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Location Preference for Risk-Averse Dutch Dairy Farmers Immigrating to the United States

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Increased environmental regulations and a milk quota that restricts growth have increased the interest in immigration to the United States by Dutch dairy farmers. A risk-based economic analysis of 23 representative U.S. dairy farms versus a representative Dutch farm shows that risk-averse Dutch dairy farmers would prefer to liquidate their dairy farms and invest in a large dairy in Idaho or north Texas. The risk ranking suggested that continuing to farm in the Netherlands rather than immigrating to the United States is preferred over only two of the 23 U.S. representative farms analyzed.

Key Words: dairy relocation, production economics, ranking risky alternatives, risk analysis

JEL Classifications: F21, F22, Q12, Q14, E37, D81

Dairy producers in the Netherlands are struggling to stay in business because of increased regulations, population density, intensity of farming systems, costs of production, and quota restrictions (Wolleswinkel and Weersink). One option available to Dutch dairy farmers is to liquidate their assets, deposit the money in an international bank, and buy an established dairy farm in the United States. A large number of Dutch dairy farmers have made this decision to move to America and buy a dairy (McNeil).

Four main factors have led to the Dutch dairy farmers decision to relocate from the Netherlands: (a) environmental regulations in the European Union (EU), (b) relatively expensive inputs (i.e., land, feed, water), (c) limited opportunities for growth, and (d) high price of milk quota (Wolleswinkel and Weersink). While EU dairy farms tend to be very homogenous in terms of herd size, production systems, and costs of production, U.S. dairy farms exhibit a wide variation over the same factors (den Besten and van Hoven; Outlaw et al. 1996). This diversity of U.S. dairy farms makes the decision of where to locate more difficult for Dutch dairy farmers wanting to immigrate to the United States.

The majority of U.S. dairy farms (71% of farms and 46% of production in 2005; USDA 2006) are located in the traditional dairy regions — Northeast, lake states, and Corn Belt — with a growing number of dairy farms in the West, Southwest, and Northwest (9% of

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farms and 41% of production in 2005; USDA 2006). Dairy farms in the traditional dairy regions are generally smaller (78 cows/farm) and depend on raised crops for a large portion of the forage fed to dairy cows. In contrast, dairies in the West, Southwest, and Northwest are larger (490 cows/farm) and generally do not raise crops to provide a significant portion of forage to their cows.

Dutch dairy farmers considering immigrating must answer two questions: (a) will I make more money if I stay in the Netherlands or move to the United States, and (b) if I move, where do I locate and how big of a dairy do I buy? These questions can be addressed, in part, by economic analysis of the profitability of dairy farms in different regions of the United States, in comparison to dairy farms in the Netherlands.

Immigrating Dutch dairy farmers must decide whether to buy a dairy farm in the traditional dairy regions or to buy a feedlot-style dairy in the West. Farms in the West offer the chance to own a much larger herd and the opportunity to focus management skills on milk production rather than also having to manage a forage production enterprise. However, dairy farms in the traditional dairy regions are smaller and use production systems more familiar to Dutch dairy farmers.

The objective of this study is to determine if a representative Dutch dairy farmer would prefer to immigrate to the United States and, if so, where he or she would prefer to locate. Monte Carlo simulation of representative dairy farms is used to estimate probability distributions of returns for representative dairy farms in the United States. Stochastic efficiency with respect to a function is used to project a risk-averse decision maker's preference for continuing to farm in the Netherlands or immigrating to the United States.

U.S. and Netherlands Dairy Industries

Trends in herd size and production per cow over the last 10 to 15 years have been similar in the United States and the Netherlands; however, the magnitudes of change are quite different. The total number of milk cows in the United States declined by 7% from 1991 to 2001 while the total number of milk cows in the Netherlands declined by 22% (Bailey; USDA 2002). Annual total milk production in the United States increased 12% from 1991 to 2001, while annual total milk production in the Netherlands increased 1.6% (USDA 2002). Annual milk production per cow for the United States increased from 15,071 lb/cow to 18,187 (or 20.7%), while in the Netherlands there was an increase from 13,500 to 17,643 (or 30.7%) over the same time period.

Dairy production is one of the most important production sectors of Dutch agriculture. Land and labor are expensive in the Netherlands, so the production systems used in agriculture are highly intensive. The Dutch dairy sector has seen radical changes in focus over the last 40 years. The period between 1960 and 1980 was known for increased productivity and efficiency, while the period between 1980 and 2000 focused on environmental quality and supply controls (van Horne and Prins).

Two major developments in EU dairy policy have driven up production costs for farmers and restricted the growth of farms, thus making it more attractive to relocate their operations. First, more stringent environmental quality regulations were introduced in the early 1980s aimed at reducing air and water pollution. Dutch dairy farmers had to satisfy the criteria for environmental licenses, requiring waste storage and management investments, as well as meet increased acreage/cow requirements (van Horne and Prins).

The new environmental regulations recommend a minimum of approximately 1.24 acres of pastureland per dairy cow (den Besten and van Hoven). If a Dutch dairy is operating at full capacity (i.e., the land requirement is met) and wishes to expand production by purchasing more cows, the dairy also has to purchase or rent more land. Purchasing the necessary land requires an additional investment of approximately $17,000 per cow added.

