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Third-Party Facilitation of Market Linkages in the Agri-Food Supply Chain: Evidence from the Armenian Vegetable Industry

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1. Introduction

Over the past two decades the global agri-food procurement systems have undergone dramatic transformations driven by various factors including market liberalization and internationalization of the food retail sector. These transformations have created unprecedented opportunities and threats to agricultural producers and small and medium sized enterprises throughout the agri-food supply chains (Dries & Reardon, 2005; Dries, Reardon, & Swinnen, 2004; Dries & Swinnen, 2004). Many chain participants were able to adjust to these changes by moving away from spot market transactions towards more coordinated linkages (Shepherd, 2007). However, increased coordination introduces new costs and risks, for both buyers and sellers, associated with contract negotiations, enforcement, and potential nonperformance (Peterson, Wysocki, & Harsh, 2001). In developed countries these issues are addressed through well-functioning public institutions designed to provide appropriate contract enforcement mechanisms (North, 1990). But in many developing and transition economies, public institutions are either weak or undergoing reforms and are often ineffective in enforcing contractual relationships (Gow & Swinnen, 2001).

The literature on transaction cost economics and game theory emphasizes the role of private contract enforcement mechanisms based on mutual dependence and reputation for ensuring reliable business relationships (Macaulay, 1963; Kreps, Milgrom, & Roberts, 1982; Williamson, 1985, 1998a). Recent empirical evidence from Central and Eastern European Countries shows that foreign direct investment (FDI) and entry of multinational enterprises (MNE) provided sufficient capital and reputation to establish private contract enforcement mechanisms and ensure productive contractual relationships between agri-food producers and

processors, compensating for weak public enforcement (Gow & Swinnen, 2001, 1998; Dries & Swinnen, 2004).

The FDI and MNE's are not present in many countries due to reasons such as unstable political-legal environments, an unattractive domestic market, and high transaction costs associated with local procurement. Moreover, the domestic private sector in such economies is often lacking necessary resources, capabilities, and reputation for developing effective marketing and procurement relationships through private enforcement mechanisms. Consequently, without effective contract enforcement, the economic transactions in many developing and transition countries are limited to a highly unstable spot market option and a large number of agricultural producers are forced to resort to subsistence production. This is where the role of third-party facilitators such as international donors, development agencies, and NGO's becomes vital for facilitating establishment of supply chain linkages.

Policy makers and the development community have recognized the need for assistance programs focused on facilitating supply chain linkages through more coordinated marketing relationships (World Bank, 2001; Kirsten & Sartorius, 2002; World Bank, 2007). The international agribusiness research and agricultural development literature have been exploring appropriate structures of third-party facilitated market linkage programs that involve various contractual and institutional arrangements (Glover & Kusterer, 1990; Gow & Swinnen, 2001; Porter & Phillips-Howard, 1997; Shepherd, 2007). However, limited research is currently available analyzing strategies that have been used to externally facilitate establishment of private enforcement mechanisms to improve long-term sustainability of contractual

relationships. Even though a large number of market linkage facilitation programs has been implemented, the lessons are not well disseminated (Shepherd, 2007). There is a need to analyze practical cases and identify strategies that proved to be effective in facilitating supply chain relationships where public institutions failed to provide appropriate contract enforcement mechanisms.

In this paper, the case of USDA Marketing Assistance Program (MAP) facilitation of the Armenian vegetable industry is used to empirically examine the impact of third-party facilitation on marketing and procurement relationships between vegetable growers and processors. The analyses are based on the third-party facilitation framework (Shanoyan, 2011) according to which the establishment of self-enforcing sustainable relationships between transacting parties can be facilitated by a third-party through programs that stimulate investments in and rearrangement of private enforcement capital. Based on the case analysis and the theoretical framework, it is hypothesized that the USDA MAP facilitation of the vegetable industry enabled processors to effectively finance growers' investments in relationship specific assets through the introduction of contractual arrangements that included input and service provision. The hypothesis is tested by comparing the investments in relationship specific assets in farms supplying to the formal marketing channel facilitated by USDA MAP versus farms in the informal channel. The informal marketing channel includes local village markets, traders and middlemen, as well as subsistence farming and barter.

The data comes from a 2004 survey of 427 tomato growers in two major vegetable producing regions of Armenia. Investments in relationship-specific assets are reflected in the

data by the change in the tomato planting area (dedicated and physical asset specificity). To address potential endogeneity of formal channel participation, multiple instrumental variables measuring the extent of farmer's social capital are used.

The rest of the paper is organized as follows: Section 2 introduces the case of USDA MAP in the Armenian vegetable industry; Section 3 discusses the conceptual framework and introduces the hypothesis; Section 4 describes the econometric model and data for testing the hypothesis, followed by discussion of results in Section 5; finally Section 6 provides conclusions and implications for further research.

2. The Case of USDA Marketing Assistance Program in the Armenian Vegetable Industry

2.1 Introduction and background

Armenia has arguably faced one of the most difficult economic and social transitions of all the former Soviet Republics (World Bank, 2001). Independence from Soviet Union, privatization, trade liberalization, war and resulting economic blockade by Azerbaijan and Turkey had a combined impact of a 60% decline in GDP between 1991-1993, and widespread poverty and financial distress (FAO, 2000). The privatization in 1991 handed ownership and control of agricultural production to over 300,000 inexperienced and resource constrained household farmers. The agroprocessing sector was privatized in the period of 1995-1996 through restitution to employees or direct sales to local buyers (FAO, 2000). The traditional business practices were no longer appropriate due to broken business relationships, constrained trade and market access, limited capital, and inadequate legal enforcement system. This left Armenian agri-food sector in a deep crisis.

