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Structural Transformation in Dairy Farming: The Consequences of a Policy Reform in Israel

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Abstract

Israeli dairy farms have been technologically advanced, but, as of the late 1990s, used old and outdated infrastructure that was far from satisfying environmental regulations. In response, the government initiated a structural reform which incentivized farms to rebuild through generous investment subsidies. The reform also aimed at moving the sector towards fewer and larger production units. We analyze the responses of dairy farmers to the reform. We estimate the probability of an existing dairy farm to (1) exit the sector, (2) expand production through purchasing production quota from exiting farms, or (3) form a partnership with other producers. We find that larger producers were less likely to sell quota and exit but also less likely to expand, indicating that the incentives were most effective for smaller farms who had to choose between exit and expansion. Still, those larger producers still had to renew their infrastructure in order to adhere to environmental regulations and avoid substantial financial sanctions. Altogether, the reform was very successful in achieving its goals, and the dairy farm sector is now much more sustainable, both economically and environmentally, than it used to be.

Keywords: Structural transformation; Dairy farm reform; Exit; Expansion; Partnership

Introduction

The dairy industry is one of the most stable and profitable branches in Israeli agriculture. This is due to a strict quota system and cost plus pricing that are administered by the Israeli Dairy Board, a regulator that is jointly controlled by the government, dairy farmers and the major milk processors. The dairy industry is also protected from international competition by a set of import tariffs and quotas. Obviously, this regime limits the effects of market forces and creates inefficiencies. It is also subject to international pressures as it violates international trade agreements. These factors, in addition to the need to renew dairy farm infrastructure in order to meet environmental standards, have led to a major reform that was initiated by the Israeli Dairy Board in 1997 and was in effect for about ten years [1]. The reform allowed dairy farmers to sell their production quotas to other dairy farmers, under certain conditions, so that the latter could increase their volume of production. Another possibility was for dairy farmers to form partnerships and merge their farms, subject to administrative conditions. The incentives provided by the reform were of the carrot and stick type. The carrot was that subsidized loans and grants were provided to farmers who bought quota or formed partnerships, in order to rebuild their farms so that they meet environmental standards. Farmers who chose to sell their production quota were also eligible

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for a financial bonus. The stick was that it was announced that the target milk price will be reduced by 2% and will continue to decline, so that inefficient farmers could not expect to continue behaving in a business-as-usual manner. One important constraint embedded in the reform rules is that quota could not be transferred between the Kibbutz (collective farm) and Moshav (cooperative farm) sectors. The reason is the fear that the relatively smaller family dairy farms in the Moshav will disappear entirely if the larger and presumably more efficient Kibbutz farms will be allowed to acquire their production quotas.

The reform achieved its goals quite successfully. Between 1999 and 2009, the number of dairy farms declined by more than 30%, while average milk production increased by more than 50% (Figure 1). The quality of milk increased as well. Protein contents increased from 3.03% to 3.20%, fat contents increased from 3.26% to 3.63%, and Somatic Cell Count (a measure of bacterial contamination) decreased by 44%. Kimhi & Reznik (2018) identified improvements in production efficiency during the reform period.

These outcomes are not unique to Israel, as the milk production quota regimes are gradually being abandoned in many advanced countries. For example, Kleinhanß, Offermann and Ehrmann [2] report a significant decline in the number of milk producers in Germany. Oskam and Speijers [3] claim that enabling quota trade benefits the more efficient producers and promotes higher production efficiency. Réquillart et al. [4] claim that abolishing the European quota system will lead to lower milk prices, higher production, lower farm profitability and higher consumer surpluses. Derville et al. [5] show that the removal of the quota system in Europe has promoted significant restructuring of the French dairy farm sector. Sauer [6] shows that deregulating the quota trading system in Denmark has led to efficiency gains. Elskamp and Hailu [7] show that regulations embedded in a quota transfer scheme in Ontario slow the process of concentrating the quota among the more efficient producers. A deregulation reform in Australia has led to a shift of production from less efficient to more efficient farms [8]. Surveys conducted in four European countries [9] revealed that most dairy farmers planned to expand production after the abolishment of the quota. These included mostly larger farms with younger operators. Another group of farmers preferred to "wait and see."

