

Supply chain relationships, supplier support programs and stimulating on-farm investment: evidence from the Armenian dairy sector

Liesbeth Dries¹, Matthew Gorton², Vardan Urutyun³, John White⁴

¹Wageningen University
Hollandseweg 1, 6706KN Wageningen, The Netherlands
Liesbeth.Dries@wur.nl

²Newcastle University Business School
5 Barrack Road, Newcastle upon Tyne, NE1 4SE, United Kingdom
Matthew.Gorton@ncl.ac.uk

³Armenian State Agrarian University
International Center for Agribusiness Research and Education (ICARE)
74 Teryan Street, Yerevan 0009, Armenia
Vardan@icare.am

⁴University of Plymouth
Cookworthy Building, Drake Circus, Plymouth, Devon, PL4 8AA, United Kingdom
John.White@plymouth.ac.uk

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1. Introduction

Supply chain inefficiencies and disruptions are common problems inhibiting the international competitiveness of emerging economies (Sahay et al. 2003; Zylbersztajn et al. 2003). During the early years of transition to more market based economies, Central and Eastern Europe (CEE) witnessed the breakdown of existing buyer-supplier relations, a rise in opportunistic behaviour and typically high transaction costs incurred in monitoring and enforcing contracts (Blanchard and Kremer, 1997; Gow and Swinnen, 1998; Boger et al. 2001; Cungu et al., 2008). These supply chain disruptions exacerbated problems in credit and financial markets, which were particularly acute in the agri-food sector (Petrick, 2004; Latruffe, 2005; Dries and Swinnen, 2010; Bojnec and Latruffe, 2011). Stable supply chain relations can play an important role in securing agricultural income flows that are necessary to access external financial resources. Hence, the breakdown of vertical relationships led to a decrease in on-farm investment and a subsequent deterioration in production, quality and productivity indicators (Ciaian et al., 2012). As a result, cash flow and profitability problems worsened, further constraining access to formal and informal finance, resulting in a vicious circle that blocked restructuring and growth. Reversing this decapitalisation has been and remains an important task for rebuilding the efficiency of agri-food supply chains in CEE.

Improved supply chain relationships are a critical precondition for the recapitalisation of the agri-food sector. A number of studies have looked at private initiatives to strengthen vertical coordination in agri-food supply chains in a transition context and found important and positive farm spillovers (Gow et al., 2000; Dries and Swinnen, 2004; World Bank, 2005). This paper analyses the impact of supply chain relations on on-farm investment. Particular attention is paid to innovative governance structures (supplier support programs) that break the vicious circle described above to overcome rural credit market imperfections. For this purpose, the paper analyses the supply chain relationships between farms and commercial milk buyers in the Armenian dairy sector. Econometric analysis identifies the determinants of investments made at the farm level. Our empirical evidence is based on a unique survey of 300 Armenian dairy farms. Data were collected through a random survey in the main dairy regions.

The focus on the Armenian dairy sector is interesting for a number of reasons. Agriculture, as in many emerging economies, remains the backbone of the rural economy in Armenia, accounting for approximately 44 per cent of gainful employment (NSS, 2012). Rural welfare is therefore inherently linked to the fortunes of agriculture and the dairy sector provides vital employment and income, in an environment of weak social security and scarce job opportunities. The dairy industry is particularly vulnerable to supply chain problems given the highly perishable nature of the good, the flow of production (twice daily milking) and the counter-cyclical nature of demand and supply, with the former highest in winter, while the latter peaks in summer (Engels and Sardaryan, 2006). In environments of significant opportunistic behaviour, dairy supply chains may collapse completely (Gorton et al. 2006).

The remainder of this paper is organized as follows. We first provide an overview of the potential nature of supply chain relationships and the rationale for the provision of supplier support programs. This is followed by a discussion of the dataset and the data collection process. Next, we discuss descriptive statistics on on-farm investments and the sources of agricultural finance that are employed in the Armenian dairy sector before introducing an investment model and analysing the determinants of on-farm investment. We pay special

attention to the role played by the milk buyer in stimulating dairy-specific investment. Relevant conclusions are drawn in the final section.

2. Supply chain relations and supplier support programs

A supply chain linkage can be defined as an exchange relationship where actors, involved in economic processes, convert resources to goods and services for immediate or eventual consumption by end users (Anderson et al., 1994). In the agri-food sector, supply chain linkages may take one of the three main forms: a spot market, vertical ownership integration or an intermediate relationship (e.g. partnership, contracting, strategic alliance). In the case of spot markets (for example live cattle marts and commodity exchanges) the governance mechanism is an immediate market transaction with no prior or post purchase commitments beyond fulfilling the given exchange. While this increases flexibility for buyers it limits their ability to control the quality and quantity of goods for sale. At the other extreme is vertical ownership integration where two stages of the supply chain are internalised within a single firm (e.g. a company both owning a dairy farm and processing unit), such an arrangement provides the second stage of the supply chain with lower procurement risks and greater control over quality. However, the dissipation of resources in vertical ownership integration places a relatively high demand on capital and may dull managerial incentives (Bhuyan, 2002). As a result, intermediate arrangements, where autonomous firms maintain contracting / partnership arrangements have become increasingly common (Hobbs and Young, 2000). Such a supply chain relationship provides buyers with the means to partially control the production process without managing or owning farms directly (Gorton and White, 2007).

