

# Regoverning Markets

Small-scale producers in modern agrifood markets

## Agrifood Sector Studies

### Farm-level restructuring in Poland Evidence from dairy sector (B)

Dominika Milczarek-Andrzejewska, Agata Malak-Rawlikowska,  
Jan Fałkowski and Jerzy Wilkin

Warsaw University / Warsaw Agricultural University

# **Farm-level restructuring in Poland. Evidence from the dairy sector (B)**

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# 1 Introduction

Profound restructuring has taken place in the Polish dairy sector during transformation, with the most significant changes occurring in milk production and processing. Evidence of restructuring at the farm level is provided by the sharp decreases in total output, total number of dairy cows and number of farmers producing milk. Further examples are an increase in average milk yield, as well as a gradual increase in the share of milk being marketed. (Milczarek et al., 2007)

The above processes have been first caused, and then accompanied, by extensive changes in farms' institutional environment. These have shaped both government policies and organisation of the dairy supply chain. In this context, interesting questions arise about how these changes have affected dairy farmers, and the strategies farmers have adopted in order to adjust.

Recent research on dairy-sector restructuring in Poland has concentrated mainly on analysis at the macro level. (For example, Seremak-Bulge, 2005). Contributions adopting a micro-level approach, on the other hand, have focused predominantly on the issue of dairy farms' efficiency and the relationship between profitability and herd size (Parzonko, 2006; Kołoszycz et al., 2006).

Relatively little attention has been devoted to dairy farms' restructuring from the angle of supply-chain reorganisation. Available studies, (Dries and Swinnen, 2004; Swinnen et al., 2006; Milczarek et al., 2007) although providing valuable insights, have generated only a partial answer to the problem of the impact of supply-chain restructuring on the adjustments and situation at the farm level. More specifically, none of them has quantitatively analysed the determinants of market-channel choices made by dairy farmers in Poland. They have also not explored the impact of market-channel choice on farms' financial situation. The main objective of the present research is to fill this gap. Furthermore, since there has been growing concern about the potential negative impact of supply-chain modernisation on small farmers' access to the market, and thus on rural poverty, this analysis attempts to address the issue of the marginalisation of smaller producers.

This report presents the results of research conducted within Component 1 of the Regoverning Markets 2 project. The key goal of Component 1 in Poland was to prepare evidence-based policy advice concerning the implications and opportunities for small dairy producers of agrifood market restructuring and to promote inclusiveness. The

analysis was conducted on three levels: macro<sup>2</sup> (the policy issues and the national business environment), meso<sup>3</sup> (the different chain segments) and micro<sup>4</sup> (household level). The first phase of the research concerned macro and meso levels, and these results have been published. (Wilkin et al., 2007). This paper presents results of the second phase of the research – the micro-level survey.

Based on research from the first phase (qualitative interviews with representatives of all segments of the dairy supply chain in Poland), specific research questions for the micro-level study were formulated (Wilkin et al., 2007) and will be addressed below. These are as follows:

- What determines the market-channel choices of dairy farms in Poland?
- What is the impact of these choices on the farms' financial situation and behaviour?
- Has assistance to farmers from dairy-processing companies been one of the main drivers of restructuring at the farm level?
- How important is the quota system<sup>5</sup> in slowing down the restructuring process?
- Which types of institutional arrangements can help farmers to adjust to the new market conditions and to enter the dynamic market?

This paper is organised into seven sections. Section 2 outlines the main changes that have occurred in the dairy sector in Poland during the last decade. This is based on results of previously conducted qualitative research, to provide the policy and wider context within which the quantitative analysis is set. Section 3 presents the data sources and sampling measures used in the quantitative analysis. Section 4 describes the surveyed producers, marketing channels and their impact on the dairy farms. Section 5 describes the econometric approach adopted to answer the research questions, and Section 6 presents the results. Section 7 concludes, and offers policy recommendations.

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<sup>2</sup> Module 1 of Component 1.

<sup>3</sup> Module 2 of Component 1.

<sup>4</sup> Module 3 of Component 1.

<sup>5</sup> The main purpose of the milk quota system, introduced in the EU in 1984, was to restrict milk production to a certain level in order to bind market support to the limited quantities of milk that could be financed by the EU budget. The central element of the system is the referenced quantity of milk and milk products that can be delivered yearly to the market by particular countries. In consequence, each producer in each country has its own individual referenced quantity (IRQ) for deliveries to processing (wholesale quota) and/or for direct sales to consumers (direct sale quota), which should not be overrun. When the national quota is overrun, every farmer who contributed to that excess has to pay the super-levy (Wilkin et al., 2007).



## 2 Restructuring of the dairy sector in Poland

The previous phase of the Regoverning Markets project, the macro and meso research,<sup>6</sup> allowed for thorough examination of economic phenomena accompanying the restructuring process of the Polish dairy sector. This research also traces the most important factors triggering the observed transformations (Wilkin et al., 2007). The main results are summarised in this section.

The process of accession and integration into the European Union (EU) – including implementation of the Common Agricultural Policy (CAP) – has been the most important driving force behind dairy-sector restructuring in Poland in the last decade. Some of the main elements of this process were quality requirements, prospects for supplying the EU market, pre-accession investment assistance, and the introduction of a quota system for milk. All this has required considerable adjustment in the dairy processing industry, which, in turn, has translated into strict requirements for the farm sector. To facilitate adjustments at the farm level, dairies have actively engaged in programmes helping farmers to comply with current regulations. Therefore, the processing sector has played the most important role in accelerating the restructuring process at this level. The process of policy-driven restructuring is expected to continue in the near future, as new regulations become binding, requiring additional investments from either the processing or milk-producing sectors.

Improvement in the quality and variety of the final product, and improvement in the quality of raw milk were seen as the main changes in the processing sector in the past ten years. The concentration process was also acknowledged, and was seen as particularly important in the past five to six years. Large dairy companies were often initiators of this consolidation process. In contrast to the situation commonly observed elsewhere, these were mostly domestic companies.<sup>7</sup> Furthermore, important changes occurred in the profitability of the dairy sector at the time of EU accession and immediately afterwards. Barriers to further restructuring of the dairy-processing sector were identified as the restrictions of the milk quota system, the cooperative ownership

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<sup>6</sup> The Module 1 (*macro*) and Module 2 (*meso*) interviews were conducted in May and August 2006 in two regions: Podlaskie and Warmińsko-Mazurskie (both located in the northeastern part of Poland). Both these regions are notable for the extent of restructuring of the dairy sector and its importance in local economies. Semi-structured interviews were conducted with representatives of all dairy supply-chain segments at both national and regional levels. In addition, focus-group interviews with farmers were organised at the regional level.

<sup>7</sup> The importance of the foreign-owned companies in this respect has been minor, although they have indirectly contributed to this process by forcing domestic companies to fight off their competition.

of the majority of dairy companies, low incomes, and low economic efficiency of the processing sector.

Expansion of the retail sector (including internationalisation and consolidation) has created new outlets for dairy processors but at the same time imposed new requirements on the sector (for quality and variety of products or volume and consistency of deliveries). The importance of retail expansion has increased in the last five years. However, in 2006 still only roughly five per cent of total milk produce was channelled through the SM/HM sector. For some products though, such as yoghurts, special cheeses and UHT milk, this share was higher and accounted for about 20 per cent.

The increase in average herd size and decrease in the number of milk producers were seen as the main changes in the milk-production sector, underlain by two main factors. On the one hand, it was necessary to invest in quality improvement and a profitable investment often required a sufficient scale. On the other hand, farmers were encouraged to increase their herds by dairy companies aiming at minimising their transaction costs.

Dairy processors have offered several incentive programmes for their suppliers to upgrade their production systems. For example, special premiums have been created for high-quality milk, for farms that have obtained certain certificates, for farmers delivering larger quantities or for having a cooling tank. Apart from these price premiums, additional incentives have been given to farmers in the form of extension services, traineeships, consultancy or low-interest loans for obtaining forage, heifers or individual quota. The main constraints to further restructuring at the farm level were seen to be the milk quota system and the increased difficulties of renting in or buying land (both issues that have been attributed directly and indirectly to the CAP).

There are two main channels through which milk producers can deliver milk to dairy processors:<sup>8</sup> for collection direct from the cooling tank at the farm, or by delivering to a collection station operated by a dairy company. Other possible channels – milk delivery to a collection station operated by a third party, and direct sales to consumers – have been very rarely used.<sup>9</sup> According to estimates, the share of milk collected from the farm increased from five per cent in 1993 to 20 per cent in 2001. (Nowakowski, 2002).

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<sup>8</sup> Currently around 98 per cent of milk is delivered to the market as raw milk (ARR, 2007).

<sup>9</sup> None of farmers surveyed in Module 3 was delivering milk to such a collection point, and only a few of them sold their products directly to final consumers.

However, this trend has significantly sped up in recent years. Several surveys show that milk collected directly from the farm ranges from 75 to 100 per cent of the dairies' supplies. (Seremak-Bulge, 2005; Wilkin et al., 2007).

Direct collection at the farm has been primarily an option for larger milk producers with a minimum herd size (which justifies the investment in a cooling tank). Selling milk via collection point, on the other hand, has been 'chosen' mainly by smaller farmers. According to the surveyed producers, while marketing milk through this latter channel they risk problems such as free-riding or quality loss during transportation to the collection station. Collection points, however, although regarded as at most a temporary solution, still constitute an important alternative for less-modernised farms.

The remainder of this paper refers to milk collection from the farm as the 'modern marketing channel' (MMC), while use of a collection station is referred to as the 'traditional marketing channel' (TMC). Several sources indicate that the role of the traditional marketing channel is continuously decreasing, and this tendency is unlikely to change in the future. (For example, Wilkin et al., 2007).

The question then remains: which small farms can make the switch from the traditional to the modern marketing channel, and how can this switch be facilitated (or stimulated)? There is an obvious investment decision (related to size) necessary to gain access to the modern marketing channel, i.e. the purchase of a cooling tank. Apart from this physical capital investment, the quota system puts an additional financial constraint on small farmers wishing to expand, as the cost of buying one extra unit of quota weighs relatively more on smaller producers than on larger ones.