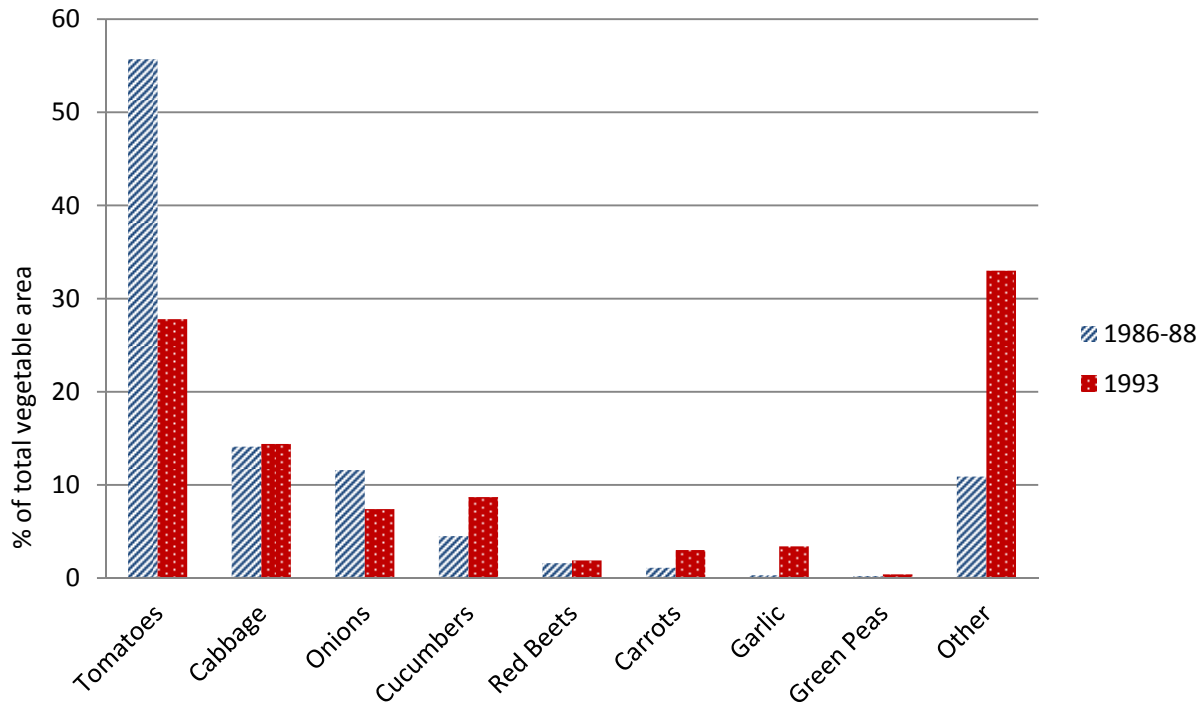
The transition had a dramatic impact on the Armenian vegetable sector, which has traditionally been an important sector in Armenian agriculture (World Bank, 1995b). Historically, two regions, Ararat and Armavir, were the main vegetable growing areas due to favorable agro-ecological conditions. A wide range of vegetable species were grown in Armenia, with tomatoes being by far the most important crop – accounting for over half of the total vegetable area (World Bank, 1995b). Other important species included cabbage and onion, jointly accounting for about 25% of total vegetable area. The processing industry was developed under a planned economy and was highly concentrated with the four largest canneries controlling 80-90% of the industry. During the soviet era the Armenian vegetable sector was able not only to fully meet domestic supply requirements but also provided considerable export of fresh and canned vegetables to Russia and other Former Soviet Republics (FSR) (World Bank, 1995b).

The combination of economic shocks that occurred during the transition period including independence, economic blockade, and land privatization left the Armenian vegetable sector in total disarray. The processing industry lost access to subsidized credit, import markets for important inputs such as packaging materials, and to guaranteed export markets in FSR. After the land reform, the upstream supply chain linkages with former state-owned large-scale collective farms disappeared, and this was closely followed by the dissolution of the compulsory sales of output at fixed prices to the state enterprises downstream (World Bank, 1995b). Processors were forced to deal with thousands of small-scale, inexperienced, and resource constrained vegetable producers for input procurement and had to find new buyers and distribution channels for selling the output.

On the growers' side, a lack of access to credit and farm inputs, combined with delayed payments from processors and the general economic decline in the country, had an adverse effect on production incentives. The rate of fertilizer and pesticide usage was at less than one percent of the suggested optimal level (World Bank, 1995b). Improved seed varieties were rarely planted – with most of planted seeds coming from the producers' own previous production. Mechanized cultivation was limited due to the highly fragmented nature of farm structure. The average farm size was 1.37 hectares for the country and 0.61 hectares for the Ararat region (FAO, 2002). Additionally, due to shortage of capital in the early nineties, many processors were unable to repay farmers for delivered vegetables and delayed payments for 10 to 12 months (World Bank, 1995b). Combined with hyperinflation, the annual inflation rate reaching 1820% in 1993 (World Bank, 2002), delayed payments left farmers financially distressed and disappointed in their procurement relationship with canneries. As a result they retreated to subsistence farming, bartering, and selling at local farmers markets.

Because of the cash transactions and generally higher prices, the direct-to-consumer fresh produce markets became preferred choice for marketing vegetables. Consequently, farmers directed their resources to producing mainly fresh market varieties of vegetables. Tomato planting area declined by 50% and was only partially replaced by other vegetables demanded by direct-to-consumer fresh produce markets (Figure 1).

Figure 1 Change in vegetable planting area from 1985-88 to 1993

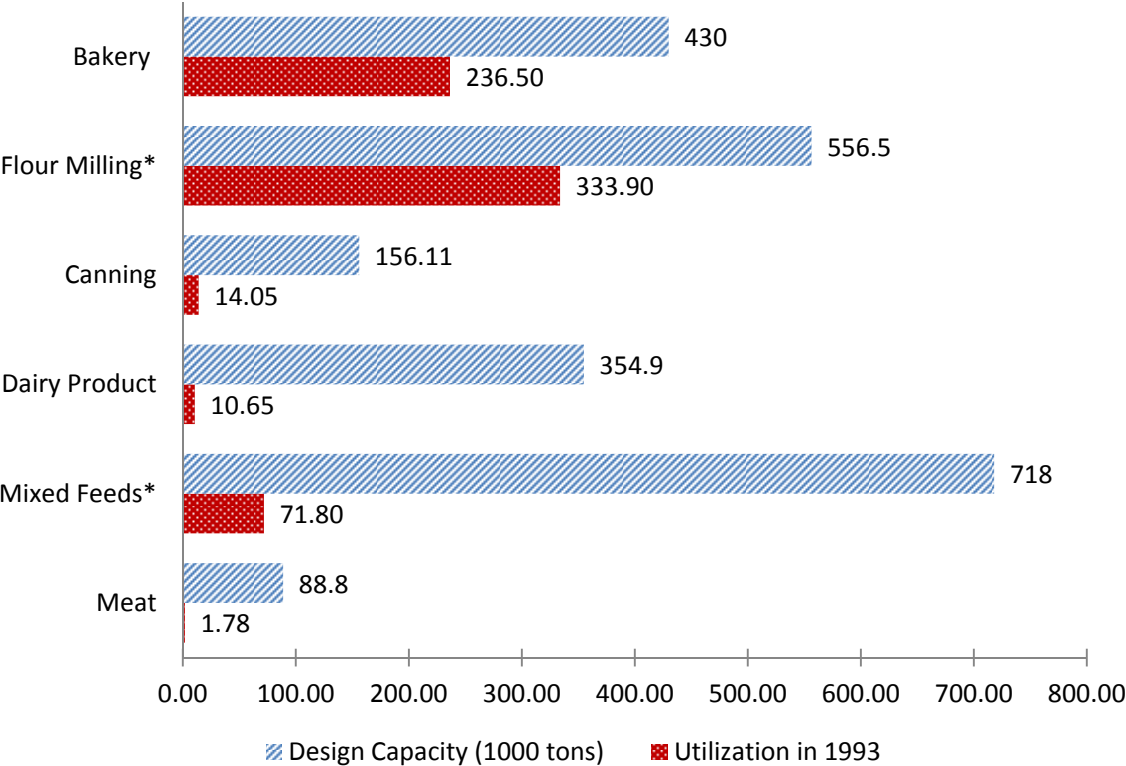


Sources: World Bank, 1995b

Most of the fresh market vegetable varieties that were planted were not suitable for processing. Moreover, only the residual lower quality vegetables were sold to processors at prices negotiated in open market. This caused serious coordination and planning problems for processors, especially since tomato paste manufacturing comprised 90% of vegetable output of the industry in the early nineties (World Bank, 1995b). The result was a significant increase in processors procurement costs accompanied by a sharp decline in revenues. Consequently, many canneries were forced to close or significantly reduce output. During the early nineties the industry averaged 9% of total capacity (Figure 2), with individual canneries ranging from zero to 61% of capacity utilization (World Bank, 1995b). In 1994, the government of Armenia eliminated subsidies to processors – followed by privatization of the industry in 1996. The

downward trend in the processing industry continued through late nineties with only minimal recovery in capacity utilization by the end of the decade (FAO, 2000).