The purpose of this paper is to examine the responses of dairy farmers to the incentives offered by the reform. In particular, farmers could choose one of the four routes: exiting, buying quota, joining a partnership, or do nothing. We want to estimate the tendency of farmers to choose

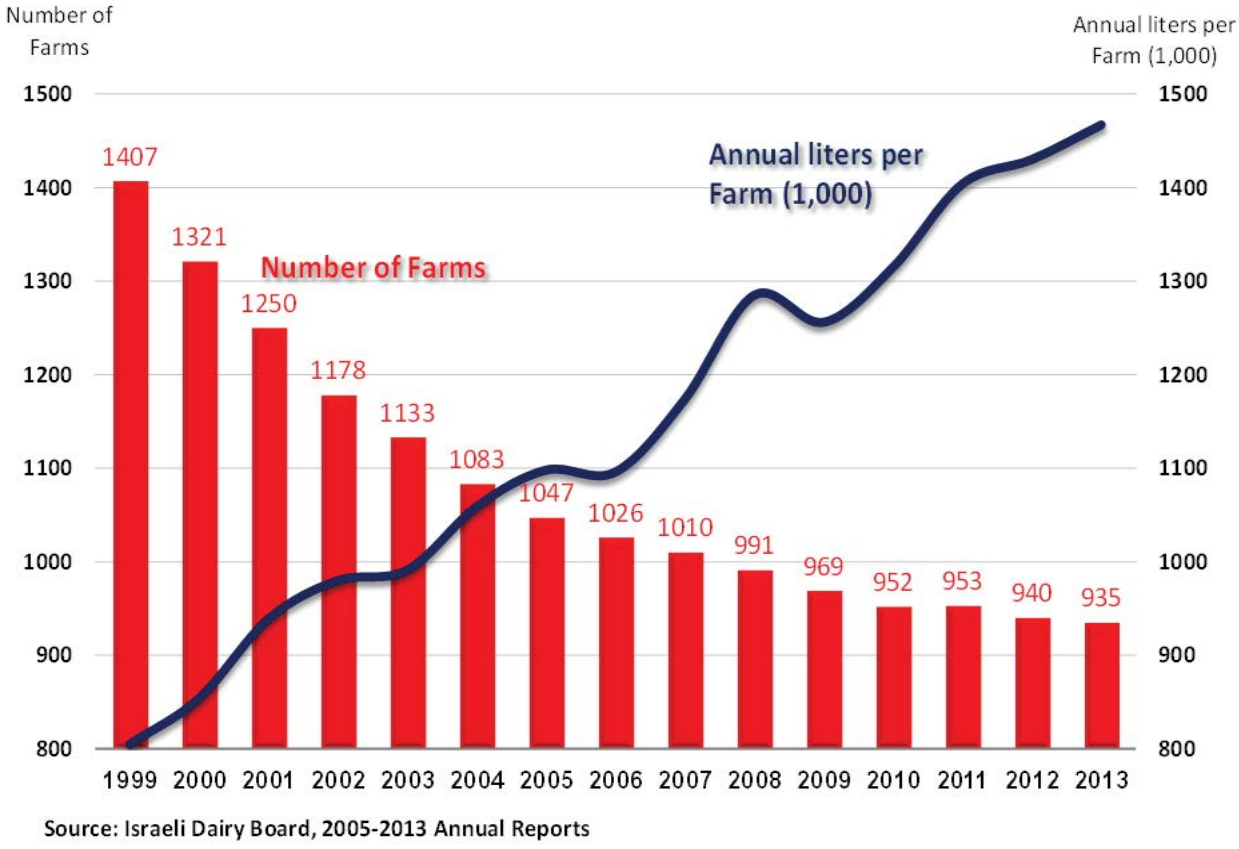


Figure 1: Structural Changes in Milk Production during and after the Reform

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each of the four routes as a function of their characteristics. We use administrative data from the National Dairy Board showing annual transitions in the status of dairy farms and their production quota, as well as data from a baseline dairy farm census that was conducted among family-farm milk producers in 2000-2001 and collected detailed characteristics of the farm and the family. We estimate multinomial choice models of the changes from 2001 to 2009, the years in which most of the changes occurred.