Sections below analyse determinants of inclusion into the modern marketing channel, and resulting impact in terms of income, volume of production, changes in a degree of specialisation in milk production, production techniques, and managerial practices. The discussion exploring these issues is preceded by a brief description of the sampling method that was used for conducting the household survey.

### 3 Data sources and sampling measures

Following the reform introduced in 1999, Poland is divided into 16 administrative regions.<sup>10</sup> For this research, two regions were selected: Podlaskie and Warmińsko-Mazurskie, both in northeastern Poland. The choice of regions was based on specific characteristics of the restructuring process in these two regions. In general, Podlaskie region is a successful case of dairy-sector development in Poland. It grew from a poorly structured (dominated by small farms) and rather underdeveloped region to the most significant dairy region in Poland. Warmińsko-Mazurskie region is another important dairy region in Poland with a rich natural environment particularly favourable for milk production. Compared to other regions in the country it has a relatively good farm structure based on privatised and restructured former state-owned farms.<sup>11</sup> As in Podlaskie region, a strong concentration process of dairy production and processing has been observed there. The dairy sector also plays an important role in sustainable development of local agriculture and the local economy in general.

The choice of these regions was premised on the assumption that developments observed there could serve as an example of a path to be followed by other regions. Of all dairy-farm households delivering to the milk industry in Poland in 2006, dairy-farm households in Podlaskie region constituted 11 per cent, and in Warmińsko-Mazurskie region, four per cent. (ARR, 2007).

For the sample selection we used a stratified random sampling methodology. From each of the two selected regions, three subregions or *powiats*<sup>12</sup> were randomly selected (from 14 in Podlaskie region and 19 in Warmińsko-Mazurskie region). From each of the selected *powiats*, a random choice was made of three or four rural or mixed (urban-rural) *gminas*<sup>13</sup> or local communities (from a total of 35 in the six chosen *powiats*). From each *gmina*, villages were randomly selected. Overall, the obtained sample contained observations from 20 *gminas* and 108 villages (Table 1).

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<sup>10</sup> According to the European Union classification (Nomenclature of Units for Territorial Statistics), they are relevant to NUTS 2.

<sup>11</sup> Agriculture in Poland, in contrast to most other post-communist countries, has always remained mostly in private hands. Notwithstanding the state's efforts to pursue the soviet model of farming, the share of collectivised or state-owned land has never exceeded 20 per cent. Therefore, although better than in the rest of the country, farm structure in Warmińsko-Mazurskie remains highly fragmented by European standards.

<sup>12</sup> NUTS 4 according to the European Union classification.

<sup>13</sup> NUTS 5 according to the European Union classification.

Since regional distribution of the surveyed households differed from the true distribution of dairy farms in both regions, weighted averages and estimation techniques with probability weights were used for the analysis. Therefore, the obtained results can be regarded as representative for the regions selected. However, detailed information on numbers of dairy farms in *powiats* and *gminas* are available only for 2002 when the Agricultural Census was conducted. For that reason, weights used in the analysis are based on the data for that year. Weights attached to a given household were  $W=1/(W_i*W_{ij}*W_{ijh})$ , where  $W_i$  represents the probability of selecting a given *powiat* in the particular region,  $W_{ij}$  the probability of selecting a given *gmina* in the particular *powiat* and  $W_{ijh}$  the probability of selecting a given household in the particular *gmina*. In total, according to the data from Agricultural Census, *gminas* covered by the study accounted for around 17 per cent of the total dairy-farm population in each of regions selected.

In order to analyse the impact of dairy-sector modernisation on milk producers, the research focused on farm households selling milk to the market in 2001 and in 2006. Although the restructuring process in the whole sector started at the beginning of 1990s, the year 2001 was chosen as a reference point for two main reasons. First, in June 2000 EU accession negotiations on the agriculture chapter began. Second, in September 2001 the regulation specifying 2002/03 as a reference year for the milk quota system was introduced. Therefore, additional impulses for dynamic changes at the farm level were created then.

Following previous research, the sample was composed to have sufficient observations for both identified marketing channels: modern and traditional (MMC and TMC). In addition, in order to gain better insights into determinants of farms' entering the modern channel, the sample was designed to contain a group of farmers who withdrew from milk sales over the analysed period.

Following accession to the EU in 2004, the Polish dairy sector is regulated by the EU milk quota system. Accordingly, farmers may deliver milk to the market under direct sales quota (direct sales to consumers) or wholesale quota (delivering to processing).<sup>14</sup> This study focused on farms having wholesale quota because there are relatively few farmers with direct sales quota in both study regions.<sup>15</sup>

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<sup>14</sup> For a description, see Wilkin et al. (2007), section 2.2.

<sup>15</sup> Direct sales quota is c.2 per cent of the whole National Quota assigned to Poland, and most of the 'direct sales' farmers are located in the southern regions of Poland, i.e. in regions beyond the scope of this study (ARR, 2007).

In total, 397 dairy-farming households were interviewed, representing 0.93 per cent of the total number of producers supplying the dairy industry in both surveyed regions. Of those, 329 farms were still delivering milk to the market in 2006, and 68 had stopped at some point after 2001. After cleaning, 389<sup>16</sup> observations remained for analysis. For the purposes of the analysis, surveyed farmers were classified into four categories, as used throughout the remainder of this paper:

- 1 'Always modern' (MMC): producers from whom a dairy company was collecting milk directly at the farm both in 2001 and in 2006.
- 2 'Always traditional' (TMC): producers who were delivering milk to a collection point both in 2001 and in 2006.
- 3 'Changed channel' (CHANGED): producers who were delivering milk to the TMC in 2001 but delivering to the MMC in 2006 (having switched into the MMC at some point between 2002 and 2006).
- 4 'Not-survived' (QUITTED): farmers who were selling milk in 2001 but stopped doing so at some point between 2002 and 2006.

Distribution of observations by channel in 2006 was derived from the Module 1 and Module 2 survey. When analysing the structure of producers delivering milk to the dairy industry, it was found that from about 65 per cent of them milk was collected directly at the farm, and about 35 per cent of farms were delivering milk to collection points. Therefore, the obtained sample comprises 218 producers in the MMC, accounting for roughly 66 per cent of 329 households selling their milk in 2006. The detailed information on distribution of the surveyed households among the four above-defined categories is presented in Table 2.

The Module 3 survey was conducted in February and March 2007. The main field research was preceded by a pilot study. The questionnaire aimed to collect the following information (see Annexe):

- general information about the channel relevant to the survey purposes
- family characteristics
- farm characteristics (land, labour force, physical assets, milk quota, access to credit, organisational capital, assistance programmes, alternative employment)
- milk production and sales (crop and animal production, costs, specialisation, sales, contracts, quality, prices, investments)
- revenues
- region-specific information.

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<sup>16</sup> Farm households selling directly to consumers were excluded due to a small number of observations.

Table 3 provides basic statistics on the sample of dairy producers in both surveyed regions. In terms of education level of the head of household, there were no considerable regional differences between farmers selling milk in 2006. However, household heads in Warmińsko-Mazurskie region were slightly older and had longer experience of farm management. Furthermore, families were larger and average agricultural revenue per capita was higher in Podlaskie region. Substantial differences between the two regions concerned the share of milk revenue in total agricultural revenue. This share was much lower in Podlaskie region, despite larger herd sizes.

In the group of farm households that quitted milk sales (QUITTED), education level of the household's head and family size were similar in both regions. However, the households differed in terms of several other characteristics. In Warmińsko-Mazurskie region, heads of household had, on average, shorter experience in farm management, but the households received more agricultural revenue per capita. As in the case of the sub-sample of households still selling milk in 2006, there was a striking difference in the share of milk revenue in total agricultural revenue. This indicates that farmers who stopped milk sales in Podlaskie region were less specialised in milk production (see Table 3).

## **4 Milk production and marketing – descriptive analysis**

In this section key characteristics of farm households engaged in the modern and traditional channels are presented. In addition, farmers marketing their milk in 2006 are compared to those who stopped doing so between 2001 and 2006. The data indicate that farms differ in terms of: human capital, herd characteristics, dairy specialisation level, physical capital and farm management. These differences can be observed both between farmers supplying different marketing channels and between those who quitted and those who continued their dairy enterprises.

### **4.1 Labour, human capital and gender characteristics**

There are no considerable differences between the four farm types in terms of the human-capital variables of age and level of education of the head of the household. Heads of households being always in the modern dairy channel tend to be slightly better educated (Table 4). However, households that stopped milk production had smaller families, and so less farm labour, than those continuing milk production (Table 4).

Dairy farms are less frequently headed by women than can be explained by the tradition of men running family businesses. In 2006, only about 17 per cent of the farms were managed by women. The differences between channels were substantial, with the share of households headed by women being much lower in farms always in the modern channel and in those in which milk sales were stopped. Another notable difference concerns off-farm employment of the head of the household, which can be also treated as a proxy for an involvement in farm management. In 2006, household heads from the traditional channel were employed outside the farm much more often than were household heads from the modern channel. This difference was less striking in 2001 (see Table 4).

The most important differences between farmers in the modern channel (MMC and CHANGED) and in the traditional one are related to level of technical training received and the share of households searching for information on milk production. Producers delivering to the modern channel were participating in special training on milk production more often than farmers from other groups. About 62 per cent of them declared such training in 2006, in comparison to only about 49 per cent of producers delivering to the traditional channel (see Table 4). The reason for that might be better availability of dairy assistance for MMC farmers, as well as their better access to information due to direct contact with the dairy (and traineeship organisers often ask



dairies to distribute information about lectures). It might also be related to better managerial characteristics of farmers delivering to the MMC, who were more active in looking for specific production information. A hypothesis can be stated that farmers in the modern channel are more motivated to improve their skills.

## **4.2 Production, organisational and managerial characteristics**

There are substantial differences between types of milk producers in terms of several production characteristics. Average farm size in the MMC is 26 to 27 per cent higher than in the TMC in both years. In addition, 59 per cent of MMC farmers were leasing in land, compared to only 39 per cent of TMC farmers in 2006. There were also differences between farmers who were always in the TMC and those who changed from TMC to MMC. In the latter case, the share of producers leasing in land during five years increased almost twice as much as in case of those who had always remained in the TMC. The average size of leased-in land doesn't differ across channels, and in 2001 amounted to around ten hectares, increasing by 2006 to 12 hectares (Table 5).