As part of a supply chain relationship, a buyer may provide goods and services to a supplier, referred to here as a supplier support program. Supplier support may be in the form of, for example, physical inputs, credit and technical advice and services. Such services may be provided for proactive reasons to improve the quality and quantity of goods supplied to the buyer. This may be particularly important in emerging economies hampered by quality control issues (Sahay et al., 2003). Supplier support programs may also be introduced in a reactive manner – a buyer may seek to prevent suppliers from switching to a competing firm which has started or threatens to introduce such measures. The spillover effects of one firm offering supplier support measures may therefore be considerable (Gow and Swinnen, 2000). However, a potential problem for buyers is that supplier support measures could be used in ways unintended by the principal. For instance, a supplier may act opportunistically by using credit provided by a milk buyer to invest in unauthorised non-agricultural activities.

To date there has been a lack of empirical research on the determinants of supplier support programs (in what circumstances are they offered by buyers) and the impact of such programs on investment by suppliers. We address this gap in the literature, utilising data for the Armenian dairy sector.

3. Data and data collection methodology

Data collection was conducted in 2006 and focused on having a better understanding of the supply chain relationships of commercial milk producers, paying particular attention to the linkages between vertical relationships and the potential to influence on-farm decisions. Given this objective, the population of interest was defined as primary producers which sold

cows' milk to another supply chain actor. Therefore, farmers without dairy cows, those who did not sell any of the milk produced or who processed all milk into cheese or other dairy products (i.e. did not sell any raw milk) were excluded from the study. Given the objective of the study these restrictions are justified but it means that our sample cannot be directly compared to official data on the structure of milk production.

To obtain the sample a quota of 300 responses was set with the intention of including a representative cross-section of commercial dairy farms, including both household producers that marketed at least part of their output and agricultural companies. Respondents were drawn from all regions (*Marzes*) which have significant commercial milk production, based on proportions drawn from statistical data on milk production. The cross-section of farm respondents was identified from contacts with national statistical agencies, local and regional authorities, village mayors, local livestock experts and agricultural agencies. Data were collected concerning: farm growth, prices, yields, investment, collaboration with other farmers, the nature of and satisfaction with relationships with their main buyer and non-price aspects of contracts. The data set by herd size is presented in Table 1. At the time of data collection, the typical commercial dairy farm had between 5 and 20 milking cows. There was an absence of corporate farms with herds of more than 200 milking cows, although a handful now exists. None of the sampled farms in Armenia were registered entities and all of them are legally classified as individual farmers.^[1]

INSERT TABLE 1 HERE

4. Supply chain relationships and on-farm investments in the Armenian dairy sector

4.1 Description of farm –milk buyer relationships

Before presenting the econometric analysis related to on-farm investments, we briefly describe the vertical relationships between milk producers and downstream buyers in the Armenian dairy supply chain. Dairy processors are the most common main buyers of milk from farmers. In Armenia over three quarters of farms sell directly to dairy processors. Another 20% of dairy farms sell through a co-operative. The remainder of milk is collected by intermediaries: dairy logistics or collecting firms (Gorton et al., 2007). The majority of dairy farms sell milk based on a contractual arrangement: 38% have signed a written contract with the milk buyer; 36% sell milk based on an oral contract; and only a quarter of the sampled farms has not entered into a contractual agreement (Gorton et al., 2007).

The institutional arrangements that exist between milk buyers and sellers are often much more extensive than simple agreements on price, volumes and delivery conditions. Table 2 shows that supply chain relationships in the Armenian dairy sector also involve a wide range of support measures. The most prevalent types of support are prompt payments and quality control, which are received by over 80 per cent of farms. Around 30 per cent of farmers in Armenia also receive credit from their main buyer.

INSERT TABLE 2 HERE

Figure 1 provides evidence of the investment activities of the sampled farms. A large share of respondents indicated that they have made on-farm investments in the past five years. Also, a

total of 120 respondents out of 300 reported purchasing cooling tanks, milk lines, cows and other dairy-specific investments.

INSERT FIGURE 1 HERE

An interesting issue is whether a link exists between investment behaviour and size of the farm. Figure 2 presents data on investments on farms of different sizes. In general we notice a positive correlation between farm size and propensity to invest, meaning that larger farms have made relatively more investments in the past five years than small farms (with a small farm being defined as having less than 7 cows).