Second, the EU introduced a milk marketing quota system in 1983 in response to the surplus production of the 1960s and 1970s. Milk quotas changed the focus from expanding milk production to reducing costs of production (van Horne and Prins). The quota is held as a nonproductive asset, which permits the owner to produce and market milk (den Besten and van Hoven,). The marginal cost per unit to purchase additional quota if a farm expands or wishes to sell more than the current milk quota is $1.05 per pound. Because of the increased costs from environmental regulations and production quotas, many dairy farmers exited the industry, and a large number have immigrated to the United States.

Materials and Methods

A comparison of the economic viability of different farms requires projecting the net income, cash flow, and net worth of representative farms over a multiple-year planning horizon. Because of the risk of dairy farming, a Monte Carlo financial simulation model is the appropriate methodology. Monte Carlo simulation models can provide estimates of probability distributions for key output variables. Net present value (NPV) is a good measure of farm profitability and economic viability because it quantifies the effects of annual retained and consumed earnings on returns to initial wealth. The NPV for a farm is calculated using the following formula:

$$(1) \quad NPV = -BeginningNetWorth + \sum_{t=1}^{n} \frac{FamilyLiving_t}{(1+i)^t} + \sum_{t=1}^{n} \frac{NetWorth_t - NetWorth_{t-1}}{(1+i)^t}.$$

The present value of annual net returns consumed by the operator is reflected in the second term on the right-hand side, and the present value of retained earnings is calculated by the third term. In a Monte Carlo simulation, the number of times NPV is greater than zero divided by the number of iterations is the probability of economic success (i.e., the probability rate of return exceeds the opportunity cost for capital). The NPV probability distribution can also be used to rank risky alternatives using subjective expected utility methods.

Ruetlinger and Pouliquen recommend using Monte Carlo simulation for estimating the NPV probability distribution of a business or investment where risk is a key concern. Monte Carlo simulations are widely used to imitate real-life systems such as farms. A whole-farm financial simulation model is used to simulate a representative Dutch dairy farm and several representative U.S. dairy farms. Stochastic yields and prices for feed, livestock, and milk are used to simulate values for the financial variables needed to estimate the empirical probability distribution of NPV, the annual net cash farm income, the rate of return to assets, the probability of negative net farm incomes, and ending cash reserves.

Farm-Level Simulation

Whole-farm simulation models have been used extensively over the past 40 years to analyze farm financial planning, growth strategies, effects of farm programs, the role of technological change on farms, and investment under uncertainty (Halter and Dean; Hutton and Hinman; Patrick and Eisgruber; Richardson and Nixon 1986). The simulation model selected for the present study is the Farm Level Income and Policy Simulator (FLIPSIM) developed by Richardson and Nixon (1986). The model is capable of simulating dairy farms in multiple regions and countries and has been maintained and updated for policy and economic changes (Outlaw et al. 2004). The FLIPSIM model uses producer input for determining costs, production history, fixed costs and assets, and projected mean prices and rates of inflation from the Food and Agricultural Policy Research Institute (FAPRI) to simulate stochastic economic outcomes for a representative farm. The model simulates prices, yields, and milk production as a multivariate empirical distribution using the procedure described by Richardson, Klose, and Gray. The model is recursive in that the simulated ending financial position for year 1 serves as the beginning position for the second year and so on for the

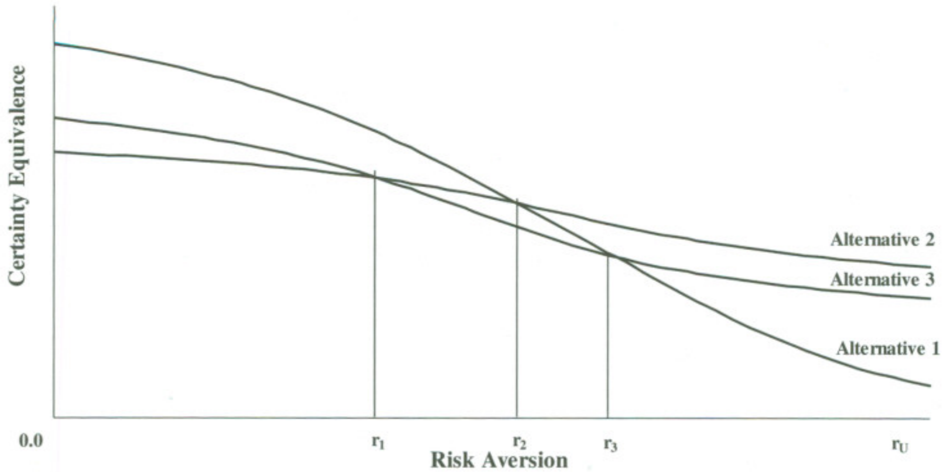

Figure 1. Illustration of Stochastic Efficiency with Respect to a Function (SERF) for Simultaneously Comparing Three Alternatives over a Range of Risk Aversion Levels

chosen planning horizon. Since its introduction, FLIPSIM has been used in more than 10 countries and 25 universities for many different types of farm-level studies.

Ranking Risky Alternatives

In addition to ranking farms by their probability of economic success, returns to farming, and other criteria, risky alternatives can be ranked using subjective expected utility methods (Hardaker et al. 2004a). Stochastic dominance is a popular method for ranking risky alternatives to identify the efficient set (the preferred alternatives) for risk-averse decision makers. Stochastic dominance with respect to a function (SDRF) has been used in simulation studies to rank risky alternatives for decision makers with different levels of risk aversion, e.g., Richardson and Nixon (1982) and Lemieux, Richardson, and Nixon. A problem with SDRF is that it can result in multiple alternatives in the efficient set if the range of risk aversion coefficients is too wide.