Farmers delivering to the modern channel had, on average, over twice as many cows as those delivering to the TMC in 2006 (22.8 heads in the MMC vs. 9.5 TMC). Producers who stayed in the TMC increased their herd on average by 22 per cent, while those who changed channel did so by 43 per cent. Furthermore, farmers in the MMC and those who changed to the MMC more often used improved breeds of cows – Holstein Friesian or mixed (see Table 5). What follows from this is that entering the MMC required investments in herd size, and in breed improvements. There are other links between herd size and choice of market channel. First, the vast majority of farmers always remaining in the traditional channel had fewer than ten cows in 2001 and none had more than 20 cows. Farmers always in the MMC, on the other hand, rarely had fewer than ten cows in 2001 (only two of them had fewer than five cows) and almost half of them had more than 15 cows.

While interpreting these observations it should be kept in mind that in 2002 the average herd size in farms delivering milk to processing amounted to about five cows per farm. (Wilkin et al., 2007). Second, the group of farmers that shifted to the modern marketing channel was dominated by farms having in 2001 more than ten cows. Only two per cent of those farms had in 2001 fewer than five cows. This suggests that it was the already larger farms that decided to enter the modern channel. Conversely, it was mostly smaller farms with fewer than ten cows that quitted milk production. The situation is similar concerning yield level. Producers in the MMC had milk yields higher on average by 1500 litres in 2006 and by 1000 litres in 2001 than those in the TMC.

There are also differences between farms with respect to the importance of milk sales. Farms in the modern channel had about 26 per cent higher shares of milk sales in their total agricultural sales (78 per cent MMC vs. 52 per cent TMC in 2001). The share of milk sales increased most (by eight per cent) in the case of those farmers who changed channel. The level of milk sales corresponds to a degree of specialisation in milk production. In the modern channel almost 87 per cent of farms were specialised,<sup>17</sup> compared to only 44 per cent in the traditional channel in 2006. Over five years, the sales share of specialised farms increased the most (by 20 per cent) in the group of farms that changed channel from traditional to modern (see Table 5).

Specialised equipment is more common in the modern channel than in the traditional one, although the difference between them decreased between 2001 and 2006, as indicated by changes in the assets index (Table 6). In 2006 only 51 per cent of farmers in the TMC had a cooling tank, compared to 100 per cent of MMC farmers. A cooling tank is essential for delivering milk to the modern channel. Again, there was a spectacular (twofold) increase in the share of farmers with a cooling tank in the group that changed channel.

MMC farmers and those who changed into the MMC had similar advantages concerning other physical assets and characteristics, such as having a milking machine or manure-storage place, cooling milk after milking, having a sanitary-veterinary (s-v) certificate, and having regular control of herd parameters. This results from dairy-purchaser requirements and investments necessary to deliver to the MMC (see Table 6). There are no substantial differences with respect to other production practices such as artificial insemination and calf stimulus.

Over 80 per cent of farmers delivering to the MMC and 76 per cent of farmers being always in the TMC had invested in milk production during the last ten years. The most common investments in the TMC were: a room for a cooling tank (52 per cent of those who invested), a cooling tank (20 per cent) and a cowshed (28 per cent). In the case of farmers who changed into the MMC, the most popular investments were: cooling tank (68 per cent), manure-storage place (18 per cent) and cowshed (17 per cent), as reflected in the assets characteristics (see Table 6). Similar investments were made by farmers in the CHANGED group as in the MMC. The above figures clearly indicate that joining the MMC has been inherently linked to investment. However, investing in a cooling

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<sup>17</sup> 'Specialised' farms are defined as having milk sales equivalent to more than 60 per cent of the total agricultural sales.

tank remains a necessary condition for making this shift but appears to be no longer sufficient in itself.

It was observed that the MMC farmers were investing much earlier than other groups of producers. In this channel 50 per cent of dairy investments (made during the last ten years) were realised before 2004. In the case of producers who changed channel, 81 per cent of investments were made in 2004 or later, and for farmers in the TMC this share was even higher (88 per cent). This explains the fact that the share of indebted farms was larger by over 25 per cent in groups of TMC and CHANGED farmers (Table 7). A larger share of MMC and CHANGED farmers invested also in an additional milk quota. About 80 per cent of MMC and 85 per cent of farmers who changed channel increased their preliminary milk production limit, compared to only 37 per cent of farmers in the traditional channel.

With regard to investment plans, it was found that about 43 per cent of TMC farmers and 51 per cent of MMC farmers planned to invest in milk production during the subsequent three years (see Table 7). Also, over half of the farmers in all channels (53 per cent TMC, 56 per cent CHANGED, 63 per cent MMC), were planning to buy a new milk quota limit and to increase their production. Most of the farmers found the milk-quota system limiting their development. About 65 per cent of them admitted that they would increase their milk production if there were no milk-quota system. This observation clearly indicates that current political regulations constitute a serious barrier for restructuring at the farm level.

During the last five years, 59 per cent of MMC farmers, versus 42 per cent of those in the TMC, were financing investments with bank credits (see Table 7). About 22 per cent of farmers in the modern channel were also using loans from dairy processor<sup>18</sup> for their milk investments (versus seven per cent of TMC deliverers). More limited access to financial support for farmers delivering to collection points could be explained by their usually smaller deliveries and lower reliability for the dairy. However, the share of farmers changing to the modern channel who used dairy funds is similar to the share of borrowers always in the MMC. This, in turn, suggests again that dairies have not restricted their financial assistance to farmers already in the MMC but actively contributed to assist also those farms at the early stage of the restructuring process.

Furthermore, dairy funds were not restricted to large farms wishing to change marketing channel. However, no loan was granted to a farm having fewer than five

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<sup>18</sup> Dairy factories often support reliable producers with loans, paid back by a producer in future milk deliveries.

cows, which might indicate a certain marginalisation of the smallest producers. It seems therefore, that herd size of around five cows is perceived as a lower size limit for dairies providing financial assistance to farmers. Similarly, no farmers from this group were granted a loan from a bank. Dairy loans were also not granted to the biggest farms, i.e. those having more than 20 cows. This might have resulted from two things: either dairies supporting only farmers with lower chances of getting credit from other sources, or simply dairies' limited financial resources being insufficient to cover the needs of all potential claimants.

Another important source of investment capital for dairy farmers was EU funds like the Special Accession Programme for Agriculture and Rural Development (SAPARD). About 24 per cent of TMC and 27 per cent of MMC farmers declared that they had used this source in the last five years (see Table 7). After the EU accession, CAP direct payments became an additional source of capital for the farmers, being received by almost all producers selling milk in 2006 (99 per cent) and most of those who stopped milk sales (83 per cent).

Farmers in Poland are not obliged to have an accountancy system introduced at the farm. They don't have to register any records about their revenues because they pay a special fixed agricultural tax. In consequence, the share of farmers who decided to keep any records about their production is rather low, although there is a visible difference between the channels (Table 8). About 39 per cent of farmers who were always in the MMC and 29 per cent of those who changed into the MMC regularly kept records in 2006, compared to only 24 per cent of those in the TMC. One of the reasons for this difference might be the greater frequency among MMC farmers of bank loans (see Table 7), which usually require evidence of revenues and cash flows.

In general, the degree of cooperation between farmers is relatively low. For example, only a single farmer (out of 323) was cooperating on marketing agricultural products. However, about 20 per cent of farmers delivering to the MMC and the TMC do cooperate on common use of machinery. TMC farmers, as well as MMC farmers, cooperate more than farmers who changed channel. A possible explanation is that TMC farmers have lower levels of physical assets, and cooperation with other farmers allows them to decrease production costs. On the other hand, a higher level of cooperation within the group of MMC farmers could be explained by longer experience in one channel and possibly stronger relationships with other farmers within the same channel.

The statistics presented above concerning characteristics of producers suggest that labour and human-capital features could hardly explain farmers' choice of market channel. However, farm and production characteristics seem to play a more significant

role here. Farms with larger herds and therefore using more land (owned and leased-in), as well as obtaining higher yields, are more likely to enter the modern marketing channel. The other key determinant is related to assets level. Farms better equipped with facilities and machinery (especially those specific to milk production, such as a cooling tank, milking parlour and manure-storage place) are more likely to enter the MMC. Those farms less well equipped in milk-specific assets could improve their situation by cooperating with other farmers (especially in the common use of machinery).

The picture presented above indicates that entering the modern channel is strongly facilitated by investment. The reported statistics show that investments have been financed mostly from external capital. Thus, access to credit (from a bank or from a dairy) seems to be another important determinant. The likely impact of this is described in detail in Section 5 below.

### **4.3 Marketing**

All producers in the sample were selling milk as raw milk. In all channels, in both years, the share of milk sold reached an average of about 94 per cent of milk produced. The milk not sold on the market was used as feed or for home needs.

Farmers delivering to the MMC had about ten per cent higher milk prices than those delivering to the TMC in both 2001 and 2006 (Table 9). The higher price for milk could therefore be an important incentive to enter the modern channel. The price difference results from the different price composition for farms in the MMC and the TMC. Farmers in the MMC usually received a wide range of premiums aiming to encourage farmers to improve the milk quality or protein content, to increase the quantity of milk delivered, or for meeting other priorities of a particular dairy (such as having the sanitary-veterinary (s-v) certificate, a contract, a cooling tank or cooperative membership).<sup>19</sup> Despite the fact that most of the premiums were theoretically available to them, TMC farmers usually did not meet the requirements, for example because of too small a quantity of milk delivered, lack of a cooling tank or lack of an s-v certificate.

A substantial proportion of farmers supplying both channels experienced an increase in milk quality during the study period: 61 per cent in the MMC and 58 per cent in the TMC (see Table 9). Not surprisingly the largest share of farmers reporting improvement in milk quality was recorded for those who shifted channels (75 per cent). While these figures are fairly similar for farmers in the MMC and the TMC, significant differences

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<sup>19</sup> Described more widely in Wilkin et al. (2007).

between both these channels could be observed in terms of the incidence of milk being spoiled. In 2006, in the TMC the share of farmers experiencing at least one milk refusal (about 29 per cent) was more than three times higher than in the MMC (nine per cent). In comparison to figures for 2001, the largest decrease in the share of farms experiencing milk refusals (28 per cent) was noted among producers who changed into the MMC.

