Technological Leapfrogging as a Source of Competitive Advantage

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Abstract:

This paper examines technological leapfrogging industries characterized by long term investments in perennial crops. Threshold farm size and economic valuation are used to evaluate adoption of harvester innovations. Less than 1 percent of Polish farmers are able to adopt overhead harvesters and sunk costs limit the ability of rapid adjustments in U.S. technology.

Technological Leapfrogging as a Source of Competitive Advantage

Introduction

This paper examines the role of technological leapfrogging in building or maintaining competitive advantage among global produce industries. Leapfrogging occurs when an economically laggard industry is able to gain competitive advantage over an economically dominant industry by adopting technology superior to that currently used by the dominant industry (Chen, 1996). Sunk costs in long term investments limit the ability of the previously dominant industry to react. An example of leapfrogging is evaluated for the Polish and U.S. tart cherry industries, which are characterized by long term investments in perennial crops and equipment.

Technological adoption is evaluated with a combination of threshold farm size analysis and economic valuation using the example of harvester innovations. Harvest cost represents approximately 35 percent of cost of production in both the Polish and U.S. tart cherry industries. The technologies under consideration are very different. The U.S. industry made a transition from hand-harvest to machine-harvest in the 1970s[1]. Polish tart cherry farmers hand harvest nearly all their fruit, but a new mechanical harvester is being developed and tested in anticipation of wage increases in the industry.

[1] In the 1960s and 70s Michigan tart cherry growers adopted mechanical harvesting (i.e., shaker) technology that had been originally developed to harvest California almonds and pistachios. Mechanical harvesters had a profound influence on tart cherry production and orchard design. For example, in order to maneuver a harvester within an orchard, plantings were limited to one tree every 18-22 feet, or about 120 trees per acre. On the other hand growers in Poland are testing a new harvester, referred to as an "overhead" harvester. It uses technology similar to an American blueberry harvester, passing over the tree and beating out fruit with rotating "fingers" rather than shaking the tree's trunk like an American harvester, or "shaker". These harvesters require smaller trees with lower trunks that are planted at high density rates (e.g., up to 1150 trees per acre or one tree every three feet)giving higher yields than orchards designed for harvest by a shaker.

Due to potential for lower total costs and increased yields from the Polish technology, there is concern within the U.S. industry that adopters of the Polish harvester may gain a competitive advantage. This concern is increased by the fact that different harvesters require different orchard designs and adoption in the United States is constrained by its sunk costs in the earlier systems. Conversely, in Poland existing technology is not a barrier in transitioning from hand-harvest to machine-harvest.

The evaluation of industry-wide harvester adoption presents some complications because orchards represent multi-year investments, yields are partly determined by planting densities, and technologies vary in each region. For example, the ability to adopt new harvesters in the United States depends on the relationship between improved yields and the time a grower must wait to recuperate his initial investment. In Poland, the ability to adopt new harvesters depends on the scale of operations and the point at which a grower is indifferent between harvesting with labor or capital.

Overview of the Tart Cherry Industry in the U.S and Poland

Poland and the United States are the two largest producers of tart cherries in the world, accounting for a combined 29 percent of the total world's production (FAO, 2005). Over the past fifteen years, Polish production has steadily grown in terms of total production volume and total area planted (Institute of Rural Economics, 2005) whereas U.S. production has declined (Figure 1).

