is little empirical evidence for genetically modified food acceptance among Central Asian consumers. This article contributes to existing literature in this field by exploring consumers' acceptance and willingness to pay for genetically modified potatoes in Tajikistan. A dichotomous-choice contingent valuation methodology is used as a primary empirical tool. The data was collected in a major city of Tajikistan. The results indicate that more than half of survey participants are not aware of genetically modified potatoes. Yet, the majority of consumers expressed a positive or neutral opinion about this particular product and for two-third of respondents no risks are associated with genetically modified potatoes. These results highlight that Tajik consumers seem to be less risk-averse towards genetically modified food than consumers in Europe. This study explores consumer preferences for genetically modified potatoes in Tajikistan. A contingent valuation method is applied to measure consumers' willingness to pay for this particular genetically modified product based upon socio-demographic variables as well as predictors related to individuals' attitudes and perceptions. Findings of the paper show the relevance and possibility to introduce and market nonconventional potato in a Central Asian market of Tajikistan.

Keywords: genetically modified potatoes, consumer acceptance, willingness to pay, contingent valuation, consumer perceptions and attitudes, consumers, random utility model, initial bid, discount and premium, Tajikistan

1. Introduction

Genetically modified (*GM*) foods can be defined as products made from particular seeds or ingredients that come from plants and animals whose DNA are transformed via the application of genetic engineering methods [1]. The farm-level adoption and commercial application of *GM* crops began in the mid-1990s [2]. Since then the worldwide cultivation of *GM* crops has increased on average by 4 % annually and it has been estimated that by 2014 18 million farmers in twenty-eight countries managed over 181 million of hectares of *GM* crops [3].

Supporters of *GM* crops stress the wide range of social, economic and nutritional benefits. "First-generation" *GM* crops or *GM* crops with input traits are for example tolerant to certain pests and thus supposed to reduce the use of chemicals in agricultural production leading to higher gross margins for farmers, lower food prices for consumers and environmental benefits [4]. It has been shown in several meta-analyses of empirical studies on *GM* crop adoption that the adoption in deed provides shared benefits to farmers, relevant industries and consumers alike by lower input costs resulting in higher profits for farmers and lower food prices for consumer [5] and [6].

However, despite this rather clear picture in the scientific literature about the benefits of *GM* crops, the public perception of *GM* crops is in most

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countries rather negative [7] and [8]. Thus, *GM* food crops have become one of the most controversially discussed topics in agricultural and food economics ever. Looking at public perceptions of genetically modified food across countries in more detail some stylized facts can be mentioned. While most US consumers seem to be rather indifferent about *GM* foods [9], [10], many European consumers remain highly skeptical due to fears related to unknown risks to human health and environment [8]. As for China and India, both representing fast-growing emerging economies with a large population, previous studies found that in general, consumer seem to possess a neutral or positive attitude towards *GM* food products [10], [11] and [12]. Besides, there is a growing body of literature analyzing consumer perceptions of *GM* food in other emerging and developing countries such as for example Kenya, South Africa, and Romania [13], [14] and [15]. However, until so far no study is available looking at public perception of *GM* foods in a Central Asian context, a region that is in general highly understudied in terms of consumer behavior. Thus, our study contributes to provide first empirical evidence on consumer acceptance and *WTP* for *GM* food in the region, specifically focusing on Tajikistan and genetically modified potatoes.

Tajikistan and potatoes have been chosen because of the following reasons. Firstly, Tajikistan is a mountainous landlocked country that used to specialize in the massive production of cotton under the centralized planning system. Only a limited amount of fruits and vegetables were administratively allowed to grow in the country although there are favorable weather conditions for a wide range of plants. As a result of the transition to market economy in 1992, Tajikistan began to shift its agricultural policy toward the cultivation of other crops to ensure food sovereignty. Along with wheat, potatoes were one of the key crops that were targeted to actively plant in the country. Different weather conditions in different areas allow local farmers to cultivate potatoes, in fact, all year around. From 2007 to 2012 the gross production of potatoes increased by 33 %, i.e. from 662,100 metric tons to 990,200 metric tons[1].

Secondly, Tajikistan does not export potatoes abroad; they are only supplied and sold domestically. The availability and affordability of potatoes enable many Tajik families to avoid malnutrition problems since potatoes are regularly consumed as relevant substitutes to other more expensive products, in particular meat, fish and poultry products.