Average distance to the dairy company differed substantially between groups of farmers. In 2006 the distance to the dairy company was almost twice as large for TMC farmers as for those who changed marketing channel (42km and 24.7km in 2006, and 39.6km and 22.5km in 2001, respectively). In addition, the distance to the collection point was smaller for producers delivering to the TMC than for CHANGED farmers in both years. This finding could suggest that distances both to dairy company and to collection point affect farmers' decisions about choice of marketing channel. The further the collection point and the further the dairy company, the higher the transaction costs for farmers.

There are considerable differences in opinions on marketing channels between the three farmer types (TMC, CHANGED and MMC). All framers delivering milk to the modern channel rate this channel more highly than do TMC farmers. On the other hand, the average share of positive opinions on the traditional channel is much higher among TMC farmers (see Table 9). In summary, it seems that the most important determinants of market choice related to marketing characteristics are differences in milk prices, incidence of refusals of low-quality milk and distance to a dairy company or collection point. In addition, strong beliefs in the advantages of a given channel could also influence the channel choice. The likely impact of all this is described in Section 5 below.

#### **4.4 Impacts of market choice**

Table 10 presents changes that have occurred in the situation of three types of farm households – those remaining in the traditional channel, those that changed into the modern channel and those always in the modern channel – in the years 2001 and 2006. The most remarkable difference between the compared groups concerns growth of agricultural revenue. The average growth of agricultural revenue per capita in the case of CHANGED and MMC farmers was about 40 per cent higher than in the case of TMC farmers (102 per cent, 96 per cent and 59 per cent respectively). The difference in the dynamics of agricultural revenue could be attributed largely to different growth rates of milk sales revenues.

Farmers who changed channel have also achieved higher growth rates of milk sales revenues (150 per cent in comparison to 90 per cent for MMC farmers and 72 per cent for TMC farmers). The growth of milk sales revenues was determined primarily by a spectacular increase in herd size, which was almost three times larger in the group of farmers who changed channel (52 per cent) in comparison to farmers in the traditional channel (18 per cent). In addition, the average growth in milk price was higher among farmers who moved into the modern channel (36 per cent in the CHANGED group, and 26 per cent in the TMC). Even though the milk yields per cow – another factor influencing revenues – grew at almost the same rate in both groups, the level of milk output per cow was higher by about 1000 litres in the MMC and CHANGED farms in comparison to TMC ones (see Table 10).

Switching into the modern channel has also been accompanied by more dynamic growth of the specific dairy assets index. The strongest increase was observed in relation to ownership of a cooling tank. An increase of about 90 per cent was noted in case of CHANGED farmers, compared with only about 56 per cent in the group of TMC farmers (see Table 10).

The other striking difference between the analysed groups relates to the level of specialisation in milk production. While the proportion of specialised farms decreased in the TMC, it increased by over 50 per cent in the CHANGED group and by 17 per cent in the MMC group (see Table 10). Therefore, one of the most important outcomes of inclusion in the modern marketing channel could be seen as increased concentration on milk production. However, this is mainly true for large farms (only about 5 per cent of all farms delivering to the modern marketing channel and specialised in milk production had fewer than ten cows in 2006).

The above-mentioned conclusion is also consistent with another finding concerning changes in the share of agricultural revenue in total household revenue. This share has decreased more among TMC farms than in CHANGED and MMC farms. This might be explained to some extent by much higher increase (by about 164 per cent) in off-farm employment of household heads in the TMC in comparison to CHANGED and MMC households (about 69 per cent and 68 per cent, respectively) (see Table 10). This suggests that farmers who remained in the TMC had to look for alternative sources of income. These were usually smaller farmers. Over 60 per cent of TMC farm households with household heads employed off-farm had fewer than ten cows in 2006.

## 5 Econometric models and estimation

This section aims to investigate econometrically two main research questions: (a) what facilitates farmers' inclusion into the modern marketing channel, and (b) the impact of joining the modern marketing channel on farms' revenue. In order to assess these issues, the following estimation strategy was adopted. First, a probit model was run to determine factors affecting farmers' marketing channel choice. Second, farm revenues were regressed against explanatory variables including market-channel choice as estimated from the results obtained from the first model. Choice of the variables to be included was based mainly on considerations outlined above, in previous sections. In addition, suggestions from other studies dealing with similar topics were taken into account (Huang et al., 2007; Neven et al., 2006; Gorton and White, 2007).

As noted in the literature, choice- or impact-evaluation models give rise to difficulties stemming from the interdependence of dependent and explanatory variables. In effect, they are likely to suffer from problems of endogeneity and/or reverse causality. In order to avoid this, both models are fitted, based on retrospective data as well as instrumental variables. The former model can be expressed as follows:

$$(1) \quad M_K = c + \sum_{k=1}^a \alpha_k I_k + \sum_{j=1}^b \beta_j A_j + \sum_{i=1}^d \chi_i F_i + \sum_{l=1}^e \delta_l L_l + \sum_{j=1}^f \Phi_j IV_j + \epsilon_i$$

where  $M_K$  is a dummy variable describing farmers' choice of marketing channel.  $I$  is a vector of  $a$  variables describing incentives faced by farmers.  $A$  is a vector of  $b$  variables measuring farm size and assets.  $F$  is a vector of  $d$  variables describing household characteristics.  $L$  stands for a vector of  $e$  variables representing local shifters whereas  $IV$  is a vector of  $f$  instrumental variables;  $\epsilon_i$  is the error term and  $c, \alpha_k, \beta_j, \chi_i, \delta_l$  and  $\Phi_j$  are coefficients to be estimated.

The model measuring the resulting effect of farmers' marketing-channel choice could be given by:

$$(2) \quad Y_i = g + \omega M_K + \sum_{k=1}^h \mu_k I_k + \sum_{j=1}^m \nu_j A_j + \sum_{i=1}^n \pi_i F_i + \sum_{l=1}^z \theta_l L_l + \lambda_i$$

where  $Y$  stands for an outcome variable and  $M_K, I, A, F$  and  $L$  are defined as above;  $g, \omega, \mu_k, \nu_j, \pi_i, \theta_l$  are coefficients to be estimated and  $\lambda_i$  is the error term.

In equation (1), the dependent variable  $M_K$  is defined as a dichotomous variable equal to 1 for households belonging to the modern marketing channel, and equal to 0 for households supplying the traditional marketing channel. This division reflects the state



of affairs for 2006. In equation (2) on the other hand, the dependent variable is defined as a natural logarithm of household revenues (in PLN) obtained in 2006.

The first set of explanatory variables describes (dis)incentives (I) that are likely to influence households' decisions about the future of their dairy enterprise. and *UNEARNED INCOME* are dummy variables distinguishing households having access to off-farm employment and unearned income respectively. In both models the year 2001 was taken as a reference point. *OFF-FARM JOB* captures two opposing effects. On the one hand, it shows households' opportunities to earn additional income and thus to raise potential funds for investments at the farm. On the other hand, household members' engagement outside agriculture is likely to restrict their involvement in farming. Therefore, while *OFF-FARM JOB* should have a positive impact on revenues, its effect on channel choice cannot be predicted. The effect of *UNEARNED INCOME* is expected to be negative on both dependent variables since households with older members tend to have fewer incentives to modernise.

*DELAYS* and *REFUSAL* are defined as dummy variables capturing how choice of marketing channel and farm revenues are affected by frictions likely within the dairy supply chain. The former variable indicates households that experienced problems with delayed payments. The latter variable distinguishes households that failed to meet quality requirements and had their milk refused by the dairy. Both of them relate to the situation in 2001. It may be assumed that delays in payments are likely to stimulate farmers to look for other purchasers and possibly to change their marketing channel. With respect to the impact of *REFUSAL*, it is reasonable to suspect that entering the modern channel for farmers who experienced their milk being refused may be even more difficult than normally due to the likely requirement of substantial improvements in milk quality. Consequently, *DELAYS* (*REFUSAL*) is expected to increase (decrease) the likelihood of joining the modern marketing channel.

*CREDIT* is a dummy variable taking on the value of 1 if the household obtained credit in 2001 (from a bank or from a dairy) for investments in dairy production, and 0 otherwise. *CREDIT* is assumed to enter both models with a positive sign.

The second set of explanatory variables, (A), describes farm size and assets. *ASSETS SPECIFIC* and *ASSETS MACHINERY* represent farms' physical capital endowments and in both models they refer to 2001.<sup>20</sup> The former variable is an index of equipment

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<sup>20</sup> Since both the marketing-channel variable and physical-capital variables are choice variables, controlling for capital endowments in 2006 is likely to result in estimates biased due to the problem of endogeneity. As noted above, the year 2001, for many reasons, was critical in making decisions about the

used specifically for milk production.<sup>21</sup> The latter, on the other hand, is an index of machinery that may have more general application.<sup>22</sup> Since the former variable directly affects efficiency of milk production it should positively influence both dependent variables. *ASSETS MACHINERY*, while providing opportunities to expand, should increase farm revenues. Its impact on the marketing-channel choice, however, cannot be predicted. This is because larger physical-capital endowments may facilitate involvement in agricultural enterprise other than dairy farming.

*HERD* and *YIELDS* stand for number of cows and annual milk yields per cow, respectively, and in both types of model refer to the situation in the year 2001. Since both of these characteristics directly determine the level of revenues and are perceived as being particularly important for dairies looking for opportunities to optimise their supplies, they should positively affect both farm revenues and the decision to join the modern marketing channel. Finally, *LAND OWNED* and *LAND LEASED*, in hectares and referring to 2001, stand for household land endowments, owned and leased in. Since they may allow for expansion of any kind of agricultural production, their impact on channel choice cannot be predicted. They should, however, promote higher revenues.

The third set of explanatory variables, (F), concerns household characteristics. *AGE* measures the age of the head of the household in 2006, while *EXPERIENCE* is the number of years for which the current manager has been running the farm. Since one may expect younger farmers to be more enterprising, the former variable is expected to be negative in both models. On the other hand, since more experienced managers should be more likely to take advantage of arising market opportunities, *EXPERIENCE* is assumed to affect dependent variables positively in both models.