Figure 2 Design capacity and utilization of food processing in 1993

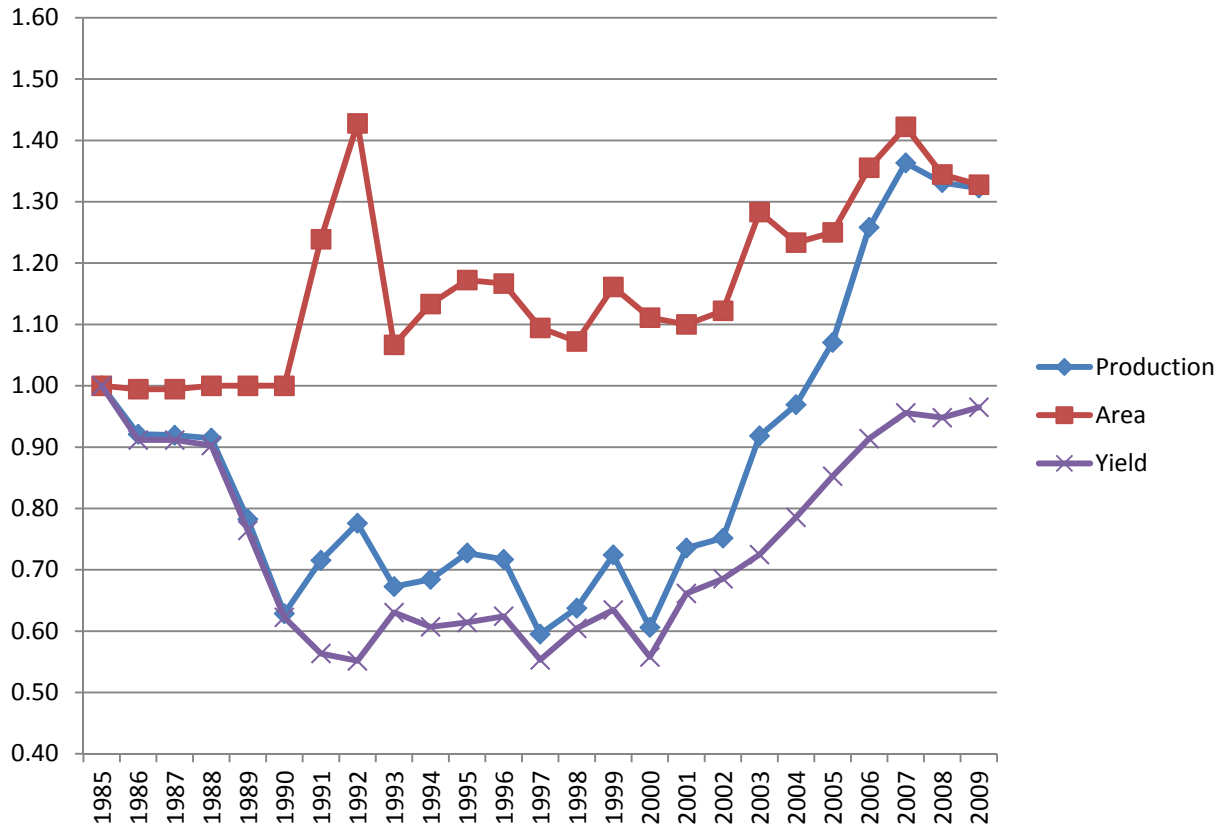


Source: Armenian Ministry of Statistics

Dramatic downscaling of the processing sector and the breakdown of supply chain relationships led to a further decline of vegetable production creating a downward spiral in the Armenian vegetable industry. Figure 3 provides a graphical representation of transition impact on vegetable production, yield, and planted area. Following land privatization in 1991 and 1992 the cultivated area increased by 43%, only to be followed by a 36% drop in 1993. This was due to the inability of the marketing infrastructure to handle the increase in production, resulting in

considerable spoilage in the fields and on farms (World Bank, 1999b). Yields and total production experienced substantial decline in the late 80's, leveling up at around 50-60% of initial potential for the next decade.

Figure 3 Change in vegetable production, area, and yield from 1985 (base) to 2009



Sources: World Bank, 1993; 1996; Armenian Ministry of Statistics

The industry crisis and the collapse of supply chain relationships left the Armenian vegetable sector in a suboptimal equilibrium characterized by low yields, inadequate quality, and significantly downscaled production on the farm level and underutilized, decapitalized canneries with seriously damaged reputation on the processing level. Given the overall

economic distress in the country, an alternative external stimulus was required to move the Armenian vegetable sector out of suboptimal equilibrium.

In 1992, Armenia requested USDA assistance for facilitating the transition of the agricultural sector. The USDA responded by establishing traditional extension-driven development assistance. The main focus of extension support was on the provision of farm level technical assistance. However, after three years of operation it became apparent that the extension-driven assistance strategy was not sufficient for addressing systemic problems faced by the Armenian agricultural sector. The effectiveness of the extension support was limited due to the lack of well-functioning markets for agricultural input supplies, procurement and marketing channels for farm output, as well as limited access to financial capital. Consequently, in 1996, the USDA advisory team redesigned the project from a technology-push to market-pull and with that shifted the focus from farmers and production to the entire supply chain. The result was the USDA Marketing Assistance Program (MAP) with an integrated market driven approach of supply chain facilitation through coordinated financial, technical, and marketing assistance (Cocks, Gow, & Dunn, 2003; Gow, Shanoyan, & Cocks, 2009).

Between 1996 and 2005, the USDA Marketing Assistance Program was actively involved in the Armenian agri-food industry – providing assistance at all levels of the supply chain. On the processing level, USDA MAP assisted over 65 processing firms in a number of key sectors of Armenian agriculture, including dairy and fruit-vegetable sectors. On the production level, USDA MAP facilitated the establishment of 33 farmer marketing associations (marketing cooperatives) to enhance farmers access to formal marketing channels. Through its microcredit

program introduced in 1999 USDA MAP facilitated establishment of 51 Agricultural Production Credit Clubs (mutual guarantee and collective liability microcredit groups) enabling over 800 farmers' access to financial capital (USAID, 2006). By 2005 over 17,000 Armenian farmers and agribusinesses received some form of marketing, technical, or financial assistance from USDA MAP (USAID, 2006). In 2005 the USDA Marketing Assistance Program in Armenia officially ended. A local Armenian foundation called the Center for Agribusiness and Rural Development (CARD) was established to carry on the legacy of the USDA MAP but at reduced programming.

2.2 USDA MAP facilitation of market linkages in the Armenia vegetable supply chain

Beginning in 1996 the USDA Marketing Assistance Program became involved in the Armenian vegetable industry with strategic assistance aimed towards the processing sector. The objective was not only to facilitate the revival of the vegetable processing sector, but also to develop reliable downstream markets for vegetable farmers – ensuring consistent demand for produce and reducing reliance on highly unstable spot markets. The assistance included a flexible and customizable package of financial, technical, and marketing assistance aimed at upgrading facilities, improving product quality, and enhancing marketing of Armenian vegetable products.

By the end of 1999, USDA MAP was working with the six largest vegetable processors in five regions of Armenia: Syunik, Tavush, Armavir, Ararat, and Kotayk (USAID, 2006). The financial assistance was provided mainly through strategic loans, small grants, and equipment leasing options to improve processing capacity, output quality, and input procurement. To address potential loan repayment issues of formal state processors, USDA MAP restructured

the composition of financial assistance increasing proportion of assistance through leasing arrangements to more than half of the total financial assistance by 2002.