Thirdly, in the process of potato production, Tajik farmers use a certain amount of chemical herbicides against plant pest predators and bacterial wilt. Curtis et al. [11] pointed out that genetically modified potato plant needs less chemicals which are a significant contribution to a safer environment; it reduces pollution from irrigation water run-off and cuts down soil erosion since less tillage is required [11]. Besides, these chemicals are imported from other countries. Fluctuations in exchange rates that have been observed in recent years raise the cost of imports and as a result, have an adverse effect on the price of potatoes grown by Tajik farmers. The majority of Tajik families are extremely sensitive to price increases due to a relatively high share of household expenditure spent on food. On the other hand, higher operation costs make farmers to look for other cost-reducing options that may not be necessarily beneficial to consumers, especially when the quality of product is negatively affected.

Given this background, our study will explore consumer preferences for *GM* potatoes in Tajikistan. A contingent valuation method is applied to measure consumers' willingness to pay (*WTP*) for this particular *GM* product based upon socio-demographic variables as well as predictors related to individuals' attitudes and perceptions. The key hypothesis of the study implies whether there exists any potential opportunity to introduce and produce genetically modified potatoes in Tajikistan. Empirical findings indicate that this particular product can be successfully marketed in Tajikistan once it is offered with lower price compared to conventional potatoes.

The rest of the paper is organized as follows. The next section gives an overview of past studies, followed by sections about survey data, methodology and empirical results. The last section concludes.

2. Previous Studies

Consumer studies analyzing Central Asian consumer food behavior are scarce. To the best of our knowledge, we are only aware of one study by Zaikin et al. [16] analyzing consumers' *WTP* for apples enriched with antioxidants in Uzbekistan. Their results show that the average *WTP* for these apples is negative even after information on the positive health effects of antioxidants is provided to Uzbek consumers. This result is in strong contrast to findings by Markosyan et al. [17] for the same product but consumers in the Unites States.

[1] Tajikistan in figures 2013. Retrieved from: http://stat.tj/ru/img/ad0df465351c083293dff8839095681b_1378536558.pdf (date of access: 26.04.2016).

US consumers were willing to pay on average an 8 % price premium for such kind of apples. The major reason for the negative *WTP* in Uzbekistan seems to be the perceived non-naturalness of these apples. Thus, this result of a strong preference for naturalness and a high aversion towards food that is perceived as non-natural is in line with the literature on consumer preferences in Russia [18] and [19]. These studies also highlight that naturalness or perceived naturalness is one of the most important product attributes in food choice among Russian consumers.

Despite the fact that more than 100 empirical studies related to consumer perception and attitudes towards *GM* food products have been conducted over the last 15 years [20], there are no studies available so far explicitly addressing *GM* food acceptance in countries of transition to market economy. We are only aware of two studies by Curtis et al. [15] investigating consumer purchase propensity for *GM* food products in Romania, an Eastern European country that might offer relevant insights due to their common history. Their results highlight is that the general Romanian consumer attitude towards *GM* food is similar to those found in studies based on Western Europe. Empirical results show that risk perception and income levels are primary factors having a negative impact on consumers' *WTP* for *GM* food, while other beneficiary product attributes appeared to be less important for Romanian consumers. They conclude that a possible explanation could be linked to Romania's accession to EU community and adhering to European food legislation framework. No other known studies have examined consumers' perceptions of *GM* food on the basis of samples from post-communist countries.

However, there is a growing literature on *GM* food acceptance in emerging and developing countries and these studies might provide highly relevant results for our sample of Tajik consumers. Since our product of interest is a "first-generation" *GM* product, namely *GM* potatoes with input traits, we solely focus on previous study results for such *GM* crops.

There are several studies available for China analyzing Chinese consumers' acceptance and willingness to pay for *GM* foods with input traits [10], [21], [22], [23]. The general conclusion from these studies is that in comparison to other countries such as the EU or the US the acceptance rate of *GM* food in China is much higher. Possible reasons discussed for this higher acceptance of *GM* food among Chinese consumers are relatively low-risk perceptions of *GM* food [30] and expected positive benefits in terms of higher food safety from lower pesticide use in growing *GM* instead of conventional crops [23]. Curtis et al. [24] discuss further that perceived levels of risk may be lower due to a stronger trust in government, positive perceptions of science, and positive media influences. However, one major factor also simply seems to be the need of affordable and safe food to satisfy daily needs and ensure food security. All these factors have also been found to be of relevance in other developing countries such as for example India [12] and [13].