Stochastic efficiency with respect to a function (SERF) is an alternative procedure for ranking risky scenarios (Hardaker et al. 2004b). The SERF method has all the advantages of SDRF, plus it is more transparent and easier to implement. SERF methods can identify a smaller number of alternatives in the efficient set over a given range of risk aversion and is potentially more discriminating than the pairwise SDRF technique (Hardaker et al. 2004b). Additionally it is capable of identifying risk aversion coefficients (RAC) levels where decision makers' preferences will change from one alternative to another. For this study SERF will be used to estimate the preference between the alternative U.S. dairy farms and a representative Dutch farm for risk-averse decision makers. The RAC levels for the analysis will range from risk neutral to extremely risk averse to show probable preferences over a range of decision makers.

The SERF method is illustrated in Figure 1. In the example SERF is used to simultaneously compare three risky alternatives over a range of risk aversion levels. The certainty equivalence (CE) for the NPV or wealth associated with a risky alternative is calculated at each RAC over the range of zero to r_u using a selected utility function specification, such as the power utility function. The CE values for risky alternatives can be presented as a chart to show how they change as the RAC changes. Assuming the decision maker prefers more to less, the risky alternative with the highest CE at a given RAC is preferred. In Figure 1 Alternative 1 is preferred over the other two alternatives for the RAC range of zero to r_2. Alternative 2 is preferred by risk-averse decision makers who have RACs greater than r_2. In the example Alternative 3 is never preferred over the 0 to r_U range of risk aversion.

Dutch Farm Data

Den Besten and van Hoven described three representative Netherlands dairies from the major dairy-producing regions in the Netherlands using budgets developed by extension and secondary data available from Wageningen University. The largest of the three farms was selected for analysis in this research; it is located in the northern grassland area of Noordelijk, Holland, and has 122 milking cows with 126 acres of pastureland harvested for grass silage. The 122-cow farm was selected for the analysis because it is comparable to the size of dairies whose owners are immigrating to the United States. Average annual milk production per cow is 18,102 lb/cow (Table 1). Total assets of the farm are $4.53 million, consisting of real estate $1.08 million, machinery $192,120, livestock $161,920, and milk quota $2.3 million. The dairy has an assumed debt-to-asset ratio of 0.40.

If the representative Dutch farm is sold, the owner could realize about $1.95 million to invest in a U.S. farm. The difference in asset value and investable funds is due to debt repayment, the effect of auction prices for machinery and buildings being less than book value, and tax payments on the sale of milk quota. Machinery sold at auction was assumed to bring only 60% of its value on the farm's balance sheet. Similarly the sale value of buildings and other fixed assets are assumed to lose 26% of their value in a sale. The EU requires that producers pay a tax equal to 42% of the value of quota, so the net proceeds of quota sold is only 58% of its market value (Ondersteijn). It is assumed the Dutch producer applies the total $1.95 million to the purchase of a U.S. dairy. If the U.S. dairy costs more than $1.95 million. a long-term debt is established to cover the difference between the cost of the dairy and the investment. If the dairy costs less than $1.95 million, the excess cash is held as a cash reserve.

U.S. Dairy Farms

The Agricultural & Food Policy Center (AFPC) at Texas A&M University maintains a database of 23 representative U.S. dairy farms in 10 states (Outlaw et al. 2004). The creation of a representative farm begins with a local extension specialist choosing a panel of farmers. The farmers are selected for their excellent management skills, for being representative of the average size farm in the region, and for being leaders in the local agricultural community. The panel of farmers is interviewed every two years to obtain data necessary to describe and simulate a farm representative of the panel members. Information on number of cows, production per cow, acres of land owned and leased, variable and overhead costs, crop production costs and yield history, and farm machinery complements are obtained from the producers. The 23 representative U.S. farms used for the analysis are summarized in Table 1. The farm names refer to the state (or a subregion of a state) and the number of cows, e.g., CA1710 is a 1,710-cow dairy in California and TXN2400 is a 2,400-cow dairy in north Texas. The Dutch dairy farm (D122) is included in Table 1 for comparison purposes.

Economic Outlook and Assumptions

Mean annual prices and mean annual inflation rates assumed for the analysis are summarized in Table 2. The FAPRI August 2004 Baseline price projections for the 2004–2011 planning horizon were used as mean annual prices for the simulation and analysis of the U.S. farms. The FAPRI Baseline assumes continuation of the 2002 Farm Bill through 2011. Average annual prices for livestock feed in the United States and annual rates of inflation for nonfeed costs and land values came from the FAPRI August Baseline as well.