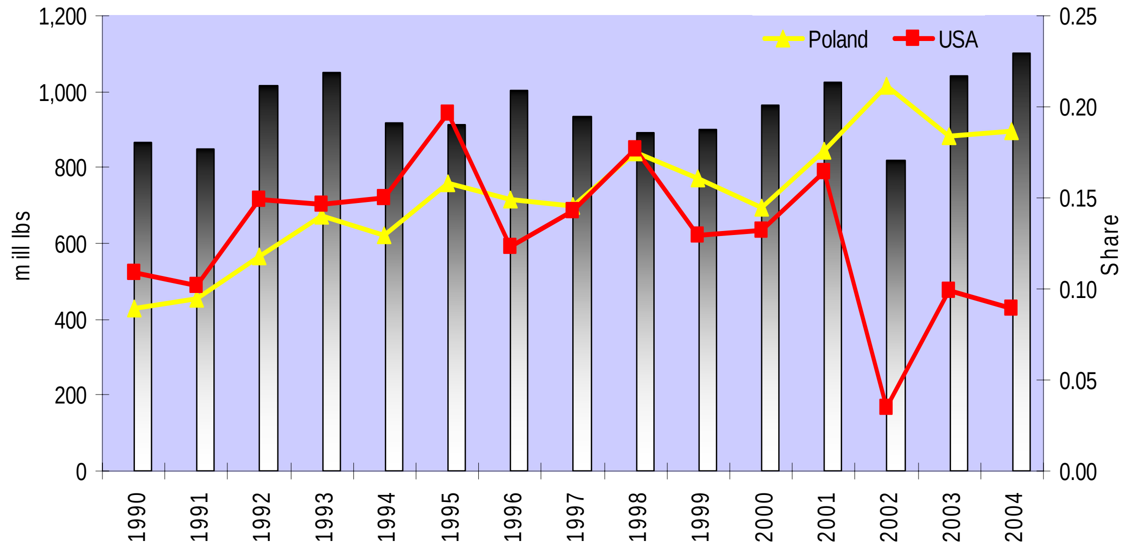

Figure 1. World Total Tart Cherry Production with Poland and the U.S. share of production*.

*Bars represent World Total production in millions of pounds; lines represent Poland and the U.S. share of total production
Source: FAOSTAT, 2005

The Polish tart cherry industry is characterized by a large number of small farm operations which rely heavily on hand labor for harvesting. According to estimations obtained from the University of Poznan, and other key informants, there are approximately 133,343 farms producing tart cherry in Poland. Out of these farms, 93.7 percent have on average of 0.5 acres per farm and together represent 67.3 percent of total land. Less that 5 percent of farms have an average farm size of 2.5 acres and use 16 percent of total land. Approximately, 1.5 percent of total number of farms has an estimated 5 acres size and utilizes 10.7 percent of land. Finally, less than 1 percent of total number of farms has average farm size ranging from 12.5 to 25 acres, representing less than 6 percent of total land (Table 1).

Table 1. Characteristics of Polish Tart Cherry Farms.

Farm Size (Acres)	Number of Farms	Percentage of Total Number of Farms	Estimated Average farm Size (acres)	Total Acreage per Farm Size* (acres)	% of Total Acreage
<2.5	125,000	93.7	0.5	62,500	67.3
2.5-4.9	6,000	4.5	2.5	15,000	16.1
5-12.4	2,000	1.5	5	10,000	10.7
12.5-24.9	265	0.2	12.5	3,312	3.5
25-50	78	0.1	25	1,950	2.1
Total	**133,343**			***92,762.5***	

* Reported total acres planted accounted for 93,898 acres and it was not available by farm size
Source: Robert Kurlus, Pomology Dept. University of Poznan and Author's Calculations, 2005

In the U.S., Michigan dominates the tart cherry production accounting for more that 70% of total volume produced. The Michigan tart cherry industry is characterized by increasing farm sizes while decreasing number of producers (Figure 2, 3), and large investment in capital-intensive production technologies.