Marketing assistance to processors included assistance in new product and package development, international market surveys, and promotional efforts at international trade shows. By 2001, the percentage of exported output of USDA MAP client canneries was ranging from 50% to 95% of total output. The technical assistance on the processing level was focused on assistance with quality improvement and certification. In 2000, USDA MAP introduced the “Quality First Initiative” – a quality assessment program based on HACCP, ISO, GMP, and SSOP quality control systems. The program promoted adoption of these systems by limiting marketing, financial, and technical assistance only to companies that met the minimum quality and sanitation standards.

As a result of USDA MAP assistance canneries were able to upgrade production quality, access export markets, and improve procurement relationships with farmers using formal contractual arrangements. A particularly successful example was Artashat cannery located in the heart of vegetable producing region in the middle of Ararat Valley. Artashat cannery was one of the largest tomato processors in the country, built in 1961 under the planned economy. Following independence, in the early nineties it was operating only at 16% of its designed capacity (World Bank, 1995b). The USDA MAP assistance to the Artashat cannery began in 1999. Over the period from 2000 to 2003 it became certified to ISO 9000, resumed exports and increased them to up to 97% of total output – simultaneously increasing diversification from 9 to 46 product lines. In 2000, Artashat cannery introduced a new contracting system which led

to more than a sixfold increase in the number of farmers contracted – reaching 2000 farmers in 2003 from an initial 300 contracted growers in 2000. Besides standard contract specifications, such as minimum price and quality, estimated quantity delivered, purchase times and payments, and repercussions for breach of contract, the new contractual arrangements also ensured provision of imported seed varieties, fertilizer, agronomical services as well as irrigation subsidies and collateral as loan guarantee for farmers in local banks. This not only led to improved procurement relationships with contracted growers but also improved the reputation of the cannery among other farmers. The result was an 80% increase in number of farmers supplying the cannery, growing from 5000 farmers in 2001 to 7000 in 2002 and 9000 in 2003. The processing output of tomatoes more than doubled from 2001 to 2003.

To assist financially distressed small scale farmers with upgrading vegetable production and delivery, the Agricultural Production Credit Club (APCC) microcredit program of USDA MAP was extended to the vegetable sector. The program was providing small production loans to groups of fifteen to thirty self-selected farmers and was using principles of collective and mutual guarantees by club members (Gow, Shanoyan, Abrahamyan, & Alesksandryan, 2006). The interest rate of APCC was almost third of that of other micro credit programs operating in Armenia (USAID 2006). Working with Armenian legislators, in 2002 MAP was able to achieve enhancement of legislation to register APCC as a self-contained micro credit financing organization required to comply with common set of administrative rules and subject to audit by the Ministry of Finance (USAID, 2006). By the end of 2005, six vegetable growers' credit clubs were formed, providing access to capital to more than 100 fruit and vegetable farmers.

The access to capital through credit clubs allowed farmers to finance their investments in expanding the production area and improving the quality of vegetables.

The case of USDA MAP in Armenia provides a unique empirical setting for analyzing a third-party market linkage facilitation strategy and its short-term and long-term impact. Firstly, the complete breakdown of supply chain relationships in Armenian agri-food sector during early transition, combined with the absence of FDI, provides a relatively controlled environment for assessing the impact of third-party facilitation strategy on the development of supply chain linkages. Secondly, the integrated supply chain facilitation approach of the USDA MAP allows concurrent examination of responses to external facilitation by firms at different levels of the supply chain. And lastly, as one of the largest and longest running agribusiness development projects managed by USDA, MAP was involved in several key sectors of the Armenian agriculture thus making it possible to analyze and compare the impact of facilitation strategies across various supply chains. In this paper the case of USDA MAP facilitation of Armenian vegetable industry is used to empirically examine the impact of third-party facilitation on investments in and rearrangement of private enforcement capital between vegetable producers and processors.

3. Theoretical Framework

This essay relies on the third-party facilitation framework, based on the probabilistic hold-up model by Klein (1996). In his model, Klein defines the self-enforcing range of contractual performance and illustrates how the presence of sufficient private enforcement capital can prevent hold-ups and lead to improved efficiency and reliability of business

relationships (Klein, 1996). Hold-ups occur when one of the transacting parties attempts an ex-post renegotiation of the contractual understanding in order to extract the quasi-rents from the other party's sunk investments in relationship-specific assets (Klein, Crawford, & Alchian, 1978; Williamson, 1998b). The self-enforcing range measures the "extent to which market conditions can change without precipitating a hold-up by either party" (Klein, 1996 p 449). It is determined by considering the degree of the private enforcement capital of each party involved in transaction. The degree of private enforcement capital can be defined by the magnitude of the losses from private sanctions that could be imposed on a transactor who attempts a hold-up. Private sanctions include termination or non-renewal of the relationship and damage of the reputation in the marketplace. The potential losses associated with termination of the relationship are equal to the discounted value of future quasi-rents from the relationship-specific investments present in a transaction. The damage of the reputation can impose additional costs on future transactions of the party that attempted a hold-up due to distrust and unwillingness of others in the marketplace to engage into relationship (Klein, 1996).

Based on this framework, the probability of contract self-enforcement can be increased by rearranging the private enforcement capital. This can be achieved by expanding the self-enforcing range through investments in private enforcement capital by one or both parties. Alternatively, one party can finance the other party's investments into specific assets, thus redistributing present enforcement capital from a party with a low hold-up potential to a party with higher hold-up potential (Klein, 1996). The third-party facilitation framework, developed in Shanoyan 2011, introduces an external facilitator to this model and extends its application to situations where transacting parties have limited resources (and reputation) necessary for

making investments in and redistribution of private enforcement capital. According to this framework the establishment of self-enforcing sustainable relationships between transacting parties can be facilitated by a third-party through programs that stimulate investments in and rearrangement of private enforcement capital.

In the context of the Armenian vegetable industry the private enforcement capital between vegetable producers and processors was virtually nonexistent in the early nineties due to the complete collapse of the supply chain after independence and privatization. The economic conditions and the nature of the transactions in the Armenian vegetable industry during early transition were consistent with the behavioral assumptions of transaction cost economics (Williamson, 1985). Firstly, consistent with the bounded rationality assumption, the lack of marketing experience of transacting parties combined with a highly uncertain economic and political-legal environment resulted in incomplete or missing contracts. Secondly, the high inflation rate combined with the inadequate public contract enforcement created ideal conditions for opportunistic behavior leading to delayed payments and low quality produce delivery. And lastly by their nature the economic transactions in the vegetable supply chain required the presence of asset specificity (i.e. physical, dedicated, and temporal asset specificity to be analyzed shortly). Consistent with the theory predictions, these conditions gave rise to significant transaction costs which combined with the limited access to capital and production inefficiencies left the Armenian vegetable industry in sub-optimal equilibrium. Vegetable producers were unwilling to invest in growing vegetables suitable for processing (Figure 1) and processors were operating far below the intended capacity with no incentives and resources to upgrade their procurement and production facilities (Figure 2).