Based on the existing evidence from other countries we are specifically interested in the risk perception of *GM* foods and the link with acceptance of and *WTP* for these specific foods among Tajik consumers. On the one hand, given the high resistance towards *GM* food found to be present in Russia and Romania, we would expect similar levels of risk aversion among Tajik consumers due to a common history and consumer culture. However, on the other hand it might be also reasonable to assume — despite the common history — that risk perceptions of *GM* foods are much lower in Tajikistan than in Russia or Romania due to the fact that ensuring food security is of central importance in this low-income country and media attention towards *GM* food seems to be rather lower.

3. Survey Data

The data set for the present study was collected via in-person interviews during autumn 2015 in front of grocery stores in Khujand, the second largest and economically developed city of Tajikistan. In total, 300 consumers were interviewed. Every respondent received a small bottle of soft drink as a modest reward for his/her participation in the survey. Summary statistics are presented in table 1.

Sixty-six percent of consumers report that either they or their spouses are primary food shoppers and 55 % are men. The mean age of respondents is 40.3 years, which is above the average median age of 24 years in Tajikistan and it is an expected result since children were not approached to participate in the survey. The average household size is five people. About seventy-eight percent of respondents indicate that they have children who are younger than 18 years old. This information reflects the general picture of Tajik society in which people live in extended families that include respondent's family, his/her parents and to some extent his/her grandparents. Also, the presence of younger children in most of the respondents' households confirms the fact that Tajikistan has one of the youngest populations in the world.

Table 1

Summary Statistics for Socio-Demographic Variables: Khujand, Tajikistan, Survey Participants, autumn 2015 (N = 300)

Variable	Description (coding)	Distribution of Responses, with Related Information	
Age, years	≤ 30	29.32 %	Mean = 40.27 years; std. dev. = 14.03 years
	31 to 41	27.34 %	
	42 to 52	21.01 %	
	53 to 63	17.34 %	
	> 63	4.99 %	
Gender	1 if male	55.33 %	
	0 if female	44.67 %	
Shopper	1 if main shopper	66 %	
	0 otherwise	34 %	
Education	Less than secondary education	8.33 %	Coding for Estimation:
	Secondary education	58.67 %	1 if college/university or advanced and higher degree
	Secondary special education (vocational training)	3.33 %	0 otherwise
	College/university	23.00 %	
	Advanced and higher degree	6.67 %	
Children	1 if children under 18 years in household	77.67 %	
	0 otherwise	22.33 %	
Income	< 1,000 TJS	7.33 %	Mean = 2,643 TJS; Std. dev. = 1,058 TJS
	1,001–2,000 TJS	48.33 %	Coding for Estimation:
	2,001–3,000 TJS	26.67 %	1 if less 1,000 TJS
	3,001–4,000 TJS	8.00 %	2 if 1,001–2,000 TJS and so on
	> 4,001 TJS	9.67 %	5 if > 4,001 TJS
Household	Number of people in household		Mean = 5.04 people; Std. dev. = 1.43 people
Employment status	1 if officially employed	21.33 %	Coding for Estimation
	2 if self-employed	38.67 %	1 if officially or self-employed
	3 if unemployed	6.00 %	0 otherwise
	4 if retired	9.00 %	
	5 if student	2.67 %	
	6 if housewife	22.00 %	
	7 if other	0.33 %	
Location	1 if from city	87 %	
	0 otherwise	13 %	

Source: Authors' own preparation.

87 % of participants represent city inhabitants, the rest being from rural areas. Sixty percent report that they are officially or self-employed. The distribution of education level among respondents is as follows: more than half of respondents have completed secondary schools followed by 23 % of survey participants who obtained a college or university degrees and the rest of consumers (18.33 %) with incomplete schooling, vocational training and advanced degrees.