INSERT FIGURE 2 HERE

4.2 *Determinants of farm support programs*

In this section we determine the role played by milk buyers' support programs in stimulating on-farm investment. Before we turn to the investment model, we want to gain insight into the elements that determine access to support programs. Support programs are offered as part of a vertical relationship between suppliers and buyers of milk. We will therefore focus on the characteristics of this relationship to identify the factors that make it more or less likely that farmers have access to support programs. The relationship that we estimate is the following:

$$SUPPORT_i = \beta_0 + \beta_1 BUYER_i + \beta_2 CONTROL_i + \varepsilon_i \quad (1)$$

where SUPPORT is a measure of access to farm support programs, BUYER is a vector of variables that characterize the vertical relationship between the milk producer and the buyer; CONTROL is a vector of control variables; and finally ε_i is the error term.

SUPPORT is a dummy taking the value of one if the farm received support from their main buyer of milk. The support categories included are: credit; investment loans; farm loan guarantees; physical inputs. BUYER includes a number of variables that characterize the supply chain relationship between the milk producer and the main buyer of milk. SHARE includes the share of the farm's total milk production that is sold to the main buyer. We expect that a more exclusive relationship with the main buyer (i.e. a higher share of milk sold to this trading partner) leads to a stronger vertical relationship and is a proxy for trust and the reputation effect. We expect SHARE to have a positive impact on the likelihood of farm assistance programs. Another factor that can affect the chances of receiving support through the buyer-supplier relationship is the degree of competition between buyers in the market. On the one hand, contracts are more difficult to enforce in a competitive market and hence providing support is more risky (Poulton et al., 2004). On the other hand, Swinnen (2007) argues that farmers that are well-informed about policies and assistance programs of different dairies may also put pressure on their own dairy to introduce these programs. COMPETE measures the number of potential buyers of milk that a farmer has access to. Given the two opposite arguments of Poulton et al. (2004) and Swinnen (2007), the expected effect of COMPETE is ambiguous. Buyer type (TYPE) is a dummy that takes the value of one if the buyer is a corporate dairy processor and zero if the buyer is a co-operative or an intermediary milk collecting company. FDI is a dummy that takes the value of one if the buyer is either a foreign owned company or the buyer is exporting dairy products. In both instances we expect that internationally focused buyers are better resourced, having the necessary financial

resources to provide support programs (Dries and Swinnen, 2010; Dries et al., 2009). COLLECT is a dummy that takes the value of 1 if milk is collected by the buyer from the farm instead of through a village collection center and may provide better opportunities for the buyer to monitor and check up on the supplier.

CONTROL includes a number of control variables that may affect the likelihood of access to support programs – independently of the characteristics of the vertical relationship. CAPSTOCK refers to the existing capital stock of the farm. Since the main capital assets in Armenian dairy farms are the cattle, we follow the approach of Petrick (2004) by using the number of cows on the farm in the year 2001 as an indicator. It is expected that larger farms have less need for dairy support. On the other hand, larger farms may be in a stronger bargaining position and can negotiate more favourable contract terms. COOPERATE is a dummy that takes the value of one if the farmer indicates that s/he is cooperating with other farmers to store, market or process milk, to buy inputs, or to engage in lobbying activities. Greater cooperation between farmers may reduce the need for dairy support programs. On the other hand, greater cooperation may also lead to a denser network that creates more social capital. This may have a positive impact on the likelihood of receiving support. Table 3 provides summary statistics of the variables included in model (1).

INSERT TABLE 3 HERE

4.2 *Determinants of on-farm investment*

The model that we employ to analyse the determinants of on-farm investments and the impact of dairy processors' support measures on investments is based on Elhorst (1993) and Petrick (2004). The model was adapted in keeping with Dries and Swinnen (2010) to answer the specific research question related to the impact of support programs on investments and to deal with a number of data limitations.

The investment model developed by Elhorst (1993) and applied by Petrick (2004) includes the following independent variables: proxies of the financial situation of the farm (net farm results or solvency indicators); the price of outputs and inputs; capital stock of the farm; the age of the farmer; the presence of a successor; the price of capital goods; the input of family labour. Our empirical model differs from these traditional investment equations in a number of ways. First, we include a series of additional variables to test our main hypothesis, namely that dairy processors' support programs affect farmers' investment decisions. Next, the cost of capital as well as input and output prices are excluded from the model. Following Petrick (2004) we assume that in our cross-sectional dataset, these prices are equivalent for all farms and hence can be excluded. Finally, we were unable to include proxies for the farm's financial situation due to data limitations. However, we do include indicators of the capital stock of the farm. We estimate the following empirical model:

$$INVEST_i = \beta_0 + \beta_1 SUPPORT_i + \beta_2 CONTROL_i + \varepsilon_i \quad (2)$$

where INVEST measures farm investment, SUPPORT is a vector of variables measuring support programs from the dairy; CONTROL is a vector of control variables; and finally ε_i is the error term.