We start by providing a general overview of the history of agriculture in modern-time Israel and its structural development. Agriculture was one of the most important foundations on which the state of Israel was established. Since the end of the 19th century, Jewish settlers in Israel saw agriculture as a channel through which the link between the Jewish people and their ancient homeland can be re-established. Cooperation has been the key to the success of settlement and agricultural production. The two dominating types of cooperative settlements have been the Kibbutz and the Moshav [10]. The Kibbutz was a commune in which each member produced according to his ability and consumed according to his needs. The Moshav was a semi-cooperative village made of individual family farms, in which certain activities such as purchasing, marketing, and financing were handled jointly in order to exploit economies of scale in these activities [11-13]. A third type of cooperative settlement, Moshav Shitufi, was a compromise between Kibbutz and Moshav: production was handled collectively while consumption was handled individually. Ideologically, all three types of cooperative settlements explicitly highlighted farming as a way of life and not only as a way of making a living.

Economically, agriculture constituted a major fraction of national income and exports in particular for many years. Socially, the cooperative agricultural sector provided a generation of political, cultural and military leaders. After Israel declared its independence and masses of immigrants started pouring in, food security became one of the top priorities of the government. Many Moshav villages were established in the early 1950s, populated by immigrants, mostly in remote areas. The new settlers were provided with infrastructure and professional guidance in order to allow them to make a living off agriculture. Agricultural research was also promoted and financed by the government, and the resulting technological progress was remarkable.

In the 1970s, terms of trade of agriculture were already worsening, but the prosperity of agriculture continued thanks to the opening of export markets for fruits, vegetables and flowers. However, the inevitable decline of farming, experienced by virtually all countries during the development process, was around the corner. The reliance on exports made farmers more vulnerable to world price fluctuations and macroeconomic conditions. The unstable economic environment brought about by the high inflation in the late 1970s and early 1980s made farm income even more uncertain. The large debt due to the capital investments could not be serviced adequately [14]. The development of non-agricultural production and service industries provided an alternative source of income, especially for the high-ability farmers. Out-migration from agriculture accelerated through two complementary channels. The first channel was by farmers selling their farms to urban families seeking rural-style residence [15]. The second channel was by continuing farmers seeking to supplement their income by engaging in non-agricultural activities [13,16]. These included on-farm small businesses as well as off-farm businesses and jobs, located in part in the surrounding rural area and in part in nearby urban centers.

The farm debt crisis that followed the economy-wide 1985 stabilization plan was a major accelerator of this process. Many farms became practically delinquent due to the high real interest rates and could not serve as a source of income anymore. Many cooperatives collapsed, leaving their members without the safety net and support system to which they were used for decades [12,17]. Farmers were increasingly shifting to alternative income-generating activities, and while some of the more productive farms were able to acquire more farm resources and expand production, increasing fractions of land and other farm inputs were left unused. Today, in most Moshav villages only a handful of families are living off agriculture [18]. The Kibbutz is currently in the midst of a privatization process [19], although this has little impact on its agricultural activity.