Projected prices and inflation rates for feed, livestock, and milk for the Dutch farm were provided by den Besten and van Hoven. Projections of land value inflation rates were not available for the Netherlands, so a 10%

Table 1. Description of the Representative U.S. and Dutch Dairy Farms

	Location								
Abbreviated Name	State	County	Number of Cows	Per Cow Milk Production (lbs/cow)	Value of Milk Sales[b] ($1,000)	Acres	Total Assets[c] ($1,000)	Total Cash Expenses/cwt[d]	Investment per Cow ($1,000)
CA1710[a]	California	Tulare	1,710	24,107	4,642	800	11,241	12.14	6.57
FLN500	Florida	Lafayette	500	18,544	1,714	600	3,184	15.97	6.37
FLS1500		Okeechobee	1,500	16,484	4,055	400	6,698	19.04	4.47
ID1000	Idaho	Twin Falls	1,000	24,000	2,700	360	5,369	12.45	5.37
ID3000			3,000	24,000	8,100	1,500	17,918	11.89	5.97
MO85	Missouri	Christian	85	18,690	189	230	970	10.24	11.41
MO400		Dade	400	20,889	1,003	450	2,593	10.35	6.48
NM2125	New Mexico	Chaves	2,125	20,440	5,299	370	9,855	12.29	4.64
NYC110	New York	Cayuga	110	24,416	368	296	974	9.73	8.85
NYC500			500	23,861	1,612	1,100	3,506	12.61	7.01
NYW800		Wyoming	800	23,592	2,425	1,440	4,408	13.96	5.51
NYW1200			1,200	23,181	3,600	2,160	4,773	13.96	3.98
TXC500	Texas	Erath	500	18,029	1,198	250	2,027	15.18	4.05
TXC1300			1,300	22,084	3,913	460	3,913	14.01	3.01
TXE550		Hopkins	550	16,500	1,141	300	1,784	12.13	3.24
TXE1000		Lamar	1,000	20,000	2,514	875	4,780	11.80	4.78
TXN2400		Bailey	2,400	20,707	5,991	260	10,824	12.09	4.51
VT134	Vermont	Washington	134	22,665	424	220	933	12.65	6.96
VT350			350	22,000	1,013	800	2,992	14.47	8.55
WA250	Washington	Whatcom	250	25,367	762	200	1,910	11.69	7.64
WA850			850	25,344	2,551	605	4,612	13.92	5.43
WI135	Wisconsin	Winnebago	135	24,260	411	600	2,136	11.55	15.82
WI700			700	23,243	2,114	1,200	4,408	12.66	6.30
D122	The Netherlands	N/A	122	18,102	411	126	4,530	13.40	37.13

Source: Outlaw et al. 2004.

[a] The farm names refer to state (subregion of a state) and number of cows. For example CA1710 is a 1,710-cow dairy in California.

[b] Value of milk sales for 2003.

[c] Value of total assets January 1, 2003.

[d] Total cash expenses/cwt for 2003.

Table 2. Projected Prices and Inflation Rates for Representative U.S. and Dutch Dairies

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	Projected Milk Price ($/cwt)									
United States										
All milk	12.18	12.55	15.55	13.51	13.12	13.00	13.04	13.13	13.23	13.37
California	10.94	11.38	14.10	12.25	11.90	11.79	11.83	11.90	12.00	12.12
Florida	15.30	15.30	18.96	16.47	16.00	15.85	15.90	16.00	16.13	16.30
Idaho	11.30	11.50	14.25	12.38	12.02	11.92	11.95	12.03	12.12	12.25
Missouri	12.30	12.60	15.61	13.57	13.17	13.06	13.09	13.18	13.28	13.42
New Mexico	11.90	12.00	14.87	12.92	12.55	12.43	12.47	12.55	12.65	12.78
New York	12.80	13.10	16.23	14.11	13.70	13.57	13.61	13.70	13.81	13.96
Texas	12.90	13.00	16.11	14.00	13.59	13.47	13.51	13.60	13.71	13.85
Vermont	12.70	13.00	16.11	14.00	13.59	13.47	13.51	13.60	13.71	13.85
Washington	12.00	12.10	14.99	13.03	12.65	12.54	12.57	12.66	12.76	12.89
Wisconsin	12.20	12.90	15.98	13.89	13.49	13.37	13.40	13.49	13.60	13.74
Holland	19.79	18.60	17.78	16.98	16.18	15.94	15.94	15.94	15.94	15.94
	Projected Prices for Crops and Feed ($/ton)									
United States										
Corn	82.82	85.68	81.50	84.62	85.65	86.74	87.13	87.12	87.48	87.87
Soybean meal	173.18	247.99	182.05	177.72	182.01	187.79	186.44	186.21	185.02	185.75
All hay	92.40	92.90	87.03	89.06	90.81	91.87	92.81	93.35	95.14	96.56
Cottonseed	101.00	111.00	80.06	82.35	80.46	82.73	82.19	83.21	82.46	82.25
Holland										
Corn silage	40.23	42.24	37.20	38.79	38.15	38.69	37.70	37.21	36.67	36.28
Concentrate A	180.84	184.28	169.05	167.52	165.99	164.46	162.93	161.40	159.87	158.34
Concentrate P	148.95	156.56	135.31	132.03	128.75	125.47	122.19	118.91	115.64	112.36
Hay	90.24	92.41	100.68	99.93	99.17	98.41	97.65	96.90	96.14	95.38
Grass silage	40.23	39.14	35.69	33.50	31.31	29.12	26.93	24.74	22.55	20.36
Fixed Cost Inflation Rates (%)										
United States		1.51	1.78	2.17	2.15	2.19	2.24	2.30	2.49	2.72
Holland		2.25	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Fuel Inflation Rates (%)										
United States		2.60	−8.83	−4.84	−1.17	2.02	1.56	1.74	2.35	3.06
Holland		2.25	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Variable Cost Inflation Rates (%)										
United States		2.00	1.78	2.17	2.15	2.19	2.24	2.30	2.49	2.72
Holland		2.31	2.00	1.78	2.17	2.15	2.19	2.24	2.30	2.49
Land Inflation Rates (%)										
United States		1.51	1.78	2.17	2.15	2.19	2.24	2.30	2.49	2.72
Holland		10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00