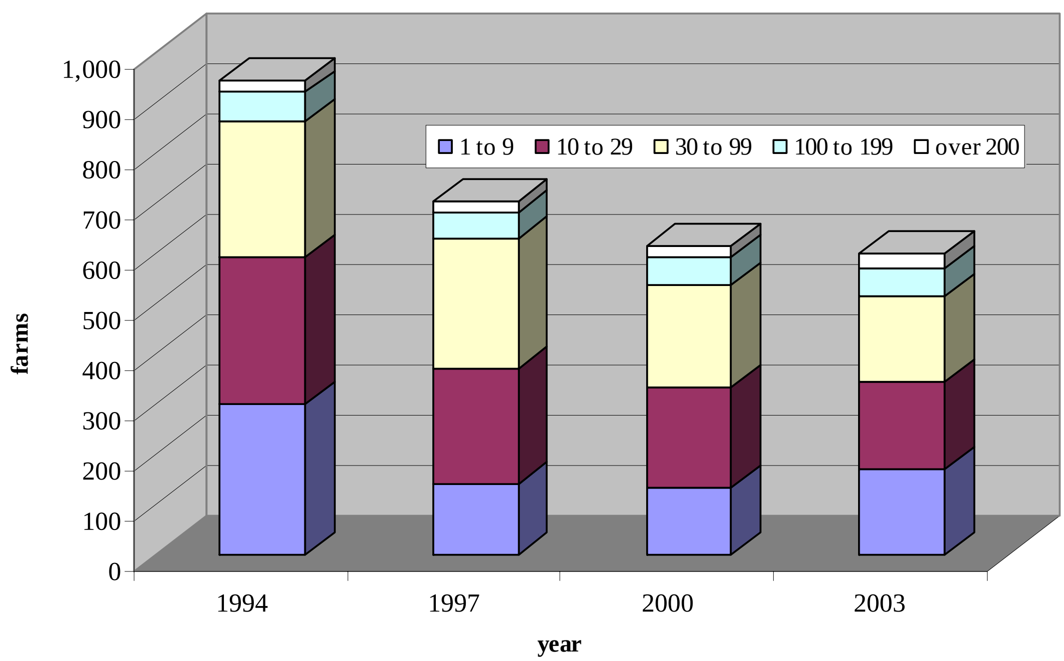

Figure 2. Total Number of Tart Cherry Farms by Different Farm Size, Michigan 1994-2003.
Source: Michigan Agricultural Statistics, 2005

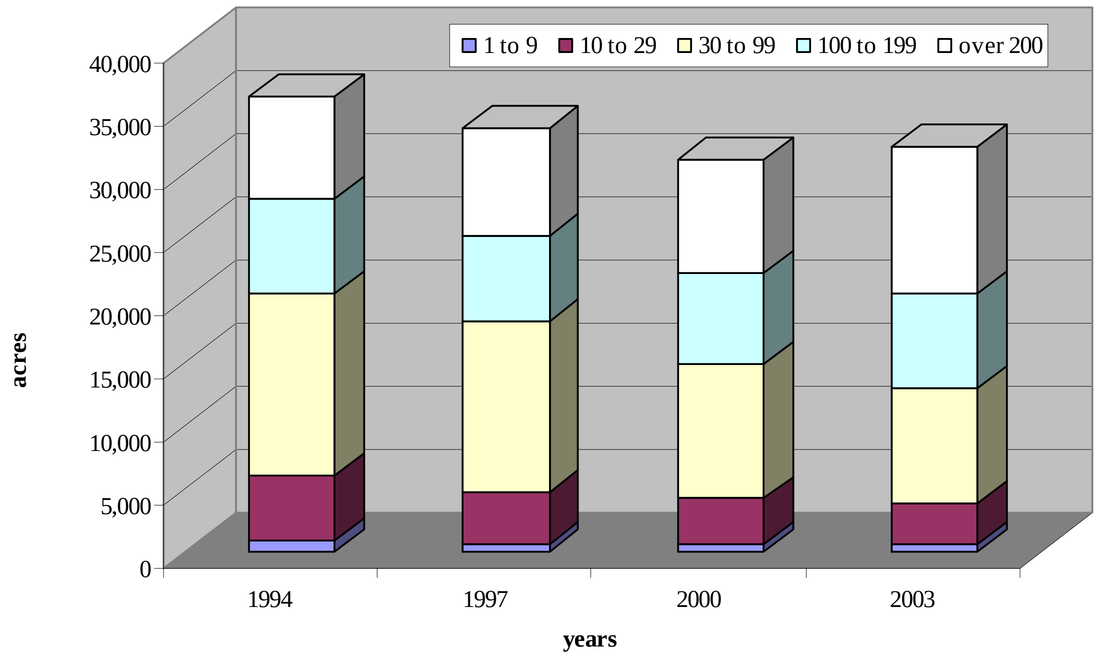

Figure 3. Total Acres of Tart Cherry by Different Farm Size, Michigan 1994-2003.
Source: Michigan Agricultural Statistics, 2005