For the year 2014, the monthly family income ranges between 1,000 TJS to more than 4,001 TJS.[1] Only 9.67 % report that their monthly household income exceeded 4,001 TJS, 26.67 % made on average 2,501 TJS. 48.33 % reported that their monthly income ranges between 1,001 and 2,000 TJS. 7.33 % of respondents indicate that their families earned less than 1,000 TJS. Furthermore, participants answered questions related to biotechnology knowledge and risk perception of *GM* food (see table 2).

About half of respondents state that they do not possess any knowledge about the application of biotechnology in food production. 78 % of consumers stated that they have a favorable or neutral opinion about *GM* food. One-third of survey participants agreed that there exist risks associated with this particular variety of food product,

[1] TJS is Tajikistani somoni (currency that was introduced in Tajikistan in 2000). The 2014 official exchange rate is 5.51 Tajikistani somoni to one United States dollar.

Table 2

Summary Statistics for Consumer Perception and Attitudes Variables: Khujand, Tajikistan, Survey Participants, autumn 2015 (*N* = 300)

Variable	Description (coding)	Distribution of Responses
Environment	Importance of environmental sensitivity versus savings jobs at all costs, based on a scale from1 to 7 where: 1 = savings jobs are all-important 7 = environment is all-important	 Mean = 3.92 Std. dev. = 1.48
Safety	Importance of food price versus food safety, based on a scale from 1 to 7 where: 1 = food price is all-important 7 = food safety is all-important	 Mean = 3.41 Std. dev. = 1.55
Knowledge	Self-reported knowledge about biotechnology 1 if high or little knowledge 0 if no knowledge	 48.67 % 51.33 %
Opinion	Opinion about use of biotechnology 1 if favorable or neutral opinion 0 otherwise	 78.33 % 21.67 %
Risk	Risk related to *GM* food products 1 if high or low risk 0 if no risk	 31.33 % 68.67 %
Label	Importance for *GM* food labeling 1 if labeling is very important 0 if labeling is somewhat or not very important	 16.67 % 83.33 %
Domestic	Preference for domestic food 1 if respondent prefers domestic food 0 otherwise	 88.33 % 11.67 %

Source: Authors' own preparation.

whereas two-thirds do not connect any risk with *GM* food. Most of the respondents (83 %) do not consider labeling of *GM* food as very important.

The survey participants were also asked to express their attitudes towards environmental and food safety aspects. We followed in this regard previous studies on *GM* food acceptance employing trade-off statements concerning food safety versus food prices and economic growth versus environmental protection [12], [10] and [25] argue that the presence of variations between alternatives increases the statistical significance of these variables and consequently enables researchers to more effectively analyze the impact of these predictors on consumers' *WTP*. As table 2 shows the mean value for a trade-off situation between preserving the environment versus preserving jobs is 3.92 implying that respondents place relatively more emphasis on the environmental protection despite the fact that employment, in particular among the youth has been a big challenge for the whole transition period. In terms of food prices versus food safety, the results indicate that on average consumers consider these two attributes equally important.

One concern is whether the sample is representative of the population under study. A potential bias could be linked to places of the survey in which interviews were conducted. Supermarkets and grocery stores are in their initial stage of development in Tajikistan and thus our results reflect predominantly urban consumers' acceptance of *GM* potatoes. While in our sample the share of respondents living in an urban environment dominates, at the national level the ratio of people living in an urban versus a rural environment is the opposite with around 75 % of Tajik people living in rural areas. This should be kept in mind while interpreting our results.

4. Methodological Framework

We used in our study a contingent valuation method (CVM) to elicit consumers' *WTP*. Even though we are aware of the drawbacks of a hypothetical setting, this methodology is well established in conducting consumer research in the field of controversial food products such as *GM* food products [26]. More specifically, we used a double-bounded approach that is typically applied in estimating individual *WTP* based on responses to market-type questions with dichotomous options [27]. In contrast to the single-bounded approach, in the double-bounded approach, a consumer is offered with two consecutive bids. The follow-up bid is contingent or dependent on a response coming from the initial bid. In other words,

a respondent is asked if she is willing to pay for the product or service at the offered price, e.g. initial bid. If her answer is "yes", then she is asked whether a higher price is acceptable to her. But when she rejects the product or service at the initial bid, the following question will offer a lower price as the second bid. More specifically, each respondent provides responses to two consecutive bids. The four possible outcomes of responses obtained in double-bounded approach are specified as: "no/no", "no/yes", "yes/no" and "yes/yes".