Sources: United States: Food and Agricultural Policy Research Institute; Holland: den Besten and van Hoven.

per year rate was assumed to reflect the high demand for land by both agricultural and nonagricultural sectors. The dairy policy in the Netherlands for the planning horizon includes a direct payment of $2.18/cwt to compensate for a decrease in milk price induced by a change in dairy policy. The milk quota is a significant disincentive for producers to produce and sell excess milk. If they produce more milk than they have quota, extra quota must be rented at $9.50/cwt or hefty fines must be paid. As a result, milk production is assumed to not exceed the quota on the Dutch farm.

The 23 U.S. dairies and one Dutch dairy were simulated assuming that crop yields, milk produced per cow, feed and crop prices, livestock prices, and milk prices are stochastic and are distributed multivariate empirical.[1] Parameters for the multivariate empirical distribution are estimated using 10 years of historical yields and prices on each farm. Projected mean annual milk production per cow and crop yields for the planning horizon are estimated for the U.S. farms using current production levels provided by the panels and regional/national technology trends in the FAPRI Baseline. Linear trend forecasts of annual prices, yields, and milk per cow are used to project the mean values for simulating the stochastic variables on the Dutch farm (Table 2).

Results and Discussion

The results are presented in two sections. The first section summarizes the simulation results for the representative Dutch dairy and for the U.S. dairies with greater than an 80% chance of economic success. The second section presents the results of ranking of the dairies using SERF.

Simulation Results

The results of the simulation analysis indicated that 11 of the 23 representative U.S. dairy farms had a probability of economic success greater than 80%. Only these 11 farms are compared to the Dutch farm.[2] Results of simulating the 11 U.S. dairy farms and the Dutch farm over the 2002–2011 planning horizon are summarized in Table 3. The key output variables from the simulation model are defined as the following:

- Net cash farm income (NCFI) is total cash receipts minus total cash expenses, not including depreciation and appreciation of assets
- Net Present Value (NPV) is defined previously
- Probability of Economic Success is the chance that NPV is greater than zero so the firm earns a rate or return greater than the 5% discount rate
- Rate of return on assets (RROA) is the average return on all assets
- Probability of negative NCFI is found by counting from the 100 simulation runs those with negative NCFI in a given year
- Ending cash reserves (ECR) is total cash balance at the end of each year and indicates the need for the farm to borrow to meet cash flow deficits. Probability of negative ECR is found by counting from the 100 simulation runs those with negative ECR in a given year.

The model was simulated using actual prices and production for the first two years and stochastic prices and production values for 2004–2011 so there is no risk on net income in

[1] A multivariate empirical (MVE) probability distribution is used when data limitations prevent the estimation of parametric distributions or when evidence exists that the random variables are not distributed as a parametric distribution. The parameters for an empirical distribution are the sorted observations (or fractional deviations from the trend forecast) and their associated cumulative probabilities. In this case 10 years of prices and production were available for each variable, so there was insufficient data to reliably test for normality. To avoid biasing the mean and variance of the output variables, correlation among the random variables can be incorporated by using the square root of the correlation matrix to simulate the random variables MVE, as proposed by Richardson and Condra (p. 433). Stochastic variables simulated using the MVE reproduce the historical correlation among the variables, as well as their means, standard deviations, minimums, and maximums (Richardson, Klose, and Gray).

[2] The 12 U.S. farms eliminated because of low probability of economic success are located in Missouri, New York, central and east Texas, Florida, Vermont, Washington, and Wisconsin. These farms had low probabilities of economic success for a variety of reasons: (1) capital investment requirements greater than $7,000 per cow (MO85, NYC110, VT134, VT350, WA250, and WI135), (2) low margin between local milk price and total cash expenses per cwt. of milk (FLS1500, NYW800, NYW1200, TXC500, VT350, and WA850), (3) low milk production per cow (TXE550), and (4) high debt financing required relative to the margin between local milk price and total cash expenses (NYW800 and NYW1200).

Table 3. Economic Viability of Representative U.S. Dairy Farms with a Common Beginning Equity and a Representative Dutch Dairy Farm