*EDUCATION* represents the level of education of the household head and takes on values from 1 to 4, with 1 indicating elementary education, and 4 standing for university education. Numbers 2 and 3 represent vocational and secondary education, respectively. While this variable should positively affect household revenues, its impact on marketing-channel choice cannot be predicted. On the one hand, it is reasonable to expect that better education should facilitate adopting new technologies and thus more efficient farming. From this perspective, *EDUCATION* should increase the chances of

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future development of the household. Therefore, it serves here as a reference point. The same approach was adopted when constructing other variables (see below).

<sup>21</sup> This index captures the incidence of having a particular piece of equipment from the following list: separate barn for cows, manure-storage place, cement milking parlour, milking machine, cement-floor stand for cows, cooling tank, and separate room for cooling tank.

<sup>22</sup> This index is a sum of following items: tractor, trailer, lorry, chaff-cutter, silo, wire-wrap tool, grip, mower, rotary swather, self-loader, muck spreader, and fan heater.

joining the modern marketing channel. On the other hand, farmers with better education face a higher opportunity cost of remaining in the dairy (agricultural) sector. In this context, a negative impact of *EDUCATION* on a household's decision about joining the modern marketing channel cannot be excluded.

*LABOUR* represents household labour endowments in 2006. This variable is a weighted sum of household members over 15 years old.<sup>23</sup> Since family labour allows for lower monitoring costs, and milk production is relatively labour-intensive, *LABOUR* is expected to have a positive sign in both models.

*COOPERATION* is defined as a dummy variable distinguishing households cooperating with other farms in at least one of the following fields: purchasing inputs, production, marketing, sharing machinery, sharing a cooling tank, negotiating with a dairy and/or transporting milk. In both models, this variable refers to 2001. Cooperation between farmers is likely to decrease their operational costs and strengthen their bargaining power, and therefore likely to provide them with better terms of transactions. For this reason, it may decrease farmers' incentives to change the way they market their production. In this context, *COOPERATION* may be assumed to have a negative affect on  $M_k$ . On the other hand, cooperation may facilitate farmers' access to information, physical capital or credit (through loans guaranteed by the whole group). Therefore, the overall impact of *COOPERATION* on channel choice is uncertain in advance.

*OWNERSHIP COOPERATIVE* is defined as a dummy variable distinguishing households that delivered their milk production in 2001 to a cooperative. This variable aims to capture potential differences between restructuring taking place in the supply chain of domestic and foreign-owned companies. As argued in several papers, for example, Dries and Swinnen, 2004. foreign direct investments have been identified as one of the most notable factors stimulating changes and innovations in the world agrifood sector. In Poland their importance, in terms of market share of dairies that have been taken over, has not been as significant as elsewhere in the region.<sup>24</sup> Nonetheless, it is interesting to see whether domestic enterprises lagged behind the

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<sup>23</sup> Weights used for this calculation were: 1.0 for men aged 18–65 years and women aged 18–60 years; 0.5 for all household members aged 15 to 17; and 0.4 for men over 65 and women over 60 (Grontkowska and Klepacki, 2006).

<sup>24</sup> It has been estimated that in 2004 domestic dairy cooperatives had around 80 per cent (70 per cent) of market share in terms of milk purchases (sales value) (Seremak-Bulge, 2005). Foreign companies' market shares on the other hand, have been estimated to be less than 10 per cent (Dries and Noev, 2006). For comparison: in Slovakia this share accounted in 2003 for roughly 77 per cent (Dries and Noev, 2006); in the Hungarian dairy sector, foreign direct investments' share in owners' equity exceeded 90 per cent in 2000 (Forgacs et al., 2004).

foreign-owned in terms of modernising their supply network. In other words, *OWNERSHIP COOPERATIVE* tries to see if in the later phase of transition in Poland, i.e. since 2001, dairy-ownership structure has mattered for the pace and scope of changes taking place at the farm level.

*RISK* aims to measure farmers' attitude to risk. It is a variable taking on values from 0 to 2, where 0 represents risk-averse farmers, 1 describes risk-neutral farmers and 2 defines risk-loving farmers. This variable is based on the following question: 'Provided that there are no costs of changing the dairy you are currently supplying, would you change it having opportunity to supply another dairy offering a 20 per cent higher price, having no guarantee, however, that this higher price will hold in the future?' Farmers answering 'yes' were classified as risk-lovers, those answering 'do not know' as risk-neutral and those answering 'no' as risk-averse. Since one may assume that less conservative farmers are also more eager to adopt new technologies, *RISK* should be positively correlated with the decision to join the modern marketing channel.

*LEAVE* captures farmers' attitude to farming. It is a dichotomous variable equal to 1 if the farmer would leave agriculture, having an opportunity to find off-farm employment with the same remuneration, and 0 otherwise. Since it may be used as a proxy for farmers' disincentives to stay in farming, this variable is expected to have a negative effect on decisions to change marketing channel.

*NEIGHBOURS MAJORITY*, *NEIGHBOURS FEW* and *PODLASKIE* aim to capture the so-called 'neighbourhood effect' and thus may be perceived as measuring the impact of local shifters (L). The former variable is a dummy taking on the value of 1 if the majority of farmers in the given household's neighbourhood withdrew from milk production in the last five years, and 0 otherwise. *NEIGHBOURS FEW* is also a dichotomous variable but takes the value of 1 if relatively few farmers in the neighbourhood withdrew from milk production in the last five years, and 0 otherwise. Assuming that farmers' behaviour is guided, at least to some extent, by the behaviour of their neighbours, *NEIGHBOURS MAJORITY* is expected to decrease, and *NEIGHBOURS FEW* to increase, the likelihood of entering the marketing channel. Variable *PODLASKIE* is a regional dummy distinguishing households located in Podlaskie region. Households situated in Warmińsko-Mazurskie region act as a reference group.

Finally, the last set of explanatory variables, (IV), features instrumental variables *DISTANCE DAIRY* measures (in kilometres) the distance from a given farm to the closest dairy. Similarly, *DISTANCE COLLECTION POINT* measures distance from the farm to the closest collection point. Both variables refer always to the situation in 2006.

Since one may assume that these two variables affect the marketing-channel choice but do not have direct impact on farm revenues, they serve as instruments for marketing-channel choice. *DISTANCE DAIRY* determines transport costs to be incurred by a dairy making direct milk collection from the farm. *DISTANCE COLLECTION POINT* determines transport costs to be incurred by farmers when delivering milk to the collection point. Thus, the further the location of a dairy, the more likely it should be for a farm to joining the modern marketing channel. Following the same logic, proximity of the collection point is likely to promote remaining in the traditional channel. *COOLING TANK* captures the share of sampled farmers in the same community (*gmina*) owning a cooling tank in 2001. Again, assuming that farmers imitate one another in their production practices, this variable should have a positive impact on joining the modern marketing channel.

The model investigating determinants of farms' revenues contains two additional variables. *MODERN* is the probability of belonging to the modern marketing channel, estimated from equation (1). This variable aims to capture the direct impact of inclusion in the modern marketing channel on farms' financial situation. The second additional variable is *FARM REVENUE*, which is the natural logarithm of farm revenues (in PLN) in 2001. This attempts to measure how the level of farm revenues depends on initial conditions.

## 6 Results of the econometric estimation

This section presents the results of the conducted estimations. First, determinants of market- channel choice are investigated. Second, the role of this decision in determining farm revenues is explored. Other factors contributing to the level of farm revenues are also assessed.

### 6.1 Determinants of market-channel choice

Results of the estimation investigating factors affecting the probability of belonging to the modern marketing channel are reported in Table 11. Presented figures are based on 323 observations, of which 218 belonged in 2006 to the modern and 105 to the traditional marketing channel. Among the variables aimed at capturing the impact of various (dis)incentives, only two appeared to be statistically significant: *UNEARNED INCOME* and *CREDIT*. No significant effect was found of *OFF-FARM JOB*, *REFUSAL* or *DELAYS*. Therefore, not surprisingly, access to unearned income seems to demotivate farmers in undergoing necessary modernisation. Taking into account the negative sign of *AGE* and the fact that it is close to being significant, it may be assumed that the impact of *UNEARNED INCOME* is mainly a reflection of farmers' old age.<sup>25</sup> However, this variable, apart from capturing the effect of pensions and allowances, also measures the impact of social benefits. Therefore, the negative sign of *UNEARNED INCOME* might have resulted also from this, in which case the obtained results could additionally indicate the negative correlation between access to social benefits and incentives to modernise. The collected data do not allow for detailed investigation of this issue.

Second, the positive and highly significant effect of *CREDIT* clearly shows that access to external funds appears to be indispensable for keeping up with demands of the market and of dairy companies. This observation is further strengthened by the non-significant impact of *OFF-FARM JOB*, which suggests that off-farm employment does not provide sufficient contribution to finance investments at the farm.<sup>26</sup> The lack of significant

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<sup>25</sup> However, for the model being presented, other specifications were also estimated in order to investigate non-linear behaviour of *AGE* and *EXPERIENCE* (no such effect has been found) or the potential impact of correlation between *AGE*, *EXPERIENCE* and *UNEARNED INCOME*. In the model without *UNEARNED INCOME*, *AGE* was negative and significant with the rest of the results remaining stable. This provides evidence that impact of *UNEARNED INCOME* captures, at least to some extent, the impact of farmers' age. For reasons of brevity, results of these estimates are not reported here but are available from the authors on request.

<sup>26</sup> The role of level of revenues in 2001 was also explored. Similarly to the effect of off-farm employment, the impact of 'own financial resources' appeared to be insignificant. This supports again the hypothesis

impact of *OFF-FARM JOB* seems also to indicate that the rural labour market fails to attract farm workers, marginalising at the same time potential benefits that households could reap from having abundant labour. This hypothesis is indirectly confirmed by the insignificant impact of *LABOUR*, which may indicate inefficient usage of production factors employed in agriculture. Finally, lack of significance of *REFUSAL* and *DELAYS* might be seen as indicative of two points. First, initial problems with meeting the required milk quality do not necessarily mean that farmers will not be able to improve quality in future. Second, given that problems with timely payments are encountered more often in the traditional channel, no impact of *DELAYS* suggests that either farmers do not perceive them as being crucial for their operation or that dairies can effectively prevent their suppliers from turning elsewhere. Insights obtained from the meso-study tend to incline towards this latter hypothesis (Wilkin et al., 2007).