Based on the case analysis, through its unique supply chain facilitation strategy, USDA MAP was able to provide vegetable processors and farmers with access to new market opportunities and resources for upgrading production. This stimulated investments in specific assets both on the processing and production levels (Table 1). Investments in specific assets on the processing level included investments in upgrading production and procurement capacity, but most importantly, the introduction of new contractual arrangements which included provision of imported seed varieties, fertilizer, agronomical services as well as irrigation subsidies and collateral as loan guarantee for farmers in local banks. By offering these provisions, processors posted hostage to their transaction with a growers, hence signaling credible commitment. Effectively, through these arrangements, processors provided partial financing of growers' investments in relationship specific assets.

The relationship specific investments on the farm level in this context included planting tomato varieties suitable for processing (physical and temporal asset specificity) and expanding total tomato planting area (dedicated asset specificity). Assets are specific to the transaction if they lose value when redeployed to an alternative use (Williamson, 1983). The tomato varieties designated for processing, once planted by farmers, become specific assets to the transaction with the processor since they will lose significant value in their second best use which is sale in the fresh market. Moreover, the perishable nature of tomatoes creates temporal asset specificity making timely marketing and procurement a critical attribute of the transaction.

Perhaps the most important type of asset specificity in this context is the dedicated asset specificity of additional tomato planting area. Dedicated asset specificity refers to investments in additional production capacity which would not have been undertaken if not a prospect of selling significant amount of product to a particular buyer (Williamson, 1983). Even though the additional land can be considered as general asset (not specific) by its nature, the investments in additional tomato planting area contingent on the supply contract with processors will result in a significant excess capacity if the contract is terminated.

Furthermore, in the context of the Armenian vegetable industry during early transition, the investments in additional land dedicated to tomatoes would provide lower returns under the alternative uses because of two main reasons. First, tomatoes historically have been by far the most used input in the vegetable processing sector. During early 90's the vegetable output of the processing industry was mainly comprised of tomato paste manufacturing. Out of total vegetables processed, tomatoes represented over 90% of total industry output (World Bank, 1995b). Second, the processing sector was highly concentrated and characterized by local monopolies with four out of six tomato processing canneries in the country accounting for 99% of total processed tomato output (World Bank, 1995b). This limited the alternative uses of the land to growing vegetables for sale in fresh markets or barter. Both of these options were characterized by high uncertainty in terms of price, volume, and timeliness of procurement providing a higher risk and lower profitability alternative to the supply contract with the processor. Consequently, in the case of termination or non-renewal of the transaction with the processor, the redeployment of the additional tomato planting area under alternative uses would have resulted in significantly lower value realization. Table 1 summarizes the

investments in relationship-specific assets by processors and growers stimulated by the USDA MAP facilitation.

Table 1 Investments in relationship-specific assets by processors and growers stimulated by the USDA MAP facilitation of the Armenian vegetable supply chain

Investments on the processing level	Investments on the farm level
<ul style="list-style-type: none"> • Investments in production and procurement assets • Introduction of contracts with input provisions including water subsidies and loan guarantees 	<ul style="list-style-type: none"> • Investments in production of new/improved varieties suitable for processing • Expansion of the tomato planting area

It can be argued that these investments in relationship specific assets on both processing and farm levels resulted in rearrangement of private enforcement capital. Additionally, the higher revenues from the USDA MAP facilitated access to export markets realigned processors incentives and provided sufficient cash flow to ensure timely payments to farmers for delivered produce. This further increased the private enforcement capital of processors through regaining farmers trust and building reputation as a reliable business partner. Table 2 provides a summary of the initial conditions defining the sub-optimal equilibrium, the USDA MAP facilitation strategy, and the resulting change in private enforcement capital between vegetable growers and processors.

Consequently, based on the case analysis and the theoretical framework, the following general hypothesis can be introduced: *H1 – The third-party facilitation strategy pursued by USDA MAP has stimulated investment in and rearrangement of private enforcement capital between vegetable producers and processors.*

Table 2 Summary of initial conditions, USDA MAP facilitation strategies, and resulting change in private enforcement capital between vegetable growers and processors

Initial Conditions Defining Suboptimal Equilibrium	USDA MAP Strategy (1996-2005)	Post-facilitation Conditions	Change in Private Enforcement Capital
<p>High transaction costs in marketing and procurement:</p> <ul style="list-style-type: none"> • Disorganized supply chain • Inconsistent quality • Hold-ups and mistrust 	<p>Marketing, technical, and financial assistance to processors:</p> <ul style="list-style-type: none"> • Export assistance • Quality First Initiative • Strategic loans 	<p>Improved marketing and procurement:</p> <ul style="list-style-type: none"> • Increased export • Improved downstream demand for vegetables • Introduction of contracting with input provisions 	<p>Short run:</p> <ul style="list-style-type: none"> • Redistribution of PEC from processors to farmers through input provision contracts <p>Long run:</p> <ul style="list-style-type: none"> • Increase in processors PEC due to improved reputation in the marketplace
<p>Limited access to capital and credit:</p> <ul style="list-style-type: none"> • Financial distress • Lack of credit capacity • High interest rates 	<p>Financial assistance on the processor and farm levels:</p> <ul style="list-style-type: none"> • Strategic loans • Microcredit 	<p>Improved ability to finance input procurement and investments in production assets</p>	
<p>Production inefficiencies:</p> <ul style="list-style-type: none"> • Missing or inadequate marketing infrastructure • Lack of expertise and experience • Capacity underutilization • Divestment in production 	<p>Technical and financial assistance on the processor and farm levels:</p> <ul style="list-style-type: none"> • Equipment Leasing • Specialized trainings and workshops • Strategic loans 	<p>Processing level:</p> <ul style="list-style-type: none"> • Increased production • Product diversification <p>Farm level:</p> <ul style="list-style-type: none"> • Expanded production area • Planting varieties suitable for processing • Reduced side-selling 	<p>Short run:</p> <ul style="list-style-type: none"> • Increase in farmers' PEC (physical asset specificity) through planting processing variety tomatoes <p>Long run:</p> <ul style="list-style-type: none"> • Increase in farmers' PEC due to investments in tomato planting area (dedicated asset specificity) and improved reputation

To test the hypothesis and to analyze the impact of USDA MAP facilitation program on farm level investment, the change in farm growth of farmers supplying vegetables to formal marketing channels (i.e. canneries) is examined. The farm growth is reflected by the change in total land area under tomatoes during the five-year period from 1999 (before the USDA MAP facilitation) to 2003 (after the USDA MAP facilitation). The comparison group consists of

farmers in the informal marketing channel. The informal channel in this context includes local village markets, traders and middlemen, as well as subsistence farming and barter.

In the context of the relationships with processors the additional land under tomato production can be considered as relationship-specific investments. Expanded tomato planting area represents two types of specific investments: i) in the short-run, planting tomato varieties suitable for processing constitutes physical and temporal asset specificity; and ii) in the long run, acquisition of additional land area constitutes dedicated asset specificity due to the substantial inability to redirect the land into profitable alternative uses. Therefore the difference in farm growth, reflected by the change in tomato planting area, between farmers in formal and informal channels will indicate the degree of farm-level investments in relationship-specific assets as a result of USDA MAP facilitation.

4. Empirical Analysis

4.1 General model

Following the literature on farm growth and previous empirical studies (Evans, 1987; Hart & Oulton, 1996; Weiss, 1999; Rizov & Mathijs, 2003; Dries & Swinnen, 2004), the farm growth model can be specified as following:

$$S_{i,t} = [F(X_i, S_{i,t_0})]^d (S_{i,t_0}) e_{i,t} \quad (3.1)$$

Where $S_{i,t}$ and S_{i,t_0} denote the size of the farm i at the subsequent period t and initial period t_0 respectively, $F(X_i, S_{i,t_0})$ denotes a function of size at the initial period and a vector of other variables including farm and marketing channel characteristics denoted by X .