	CA1710	FLN500	ID1000	ID3000	MO400	NM2125	NYC500	TXC1300	TXE1000	TXN2400	WI700	D122
Average Annual Net Cash Farm Income ($1,000)												
Over 2002–2011	348.94	460.00	240.35	1062.45	247.17	1202.01	339.62	424.41	609.90	1060.21	330.33	162.33
Std Dev.	261.44	90.74	145.05	448.28	50.23	270.20	63.32	173.68	134.80	287.57	112.35	7.46
Coeff. Var. (%)	74.92	19.73	60.35	42.19	18.32	22.48	18.64	40.92	22.32	27.72	34.01	4.59
Net Present Value (NPV) ($1,000)												
2002–2011	3522.86	1545.22	1343.64	9146.25	192.77	7061.59	781.84	1874.42	3477.11	8463.35	1077.19	-805.14
Std Dev.	1343.90	421.71	745.40	2205.16	223.50	1317.58	281.66	906.88	679.10	1507.48	538.74	60.93
Coeff. Var. (%)	38.15	27.29	55.48	24.11	115.94	18.66	36.03	48.38	19.53	17.81	50.01	−7.57
Probability of Economic Success												
Over 2002–2011 (%)	99	99	95	99	80	99	99	99	99	99	98	0
Rate of Return on Assets (RORA) (%)												
Over 2002–2011	6.71	10.42	5.03	9.66	6.44	11.88	8.68	7.36	9.92	9.62	7.45	2.40
Probability of Negative Net Cash Farm Income (%)												
2004	59	10	45	39	2	20	1	32	15	18	31	0
2005	38	2	33	25	3	1	1	18	5	8	17	0
2006	20	1	29	16	1	2	1	11	4	5	15	0
2007	21	2	27	14	2	1	1	14	3	3	14	0
2008	28	2	24	18	2	2	1	11	4	4	14	0
2009	26	3	28	15	4	3	1	17	4	5	16	0
2010	17	3	27	11	3	3	1	15	5	5	11	0
2011	18	2	25	11	2	1	1	14	2	4	10	0
Probability of Negative Ending Cash Reserves (%)												
2004	94	20	50	59	13	29	12	38	22	28	41	1
2005	85	5	52	62	7	15	4	35	10	14	34	1
2006	87	6	45	53	15	11	5	33	8	7	32	1
2007	78	7	43	47	10	12	6	29	11	11	32	2
2008	77	6	50	47	16	11	7	28	12	9	31	1
2009	68	11	43	43	20	13	14	31	14	17	34	1
2010	77	11	51	48	20	12	12	35	11	12	38	3
2011	69	7	48	45	25	12	17	32	13	13	38	1

years 1 and 2 (Table 3).[3] The annual NCFI for the Dutch farm averages $162,330 over the 10-year planning horizon. The farm's income level is very stable, as indicated by the small standard deviation for NCFI ($7,460) and the zero probability of having a negative annual NCFI. The farm's annual NCFI is more than adequate to cover the cash flow needs (family living, debt servicing, machinery replacement, and income tax requirements) because the probability of negative ending cash reserves is less than 3% every year. Despite the large average NCFI and the good cash flow on the Dutch farm, it is expected to have an average NPV of −$805,140.[4] Over the 100 iterations simulated for the analysis, the farm never had a positive NPV, thus resulting in a zero probability of economic success. The average RROA is low (2.4%), largely because the quota makes up a large part of beginning net worth. Ignoring the value of the quota when calculating RROA yields an average value of 4.8%.

Wolleswinkel and Weersink surveyed Dutch farmers who had immigrated to Canada about their reasons for leaving the Netherlands. Fifteen of the 24 respondents indicated that the high price of quota was a "very important" reason for leaving. The results presented here indicate that high quota prices are an issue in determining whether to immigrate.

The average annual NCFI for the 11 U.S. farms in Table 3 range from $240,000 for the Idaho 1,000-cow dairy (ID1000) to $1,202,000 for the New Mexico dairy (NM2125). Based on average annual NCFI, the three best performing U.S. farms are the ID3000, NM2125, and TXN2400 dairies. On a NCFI per cow basis the three best performing farms are MO400, TXE1000, and TXN2400 with per cow NCFIs ranging from $4,020 to $5,260. The U.S. farms with the lowest NCFI per cow are ID1000 ($1,800) and CA1710 ($1,960), but these values are still larger than the Dutch farm's NCFI of $1,330 per cow.

NCFI variability is significantly greater for the U.S. dairy farms than the Dutch farm (Table 3). The standard deviation and coefficients of variation (CV) for NCFI provide an absolute and relative measure of income risks faced by the representative dairy farms. The CV on NCFI is 4.6% for the Dutch farm, while it is three to 15 times greater for the U.S. representative farms. The benefits of higher NCFIs for U.S. dairies thus come with significantly higher relative variability. Prices of concentrate feeds for the Dutch farm have a CV of 5.5%, while over the same 10-year period the CV for corn price in the United States is 19.6%. Milk per cow for the Dutch farm has a CV of 1.7%, while the CV is much greater on the U.S. farms; e.g., the TXN2400 has a CV of 7.9%, and the WI700 has a CV of 12.4%.

Because of the higher relative variability of NCFI, several of the U.S. farms have large probabilities of negative annual NCFI. The probability of negative annual NCFI decreases from 39% in 2004 to 11% in 2011 on the ID3000 farm as the farm repays a relatively high startup debt (Table 3). Farms with relatively lower asset values and thus low initial debt have low probabilities of negative NCFI, e.g., FLN500, MO400, NYC500, and TXE1000. Farms with very favorable margins between price and total costs of production have low probabilities of negative NCFI after the initial debt is paid down, e.g., NM2125, TXN2400, and WI700.

If a farm has adequate cash reserves, a negative NCFI may not require refinancing

[3] The first two years of the 10-year planning horizon used actual data for the stochastic variables to verify the model. Results for 2002 and 2003 were compared to producer panel survey data and extension budgets to ensure the FLIPSIM model was correctly calculating receipts, costs, net returns, and cash flows. Values for 2004–2011 were not available, so they were simulated using a MVE probability distribution. The model simulated each iteration recursively, so the deterministic results for year 2 were used to define the beginning financial position of the farms in year 3 for every iteration.