INVEST is a dummy taking the value of one if a household has made an investment in farm assets^[2] in the past five years and it takes the value of zero if no investment was made in the specified period. Dries and Swinnen (2010) have shown that there exists an important correlation between the type of finance (own resources, bank loan, processor loan) and the type of investment (dairy-specific investment, general agricultural investment). We therefore also estimate the model with the dependent variable, INVEST_d, being a dummy that takes the value of one only if an investment was made in a dairy-specific asset.^[3]

The first set of variables (SUPPORT) includes several indicators of dairy assistance programs. PLOAN is a dummy that takes the value of one if a supplier is delivering to a dairy company that offers financial assistance, in other words, if the supplier has access to dairy processor loans or credit or bank loan guarantee programs that improve access to external financial resources. INPUTS is a dummy that takes the value of one if the supplier has access to an input supply program from the dairy company and that is zero in the other case. Apart from the direct impact on investments through processor loans, dairy input supply programs are likely to have an indirect impact on suppliers' investments by enhancing the profitability of the farm by lowering input costs, or reducing transaction costs in accessing inputs. Furthermore, bank loan guarantee programs have a potentially important indirect impact on investments by facilitating access to external finance (Dries and Swinnen, 2010). We expect PLOAN and INPUTS to have a positive effect on INVEST. Other factors that may cause an indirect impact on the likelihood to invest are the provision of guaranteed prices (PRICE) and prompt payments (PAYMENT). Price guarantees and the absence of payment delays reduce the riskiness of the business environment for the farm operator. As a result, farms may be more inclined to invest than in more uncertain situations.

The control variables (CONTROL) are related to the farm and the farmer. The expected sign of the variable CAPSTOCK depends on the optimal size of the capital stock. A negative sign implies that larger farms are less likely to invest than small farms and consequently, that farm sizes are likely to converge. A positive sign would lead to the opposite conclusion and farm sizes diverge. Apart from efforts to achieve the optimal capital stock, CAPSTOCK may also capture a different effect on investment decisions. Larger farms may benefit from reputation effects and the availability of more collateral. Furthermore, larger farms may benefit from more frequent interactions with the dairy company (Fafchamps, 1997; Petersen and Rajan, 1997; Johnson et al., 2002; McMillan and Woodruff, 1999). This second effect suggests that CAPSTOCK has a positive effect on the likelihood to invest.

COOPERATE is a dummy that takes the value of one if the farmer indicates that s/he is cooperating with other farmers to store, market or process milk, to buy inputs, or to engage in lobbying activities. We expect that greater cooperation leads to a denser network that creates more social capital, which facilitates investment. Table 3 provides summary statistics of the variables included in model (2).

4.3 *Regression results*

Models (1) and (2) are estimated using a logit regression technique. The results for the support relationship are shown in Table 4. Results of the investment model and the dairy-specific investment model are presented in Tables 5 and 6 respectively.

Table 4 shows that a more exclusive vertical relationship (i.e. a higher share of milk being sold to the main buyer) increases the likelihood that the milk supplier receives support from the buyer. COMPETE has a significantly negative sign which seems to suggest that milk buyers that operate in a more competitive environment are less likely to offer farm support to their suppliers. The risk of losing suppliers to competitors after support has been provided may be a genuine deterrent for firms to implement farm assistance programs. This finding is in line with Poulton et al. (2004) who find a negative effect of a competitive buyer market on farm support in the African cotton sector. Corporate dairy companies seem to be less inclined to offer support to their suppliers. In other words, farmers supplying cooperative buyers are more likely to benefit from farm assistance. Export-oriented firms and buyers with foreign direct investments are offering more farm support to their suppliers than domestic firms. This finding is in line with the hypothesis that international firms have easier access to the financial resources that are necessary to provide these programs. Finally, having the buyer collect milk at the farm gate reduces a farmer's chances of benefiting from farm support. This result is counterintuitive and requires further investigation. As for the control variables, both CAPSTOCK and COOPERATE have a significantly positive impact on the likelihood of farm support. The former means that larger farms have easier access to support from the buyer. This may indicate that relatively large farms benefit from a stronger bargaining position *vis-à-vis* the buyer and are able to negotiate more favorable contract terms. Furthermore, transaction costs will be lower if support is given to larger suppliers as compared to large numbers of small suppliers. The positive effect of cooperation points to the value of being part of an extensive network.

INSERT TABLE 4 HERE

Table 5 (6) presents results on the determinants of (dairy-specific) on-farm investments. We are particularly interested in the effect that different buyer support programs have on the likelihood of farmers to invest. First, access to dairy loans, credit and bank loan guarantees plays a significant role in improving the probability of investments in the Armenian dairy sector. This indicates that access to credit through formal channels (rural finance sector) may be restricted and that dairy loans are crucial to overcome this market imperfection and the sector's financial constraints. Surprisingly, PLOAN is not significant in the dairy-specific investment model. Apart from the direct impact of investments through loans and credit, milk buyers' input supply programs increase the propensity to invest indirectly by enhancing the profitability of the farm by lowering input costs, or reducing transaction costs in accessing inputs. Tables 5 and 6 also provide evidence of the importance of reducing the riskiness of the business environment to stimulate on-farm investments. On the one hand, providing guaranteed prices significantly increases the farmer's likelihood to invest. Furthermore, to stimulate dairy-specific investment it seems crucial to avoid delayed payments. Finally, farm size (CAPSTOCK) plays only a minor role in explaining on-farm investment, while cooperation within a farm network increases the likelihood to invest significantly.