The time interval over which the growth is measured is denoted by $d = t - t_0$, and finally e denotes a lognormally distributed error term with possibly non-constant variance. Based on (3.1) the following general equation can be specified to serve as the basis for econometric analysis of farm growth:

$$\ln(S_{i,t}) - \ln(S_{i,t_0}) / d = \alpha_0 + \sum_{j=1}^n \beta_j H_{i,j} + \gamma D_{i,t} + \mu_1 \ln(S_{i,t_0}) + \mu_2 \ln(S_{i,t_0})^2 + u_i \quad (3.2)$$

In this equation $S_{i,t}$ and S_{i,t_0} denote the total tomato planting area in farm i at the subsequent period t and initial period t_0 respectively, H_i is a vector of n variables controlling for farm and production characteristics, D_i is an indicator of participation in formal marketing channel, and u_i is an error term. The left-hand side of equation (3.2) reflects the average annual proportionate change in tomato planting area in the period $d = t - t_0$, and serves as a measure of farm growth over the given period. The main parameter of interest on the right-hand side is γ which can be interpreted as the difference in average annual proportional change in tomato area in farms supplying to formal marketing channel, compared to farms in informal channel.

4.2 Estimation strategy

Estimation of parameters in (3.2) requires careful consideration due to potential endogeneity of participation in formal marketing channel. There might be unobservable factors

affecting both participation in formal channel and farm growth (e.g. entrepreneurial ability of the farmer). In other words D_i might be correlated with u_i . This can lead to the bias and inconsistency of ordinary least squares (OLS) estimators. The widely used method for addressing endogeneity of one or more explanatory variables is two stage least squares (2SLS) estimation method. This method allows using multiple instrumental variables (IV) for estimating parameters in the presence of endogenous explanatory variables. Instrumental variables must be excluded from (1.2) and must be correlated with the endogenous variable, D_i , and uncorrelated with u_i .

In this analysis, the number of variables measuring the extent of farmer's social capital is used as instrumental variables. These variables are defined based on: i) whether the farmer was born in the village where he/she lives, ii) the distance from the house of the nearest relative, iii) the number of households that the farmer might turn to for help in past five years, iv) number of households that might turn to the farmer for help in past five years, and v) whether farmer takes part in the meetings concerning the village that he/she lives. There is a good reason to believe that these measures of social capital will be correlated with participation in the formal marketing channel since they can influence the likelihood of supplying vegetables to processor/cannery. The empirical evidence from studies of agricultural innovation and technology adoption in developing country settings suggest positive correlation between social capital and farmer's decision making due to mutual learning and information sharing among households (Bandiera & Rasul, 2006; Conley & Udry, 2010; Foster & Rosenzweig, 1995). Another instrumental variable based on the annual number of trips to Yerevan

(Armenian capital) is used as a proxy for access to direct-to-consumer fresh markets which could be negatively correlated with participation in formal marketing channel (i.e. supplying cannery). There is a little reason to believe that after controlling for other variables, these variables will be correlated with unobserved factors in the error term of (3.2).

Since the participation in formal marketing channel is a binary endogenous variable, the two step procedure proposed by Wooldridge (2002) is used. First, the binary response model is estimated by probit using the set of instrumental variables and explanatory variables, and then the fitted probabilities \hat{D}_i are obtained. Second, the equation (3.2) is estimated by 2SLS using \hat{D}_i as an instrument. Due to its robustness properties this procedure produces more efficient estimates compared to usual 2SLS estimates (Wooldridge, 2002, pp 623-625).

4.3 Data and variables

The data used in the analysis come from a farmer survey conducted in 2004 as a part of the larger effort to assess the impact of the USDA MAP initiatives in Armenian agriculture. The sample consists of 427 tomato farmers from two major vegetable producing regions of Armenia. The survey instrument was designed to obtain information on household demographics, income generation, asset ownership and investment, production, finance, land use, marketing channel structure, and business relationships. The data is a cross section for 2003 which also includes a series of retrospective information regarding household income, farm productivity, land area, and choice of marketing channel for each of the five years prior to the survey (1999-2003).

Approximately 55% of respondents in the sample were in the formal marketing channel, which means they supplied tomatoes directly to processor in 2003. The rest of the sample, approximately 45% of respondents, consists of farms in the informal channel which includes local village market, traders and middlemen, as well as subsistence farming and barter. Table 3 presents description of variables included in the analysis with the summary statistics for the total sample and for two groups based on participation in formal and informal channels.

The depended variable (*GROWTH*) is the average annual proportionate change in tomato planting area over the period from 1999 to 2003, measured in hectares. It is calculated as in left-hand side of equation (3.2) and is based on the logarithm of the total tomato planting area in 1999 (before USDA MAP facilitation) and in 2003 (after five years of USDA MAP facilitation). The log-transformation was done after adding 0.0001 to the reported area in hectares. The main variable of interest is the binary variable *FCHANNEL* indicating participation in formal marketing channel.

Table 3 Variable description and summary statistics

Variable	Description	Total sample	Formal Market	Informal Market
		mean (s.e.)	mean (s.e.)	mean (s.e.)
Dependent Variable				
<i>GROWTH</i>	Measure of growth in planted area over the period from 1999 to 2003 (average annual proportional change in tomato planting area)*	0.664 (1.058)	0.882 (1.056)	0.402 (1.002)
Independent Variables				
<i>FCHANNEL</i>	Equals 1 if the farm is supplying tomatoes to formal marketing channel and 0 otherwise	0.546		
<i>INC99M</i>	Equals 1 if the household belonged to Middle income category in 1999 (annual income between 360.00 and 1250.00USD) and 0 otherwise	0.356	0.305	0.417
<i>INC99U</i>	Equals 1 if the household belonged to Upper income category in 1999 (annual income over 1250.00USD) and 0 otherwise	0.405	0.524	0.263
<i>FEMALE</i>	Equals 1 if household head is female and 0 otherwise	0.201	0.167	0.242
<i>AGE</i>	Age of household head	44.14 (11.69)	42.14 (10.54)	46.53 (12.56)
<i>EDCOLL</i>	Equals 1 if household head has a technical college degree and 0 otherwise	0.279	0.287	0.268
<i>EDUNIV</i>	Equals 1 if household head has a university degree or higher and 0 otherwise	0.234	0.249	0.216
<i>OTHEROC</i>	Equals 1 if household head has a primary occupation other than farming (e.g. teacher, nurse, vet., accountant, plant worker, etc...) and 0 otherwise	0.161	0.142	0.186
<i>PPLHH</i>	Number of people in the household	5.64 (2.59)	5.80 (3.09)	5.45 (1.82)
<i>TVARIETY</i>	Equals 1 if imported varieties of tomatoes are planted and 0 otherwise	0.855	0.944	0.747
<i>CHFERT</i>	Change in amount of fertilizer use from 1999 to 2003 measured in kilograms per hectare	189.57 (757.34)	288.91 (996.11)	70.26 (216.9)
Number of observations		427	233	194

* Computed as in left-hand side of equation (3.2)

Table 3 (cont'd)