[4] A negative NPV for the Dutch farm is observed because the farm's beginning net worth includes the $2.4 million milk quota, which does not produce any returns. The value of the quota was inflated 5% per year to avoid making NPV even more negative. Simulations run without the quota result in the same net cash farm income, but NPV averages $670,610 and the probability of economic success is 99%.

assets. When cash reserves plus NCFI are not adequate to cover cash outflows for principal payments, owner withdrawals, income taxes, and machinery replacement, the farm will experience negative ECRs and must refinance to remain in business. On the Dutch farm, the probability of negative annual ECR never exceeds 3%. Farms with less than a 25% probability of having negative annual ECR (FLN500, MO400, NM2125, NYC500, TXE1000, and TXN2400) are farms that have lower initial debt or larger profit margins. The high probabilities of negative ECR and refinancing of assets on the U.S. dairy farms are symptoms of the increased income and cash flow variability a Dutch dairy farmer could experience in America.

The average rate of return on assets (RROA) for the U.S. representative farms is considerably greater than for the Dutch farm (Table 3), ranging from 5% for the ID1000 farm to 11.88% for NM2125. U.S. dairies with high average RROA (FLN500 and NM2125) have low initial debt levels or favorable profit margins.

The individual financial results over the 10-year planning horizon can be summarized in the NPV variable. The dairy farms with the highest average NPV are ID3000 ($9.14 million), TXN2400 ($8.4 million), and NM2125 ($7.1 million). These three farms have a 99% chance of having a positive NPV, i.e., of earning a return greater than the 5% discount rate. Also, these three farms have the highest average annual NCFI, in part because of herd size and their low costs of production relative to the price of milk. Another five U.S. farms have a 99% chance of being an economic success. Given that eight of the U.S. farms have the same probability of economic success, a more discriminating criteria is needed for ranking a decision maker's preferences as to which farm to buy.

Ranking Farms

The SERF method for ranking risky alternatives is used to predict which dairy would be preferred by a risk-averse Dutch farmer who had $1.95 million to invest in a U.S. dairy, or if the producer would prefer to remain in the Netherlands. The empirical probability distributions for NPV were used for the analysis in a constant relative risk aversion (CRRA) power utility function framework (Hardaker et al. 2004b). The risk-neutral relative risk aversion coefficient (RRAC) of zero is used for the lower bound level of risk aversion. The upper bound RRAC is assumed to be four, to represent producers who are extremely risk averse (Anderson and Dillion). The initial wealth assumed for the power utility function is $1.95 million.

The SERF analysis for the 11 U.S. dairies indicated a moderately risk-averse decision maker (RRAC of 2) would rank the farms as ID3000, TXN2400, NM2125, TXE1000, CA1710, TXC1300, FLN500, ID1000, WI700, NYC500, MO400, and D122.[5] The results of the SERF analysis are presented in Figure 2 for the five most preferred U.S. dairies and the representative Dutch dairy. The certainty equivalent (CE) for NPV is on the vertical axis of Figure 2, and the RRAC is on the horizontal axis, indicating alternative risk aversion levels. At each RRAC level, the preferred dairy is the one with the highest CE. The preferred dairy is ID3000 for decision makers who are risk neutral to moderately risk averse. The TXN2400 dairy is ranked second for decision makers who have RRACs less than 3.9 and is ranked first for extremely risk-averse decision makers (RRAC $>$ 3.9). The Dutch farm is the least preferred dairy among the 12 dairies summarized in Table 3. The results indicate that a Dutch dairy farmer would prefer to sell out in the Netherlands and buy a dairy in Idaho or north Texas rather than continue farming in his or her native country. A separate SERF analysis showed that of all 23 representative U.S. dairies, only the WA850 and FLS1500 are less preferred than the Dutch dairy—because of high investment costs per cow and low profit margins.

[5] In a separate analysis where the value of the quota was assumed to be zero, the SERF rankings for moderately risk-averse decision makers were the same.