INSERT TABLES 5 AND 6 HERE

Finally, we have addressed the potential endogeneity problem that exists between investment decisions and access to support programs by using an instrumental variable estimation procedure. The estimated model is a two-stage least squares regression in which the first step consists of the creation of an instrumental variable for support programs. In the second step, the instrumental support variable is included as an independent variable in the investment model. Tables 7 and 8 detail the results of this procedure for on-farm investments and dairy-

specific investments respectively. We conclude that milk buyers' support to dairy farmers has a strong positive effect on the likelihood to make on-farm investments. Looking solely at dairy-specific investments, the impact of support programs is not significant. This suggests a possible leakage problem for buyers – resources provided as part of a support program may be used by the recipients to invest in other activities, outside of the specific supply chain of the buyer.

INSERT TABLES 7 AND 8 HERE

5. Conclusion

This paper analyzed how the nature of supply chain relationships between milk producers and milk buyers – and specifically the support programs that buyers have implemented for their suppliers – affect on-farm investment in the Armenian dairy sector. Hypotheses are tested using a unique dataset of 300 Armenian commercially oriented dairy farms. The first part of the empirical analysis linked the specifics of the relationship between the buyer and the supplier to the likelihood of gaining access to farm support programs. The main conclusions are that farmers with a more exclusive relationship with the buyer and farmers that deliver to more internationally oriented buyers (be it exporters or FDI firms) are more likely to receive support. On the other hand, buyers that operate in a more competitive market are less likely to provide support to their suppliers. These findings have interesting policy implications. On the one hand, our results seem to point to the gains that can be made from openness to international firms – which bring in the financial means and experience to provide farm support programs. On the other hand, the negative competition effect may indicate that buyers are limited in their ability to enforce repayment of the provided farm services in an environment where a lot of buyers are competing for the same supply. Policy makers may want to look at ways of improving the enforcement capability of dairy companies under these circumstances.

The second part of the empirical analysis focused on identifying the determinants of on-farm investments, with special emphasis on the impact of buyers' support programs on the likelihood to invest. The results of this analysis indicate that dairy support programs play a very important role in stimulating on-farm investment. Farm assistance programs affect investment decisions in several ways. First, dairy loans, credit and loan guarantee programs directly improve farmers' access to financial resources. Second, milk buyers' input supply programs increase the propensity to invest indirectly by enhancing the profitability of the farm by lowering input costs and by reducing transaction costs in accessing inputs. Finally, support programs reduce uncertainty and the riskiness of the business environment by providing guaranteed prices and prompt payments. All these elements have an important effect on the likelihood of investment by suppliers. This is critical given the problems of decapitalisation which affected the Armenian dairy sector, like many industries in CEE during transition.

Notes

^[1]Since 2009, Armenian farms have to be registered and thus taxed on their activities. However, only farms which sell over 58.35 million AMD (equivalent to approximately \$150,000) must be registered and pay VAT (20% on the amount exceeding the threshold). Given this high threshold, the vast majority of farms are not registered and paying VAT. Agriculture is exempt from taxes on profits.

^[2] Farm assets include investments in animal housing facilities (building, enlarging or modernizing stalls, sheds and herdsman's camps); dairy-specific investments (buying new calves and cows, milk lines, cooling tanks and fodder mixers); and general investments that are not specifically related to milk production such as buying new land, pastures, investments in fences and general agricultural equipment.

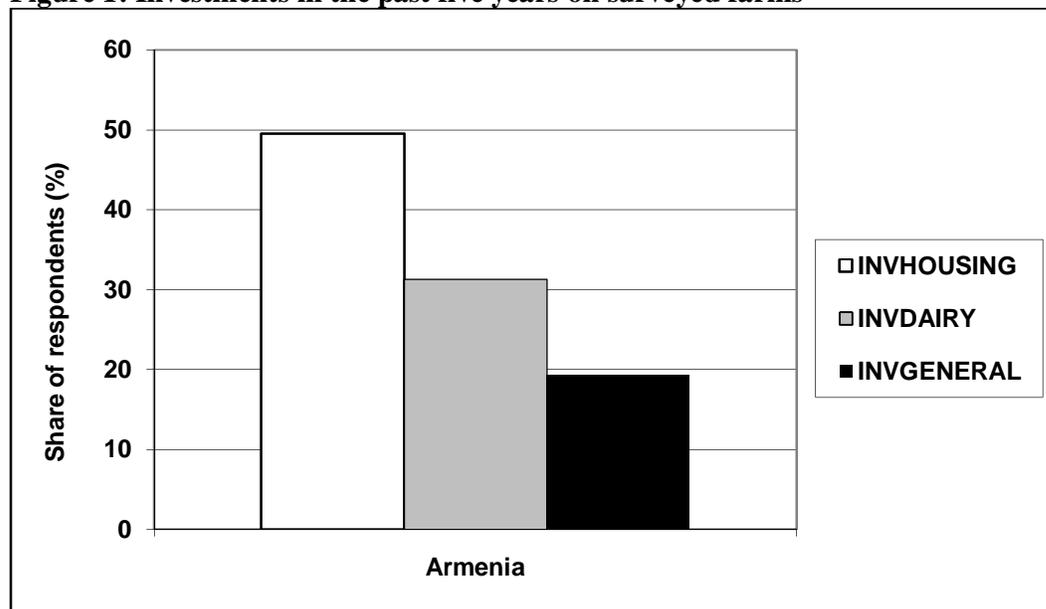
^[3]Dairy-specific investments include the buying of new calves and cows, milk lines, cooling tanks and fodder mixers.