<i>FLOAN</i>	Equals 1 if has a loan from a formal source (ACBA bank, other banks, and Credit Clubs)	0.393	0.429	0.35
<i>NONAGINC</i>	Percentage of income from wages and non-agricultural business	7.325 (18.495)	8.139 (20.226)	6.348 (16.172)
<i>LNAREA99</i>	Logarithm of land area (ha) under tomatoes in 1999**	-4.046 (3.854)	-4.107 (4.224)	-3.972 (3.365)
<i>LNAREA992</i>	Squared term of the logarithm of land area under tomatoes in 1999	31.186 (38.904)	34.637 (41.017)	27.042 (35.873)
<i>BORNHERE</i>	Equals 1 if the household head was born in the village where he/she operates the farm and 0 otherwise	0.735	0.760	0.706
<i>DISTREL</i>	Distance from the house of the nearest relative (km)	11.010 (47.826)	14.597 (57.968)	6.702 (31.229)
<i>GETHELP</i>	Number of households farmer might turn for help in past five years (1999-2003)	4.769 (13.613)	6.203 (17.517)	3.046 (5.896)
<i>GIVEHELP</i>	Number of households might turn to farmer for help in past five years (1999-2003)	8.703 (23.932)	9.785 (25.276)	7.402 (22.205)
<i>VMEET</i>	Equals 1 if the farmer takes part in the meetings concerning the village where he/she lives, and 0 otherwise	0.609	0.639	0.572
<i>TRIPSYER</i>	Number of trips per year to the capital	43.522 (98.315)	42.558 (93.309)	44.680 (104.243)
Number of observations		427	233	194

** Log transformation is done after adding 0.0001 to the reported area in hectares

Following the farm growth model specified by the general equation (3.2) and guided by the economic rationale, a number of explanatory variables are included in the analysis to control for differences in household characteristics, initial farm size, production, and access to financial capital.

To control for farm income in the initial period, two dummy variables are included in the analysis indicating whether farm income in 1999 was in the middle (*INC99M*) and upper (*INC99U*) income category. The lower income category serves as the base group. The set of variables are included to account for demographic characteristics of the household head such as gender, age, and education. The variable *EDCOLL* indicates whether the household head has a technical college degree, while the variable *EDUNIV* indicates if he/she has a university or higher degree. The base group for education consists of farmers who have ten or fewer years of education. Variable *OTHEROC* indicates whether the household head has a primary occupation other than farming. The variable indicating the number of people in the household (*PPLHH*) is included in the analysis to control for household size and household labor effects. To control for the differences in initial tomato area, the logarithm of tomato area in 1999 (*LNAREA99*) and its squared term (*LNAREA992*) are included in the analysis.

In theory, the participation in the formal marketing channel can lead to on-farm investments directed not only on expanding the planted area, but also improving the quality and yield of planted vegetables. Therefore, in order to obtain more precise estimates of channel effect on tomato area expansion, the difference in quality and yield of tomatoes must be controlled. This is done by including the following two variables in the analysis: *TVARIETY* –

a dummy variable indicating whether farmers planted imported varieties of tomatoes versus traditional Armenian varieties, and *CHFERT* a continuous variable indicating change in amount of fertilizer use from 1999 to 2003 measured in kilograms per hectare.

Another important factor that can influence investments in expanding the planted area is the access to financial capital. The access to formal financing is controlled by including two dummy variables. First variable (*FLOAN*) indicates whether the farm has a formal loan from sources that include: the ACBA bank, a major agricultural credit provider of the time; other banks; and Agricultural Production Credit Club, the USDA MAP initiated microcredit program. The base group consists of farms that either had no loans or borrowed from informal sources which mainly include friends and relatives in Armenia or abroad.

The list of instrumental variables used in the first stage binary response model consists of six variables measuring the extent of social capital and the access to direct-to-consumer markets. Two dummy variables indicate whether the household head was born in the village where he/she lives (*BORNHERE*) and whether the farmer takes part in the meetings concerning that village (*VMEET*). Another two instrumental variables (*GETHELP* and *GIVEHELP*) indicate the number of households that farmer might turn for help and number of households that might turn to farmer for help within past five years. The final instrument measuring social capital is based on the distance from the house of the nearest relative (*DISTREL*) measured in kilometers. Approximately, 41% of farmers in the sample named “other farmers” as the number one source of information on vegetable prices confirming the importance of social capital in channel participation decision. The last instrumental variable, *TRIPSYER*, included in the first stage

binary response model is a proxy for access to direct-to-consumer fresh markets and is based on annual number of trips to Yerevan (capital of Armenia).

5. Results

The estimation results are reported in Table 4. For comparison purposes two sets of results are presented: the first two columns, following variable names, present the OLS estimates and corresponding standard errors, while the last two columns present the results obtained using the 2SLS method with fitted probabilities from the first stage probit model as the instrument to account for endogeneity of participation in the formal marketing channel. For both methods the reported standard errors are robust to arbitrary heteroskedasticity. Relevant post-estimation tests are performed to test whether the participation in formal marketing channel is truly endogenous.

The results from OLS and 2SLS are comparable in terms of the significance of estimated coefficients for main variable of interest (*FCHANNEL*) as well as for most of the control variables. Both sets of results indicate that the participation in formal marketing channel has a positive effect on change in the tomato planting area. However the 2SLS estimate of participation effect (0.5329) is twice as large in magnitude compared to the OLS estimate (0.2496) and is still statistically significant at the 1% level. If the participation in formal marketing channel is truly endogenous then the 2SLS estimates are more consistent assuming appropriate instruments were used. Based on the results of two post-estimation tests, Wooldridge's (1995) robust score test ($\chi^2 = 4.63, p = 0.031$) and a robust regression-based test of endogeneity ($F = 4.79, p = 0.029$), the null hypothesis that *FCHANNEL* is exogenous can be

rejected at the 5% level and therefore the participation in formal marketing channel must be treated as endogenous.

Table 4 Two Stage Least Squares Results

Dependent variable: <i>GROWTH</i> (average annual proportionate change in tomato planting area)				
Variables	OLS Results		2SLS with fitted probabilities	
	Coef.	Std. err.	Coef.	Std. err.
<i>FCHANNEL</i>	0.2496 ***	0.0398	0.5329 ***	0.1314
<i>INC99M</i>	-0.0942 *	0.0503	-0.0863 *	0.0519
<i>INC99U</i>	-0.0004	0.0441	-0.0352	0.0482
<i>FEMALE</i>	0.0249	0.0354	0.0122	0.0392
<i>AGE</i>	-0.0006	0.0015	0.0009	0.0017
<i>EDCOLL</i>	0.0314	0.0458	0.0021	0.0054
<i>EDUNIV</i>	0.036	0.0406	0.0337	0.0476
<i>OTHEROC</i>	0.0407	0.0315	0.0720 *	0.0403
<i>PPLHH</i>	0.0053	0.0057	0.0021	0.0054
<i>TVARIETY</i>	0.1051 *	0.0551	0.0399	0.0651
<i>CHFERT</i>	0.00003	0.00004	0.00004	0.00003
<i>FLOAN</i>	0.0769 **	0.0324	0.0769 **	0.0340
<i>NONAGINC</i>	0.0177 ***	0.0006	0.0015 **	0.0007
<i>LNAREA99</i>	-0.0177	0.026	-0.0896 **	0.0384
<i>LNAREA992</i>	0.0233 ***	0.0025	0.0159 ***	0.0039
<i>Constant</i>	-0.408	0.1196	-0.6071	0.1551

Number of observations = 427

Note: *, **, *** indicate that the corresponding coefficients are significant at the 10%, 5%, and 1% level respectively

Based on the 2SLS results, farms supplying to the formal marketing channel had approximately 53.3% higher average annual proportionate change in the tomato planting area compared to farms in the informal marketing channel. In other words, for the farms in the formal marketing channel the additional 53% of increase in tomato planting area per year can be considered as dedicated investments to formal supply chain relationships with processors.