In the 1960s and 70s, Michigan tart cherry growers adopted mechanical harvesting technology. The transition from hand harvest to mechanical harvest induced Michigan growers to heavily invest in asset specific equipment (i.e., harvester), and commit themselves to specific cultural practices (i.e., tree maintenance, tree varieties and planting densities). In order to recover the high investment cost of adopting a new technology, producers pursued multiple strategies, including increasing orchard size, purchasing orchards throughout different climatic zones and changing the mix of crops produced to make additional use of harvester. A drop in the labor supply occurred as the shift from labor intensive to capital intensive production methods drove workers to other regions and demand for skilled labor to operate the new machinery increased

Although after adopting new harvesting technologies Michigan growers have been able to minimize their total costs, they have also been limited by their potential to increase yield per acre. In Michigan, on average the number of trees per acre is 120 whereas in Poland planting density range from 200 trees per acre to over 1,000 trees per acre.

In Poland, the tart cherry industry is showing a move towards developing a new harvesting system. The industry has invested in developing a mechanical harvester given the concern that as wages increase over the long-run, Polish tart cherry growers may become less competitive[2]. This harvester is well adapted to Polish conditions and has clear advantages over American harvesters, including the ability to harvest younger orchards; thus increasing the number of times a mechanically harvested orchard can be harvested, and minimizing the damage that current harvesters inflict on both trees and fruit. Also, this technology allows Polish grower to continue hand-harvest while transitioning to the new harvester.

The planting of higher density orchards gives Polish growers a potential for higher yields than Michigan growers. Moreover, adding a new mechanical harvester will further increase Polish production efficiencies and possibly lead to economic leapfrogging.

Methodology

Possible leapfrogging in the tart cherry industry is analyzed using threshold farm size and economic valuation to address the issue of new harvesting technology that may

[2] Polish wages are anticipated to increase as alternative employment in the European Union increases or as off-farm opportunities within Poland increase

influence competitive advantage between tart cherry farmers in Michigan and Poland. Threshold farm size measures the minimum acreage at which a farm can be converted from hand-harvest to machine-harvest technology, and economic valuation measures the incentives for, and ability of, growers to switch from old harvesters to new style harvesters.

Threshold farm size analysis was introduced to evaluate Midwestern grain farmers' ability to replace grain harvesting labor with a mechanical reaper (David, 1966 and Pomfret, 1976). Such analysis has been used mainly to analyze capital to labor trade-offs for annual crops; however, tart cherry orchards are perennial crops that generally consist of several plantings (i.e., blocks) with different tree ages. Consequently, in this study threshold farm size measures the minimum block size in order to adopt overhead harvester technology.

Using a simple ratio, it is possible to measure the minimum farm size necessary for a farmer to be indifferent between paying harvest labor and buying a mechanical harvester. Threshold farm size analysis is shown by the following ratio:

$$S_t = \frac{C}{L_s W}$$

where C is the annual cost of a harvester based on a projected price for a new Polish harvester valued at US$ 84,000 (US$11,095 annually assuming a 12.5 year lifespan), and a new American harvester valued at US$150,000 (US$19,812 annually) (Table 2).

Table 2. Annual Equipment Costs for Different Harvesters in the U.S. and Poland

Harvester	[a] Purchase Price	[b] Yrs	[c] Salvage Value	Interest Rate	[d] Capital Recovery	[e] Insurance	[f] Taxes	Total
U.S.	$150,000	12.5	$30,000	0.08	$17,937	$375	$1,500	$19,812
Polish	$84,000	12.5	$16,800	0.08	$10,045	$210	$840	$11,095

[a] Purchase price is form listening sessions, and local dealers estimations
[b] Lifespan is estimations from Minnesota.
[c] Salvage value is estimated 20% of nominal purchase price based on calculations from ASAE remaining values function.
[d, e, f] Calculations based on ASAE

L_s represents the difference between labor hours necessary to hand harvest and to machine harvest an orchard. Approximately 800 to 1,100 labor hours are necessary to hand harvest one hectare of tart cherries (i.e., 325 to 445 hours per acre), while 30 labor hours are necessary to machine harvest one hectare (i.e., 12 labor hours per acre)[3]. Thus, L_s equals 770 to 1,070 hours per hectare (i.e., 310 to 430 hours per acre).