References

- Anderson, J.C., Håkansson, H. and Johanson, J. (1994), “Dyadic Business Relationships within a Business Network Context”, *Journal of Marketing*, Vol. 58 No. 4, pp. 1-15.
- Blanchard, O. and Kremer, M. (1997), “Disorganization”, *Quarterly Journal of Economics*, Vol.112 No.4, pp.1091-1126.
- Boger, S., Hobbs, J.E. and Kerr, W.A. (2001), “Supply chain relationships in the Polish pork sector”, *Supply Chain Management: an International Journal*, Vol. 6 No. 2, pp.74-83.
- Bojnec, S. and L. Latruffe, (2011), “Financing availability and investment decisions of Slovenian farms during the transition to a market economy”, *Journal of Applied Economics*, Vol. 14 No. 2, pp. 297-317.
- Bhuyan, S.(2002). “Impact of vertical mergers on industry profitability: An empirical evaluation”,*Review of Industrial Organization*, Vol. 20,pp. 61–79.
- Ciaian, P., Falkowski, J.and Kancs, D. (2012),“Access to Credit, Factor Allocation and Farm Productivity: Evidence From the CEE Transition Economies”, *Agricultural Finance Review*, Vol. 72 No. 1, forthcoming.
- Cungu, A., Gow, H., Swinnen, J.F.M. and Vranken, L.(2008), “Investment with Weak ContractEnforcement: Evidence from Hungary during Transition”,*European Review of Agricultural Economics*,Vol. 35 No. 1, pp. 75–91.
- Dries, L. and Swinnen, J.F.M.(2004), “Foreign Direct Investment, Vertical Integration, and Local Suppliers: Evidence from thePolish Dairy Sector”,*World Development*,Vol. 32 No. 9, pp. 1525–44.
- Dries, L. and Swinnen, J.F.M. (2010), “The Impact of Interfirm Relationships on Investment: Evidence from the Polish Dairy Sector”, *Food Policy*, Vol. 35, pp. 121-129.
- Dries, L., Germeji, E., Noev, N. and Swinnen, J.F.M. (2009), “Farmers, Vertical Coordination, and the Restructuring of Dairy Supply Chains in Central and Eastern Europe”, *World Development*, Vol. 37 No. 11, 1742-1758.
- Elhorst, P.J. (1993), “The Estimation of Investment Equations at the Farm Level”, *European Review of Agricultural Economics*, Vol. 20 No. 2, pp. 167-182.
- Engels, J.E. and Sardaryan, G. (2006), Developing the food supply chain in Armenia. Paper presented at the 98th EAAE Seminar on Marketing Dynamics with the Global Trading System: New Perspectives, 29th June–2nd July, Chania, Crete.
- Fafchamps, M. (1997), “Trade Credit in Zimbabwean Manufacturing”, *World Development*, Vol. 25 No. 3, pp. 795-815.
- Gorton, M., Dumitrashko, M., and White, J. (2006), “Overcoming supply chain failure in the agri-food sector: a case study from Moldova”, *Food Policy*, Vol 31, No 1, pp 90–103.
- Gorton, M. and White, J. (2007),“Transformation and contracting in the supply chains of the former Soviet Union”, in Swinnen, J.F.M. (Ed.), *Global Supply Chains Standards and The Poor: How the Globalisation of Food System and the Standards Affects Rural Development and Poverty*, CABI, Wallingford, pp. 175–187.
- Gorton, M., White, J., Dries, L., Ignat, A., Sardaryan, G. and Skripnik, A. (2007), “Dairy Farming and Milk Marketing Relationships in the CIS”, *Eurasian Geography and Economics*, Vol. 48 No. 6, pp. 733-747.