This means that over the four years (1999-2003) of USDA MAP facilitation of vegetable supply chain, farmers linked to the formal marketing channel have expanded their tomato planting area three times more than farmers in the informal channel. These results are consistent with the hypothesis that the USDA MAP facilitation strategy has stimulated investments in private enforcement capital between vegetable producers and processors.

Results also indicate that farms in the lower income category grew faster compared to farms in the middle and upper income categories. The signs on estimated coefficients for both income categories in 1999 are negative and coefficient of INC99M is significant at the 10% level indicating that on average farms in the middle income category experienced 8.6% lower proportionate change per year compared to farmers in the low income category. This finding is supported by additional evidence based on the farmers' response when asked to compare their farm production in 2003 to that of 1999. Out of all respondents, 43.1% of low income farmers reported better production in 2003 compared to 1999, while only 28.7% of farmers in the middle and 25% of farmers in the higher income categories reported better production.

This finding seems contradicting with the theory at first since it would be reasonable to expect that households in the higher profit category will be able to finance on-farm investments better compared to low income households. However, it is important to recognize that in this context farming may not be the only or even the main source of income. The households may be in higher income categories because of income from non-farm businesses or wages from non-farm occupation. Therefore, since both of these factors are controlled, the remaining difference in production growth may be attributed to low income households' higher

reliance on farming. In fact, according to the data farmers in lower income category had 49% of their total household income coming from crop production, while it was 39% for farmers in higher income category. Moreover, the estimated coefficients on both *OTHEROC* and *NONAGINC* are positive and significant.

The results indicate that households where the head has a main occupation other than farming have on average 7.2% higher annual increase in the tomato planting area. Furthermore, each additional percentage increase in non-farm income (including wages) leads to 0.15 percentage point increase in average annual expansion of the area under tomatoes. These findings are consistent with economic theory since the availability of financial capital is one of the key factors affecting investments in general and on-farm investments in particular. Moreover, these results are consistent with the qualitative responses provided by farmers in the sample.

For instance, the ability to make new investments to expand the production area was by far the most cited factor by farmers who reported increase in the vegetable planting area since 1999. Out of the farmers who expressed interest in increasing their vegetable production activities (70.1% of total sample) approximately 29.4% reported inability to obtain loans and credit as the main constraint to increasing households' vegetable farming activities. As the principal constraints to obtaining more financing, high collateral requirement was mentioned by 37.8% of respondents, and high interest rates was mentioned by 10.1% of respondents. Approximately 21.4% of respondents said that they cannot obtain more loans because they are unable to repay them.

Not surprisingly, the estimates for *FLOAN1* are statistically significant, indicating that farms with formal loans from a bank or the Agricultural Production Credit Clubs have on average 7.7% higher annual proportionate change in the tomato planting area compared to farms that have no reported loans or borrowed from friends and relatives.

The results also indicate that the initial tomato planting area has a significant negative effect on the proportionate annual growth (-0.0896). However its squared term has a significant positive estimate (0.0159). This implies that the growth in production area is negatively related to initial size however at some level of initial size the effect of size on growth turns positive. In other words there is a certain optimal level of land area below which smaller farms tend to grow faster, while above that optimal level the growth return on size turns positive meaning larger farms have higher proportionate increase in production area.

In summary, the results indicate that the participation in the formal marketing channel has a very large positive effect on farm growth when addressing the endogeneity problem and controlling other key factors that can potentially influence the farm growth. Among the controlled factors, the household characteristics such as income level and sources have a significant positive effect on expansion of production area. On the other hand the initial size has a diminishing growth return.

6. Discussion and Conclusion

Without effective contract enforcement, the economic transactions in many developing and transition economies are limited to the highly unstable spot market option leaving a large number of agricultural producers and processors stuck in suboptimal equilibrium. While the

international agribusiness research and agricultural development literature have been exploring various approaches for third-party facilitation of market linkage programs, limited research is currently available on strategies for external, third-party facilitation of supply chain relationships based on private enforcement capital. This paper attempts to contribute to filling that gap in the literature.

The contribution of this paper is twofold. First, it applies the third-party facilitation framework based on private enforcement capital in the analysis of the USDA MAP facilitation of the Armenian vegetable industry. And secondly, it measures the impact of third-party facilitation strategy on investment in and redistribution of private enforcement capital between Armenian tomato growers and processors. The main results indicate that for the farms in the formal marketing channel the additional 53.3% of the tomato planting area per year can be considered as dedicated assets to formal supply chain relationships with canneries. These results are consistent with the hypothesis that the USDA MAP facilitation strategy has stimulated investments in and redistribution of private enforcement capital between vegetable producers and processors. They imply that as a result of the USDA MAP facilitation of the vegetable supply chain, farmers linked to the formal marketing channel over the period from 1999 to 2003 have made significant investments in expanding their tomato production area. Additionally, the household and farm characteristics such as income level and sources, access to bank loan, and initial tomato planting area were shown to have significant effect on farm growth.

Limitations and further research

This paper has mounted a strong argument for the appropriateness of Klein's model in explaining underlying economic incentives in the Armenian vegetable supply chain established as a result of the USDA MAP facilitation. However, it can be argued that the assets involved in transactions in the vegetable industry (i.e. additional land area) provide relatively higher degree of flexibility in terms of alternative use. In particular, even if market linkages between farmers and processors fail, the land remains intact for other profitable uses if such alternatives evolve as a transition economy matures. Consequently, some readers may argue that the incentives in the vegetable supply chain became aligned due to mere reestablishment of formal markets rather than the redistribution of private enforcement capital. This would have been an especially valid argument in the context of the vegetable supply chain linkages in developed countries (i.e. supply chain linkages between Californian vegetable growers and processors) where growers often have multiple, equally profitable options for land use. However, it is important to recognize that in the context of the Armenian vegetable industry during early transition, growers had a very limited set of options for alternative use of the additional land dedicated to tomatoes.

Firstly, during early 90's the vegetable output of the processing industry in Armenia was mainly comprised of tomato paste manufacturing. Out of total vegetables processed, tomatoes represented over 90% of total industry output (World Bank, 1995b). Secondly, the processing sector was highly concentrated and characterized by local monopolies with four out of six tomato processing canneries in the country accounting for 99% of total processed tomato output (World Bank, 1995b). This limited the alternative uses of the land to growing vegetables

for sale in fresh markets or barter both of which provided a higher risk and lower profitability alternative to the supply contract with the processor.

The more in-depth longitudinal study of the USDA MAP impact on the structure and performance of the Armenian vegetable industry may provide much richer insight on processes involved in the revitalization of the industry. Nevertheless, even within the simpler framework of incentive alignment through reestablishment or “jumpstart” of the formal marketing channel, this paper provides important lessons from the USDA MAP facilitation strategy in the Armenian vegetable industry which in and of itself is a valuable empirical contribution to the literature.

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