As far as farm size and farm assets are concerned, the obtained results are as follows. Neither initial physical-capital endowments nor initial land resources appeared to matter for farmer's choice of market channel. What seemed to be crucial in determining this decision were the size and, to a lesser extent, the quality of the herd. Given this, there are three key points to note. First, it seems that being relatively backward in terms of physical assets was not a factor preventing a farm from joining the modern channel. In that sense, this observation strengthens earlier considerations on *REFUSAL*. Second, farms with larger herds were more successful in adjusting to new conditions. Third, given that belonging to the modern channel is strongly facilitated by access to external funds and larger herd size, the obtained results could be indicative of small farmers' marginalisation. The logic behind this argument is as follows.

Initial herd size (and quality of breed) might simply have been used by loan granters to select potential borrowers. This hypothesis finds support in the positive and statistically significant correlation between herd size in 2001 and obtaining bank or dairy credit afterwards ( $q=0.18$ ). Evidence for this negative selection is stronger in relation to bank loans than to loans granted by dairy companies. However, after 2001, dairy loans were granted half as often as bank loans. Further, as depicted in Figure 1, there are some visible similarities in the pattern of granting bank and dairy loans. The smallest farmers have clearly poorer access to external funds from either source than their larger counterparts. These observations may be used to support arguments from Section 4 above that the smallest dairy producers may be marginalised. In this sense then, the obtained results here oppose what has been found in other studies dealing with the

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that internal funds were far too small to bear the burden of investments conditioning the shift to the modern marketing channel.

Polish dairy sector, where no evidence for such arguments was provided (Dries and Swinnen, 2004).

The significant impact of *HERD* and *YIELDS* may also help to explain the lack of statistically significant relationship between joining the modern marketing channel and distance between the farm and the dairy company (*DISTANCE DAIRY*). The obtained results indicate that higher transport costs, although having potential for discouraging the dairy company from coming to collect milk at the farm, seem to be outweighed by the benefits of enlisting large and high-quality suppliers. However, unfavourable location might have had a strong impact on the market-channel decision of the smallest farmers, i.e. those having fewer than five cows. This conjecture stems from the fact that, on average, both in 2001 and 2006 distance between the dairy and farms from this group has been much larger than in the case of farmers with larger herds. Regarding the impact of *DISTANCE COLLECTION POINT*, proximity to milk-collection point seems to facilitate preservation of the traditional way of selling milk. Since transport costs in this case are incurred by farmers, remaining in the traditional channel becomes less profitable with increasing distance from the collection point.

Interesting insights are also provided from analysis of the 'neighbourhood effect'. *COOLING TANK*, as expected, increases the chances of belonging to the modern marketing channel, supporting the hypothesis that farmers imitate each other in terms of production and marketing practices. Similar conclusions could be drawn when analysing the negative impact of *NEIGHBOURS MAJORITY*. The latter observation could indicate that a high proportion of farmers quitting dairy production in a given region may discourage other farmers from undertaking modernisation investments through fear of the dairy company not being eager to engage in direct milk collection due to high transport costs. Regions where the majority of farmers have withdrawn from dairy production were dominated in 2001 by smaller farmers, supporting this supposition. The negative impact of *NEIGHBOURS FEW* poses more interpretational difficulties. Potential explanation could be linked to the issue of the level of competition. The fact that most farmers in a given region remained in dairy production obviously results in a high level of competition. This in turn could discourage less advanced farmers from undergoing the process of modernisation. The reason for this is fear of low future profitability and, consequently, potential problems with covering the costs of necessary investments.

Finally, and quite surprisingly, no effect has been found of variables measuring household human capital. What seems to matter here then is practical rather than theoretical knowledge. A negative and statistically significant impact of *COOPERATION* was found, indicating that potential costs of remaining in the



traditional channel (e.g. lower price, higher risk of milk refusals, lower quality premiums) may be outweighed by benefits created by cooperation. This result is the more interesting as it suggests that farmers' collaboration, commonly advised as a tool having great potential for stimulating further restructuring, does not necessarily have these desired effects.

## 6.2 Determinants of farm revenues

Obtained results from the model investigating determinants of farm revenues are presented in Table 12. The results provide strong evidence that inclusion in the modern marketing channel contributes to considerable improvement in farms' financial situation. This is clearly indicated by the positive and statistically significant coefficient of the variable *MODERN*. This result concurs with theoretical predictions as well as with results of other studies examining restructuring of the agrifood supply chain. For example, Swinnen et al., 2006; White and Gorton, 2005. The effect of belonging to the modern channel holds regardless of herd size.<sup>27</sup> Therefore, inclusion in the modern marketing channel appears to be beneficial not only for the largest farms, as suggested by the positive and statistically significant impact of *HERD*, but also for farms of medium and smaller size. However, the situation in this respect is slightly different for the smallest farmers, with fewer than five cows, for whom joining the modern channel has been on average slightly less beneficial.

A positive and statistically significant impact of *YIELDS* was also found, although of much smaller magnitude than that of *HERD*. This result can be seen as capturing rents from applying more sophisticated production techniques and having cows of higher quality. No effect of herd size has been found here, suggesting that it was not only large farms that adopted better technologies. Regarding other indicators capturing the impact of physical and financial assets, a strong and positive effect of initial level of revenues has been found. On the edge of being statistically significant is also *ASSETS MACHINERY*. Since this variable measures how well equipped a farm is with machinery applicable to various agricultural production methods, it may indicate that farm revenues of dairy farms have been positively correlated with running diversified enterprises. This hypothesis is indirectly confirmed by the positive and statistically

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<sup>27</sup>Interaction between *MODERN* and *HERD* as well as interaction between *MODERN* and dummy distinguishing households with more than 20 cows or ten to 20 cows appeared to be statistically insignificant. Interaction between *MODERN* and dummy distinguishing farms with fewer than 5 cows was negative and on the edge of being statistically significant. Specifications including these variables are not reported here, but may be obtained from the authors on request.

significant relationship between the level of revenues and milk sales accounting for 40–60 per cent of total agricultural sales.<sup>28</sup>

Interesting insights are provided from the analysis of *REFUSAL* and *OFF-FARM JOB*, both of which enter the estimated equation with negative signs. The former finding is as expected and reflects the fact that farms having problems with satisfying quality standards had only limited opportunities to grow. The latter observation, on the other hand, deserves more attention since it might appear counterintuitive. In all normal cases, access to off-farm job opportunities is expected to positively affect farm revenues. However, as discussed above, it is reasonable to assume that the rural labour market in Poland is heavily biased towards agricultural employment. Under these circumstances, undertaking off-farm work might be an expression of seeking any available employment in order to make ends meet, rather than having a stable and rewarding job. This hypothesis finds support in the negative and statistically significant correlation between the level of 2001 farm revenues and access to off-farm activities.

None of the variables aimed at capturing the effect of human capital endowments was found to be statistically significant. This result might give rise to concern about farmers' returns from education. Although this finding needs further confirmation, if lack of return from education becomes as permanent phenomenon, farmers may lack incentives to educate and train. This is obviously of interest for policy designers aiming to facilitate rural development.

Finally, the results include a negative impact of *COOPERATION*, and a positive effect of *NEIGHBOURS FEW*. The former result, at first glance, looks surprising because cooperation is generally recognised as allowing farmers to benefit from pooled resources and higher bargaining power. Accordingly, cooperation is recommended to farmers as having great potential to increase their revenues. However, as noted above, cooperation may also contribute to preservation of traditional production and marketing practices. In this regard, it may slow down the modernisation process. The negative impact of *COOPERATION* here seems to indicate that this unfavourable scenario has affected Polish dairy farmers. The positive impact of *NEIGHBOURS FEW* seems to show that farmers benefit from a 'production cluster'. In the case of farmers in the modern marketing channel, these benefits may stem from the fact that a dairy can economise on transport costs and thus provide farmers with better terms. In the case of traditional farmers, on the other hand, it is reasonable to assume that they are likely to

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<sup>28</sup> No such relationship has been found for stronger dependence on dairy production. These variables are not reported here, but may be obtained from the authors on request.

benefit from the existing infrastructure in the form of collection points and various assistance programmes in which costs per farm are relatively small.

## 7 Conclusions and policy recommendations

In response to dynamic and thorough transformations taking place in the Polish dairy sector, this paper has analysed determinants of the choice of marketing channel among local dairy farms. Moreover, it has investigated the possible impacts of this choice on farmers' financial situation and behaviour. Using microdata from Polish dairy farms, several other more specific questions were also addressed. The main conclusions drawn from this analysis are summarised in this section.

Entering the modern marketing channel seems to be conditioned by exogenous rather than endogenous factors. Access to funds to pay for the necessary adjustments is the critical factor here, rather than human capital or households' initial physical-capital endowments. Given that farms' financial capital endowments are limited, the marketing-channel choice is crucially dependent on having access to external funds.

Provided that dairies engage actively in providing farmers with loans as well as with other assistance programmes, they can be identified as a main driving force behind restructuring at the farm level. The operations of milk processors and contractual arrangements in the dairy sector in Poland have been adjusted to relatively small-scale and dispersed milk producers. This is in contrast to many other post-communist countries, where big farms prevail. This specific dairy system offers better opportunities for small farms to enter the modern marketing channel in Poland than in countries where concentration of milk production is much higher.

Another exogenous factor affecting farmers' choice of marketing channel choice is the milk quota system. This was found to restrict more advanced farmers already delivering to the modern channel, and also those lagging behind in terms of farm modernisation. The market regime for dairy production, especially the production quota system, established within the EU is becoming a major barrier to development of the dairy sector in Poland. There is significant potential for expansion of production and for more efficient allocation of resources unused because of constraints related to the Common Agricultural Policy (CAP). In the surveyed regions of Poland, all three categories of producers exceeded milk quota despite the associated penalties.

This analysis provides additional arguments for reforming the CAP in relation to the dairy market. These reforms should make policy instruments more flexible and give more space for market adjustments. The growing demand for milk, and the increase in prices of dairy products, observed recently, provide favourable conditions for more market-oriented dairy policy in the EU. In addition, EU support for dairy farms could

be aimed at compensation for environmental services delivered by them (environmental stewardship), transitory measures linked with adjustment to market liberalisation, and transfer of knowledge to farms.