Data and Descriptive Statistics

The main source of data for this research is a census of family-farm milk producers that was conducted between December 2000 and April 2001, on behalf of the Israeli Dairy Board. 95% of producers were surveyed, for a total of 1,251 farms. The data included several types of information: (a) producer's profile, including age, education, secondary employment, existence of a successor, and household size; (b) dairy farm characteristics, including location, production quota, number of cows, calves, etc., partnership status, physical condition, years since last investment, number of milking per day, hired labor, and profitability; and (c) village attributes, including the existence of cooperation among producers, the existence of a central sewer system, and the existence of a cow feed enterprise. These data were merged (by farm) with administrative data provided by the Israeli Dairy Board for the years 2001-2015, including details on production quotas, new partnership formation, and buying and selling of production quotas. Using the administrative data, we constructed the dependent variable as a qualitative indicator with four possibilities indicating the decision

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taken by dairy farmers between 2001 and 2009, whether to exit from milk production, expand by purchasing additional production quota, join a partnership with other producers, or do nothing (the default). It should be noted that while the 2000-2001 census was conducted after the official beginning of the reform, the actual implementation of the reform took a few more years, so that it is reasonable to use the census data as indicating the characteristics of the dairy farms prior to the reform.

Of the 1,251 family dairy farms included in the baseline census, 1,194 farms had sufficient information to be included in the analysis, out of those, 789 (66%) operated individually while the other operated as part of partnerships. In this research we focus on the former. Figure 2 shows that by 2009, 20% of those farms were no longer in the milk production business, 33% expanded by purchasing additional production quotas, 16% joined partnerships, and the remaining 31% did not change their status or level of production.

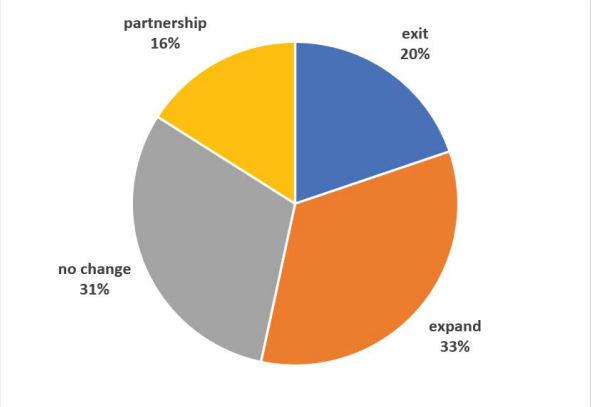


Figure 2: Dairy Farm Status Transitions from 2001 to 2009.

Table 1: Explanatory Variables and their Correlation with Transition Outcomes.

	Transition outcome				
Variable	**Exit**	**Expand**	**No change**	**Partnership**	**Count**
Location					
valleys	0.176	0.361	0.395	0.069	233
north	0.159	0.37	0.304	0.167	138
south	0.134	0.42	0.313	0.134	112
mountains	0.162	0.315	0.269	0.254	197
center	0.422	0.193	0.183	0.202	109
Age					
30-45	0.156	0.312	0.367	0.165	109
46-66	0.172	0.35	0.321	0.157	408
67-91	0.241	0.32	0.265	0.174	253
Years operated					
12785	0.169	0.324	0.342	0.164	225
36-65	0.203	0.345	0.302	0.149	443
66-93	0.227	0.341	0.239	0.193	88
Successor					
no	0.311	0.277	0.257	0.155	148
undecided	0.167	0.363	0.335	0.135	251
yes	0.174	0.341	0.308	0.177	390
Other work					
none	0.225	0.328	0.315	0.132	448
on-farm	0.132	0.322	0.344	0.203	227
off-farm	0.219	0.395	0.202	0.184	114
Cooperative					
none	0.185	0.345	0.301	0.169	634
yes	0.252	0.297	0.329	0.123	155
Feed facility					
no	0.236	0.367	0.283	0.113	441
yes	0.149	0.296	0.336	0.218	348
Quota					
0-350K	0.301	0.404	0.164	0.131	329
350-450K	0.152	0.317	0.344	0.188	224
450K+	0.097	0.258	0.47	0.174	236

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Empirical Analysis

The Multinomial Logit model was chosen to estimate the probability of choosing each of the transition outcomes. The appendix provides the technical details of the model. Table 1 shows the explanatory variables used to explain the transition and their correlation with the transition outcomes. It can be seen that the response to the reform differs by geographic location. Farms in the center of the country are much more likely to exit, probably due to the superior alternative income opportunities. Farms in the mountain areas are more likely to form partnerships, while farms in the south are more likely to expand. The age of the farm owner is also a factor, with farmers above age 67 more likely to exit, and farmers in the intermediate age group more likely to expand. In addition to age, we included the number of years the farm has been operating as a dairy farm. Relatively newer farms were least likely to exit, while relatively older farms were most likely to form partnerships.