Finally, *W* represents wages saved by using a harvester. Hourly harvesting wage rates in Poland are estimated to fall between $1.2 and $2 per hour (Dr. Robert Kurlus, personal correspondence, 2005).

Since Michigan already transitioned form labor intensive to capital intensive technologies, threshold farm size does not provide a good measure of ability to move between technologies. Here Economic valuation is used to analyze the point in the life cycle of an established orchard when it becomes feasible to replant in order to adopt a new technology. In this study, economic valuation is used to evaluate the ability and incentive of Michigan growers to transform orchards and adopt Polish harvesters under four different scenarios.

[3] The range of harvest hours is a function of yield. Yield fluctuations are the result of both varying orchard density and nature.

Data was obtained from Michigan farmers during four focus groups in three major production regions. The average orchard is a 200-acre farm with 100 acres of tart cherries in full capacity production based on 25 years production cycle[4]. In scenarios 1 and 2 years 0 to 5 represent establishment and maintenance costs for un-harvested orchard. Years 6 through 25 represent annual costs including harvest expense[5] (Appendix 1)

Yields per tree fluctuate over time based on annual weather patterns and maturity level of the tree. In scenario 1, yields represent annual yields and variations are adjusted from years 6 to 25 using an index to reflect variations that orchards experience as trees mature[6]. The historic yield is reported by the National Agricultural Statistics Service. Projected cash inflow is the total revenue a farm earns on a per acre basis and it is calculated multiplying yield by price. Price data is based on historic price reported by the National Agricultural Statistics Service and adjusted to 2004 dollars using Producer Price Index-Farm Products data. Net Cash In refers to total revenues minus total costs and is calculated as the projected cash inflow minus cost. Finally, discount cash flow represents net cash in discounted by 4.5 percent, which represents grower's second best option for a thirty-year bond investment. In the second scenario, yields are further adjusted to calculate the increase or decreases from historic yield necessary for NPV to equal zero (Appendix 2).

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[4] When focus groups were divided by large and small farm sizes, the participants were instructed to estimate costs for the same size farm (200 acres with 100 acres of tart cherries).
[5] Land values are not included in Michigan or Polish production costs given general disagreement between growers as to a standard value.
[6] Based on calculations made by Dr. Roy Black and Tracy Beedy from the department of Agricultural Economics, Michigan State University, 2005

Growers in both Michigan and Poland reported producing higher yields than those cited by either Michigan Agricultural Statistics or the Polish Institute of Rural Economics. In Michigan, farmers claim their average yield is closer to 10,000 pounds (Michigan Producer Focus Groups, 2004) whereas in Poland growers reported average yields close to 11,000 pounds per acre.7 This claim by Polish growers appears credible for three reasons. First, the Institute of Rural Economics includes non-bearing trees when calculating average yields per acre. When non-bearing acres are removed, yield per acre increases. Second, Polish statistics include about 125,000 farmers with less than 2.5 acres who produce tart cherries as a source of supplemental income, suggesting that the majority of Polish farmers invest their time and resources heavily in other activities. The resulting average would likely under-represent yields for commercial cherry growers. Third, survey results demonstrated that Polish farmers pursue a wide variety of production techniques.

Michigan grower claims of average yields higher than those reported also appear credible. When broken down into regions, Northwest Michigan has substantially higher yields per acre than the west central and southwest regions, and when the 2002 disaster crop is removed from the averages, northwest yields approach 9,000 pounds per acre. In addition the NASS definition of "non-bearing acres" refers only to orchards that are six years old and older. Although this is a good estimate, some northwest orchards may not bear until their 7th or 8th year, in comparison to southwest and west central Michigan orchards, which generally can be harvested earlier. As a result, the grower claimed

[7] Based on grower interviews, Thornsbury reported that average Polish yields were 12,000 to 15,000 lbs. per acre. Kurlus suggested that average yields were three times the published rate, which would equal approximately 11,000 lbs. per acre.

average yield of 10,000 pounds per acre appears accurate for growers in northwest Michigan.