Entering the modern marketing channel is facilitated by having herds of larger size and improved breeds. No systematic evidence for small farms being excluded from the modern channel was found, although it seems that the smallest farms (with fewer than five cows) are marginalised through having no access to external funds, either from a bank or from a dairy.

Entering the modern marketing channel positively affects farms' financial situation. This effect has been found for all farms regardless of their size. For the smallest ones, however, the impact is of lesser magnitude. In this context, further restructuring should be encouraged since it not only improves the average farms' welfare but also has potential to reduce the incidence of rural poverty. Since the necessary adjustments obviously require substantial investment, there is a need for broadening farms' access to external funding. This is especially important for the very smallest producers. In this connection, rather than lump-sum transfers, microcredit programmes would provide farmers with appropriate incentives to use a loan efficiently, and should be facilitated.

Changing marketing channel also influences farms' specialisation level. Farms delivering to the modern channel tend to concentrate on milk production. However, these are mostly larger farms (having more than ten cows). Small farmers and those who remained in the traditional channel tend to search for off-farm sources of income. Apparently, this strategy does not allow them to reach the level of revenues enjoyed by larger farms. Therefore, there is a strong need for development of non-agricultural income sources in rural areas in order to improve welfare of the smallest farms and to encourage and enable less efficient farmers to quit milk production.

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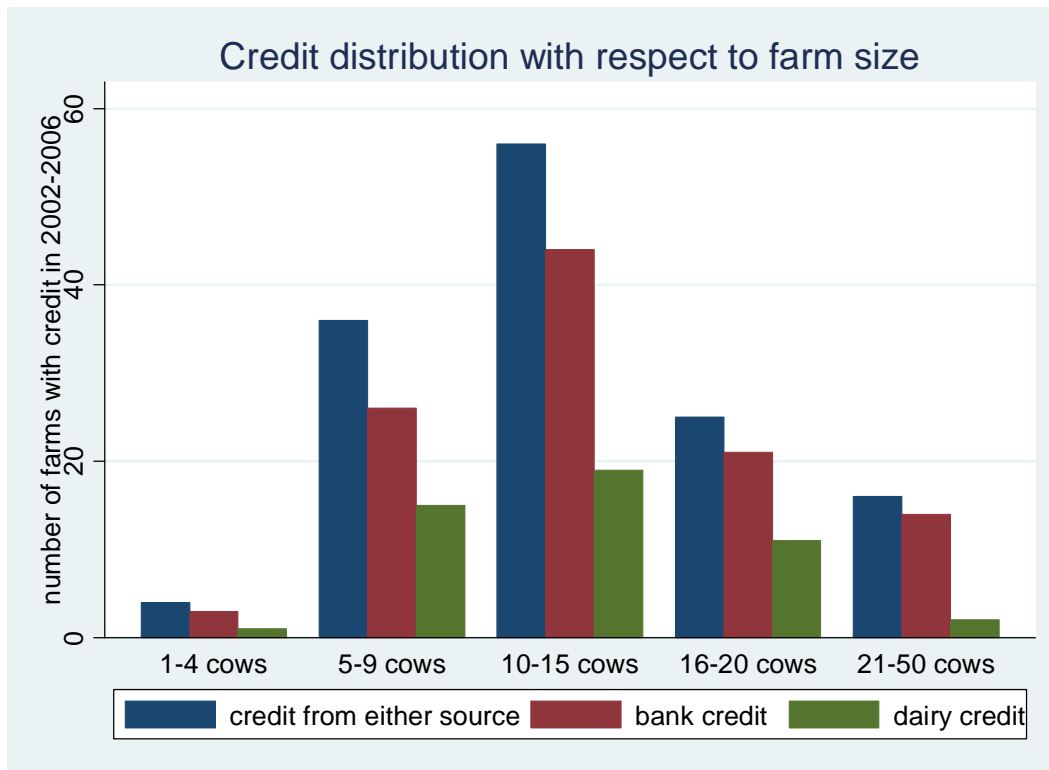
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## 9 Figure and tables

Figure 1. Credit distribution with respect to farm size\*



\* Farmers could receive a credit from a bank, a dairy-processing company, or both of these sources.  
Source: authors' farm households survey, 2007



**Table 1. Number of observations by region (NUTS 2) and powiat (NUTS 4)**

	9.1.1 Powiat						Total
	1	2	3	4	5	6	
<b>Region 1</b>	63	68	64	-	-	-	<b>195</b>
<b>Region 2</b>	-	-	-	67	66	67	<b>200</b>
<b>Total</b>	<b>63</b>	<b>68</b>	<b>64</b>	<b>67</b>	<b>66</b>	<b>67</b>	<b>395</b>

Source: authors' farm households survey, 2007

**Table 2. Distribution of observations in the sample by channel and region**

	2001	2006	Total sample	Region 1 <sup>a</sup>	Region 2 <sup>a</sup>
<b>MMC</b>	138	138	138	70	68
<b>TMC</b>	105	105	105	51	54
<b>CHANGED</b>	80	80	80	42	38
<b>QUITTED</b>	66	Not selling	66	32	34
<b>Total</b>	<b>389</b>	<b>323</b>	<b>389<sup>b</sup></b>	<b>195</b>	<b>194</b>

<sup>a</sup> Region 1 = Warmińsko-Mazurskie; Region 2 = Podlaskie; <sup>b</sup>6 observations were dropped from the total 395 surveyed households due to incomplete information

Source: authors' farm households survey, 2007

**Table 3. Selected statistics on farm households, by region**

	Farm households selling milk in 2006 <sup>a</sup>			QUITTED		
	Region 1 <sup>b</sup>	Region 2 <sup>b</sup>	Both regions	Region 1 <sup>b</sup>	Region 2 <sup>b</sup>	Both regions
	n = 160	n = 163	n = 323	n = 31	n = 35	n = 66
Age of household's head in 2006	44.31	41.67	42.7	44.35	46.38	45.92
Level of education of household's head <sup>c</sup>	1.85	2.07	1.98	1.71	1.85	1.82
Head's experience in farm managing in 2006 (years)	16.05	17.18	16.73	17.00	19.32	18.79
Family size in 2006	4.40	5.16	4.86	3.86	3.76	3.78
Family size in 2001	4.43	5.52	5.13	4.13	4.48	4.40
Agricultural revenue per capita in 2006 (PLN)	22934	30642	27576	16504	12766	13618
Agricultural revenue per capita in 2001 (PLN)	12372	16291	14732	13262	12967	13034
Share of milk revenue in total agricultural revenue in 2006 (%)	74.8	65.4	69.2	-	-	-
Share of milk revenue in total agricultural revenue in 2001 (%)	81.1	55.5	65.7	54.5	33.2	38.0
Share of agricultural revenue in total household revenue in 2006 (%)	95.2	93.8	94.4	72.2	76.3	75.4
Share of agricultural revenue in total household revenue in 2001 (%)	96.1	95.6	95.8	78.0	85.4	83.7
Herd size in 2006	14.2	17.8	16.4	2.1	1.7	1.82
Herd size in 2001	11.7	12.9	12.4	6.5	6.3	6.39

<sup>a</sup> MMC, TMC and CHANGED

<sup>b</sup> Region 1 = Warmińsko-Mazurskie; Region 2 = Podlaskie

<sup>c</sup> 1 = elementary, 2 = vocational, 3 = secondary, 4 = university

Reported numbers are weighted averages

Source: authors' farm households survey, 2007

**Table 4. Labour, human capital and gender characteristics by channel, 2001 and 2006**

		2001				2006		
		QUITTED	TMC	CHANGED	MMC	TMC	CHANGED	MMC
1	Age of household's head (years) <sup>a</sup>	41.7	37.9	38.7	36.8	42.9	43.7	41.8
2	Percentage of female household heads	13.4	-	-	-	24.8	22.6	11.3
3	Level of education of household's head <sup>b</sup>	1.8	-	-	-	2.0	1.7	2.1
4	Average highest level of education of any household member <sup>b</sup>		-	-	-	2.4	2.3	2.7
5	Households having training in milk production in 2006 (%)	-	-	-	-	49.3	62.4	58.8
6	Search for information on milk production in last 6 years (%)	-	-	-	-	27.4	54.7	53.7
7	Head's experience in farm managing (years) <sup>a</sup>	16.0	14.1	18.0	15.3	15.2	18.2	17.1
8	Off-farm employment of household's head (%)	6.2	5.3	3.2	4.0	14.0	5.4	6.7
9	Family size	4.3	4.8	5.2	5.3	4.6	5.1	5.0

<sup>a</sup> in 2001 only for those who were household heads

<sup>b</sup> 1 = elementary, 2 = vocational, 3 = secondary, 4 = university

<sup>c</sup> in 2006

Reported numbers are weighted averages

Source: authors' farm households survey, 2007

**Table 5. General farm characteristics by channel, 2001 and 2006**

		2001				2006		
		QUITTED	TMC	CHANGED	MMC	TMC	CHANGED	MMC
1	Land owned (ha)	15.3	18.4	22.9	25.3	19.5	23.9	26.12
2	Size of leased-in land (ha)	0.24	1.3	3.1	4.2	3.14	6.13	7.58
3	Farms leasing in land (%)	6.5	20.5	24.2	44.7	33.4	46.9	61.5
4	Herd size (head)	6.4	7.9	11.3	17.9	9.3	17.1	23.3
5	Yields (litres)	3678	3480	4275	4676	3901	4834	5252
6	Farms with mixed or HF breed (%)	24.8	33.1	56.0	50.1	40.3	65.7	57.4
7	Milk sales as percentage of total agricultural sales (%)	40.6	58.2	59.7	77.3	57.9	71.2	79.6
8	Farms specialising in milk production (milk inc. >60%) (%)	26.3	47.3	45.3	74.9	42.4	67.6	87.6
9	Farms concentrated on milk production (milk inc. 40–60%) (%)	11.4	13.9	22.1.7	15.6	40.0	23.8	10.5
10	Share of agricultural revenue in total household revenue (%)	82.0	94.4	93.7	97.3	91.8	94.6	97.0