It has been shown that the double-bounded dichotomous choice model is asymptotically more efficient and consistent than the single-bounded approach [28] and it has been applied extensively in many empirical studies on consumer acceptance of *GM* food products [10], [12] [13] and [25].

In our specific case survey participants were first asked whether they were willing to pay an initial bid price for genetically modified potatoes.[1] If the answer to the question was "yes", the follow-up question was if the respondent was willing to pay a higher price for the product. Alternatively, if the answer to the first question, e.g. initial bid price was no, then the respondent was offered a discount on genetically modified potatoes. The randomly assigned premium or discount levels were set at ±5 %, ±10 %, ±25 %, ±40 % and ±50 % accordingly. Each level of premium or discount was used for one-fifth of the surveys — i.e. 60 of the 300 surveys had a 5 % discount or premium, another 60 surveys had a 10 % discount or premium for *GM* potatoes, and so on. The responses to contingent valuation questions reflect four possible outcomes in the double-bounded model: (1) the respondent was not willing to pay for genetically modified potatoes the same market price set for regular potatoes and she is reluctant to purchase them even at the discounted price (i.e. "no" to both bids); (2) the respondent was not willing to pay for genetically modified potatoes the same market price set for regular potatoes but she would be willing to purchase them at the discounted price (i.e. "no" followed by "yes"); (3) the respondent was willing to purchase genetically modified potatoes at the offered price but she would not be willing to pay a higher price for them (i.e. "yes" followed by "no"); (4) the respondent was willing to purchase genetically modified potatoes at the offered price and she would be willing to buy them even at premium prices (i.e. "yes" to both bids).

Due to the sequential nature of the questions, it is possible to identify the upper and lower bounds of respondent's true *WTP* which can be partitioned into the following four intervals: $(-\infty, B_d)$, (B_d, B_f), (B_f, B_p), and $(B_p, -\infty)$. Assuming that *WTP*i is respondent i's true *WTP*, we will have the following discrete outcomes:

$$W = \begin{cases} 1 \ \textit{if} \ WTP_i < B_d, \\ 2 \ \textit{if} \ B_d \le WTP_i < B_f, \\ 3 \ \textit{if} \ B_f \le WTP_i < B_p, \\ 4 \ \textit{if} \ WTP_i \ge B_p. \end{cases} \quad (1)$$

The fundamental idea behind *WTP* analysis lies in the well-known random utility model in which consumer purchases a product that maximizes her utility compared to the alternative. In our specific survey context this means that a respondent chooses genetically modified potatoes at the associated bid price if the expected utility derived from this particular product is higher than from rejecting the bid and refusing the product. The *WTP* function for genetically modified potatoes for respondent i is then specified as:

$$WTP_i(\gamma_i, u_i) = \gamma_i \beta + u_i, \ i = 1, 2, \ldots, n. \quad (2)$$

where γ_i is a vector of explanatory variables, β refers to a vector of parameters and u_i is an error term. The distribution of error term is assumed to follow $u_i \sim N(0, \sigma^2)$.

The empirical representation of equation (2) for genetically modified potatoes is stated below:

$$WTP_i(\gamma_i, u_i) = \gamma_0 + \gamma_1 \textit{Perceptions and Atittudes}_i + \\ + \gamma_2 \textit{Demographics}_i + \gamma_3 \textit{Economics}_i + \gamma_4 \textit{Other}_i + u_i, \quad (3)$$

where γ_0 is model intercept, γ_1 refers to consumers' perceptions and attitudes towards *GM* potatoes, namely self-reported knowledge about *GM* food, risk, opinion, label, food safety and environment expressed by respondent *i*. γ_2 is a vector of variables representing respondent's *i* demographic characteristics, e.g. age, gender, household, etc. γ_3 is employment status and household income of respondent *i*, other is whether the survey participant *i* is from city or rural area and u_i is error term. The summary statistics tables display descriptions of covariates and relevant coding for estimation of variables of interest used in the model.

5. Empirical Results

Table 3 shows the distribution of bid responses by survey participants. Following the empirical approach proposed by Lopez-Feldman [29], we estimated the parameters of the model using the maximum likelihood method with the statistical package STATA. Unlike previous studies [30] in which the empirical implementation of *WTP* model follows the logistic distribution with mean zero and

[1] The initial bid price in the study is the market price for regular potatoes.