Having a designated successor seems to be critical to the response of dairy farmers to the reform. Farmers without a successor were most likely to exit, by a wide margin. This is consistent with findings from other countries (e.g., Gastaldi et al. [20]; Holmes et al. [21]; Uddin [22]). Farmers who combined dairy farming with other on-farm activities were least likely to exit, while farmers with other off-farm activities were most likely to expand or form partnerships. Farmers who live in villages where a dairy farm cooperative exists were more likely to exit and less likely to expand or form partnerships. This is somewhat counter-intuitive. Farmers who live in villages where a local feed facility exits were less likely to exit or expand and more likely to form partnerships or do nothing. Finally, farm size is, not surprisingly, an important factor. The tendency to exit declines with size (measured here by the milk quota) as well as the tendency to expand by purchasing additional quota. The smallest farms are least likely to form partnerships.

It should be noted that we have divided the continuous explanatory variables age, years operated and quota into three categories for the sake of presentation, but in the empirical analysis they were included in their continuous form. We also initially included additional variables such as a quadratic in age, years of schooling and family size, but these turned out insignificant and their exclusion did not change the results much.

Table 2: Multinomial Logit Results (Marginal Effects).

	Outcome			
Variable	**Exit**	**Expand**	**No change**	**Partnership**
Valleys	-12.18%**	14.00%*	18.91%**	-20.73%**
	-0.001	-0.024	-0.001	0
North	-24.15%**	0.0869	14.49%*	0.0096
	0	-0.236	-0.039	-0.845
South	-26.12%**	20.29%**	14.69%*	-0.0886
	0	-0.004	-0.033	-0.079
Mountains	-23.43%**	0.0891	0.098	0.0471
	0	-0.164	-0.111	-0.22
Age	0.31%**	-0.0017	-0.0004	-0.0009
	-0.009	-0.285	-0.743	-0.45
Years operated	0	0.34%**	-0.25%**	-0.0008
	-0.907	-0.001	-0.01	-0.275
Successor undecided	-0.0859	0.0585	0.0256	0.0017
	-0.21	-0.262	-0.606	-0.965
Successor decided	-11.29%**	0.0377	0.0215	0.0536
	-0.003	-0.481	-0.669	-0.177
Off-farm work	0.047	11.94%*	-19.37%**	0.0272
	-0.204	-0.016	0	-0.459
Cooperative in village	15.98%**	0.0215	-0.0328	-14.85%**
	0	-0.657	-0.483	0
Feed facility in village	-7.81%**	-0.0623	-0.0078	14.84%**
	-0.01	-0.102	-0.823	0
Milk quota	-8.98%**	-0.0269	11.10%**	0.0057
	0	-0.08	0	-0.625

Notes: Level of significance in parentheses. *, ** significant at 5% and 1%, respectively.

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Table 2 shows the marginal effects derived from the multinomial logit results. For the continuous variables (age, years operated and milk quota) the marginal effects are the change in probabilities of each of the possibilities as a result of changing the increasing the variable by one unit, for the average sample observation. For the dummy explanatory variables, they indicate the difference in probabilities between the group represented by the dummy variable and the excluded category.