- Gow, H., and Swinnen, J.F.M.(1998), “Agribusiness Restructuring, Foreign Direct Investment, and Hold-Up Problems in Agricultural Transition”, *European Review of Agricultural Economics*, Vol. 25 No. 4, pp. 331–50.
- Gow, H., Streeter, D. and Swinnen, J.F.M.(2000), “How Private Contract Enforcement Mechanisms Can Succeed Where Public Institutions Fail: The Case of Juhosucor A.S.”, *Agricultural Economics*, Vol. 23 No. 3, pp. 253–65.
- Hobbs, J.E. and Young, L.M. (2000), “Closer vertical co-ordination in agri-food supply chains: a conceptual framework and some preliminary evidence”, *Supply Chain Management: An International Journal*, Vol. 5 No. 3, pp.131 – 143.
- Johnson, S., McMillan, J. and C. Woodruff, (2002), “Courts and Relational Contracts”, *Journal of Law, Economics and Organization*, Vol. 18, pp. 221-277.
- Latruffe, L. (2005), “The impact of credit market imperfections on farm investments in Poland”, *Post-Communist Economies*, Vol. 17 No. 3, pp. 349–362.
- McMillan, J. and Woodruff, C. (1999), “Interfirm Relationships and Informal Credit in Vietnam”, *The Quarterly Journal of Economics*, Vol. 114 No. 4, pp. 1285-1320.
- NSS. (2012), “Food Security and Poverty Report”, National Statistical Service of the Republic of Armenia, Yerevan, Republic of Armenia.
- Petrick, M. (2004), “Farm Investment, Credit Rationing, and Governmentally Promoted Credit Access in Poland: A Cross-Sectional Analysis”, *Food Policy*, Vol. 29 No. 3, pp. 275-294.
- Poulton, C., Dorward, A., Kydd, J. (1998), “The revival of smallholder cash crops in Africa: Public and private roles in the provision of finance”, *Journal of International Development*, Vol. 10, pp. 85-103.
- Petersen, M.A. and Rajan, R.G.(1997), “Trade Credit: Theories and Evidence”, *The Review of Financial Studies*, Vol. 10 No. 3, pp. 661-691.
- Sahay, B.S., Cavale, V. and Mohan, R. (2003), “The ‘Indian’ supply chain architecture”, *Supply Chain Management: An International Journal*, Vol. 8 No. 2, pp. 93-106.
- Swinnen, J. (2007), *Global supply chains, standards and the poor*, CABI, Wallingford.
- World Bank. (2005), *The Dynamics of Vertical Coordination in Agri-food Chains in Eastern Europe and Central Asia. Implications for Policy Making and World Bank Operations*, World Bank, Washington, DC.
- Zylbersztajn, D., Filho, C.A. and Pinheiro, M. (2003), “Competitiveness of meat agri-foodchain in Brazil”, *Supply Chain Management: An International Journal*, Vol. 8 No. 2, pp. 155-65.

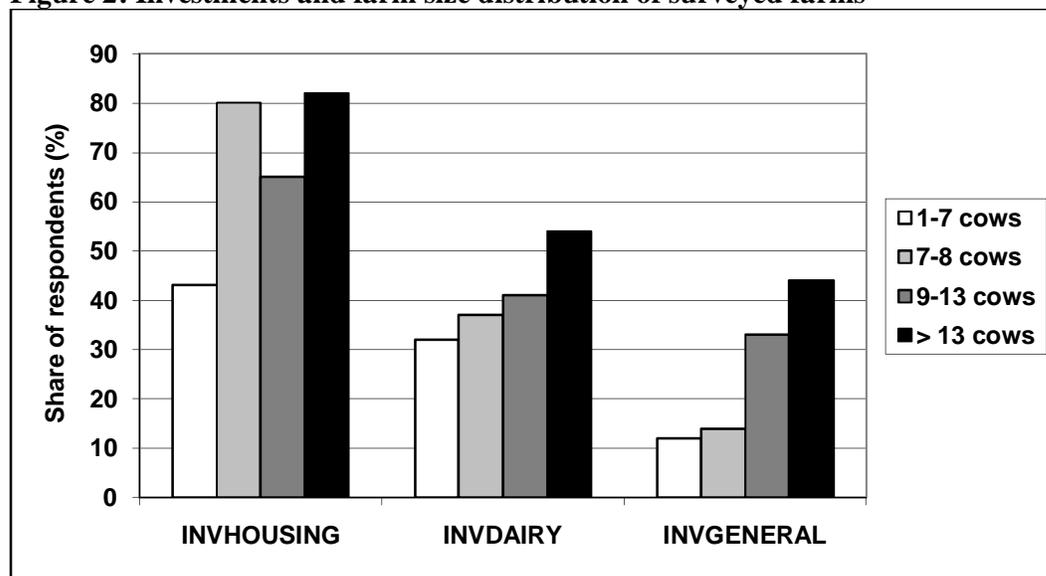
Figure 1: Investments in the past five years on surveyed farms^a



^aINVHOUSING includes investments in animal housing facilities: building, enlarging or modernizing stalls sheds and herdsman’s camps. INVDAIRY includes dairy-specific investments in new calves and cows, milk lines, cooling tanks and fodder mixers. INVGENERAL are investments that are not specifically related to milk production such as buying new land, pastures, investments in fences and general agricultural equipment.