Table 3

Distribution of Bid Responses

	Premium, %					
	5	**10**	**25**	**40**	**50**	**Total**
Yes	4	3	1	2	0	10
No	2	2	5	5	10	24
Total	6	5	6	7	10	34
	Discount, %					
	5	**10**	**25**	**40**	**50**	**Total**
Yes	17	20	48	52	49	186
No	37	34	6	2	1	80
Total	54	54	54	54	50	266

Source: Authors' own preparation.

standard deviation $\sigma = \sqrt{3}$, the present study complies with the assumption of normality in evaluating the double-bounded dichotomous choice model for contingent valuation [29].

Furthermore, the variable B_{id} is an explanatory variable in some other studies [12] and its coefficient follows the idea of contingent valuation concept that is likely to be negative with statistically significant outcome nearly in all of the model specifications. However, the variable Bid is not reported in our *WTP* model because the initial and follow-up bids enter the model as dependent variables and the third and fourth variables should be the dummies for responses to the first and second dichotomous choice questions respectively [27].

The estimation results are presented in table 4. With respect to the perception and attitudes variables, one may notice that the self-reported knowledge about biotechnology and opinion yield statistically significant patterns implying that they are likely to increase consumer's *WTP* for this particular product. Another interesting implication can be seen from the statements related to food safety and environmental aspects. In particular, there exists a significantly positive relationship between stressing food safety over food prices and the likelihood of choosing *GM* potatoes. Moreover, there is a statistically significant negative impact from the variable environment on consumers *WTP*. Thus, consumers who place a strong emphasis on the environment have a significantly lower *WTP* for *GM* potatoes than consumer placing a stronger emphasis on economic growth and employment.

In terms of respondents' demographic characteristics age is statistically significant. Thus, older participants exhibited a higher *WTP* for *GM* potatoes than younger ones. Compared to female consumers, men exhibited a higher *WTP* for *GM* potatoes. The estimated coefficient for education is found to be negatively significant. Respondents with a higher education level have a lower *WTP* for *GM* potatoes, ceteris paribus. Variables reflecting respondents' employment and income level as well as their place of residence showed expected signs but without statistically significant outcomes.

The estimated mean *WTP* for *GM* potatoes is reported in table 5. The results indicate that survey participants on average are willing to pay 15 % less for *GM* potatoes than for conventional ones.

Table 4

Parameter Estimates for *WTP* Model with Consumer Characteristics

	Explanatory Variable	**Estimate**	**Standard Error**	***Z*-statistic**	***p*-value**
Perceptions and Attitudes	Constant	26.690***	3.142	8.49	0.000
	Risk	0.875	1.542	0.57	0.570
	Knowledge	1.953*	1.188	1.64	0.100
	Opinion	2.910**	1.436	2.03	0.043
	Label	0.954	1.672	0.57	0.568
	Safety	0.913*	0.496	1.84	0.066
	Environment	−1.038**	0.478	−2.17	0.030
Demographic	Age	0.067**	0.301	2.22	0.027
	Gender (male = 1, female = 0)	1.743*	0.937	1.86	0.063
	Presence of children	0.342	1.230	0.28	0.781
	Household size	0.320	0.398	0.80	0.422
	Education	−2.157*	1.260	−1.71	0.087
Economic	Employment	0.048	0.954	0.05	0.959
	Income	−2.811	0.505	−0.56	0.578
Other	City	0.565	1.376	0.41	0.681
Observations		300			
Log-likelihood		−258.443			

Note: * 10 % significant level, ** 5 % significant level and *** 1 % significant level. Source: Authors' own preparation.

Table 5

Estimates of mean *WTP* for genetically modified potatoes in US Cents per kg

	Coefficient	Standard Error	*Z*-statistics	*P*-value	95 % confidence Interval	
WTP	33.996	0.448	75.79	0.000	33.117	34.875

Note: Converted into TJS this equals 1.86978. The initial bid for conventional potatoes was 2.20 TJS/kg, i.e. consumers are on average willing to accept *GM* potatoes at a price discount of 15 %. Source: Authors' own preparation.

The required average discount range for *GM* potatoes acceptance lies between 17 % and 13 % (this is a 95 % confidence interval) accordingly.