Results

According to the threshold analysis, Poland farms need to falls within the range of 12 to 30 acres in order to change to a new machine harvester. Considering that similar American machines (e.g., blueberry harvesters, tart cherry shakers) are valued around US$150,000, the estimate obtained for the cost of the Polish harvester seems low (US$84,000). As a consequence, threshold farm size is measured a second time, using the value of American shakers (US$150,000). Using these values, results indicate threshold farm size falls within the range of 23 to 53 acres (Table 3).

Table 3. Threshold analysis for different harvesting technologies in Poland and U.S.

Harvester	Purchase Price	Annual Cost	Labor Hours/hectare	Wages US$/hour	Threshold Farm Size Hectare	Threshold Farm Size Acre
Polish	$84,000	$11,095	770	1.2	12.01	29.66
Polish	$84,000	$11,095	1,070	2.0	5.18	12.81
U.S.	$150,000	$19,812	770	1.2	21.44	52.98
U.S.	$150,000	$19,812	1,070	2.0	9.26	22.88

Based on threshold farm size calculations, less than 1 percent of Polish farmers will be able to adopt overhead harvesters on less than 6 percent of the tart cherry land under current conditions[8]. Nevertheless, leapfrogging still appears likely in the short-run. This same minority of Polish farmers, however, is probably the most important group to U.S. growers in terms of international tart cherry competition. The larger farms are

[8] See Table 1

currently the most advanced in terms of production techniques, report the lowest per pound cost of production, generally produce a more consistent high-quality product, and have access to international market channels.

According to statistical data and economic trends in Poland, farms are anticipated to increase in average size, thus, making mechanical-harvesting less expensive than hand-harvesting. The reasons to expect increasing farm sizes are mainly the economies of scale as farm sizes become larger and the potential of small farms to exit the industry induced by better paid off-farm work. A majority of small farms are less efficient and thus have higher production costs, which make them more likely to merge into larger farms or converted to other uses. Finally, larger farms currently have the advantage of being able to vertically align with processors and demand price premiums.

Economic valuation is used to evaluate the ability and incentive of Michigan farmers to adopt overhead harvesters. First, historic price, average historic yield, and cost of production data were used to estimate the net present value (NPV) of investing in an acre of tart cherries. This resulted in a negative NPV of US$7,798, with a discount rate of 4.5 percent. Given negative NPV in Scenario 1, average yield data was varied to find NPV equal to zero[9].

Historic data estimates show that NPV equals zero only when average yields equal 9,654 pounds per acre (

Table 4), which is approximately the same yield that Michigan growers claim they produce (i.e., 10,000 lbs/acre). Economic valuation implies that Michigan orchards are likely to earn back their initial investments near the end of their lifespan (25 years) and that early replanting for overhead harvest will result in economic loss (Appendix 2).

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[9] Cost was left in real dollars, price was adjusted for the annual rate of inflation, and yield was indexed to reflect tree production cycle according to calculations of Black and Beedy, 2005.

There is, however, an incentive for Michigan growers to adopt overhead harvesters. By calculating the NPV of an orchard that is harvested starting at year three and without changing costs, historic yields, or planting densities overhead harvesters can be attractive to Michigan growers. These orchards, although more expensive to install, are advantageous because they extend the number of years an orchard can be harvested and have the potential to increase yields. Results from scenario 3 show NPV equal to – US$ 4,577 when harvest begins in year 3. Extending the number of years an orchard can be harvested obviously reduces the yield increases that are necessary to make NPV equals zero. Scenario 4 assumes the same conditions in Michigan (e.g., historic yields, planting densities). Results indicate average historic yield needs to increase only 44 percent for NPV to equal zero (Appendix 3). Given that tart cherry farmers are locked into long-term investments, it is likely that transformation of the Michigan industry will be drawn out over at least 25 years, corresponding with the typical lifespan of Michigan orchards.

Table 4. Economic valuation results under different scenarios.