Reported numbers are weighted averages

Source: authors' farm households survey, 2007

**Table 6. Assets and production characteristics by channel, 2001 and 2006**

		2001				2006		
		QUITTED	TMC	CHANGED	MMC	TMC	CHANGED	MMC
1	Index of specific milk-production assets (maximum 7)	2.5	3.3	3.7	5.0	4.3	5.6	5.8
2	Farms having cooling tank (%)	28.1	33.5	49.4	87.9	52.5	96.1	100
3	Farms using machine milking (%)	44.5	57.3	79.1	87.8	66.5	93.9	94.4
4	Farmers with manure storage place (%)	12.7	22.0	23.0	34.5	34.8	54.1	68.5
5	Farms cooling milk after milking (%)	74.6	63.6	89.3	98.5	74	100	100
6	Farms having s-v certificate in 2006 (%)	-	-	-	-	38.4	34.3	43.7
7	Farms with regular control of the herd parameters (%)	-	-	-	-	15.1	12.4	29.0

Reported numbers are weighted averages

Source: authors' farm households survey, 2007

**Table 7. Credit and investment characteristics by channel**

		2006			
		QUITTED	TMC	CHANGED	MMC
1	Farms with investments in milk production during last 10 years (%)	-	79.0	90.6	81.1
2	Farms planning investment in milk production in next 3 years (%)	-	34.5	60.2	49.8
3	Farms which increased milk quota (received in 2004) (%)	-	58.6	91.6	83.0
4	Farms which plan to increase the quota (%)	-	47.1	55.2	63.1
5	Farms which exceeded the quota in 2005/2006 (%)	-	56.0	56.3	56.1
6	Indebted farmers (%)	27.4	29.9	39.3	62.0
7	Farms that invested after 2003 (%)	-	65.5	54.2	48.9
8	Farmers financing investments (last 5 years) from own savings (%)	82.2	84.0	92.1	87.7
9	Farmers financing investments from bank during last 5 years (%)	37.5	47.4	56.3	61.7
10	Farmers financing investments from dairy factory during last 5 years (%)	2.6	10.6	34.6	23.2
11	Farmers financing investments from EU funds during last 5 years (%)	26.2	19.5	38.4	26.4

Reported numbers are weighted averages

Source: authors' farm households survey, 2007

**Table 8. Managerial characteristics by channel, 2001 and 2006**

		2001				2006		
		QUITTED	TMC	CHANGED	MMC	TMC	CHANGED	MMC
1	Membership of a dairy cooperative (%)	77.8	82.5	75.5	81.0	85.6	80.0	82.8
2	Farms having any record-keeping (%)	-	-	-	-	22.6	29.7	40.1
4	Cooperation with farmers on machinery use (%)	-	-	-	-	18.5	10.7	23.8
5	Cooperation with farmers on buying inputs (%)	-	-	-	-	1.1	0.8	8.5

Reported numbers are weighted averages

Source: authors' farm households survey, 2007

**Table 9. Marketing characteristics by channel, 2001 and 2006**

		2001				2006		
		QUITTED	TMC	CHANGED	MMC	TMC	CHANGED	MMC
1	Average milk price (PLN/100 litre)	68.4	70.3	73.2	80.7	88.4	99.5	100.1
2	Share of sold milk production (%)	85.5	93.3	93.2	95.1	93.0	94.3	95.3
3	Farms that improved milk quality 2001–2006 (%)	-	-	-	-	58.4	75.2	61.0
4	Share of farmers whose milk was refused at least once by dairy (%)	-	38.9	38.5	27.5	28.6	10.8	9.0
5	Distance to dairy (km)	27.8	39.6	22.5	26.1	42.0	24.7	27.7
6	Distance to collection point (km)	1.1	1.7	2.3	3.4	1.7	2.8	3.7
7	Having written contract on milk sales (%)	72.7	80.1	91.6	89.9	82.9	99.1	97.8
8	Having oral contract on milk sales (%)	0	13.5	5.0	5.1	8.0	3.3	0.8
9	Opinion on modern channel (% of positive opinions)	80.9 <sup>a</sup>	-	-	-	45.0	81.8	74.4
10	Opinion on traditional channel (% of positive opinions)	34.2 <sup>a</sup>	-	-	-	58.0	37.7	34.4

<sup>a</sup> in 2006

Reported numbers are weighted averages

Source: authors' farm households survey, 2007



**Table 10. Growth and upgrading by farm household type between 2001 and 2006**

		TMC			CHANGED			MMC		
		2001	2006	Growth rate average (%)	2001	2006	Growth rate average (%)	2001	2006	Growth rate average (%)
1	Herd size (head)	7.9	9.3	17.7%	11.1	16.9	52.3%	17.9	23.3	30.2%
2	Yields (litres)	3480	3901	12.1%	4272	4844	13.4%	4676	5252	12.3%
3	Milk sales revenue (PLN)	18676	32022	71.5%	34152	85249	149.6%	72306	137218	89.8%
4	Average milk price (PLN/100 litres)	70.3	88.4	25.7%	73.3	99.4	35.6%	80.7	100.1	24.0%
5	Milk sales as percentage of total agricultural sales (%)	58.2	57.9	-0.5%	59.2	71.4	20.6%	77.3	79.6	3.0%
6	Farms specialising in milk production (milk inc. >60%) (%)	47.3	42.4	-10.4%	44.0	66.9	52.0%	74.9	87.6	17.0%
7	Agricultural revenue per capita (PLN)	10240	16317	59.3%	14874	30027	101.9%	19306	37794	95.8%
8	Share of agricultural revenue in total household revenue (%)	94.4	91.8	-2.8%	96.0	94.7	-1.4%	97.3	96.9	-0.4%
9	Off-farm employment of household's head (share of households) (%)	5.3	14.0	164.2%	3.3	5.4	68.7%	4.0	6.7	67.5%
10	Index of specific milk-production assets (maximum 7)	3.3	4.3	30.3%	3.7	5.6	51.4%	5.0	5.8	16.0%
11	Farms having cooling tank (%)	33.6	52.5	56.3%	50.6	96.0	89.7%	88.0	100	13.6%

Reported numbers are weighted averages

Source: authors' farm households survey, 2007

**Table 11. Factors increasing probability of belonging to MMC**

Dependent variable: Market channel choice in 2006 (1=modern, 0=traditional)	Probit with weights
<b>Incentives</b>	
Unearned income 2001	-0.613** (0.010)
Off-farm job 2001	0.084 (0.836)
Refusal 2001	-0.143 (0.425)
Delays 2001	0.364 (0.170)
Credit 2001	1.925*** (0.000)
<b>Farm size and assets</b>	
Assets specific 2001	-0.082 (0.293)
Assets machinery 2001	-0.011 (0.866)
Herd 2001	0.328*** (0.001)
Yields 2001	0.001*** (0.001)
Land owned 2001	-0.008 (0.602)
Land leased 2001	0.039 (0.144)
<b>Household characteristics</b>	
Age 2006	-0.029 (0.143)
Experience 2006	0.032** (0.036)
Education	-0.273 (0.255)
Labour 2006	-0.046 (0.740)
Cooperation 2001	-1.121** (0.013)
Ownership cooperative 2001	0.170 (0.869)
Risk	0.497 (0.211)
Leave	-0.085 (0.758)
<b>Local shifters</b>	
Neighbours majority	-1.120**

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	(0.011)
Neighbours few	-1.095**
	(0.045)
Podlaskie	0.227
	(0.713)
<b>IVs</b>	
Distance_dairy_2006	-0.012
	(0.274)
Distance_point_2006	0.339**
	(0.011)
Cooling_tank_2001	3.414*
	(0.079)
Constant	-5.033*
	(0.053)
Observations	323

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p values in brackets; \*\*\*, \*\*, \* denote 1%, 5% and 10% significance level respectively.  
Source: authors' farm households survey, 2007

**Table 12. Determinants of farm revenues**

Dependent variable:	OLS
Natural logarithm of farm revenues in 2006	With weights
<b>Market channel choice</b>	
Modern	0.236*** (0.004)
<b>Incentives</b>	
Unearned income 2001	-0.067 (0.209)
Off-farm job 2001	-0.089** (0.016)
Refusal 2001	-0.069* (0.099)
Delays 2001	0.018 (0.708)
Credit 2001	0.007 (0.907)
<b>Farm size and assets</b>	
Assets specific 2001	-0.017 (0.395)
Assets machinery 2001	0.021 (0.101)
Herd 2001	0.012*** (0.001)
Yields 2001	0.000** (0.031)
Farm revenue 2001	0.498*** (0.001)
Land owned 2001	0.004 (0.278)
Land leased 2001	-0.001 (0.872)
<b>Household characteristics</b>	
Age 2006	-0.002 (0.365)
Experience 2006	-0.002 (0.402)
Education	0.021 (0.654)
Labour 2006	-0.005 (0.617)
Cooperation 2001	-0.096* (0.081)
Ownership cooperative 2001	-0.017 (0.899)
Risk	0.035

	(0.336)
Leave	0.047
	(0.261)
<b>Local shifters</b>	
Neighbours majority	0.223
	(0.179)
Neighbours few	0.350*
	(0.079)
Podlaskie	0.133
	(0.264)
Constant	4.873***
	(0.001)
Observations	322
R-squared	0.805

p values in brackets; \*\*\*, \*\*, \* denote 1%, 5% and 10% significance level respectively.  
Source: authors' farm households survey, 2007

### Regoverning Markets

Regoverning Markets is a multi-partner collaborative research programme analysing the growing concentration in the processing and retail sectors of national and regional agrifood systems and its impacts on rural livelihoods and communities in middle- and low-income countries. The aim of the programme is to provide strategic advice and guidance to the public sector, agrifood chain actors, civil society organizations and development agencies on approaches that can anticipate and manage the impacts of the dynamic changes in local and regional markets. The programme is funded by the UK Department for International Development (DFID), the International Development Research Centre (IDRC), ICCO, Cordaid, the Canadian International Development Agency (CIDA), and the US Agency for International Development (USAID).

### Agrifood Sector Studies

These studies look at specific agrifood sectors within a country or region. Research studies have been carried out in China, India, Indonesia, Mexico, South Africa, Turkey, Poland and Zambia covering the horticulture, dairy and meat sectors. Part A describes the observed market restructuring along the chains. Part B explores the determinants of small-scale farmer inclusion in emerging modern markets. Using quantitative survey techniques, they explore the impacts on marketing choices of farmers, and implications for rural development.

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