The results mostly support the findings of the descriptive statistics. Farmers in the center are most likely to exit while farmers in the valleys are least likely. Farmers in the south are most likely to expand production, while farmers in the valleys are least likely to form partnerships. Farmer's age increases the exit probability, while years in operation increase the probability of expanding and reduce the probability of no change. The existence of a successor, whether decided or not, reduces the exit probability. However, for undecided successors the change in probability is not statistically significant. Off-farm work of the farmer increases the probability of expanding and reduces the probability of no change. The existence of a dairy cooperative in the village increases the exit probability and reduces the probability of joining a partnership. This result is somewhat surprising. The existence of a feed facility in the village, on the other hand, has the opposite effects. The size of the milk quota decreases the exit probability and increases the probability of no change.

As some of the explanatory variables, namely age and decided successor, were found to affect the exit probability but not to significantly distinguish between the remaining possibilities, we tried an alternative two-stage decision model, in which the exit choice is evaluated first, and the other possibilities are evaluated conditional on remaining in business. The results are mostly unchanged. One exception is that the decreased exit probability as a result of the existence of a successor who is still undecided becomes statistically significant. Another exception is that in the second stage, larger quotas had negating effects on the expansion probability.

Discussion

In this article we have analyzed the responses of dairy farmers in Israel to the introduction of an institutional reform that allowed, for the first time, for buying and selling of production quotas, and provided financial incentives for the purchase of quota and cows and for the construction of modern farm facilities. We found that farmers with relatively large quotas to start with were less likely to sell quota but also less likely to expand. This means that the incentives made it less viable for smaller farms to not respond to the incentives. In other words, small farms had to exit or expand in order to survive, while large farms could afford not to respond. As shown by Kimhi and Reznik [23], this has enabled the production efficiency of smaller farmers to converge to that of the larger farmers. In that sense, the reform was successful.

Another interesting result is that dairy farmers who have an off-farm job are more likely to respond by buying additional quota. It could be that the off-farm income reduces the risk associated with farm investments. It could also be that part-time farming stabilizes the farm business and expands its horizon (Kimhi, 2000). This result is in line with the finding of Zorn and Zimmert [24] that more specialized farms are more likely to exit, but contrary to the result of Foltz and Silva [25]. The existence of a successor is also essential for staying in business over the long run, as has been shown by Kimhi and Rubin [1], O'Donnell et al. [26] and Dong et al. [27].

We plan to extend this research by looking at what happened to those dairy farms who remained in business after the reform period. It should be mentioned that another reform took place between 2013 and 2016, as a consequence of the social protests that erupted in the summer of 2011 that targeted food prices in general and dairy product prices specifically. This time, smaller farmers received priority access to quota sold by other small farmers, so the targeting of small farms is more explicit. We plan, in the next phase of this research, to examine which farmers changed their long-run plans between the first and the second reforms, and what explains this change.

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Appendix:

The multinomial logit model is useful for evaluating the explaining the probabilities of choosing a preferred alternative out of a set of more than two possibilities. The individual is assumed to compare the indirect utility of the different possibility and choose the one yielding the highest indirect utility. Specifically, the indirect utility associated with each possibility is be specified as $u_{it}^{j} = Z_{it}^{j}\lambda_{t}^{j} + \eta_{it}^{j}, j = 1,\ldots,M$, where u_{i}^{j} is indirect utility of individual i from possibility j (out of M possibilities) at time t, Z_{it}^{j} is a row vector of explanatory variables, λ_{t}^{j} is a column vector of coefficients, and η_{it}^{j} is a stochastic term. The individual will choose possibility k when it yields the highest indirect utility, in which case, it must hold that $u_{it}^{k} > \underset{j\neq k}{\text{Max}}(u_{it}^{j}) \Leftrightarrow Z_{it}^{k}\lambda_{t}^{k} + \eta_{it}^{k} > \underset{j\neq k}{\text{Max}}(Z_{it}^{j}\lambda_{t}^{j} + \eta_{it}^{j})$. Assuming that η_{it}^{j} are i.i.d. random variables drawn from the Gumble distribution, the coefficients λ_{t}^{j} can be estimated by maximum likelihood after normalizing the coefficients of one possibility to zero.