Scenario	Orchard establishment (years)	Average yields (Lbs/acre)	NPV (US$)	% variation from historic yields
1	5	5,701	-7,798	0
2	5	9,654	0	69.33
3	3	5,701	-4,577	0
4	3	8,234	0	44.40

Conclusions

Technological leapfrogging occurs when an economically laggard industry is able to gain competitive advantage over a previously dominant industry by adopting technology superior to that currently used by the dominant industry. Analysis of harvesting technology adoption in the Polish and U.S. tart cherry industries shows that although only a minority of Polish producers can adopt new technology in the short-run there is still a possibility of leapfrogging. This is possible given that this small minority of Polish farmers is the group of farmers best able to compete with Michigan producers for international markets. Long-term investments in perennial crops and existing technologies constrain the ability of many U.S. firms to make swift changes in production systems. This does not imply that Polish product will dominate the U.S. market, but that some Polish growers will be competitive.

Short-run evaluation of Polish and American competitiveness is distinguished from long-run evaluation by the lack of significant wage increases and structural change in the Polish production system. Results indicate that short-run comparative production costs for Michigan growers and the majority of Polish growers are not likely to change dramatically because of new harvesting technology in the short-run. Threshold analysis shows less than one percent of Polish producers can adopt the new technology under current conditions. Results also suggest that the trend of Michigan producers exiting and the consolidation of tart cherry acreage will continue. Economic valuation shows that, on average, small Michigan growers are not able to adopt more efficient harvesters within the normal 25-year production-cycle without economic loss.

Structural change and wage increases in the Polish production system are expected to influence future competitive advantage in tart cherry production. Structural transformation, characterized by the exit of small Polish growers and the entry of a more concentrated industry characterized by larger, mechanized, and more specialized growers, and increase wages due to shortage in labor supply are not likely to occur in the short run. In the long run, however, wages are expected to rise as they find a new equilibrium with employment alternatives throughout the European Union and a structural transformation is likely to occur as small producers exit the industry due to the rise of these alternate employment opportunities. As these changes occur, the number of Polish growers adopting new technologies will put additional pressure on the competitiveness of U.S. suppliers if no adjustments are made in the U.S. system.

Economic valuation indicates that although a short-run switch to overhead harvesting in the Michigan industry is unlikely, there are incentives to adopt overhead harvesters in the long-run. Larger growers potentially have the scale to operate two technologies simultaneously and thus make a more immediate transition. Assuming that both regions adopt new harvesting technology in the long run, per unit production costs are likely to converge. With the development and adoption of a standardized harvesting system, Polish production techniques will become more homogenous within the country. Likewise, given that Polish wages are expected to increase over the long-run, Polish labor costs will be increasingly similar to Michigan labor costs. The combination of similar yields per acre and costs per acre therefore indicates a long-run trend of converging production costs on a price per unit basis. However, if Michigan farmers do not adopt and adapt to technological changes they are likely to loose their position in the global tart cherry market.

Appendix 1. Economic Valuation for the Ability of Michigan Tart Cherry Farmers to Remove an Orchard Early

YEAR	COST	YIELD	PRICE	INFLOW	NET CASH IN	DISCOUNT CASH FLOW
0	1,300	0	0.60	0	-1,300	-1300
1	2,665	0	0.24	0	-2,665	-2550
2	871	0	0.54	0	-871	-798
3	901	0	0.17	0	-901	-790
4	901	0	0.59	0	-901	-756
5	901	0	0.29	0	-901	-723
6	1,050	1,160	0.28	326	-724	-556
7	1,067	1,703	0.26	445	-622	-457
8	1,100	3,895	0.10	372	-728	-512
9	1,134	3,607	0.21	755	-379	-255
10	1,160	4,508	0.16	727	-433	-279
11	1,180	4,860	0.20	961	-219	-135
12	1,200	3,200	0.56	1,792	592	349
13	1,200	7,230	0.20	1,463	263	148
14	1,200	8,180	0.13	1,036	-164	-89
15	1,200	6,560	0.19	1,271	71	37
16	1,200	10,330	0.06	617	-583	-288
17	1,200	6,700	0.16	1,087	-113	-54
18	1,200	7,920	0.17	1,375	175	79
19	1,200	9,260	0.17	1,583	383	166
20	1,200	6,580	0.27	1,797	597	248
21	1,200	7,020	0.23	1,601	401	159
22	1,200	10,840	0.22	2,356	1,156	439
23	1,186	525	0.55	290	-896	-326
24	1,172	5,182	0.40	2,051	879	306
25	1,158	4,767	0.33	1,568	410	137
					NPV	**-7,798**