Source: Survey data

Figure 2: Investments and farm size distribution of surveyed farms^a



^aINVHOUSING includes investments in animal housing facilities: building, enlarging or modernizing stalls sheds and herdsman’s camps. INVDAIRY includes dairy-specific investments in new calves and cows, milk lines, cooling tanks and fodder mixers. INVGENERAL are investments that are not specifically related to milk production such as buying new land, pastures, investments in fences and general agricultural equipment.

Source: Survey data

Table 1: Number of milking cows per commercial farm

No of milking cows	No of farms in the sample
1	0
2	0
3	4
4	16
5	50
6 to 9	111
10 to 19	77
20 to 49	29
50 to 99	8
100+	5
Total	300
Mean	13.4
Standard Deviation	18.5

Source: Survey data and Gorton et al. (2007)

Table 2: Percentage of farms receiving support from their main buyer

Support measure	% farms receiving support
Credit	30.7
Physical inputs	16.3
Machinery	1.7
Transportation	20.3
Specialist storage	2.0
Guaranteed prices	46.7
Veterinary support	23.7
Business and financial management support	4.0
Farm loan guarantees	4.0
Investment loans	1.7
Quality control	82.7
Prompt payments	87.7
Market access	40.0

Source: Survey data and Gorton et al. (2007)

Table 3: Descriptive statistics on model variables

Variable	Variable description	% sample (dummy) or average	Std. dev.
SUPPORT	1 if support provided by buyer	37.3	-
o.w. PLOAN	1 if credit, investment loan or loan guarantee provided by buyer	35.0	-
o.w. INPUTS	1 if inputs provided by buyer	16.3	-
o.w. PRICE	1 if guaranteed prices provided	46.7	-
o.w. PAYMENT	1 if no payment delays	87.7	-
INVEST	1 if on-farm investment in last 5 years	72.7	-
INVESTd	1 if dairy-specific investment in last 5 years	40.0	-
SHARE	Share of total milk production delivered to the main buyer	86.4	18.3
COMPETE	Number of potential milk buyers for the farmer's milk	2.0	1.9
TYPE	1 if buyer is a corporate dairy	76.0	-
FDI	1 if buyer is foreign-owned dairy or exporter of dairy products	22.0	-
COLLECT	1 if on-farm milk collection	70.0	-
CAPSTOCK	Number of dairy cows	8.5	13.24
COOPERATE	1 if farmer cooperates with other farmers to store, market or process milk, to buy inputs, or to lobby	29.3	-

Source: Survey data

Table 4: Determinants of farm support programs

SUPPORT	Coefficient	Standard Error	Significance ^a
SHARE	0.030	0.010	***
COMPETE	-0.170	0.085	**
TYPE	-2.376	0.373	***
FDI	1.920	0.367	***
COLLECT	-1.054	0.332	***
CAPSTOCK	0.032	0.012	**
COOPERATE	0.712	0.317	**
Constant	-1.335	0.847	
Observations: 300			
PseudoR2: 0.243			

^a The significance level is indicated as follows: *** 1%; ** 5%; * 10%

Source: Own calculations based on survey data

Table 5: Determinants of on-farm investments

INVEST	Coefficient	Standard Error	Significance ^a
PLOAN	1.126	0.402	***
INPUTS	1.682	0.783	**
PRICE	0.959	0.302	***
PAYMENT	0.363	0.408	
CAPSTOCK	0.038	0.022	*
COOPERATE	1.059	0.377	***
Constant	-0.696	0.423	
Observations: 300			
PseudoR2: 0.169			

^a The significance level is indicated as follows: *** 1%; ** 5%; * 10%

Source: Own calculations based on survey data

Table 6: Determinants of dairy-specific on-farm investments

INVESTd	Coefficient	Standard Error	Significance ^a
PLOAN	0.126	0.297	
INPUTS	1.398	0.388	***
PRICE	0.157	0.256	
PAYMENT	0.867	0.441	**
CAPSTOCK	0.014	0.011	
COOPERATE	0.376	0.280	
Constant	-1.757	0.442	***
Observations: 300			
PseudoR2: 0.082			

^a The significance level is indicated as follows: *** 1%; ** 5%; * 10%

Source: Own calculations based on survey data

Table 7: Determinants of on-farm investments, instrumental variables

INVESTd	Coefficient	Standard Error	Significance ^a
SUPPORT	0.552	0.114	***
CAPSTOCK	0.002	0.002	
COOPERATE	0.051	0.063	
Constant	0.491	0.045	***
Observations: 300			
PseudoR2: 0.028			

^a The significance level is indicated as follows: *** 1%; ** 5%; * 10%

Source: Own calculations based on survey data

Table 8: Determinants of dairy-specific on-farm investments, instrumental variables

INVESTd	Coefficient	Standard Error	Significance ^a
SUPPORT	0.064	0.124	
CAPSTOCK	0.003	0.002	
COOPERATE	0.111	0.069	
Constant	0.315	0.049	***
Observations: 300			
PseudoR2: 0.041			

^a The significance level is indicated as follows: *** 1%; ** 5%; * 10%

Source: Own calculations based on survey data