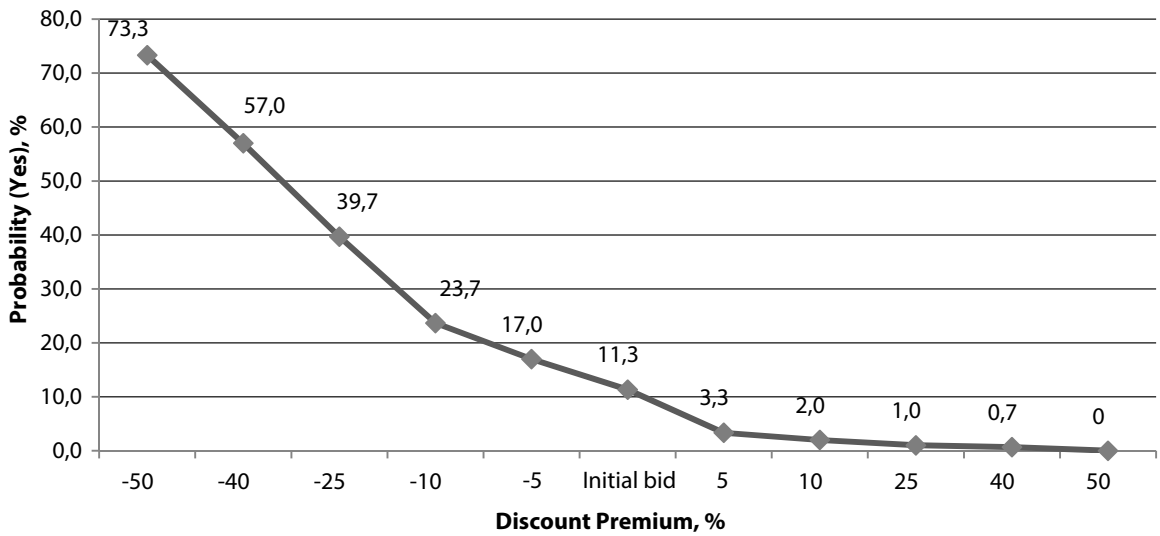
We also calculated the probability that sample respondents accept genetically modified potatoes. Figure shows the probability of stating "yes" to this particular product depending on various levels of bids.

The probability of choosing the *GM* potatoes over the conventional ones given the market price for conventional potatoes (i.e. initial bid of 2.20 TJS) is 10 %. As expected the probability of choosing the *GM* potatoes over the conventional ones increases with increasing discount levels and decreases with increasing premium levels.

6. Discussion

Looking at our results with respect to knowledge and awareness levels the results for Tajik consumer are rather comparable to study results by Li et al. [10] for China and Anand et al. [12] for India. Moreover, risk perception levels in our Tajik consumer sample are very much in line with results presented by Li et al. [10] for China. Around one-third of our sample stated that they connect either low or high risks with *GM* food, whereas two-thirds do not connect any risks with *GM* food. Yet, these shares are substantially different to the ones presented by Curtis et al. [15] for their Romanian consumer sample. In their case, 37 % of Romanian consumers stated that they connect high risks with *GM* food and only 11 % stated to connect no risk at all. Thus, there seems to be pronounced cross-country differences across post-Soviet union countries in terms of risk perception related to *GM* food. Another interesting finding is related to the statement on labeling. Both, in China [10] and India [12], the majority of respondents stated that labeling of *GM* food is very important (78.5 % and 61.9 %, respectively). In Tajikistan, however, only 16.7 % of respondent answered that labeling is very important. One possible explanation might be that food and consumer topics are not extensively broadcasted in the local media and people simply do not consider *GM* major risks with *GM* food and thus also see no need for differentiating between *GM* and non-*GM* food. However, another reason might be low trust in governmental institutions in general and the perception that labeling will not help to make more informed decisions since labels cannot be trusted. This would be in line with results from consumer studies conducted in Russia showing that most Russian consumers do not trust any domestic labels due to a high level of corruption and thus substantial mislabeling [19].

Looking at the factors influencing the *WTP* for *GM* potatoes the following points are noteworthy to highlight. First, with respect to perceptions and attitudes, our results show that respondents with



Source: Authors' own preparation.