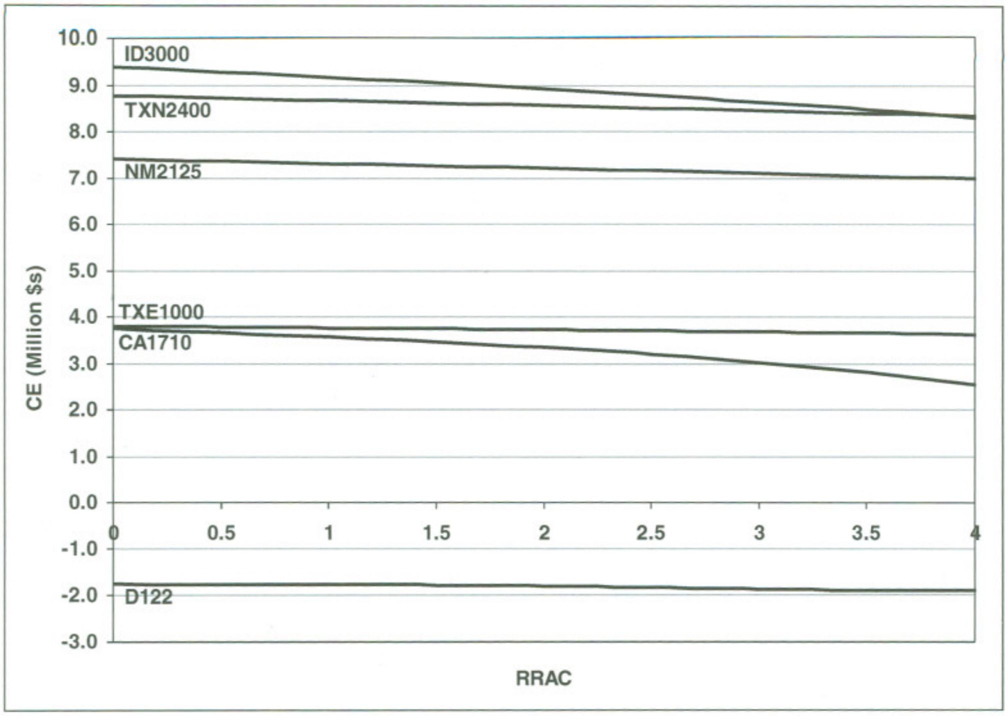

Figure 2. Stochastic Efficiency with Respect to a Function (SERF) Analysis of Alternative Dairy Farms in the United States and a Representative Dairy Farm in the Netherlands

Summary and Conclusions

In a free market, resources and management are free to move to countries with greater expected rates of return on those assets. Because of increased environmental regulations, changes in farm programs, and relative costs of inputs, Dutch dairy farmers are immigrating to other countries. The United States is an attractive location for immigrating dairy farmers because there is no milk quota and no barriers to entry beyond compliance with local environmental permits including nutrient management plans and manure-handling equipment specified in the permit and local zoning regulations, all of which are less restrictive than in the Netherlands.

The objective of this study was to compare the economic viability of a representative Dutch dairy farm to representative dairy farms in major production regions of the United States. This was done to determine if risk-averse Dutch dairy farmers would prefer to liquidate their farms and, if so, where they would prefer to locate if the United States were their destination of choice. A 10-year, Monte Carlo simulation analysis of 23 representative U.S. dairy farms was done assuming the equity from selling a representative Dutch farm was invested in such U.S. dairy farms. The empirical NPV distributions for the U.S. farms and the Dutch farm were ranked using SERF to determine the preference rankings for a risk-averse decision maker, in this case the Dutch dairy farmer considering immigration to continue operating a dairy.

Results of the analysis indicate that risk-averse, utility-maximizing Dutch dairy farmers would prefer to liquidate their assets in the Netherlands and invest in a large U.S. dairy in Idaho or north Texas. Large farms in these areas have much higher certainty equivalences for NPV than the other U.S. dairy farms in the study. Continuing to farm on the representative Dutch farm was preferred over only two of the U.S. representative farms in Washington and Florida.

The rankings of the U.S. dairies are consistent with annual FAPRI/AFPC Baseline projections of economic viability of U.S. dairy farms in 2005 and 2006. Also, the ranking of Idaho, Texas, New Mexico, and California in the top four is supported by increases in milk sales in these states over the past five years. These four states constitute 34% of milk production in the United States, and milk sales in these states have grown 21% over the past five years while U.S. milk sales have grown only 6%.

There are several explanations for the low preference ranking of the representative Dutch dairy farm by a risk-averse decision maker, even though the farm's NCFI averages $166,000 per year. First, the EU dairy quota increases beginning net worth so the farm does not produce a return greater than the 5% discount rate. The NPV probability distribution is effectively shifted to the left by approximately the after-tax value of the quota, about $1.4 million. Second, the quota regime restricts growth by forcing farmers to buy quota to increase the herd size. As a result Dutch dairy farms are not able to take advantage of their $4.38/cwt profit margin to increase net farm income by expanding the number of cows. Third, environmental regulations require significant investments in land ($17,000/cow) to increase herd size. The cost of quota plus the cost of additional land act as a barrier to efficient Dutch dairy farmers wanting to increase net cash income.

A Dutch dairy farmer immigrating to the United States must consider the fact that he or she will face more variable income in the United States than in the Netherlands. There are several sources of increased risk for U.S. dairy farms. Milk per cow in the Netherlands is held constant at the quota through effective herd management. In contrast, U.S. dairy farmers experience changes in milk per cow from year to year because of health issues, feed quality differences, and weather conditions. The price of milk in the EU is more regulated than in the United States, where milk prices vary widely within the year and from year to year. Prices of concentrate feeds in the United States show higher relative variability than comparable feed prices in the Netherlands over the past 10 years. The coefficient of variation on NPV is 4.6% for the Dutch farm and is 27.7% and 42% for the two most preferred U.S. dairy farms, which indicates a six-to-nine times greater variability.

Given the positive economic benefits presented in this paper, further research in the area of dairy producer immigration to the United States should consider factors not included in this study. For example, it was assumed the Dutch dairy farmer was able to purchase a farm immediately without any loss of earnings. In fact, immigrating dairy farmers may experience lower earnings during the first year as they adopt their management skills to American conditions and the variability of prices. Other considerations that will impact immigrant dairy farmers are language, schools, churches, and nearness to other farmers from their home country. These unknown costs may offset the economic benefits from immigration and prevent a more optimal allocation of resources and management across countries.

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