NPV assuming farmers are indifferent (i.e., discount rate of 0)

Appendix 2. Economic Valuation for the Necessary Increase on Yields for NPV to Equal Zero

YEAR	COST	YIELD [1]	PRICE	INFLOW	NET CASH IN	DISCOUNT CASH FLOW
0	1,300	0	0.60	0	-1,300	-1,300
1	2,665	0	0.24	0	-2,665	-2,550
2	871	0	0.54	0	-871	-798
3	901	0	0.17	0	-901	-790
4	901	0	0.59	0	-901	-756
5	901	0	0.29	0	-901	-723
6	1,050	1,964	0.28	553	-497	-382
7	1,067	2,884	0.26	754	-313	-230
8	1,100	6,595	0.10	630	-470	-330
9	1,134	6,107	0.21	1,278	144	97
10	1,160	7,634	0.16	1,231	71	46
11	1,180	8,229	0.20	1,628	448	276
12	1,200	5,418	0.56	3,034	1,834	1,081
13	1,200	12,242	0.20	2,477	1,277	721
14	1,200	13,851	0.13	1,754	554	299
15	1,200	11,108	0.19	2,152	952	492
16	1,200	17,492	0.06	1,044	-156	-77
17	1,200	11,345	0.16	1,840	640	303
18	1,200	13,411	0.17	2,329	1,129	511
19	1,200	15,680	0.17	2,680	1,480	641
20	1,200	11,142	0.27	3,044	1,844	764
21	1,200	11,887	0.23	2,710	1,510	599
22	1,200	18,355	0.22	3,990	2,790	1,059
23	1,186	889	0.55	490	-696	-253
24	1,172	8,774	0.40	3,474	2,302	800
25	1,158	8,072	0.33	2,656	1,498	498
					NPV	**0**
					Average yield	**9,654**

[1] Yield increase factor 1.69

Appendix 3. Economic Valuation for the Incentive to Adopt Overhead Harvesters in Michigan.

YEAR	COST	YIELD	PRICE	INFLOW	NET CASH IN	DISCOUNTED CASH FLOW
0	1,300	0	0.60	0	-1,300	-1,300
1	2,665	0	0.24	0	-2,665	-2,550
2	871	0	0.54	0	-871	-798
3	901	1,605	0.17	267	-634	-555
4	901	1,033	0.59	611	-290	-243
5	901	3,500	0.29	1,014	113	91
6	1,050	4,640	0.28	1,305	255	196
7	1,067	4,258	0.26	1,113	46	34
8	1,100	7,790	0.10	744	-356	-250
9	1,134	5,410	0.21	1,132	-2	-1
10	1,160	5,410	0.16	872	-288	-185
11	1,180	4,860	0.20	961	-219	-135
12	1,200	3,200	0.56	1,792	592	349
13	1,200	7,230	0.20	1,463	263	148
14	1,200	8,180	0.13	1,036	-164	-89
15	1,200	6,560	0.19	1,271	71	37
16	1,200	10,330	0.06	617	-583	-288
17	1,200	6,700	0.16	1,087	-113	-54
18	1,200	7,920	0.17	1,375	175	79
19	1,200	9,260	0.17	1,583	383	166
20	1,200	6,580	0.27	1,797	597	248
21	1,200	7,020	0.23	1,601	401	159
22	1,200	10,840	0.22	2,356	1,156	439
23	1,186	495	0.55	273	-913	-332
24	1,172	4,560	0.40	1,805	633	220
25	1,158	3,864	0.33	1,271	113	38
					NPV	**-4,577**
					Average Yield for NPV = 0	**8,233**

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