Fig. *Probability of Choosing Genetically Modified Potatoes as Bid Varies*

a higher knowledge about biotechnology and genetic modification exhibit a higher *WTP* for these products. This might be at first glance surprising but previous studies found mixed effects of higher knowledge on *WTP*. While Anand et al. [12] found a statistically significant negative impact of higher knowledge on *WTP* for *GM* wheat among Indian consumers, Li et al. [10] found the opposite for their Chinese sample and *WTP* for *GM* soybean oil. The latter study argues that this might indicate that self-reported knowledge was obtained from sources that were supportive of biotechnology and genetic modification. A similar argumentation might apply to our sample. As expected and found in previous studies a favorable opinion about *GM* foods results in a higher *WTP*. Surprisingly, in comparison to previous studies, the risk perception variable does not have a statistically significant impact in our model. Participants connecting a certain risk with *GM* food did not exhibit a lower *WTP* for *GM* potatoes.

With respect to the two trade-off statements, our results indicate that consumers who place a relatively strong emphasis on food safety exhibit a higher *WTP*. As discussed in the literature review this might be explained by the fact that consumers expect positive benefits in terms of higher food safety from lower pesticide use in growing *GM* instead of conventional crops [23]. Second, consumers placing a strong emphasis on the environment exhibit a statistically significant lower *WTP* for *GM* potatoes than consumers who place more emphasis on the economy. This result is in line with previous studies showing that major concerns related to *GM* foods are the unknown consequences on the environment [26] and [7].

Regarding the influence of sociodemographic variables, our econometric estimations highlight that age and gender (e.g. male) have a statistically significant effect on consumers' *WTP* for genetically modified potatoes. These results are in line with previous studies results for example by Chen et al. [31] for consumers in the United States. Similar to findings by McCluskey et al. [25], Grimsrud et al. [29] and Canavari et al. [2] respondents with a higher level of education are more skeptical towards *GM* foods than consumers with a lower educational level. Educated consumers are likely to put more emphasis on conventional potatoes and different magnitudes of discount may not induce them to choose genetically modified potatoes. For these respondents, *GM* potatoes may not provide additional benefits.

The economic variable associated with respondents' household income and their employment status had no significant effects on consumer *WTP* for genetically modified potatoes. The income result is surprising and in contrast to study results for Kenya [13] and Uganda [32].

7. Conclusions

The objective of the paper was to explore Tajik consumers' perception and willingness to pay for genetically modified potatoes. For this purpose, face-to-face consumer surveys were conducted in Khujand, a major city in Tajikistan with a total of 300 respondents. Results indicate that more than half of survey participants were not aware of genetically modified potatoes. Yet, the majority of consumers expressed a positive or neutral opinion about this particular product. This might be mainly due to the fact that for most consumers no risks are associated with genetically modified potatoes. Moreover, more than half of respondents would be willing to purchase *GM* potatoes, yet with discounts. This finding is in line with existing literature implying that in general consumers are willing to pay for *GM* food product less than for non-*GM* one [19].

Given the results of the survey and empirical findings, there seems to be potential for the development of *GM* crops in Tajikistan. The public perception of *GM* crops with input traits is already rather favorable and it might be reasonable to assume that "second-generation" *GM* crops, that crop with additional health benefits would be even more widely accepted. On the one hand, agricultural biotechnology may benefit farmers to have harvests being resistant to climate changes and pests; also, genetically modified potatoes offered at lower prices compared with conventional ones could have a positive financial impact on Tajik families who spend a bulk of their income on food items.

Finally, even though we provide some empirical evidence on *GM* food acceptance for Tajikistan and a Central Asian country at all, our study has several shortcomings. First, we use a hypothetical setting and as it is well known from the literature this might create a hypothetical bias in results. However, given the fact that we analyze a product of daily life we assume this bias might be rather marginal. Second, survey participants could be asked to specify in detail reasons behind their perceptions and opinions. Third, drawing general conclusions for Tajik consumers might be limited due to the high share of urban consumers in the sample. Thus, future studies could target respondents from more rural areas of the country and may use experimental auctions in case real *GM* products are available to avoid consumer deception. Despite these limitations, our study is unique of-

fering empirical evidence for a highly understudied region in terms of consumer behavior and our results provide several interesting findings worth to be addressed in future research.

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