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MULTINATIONAL SUPERMARKET CHAINS IN DEVELOPING COUNTRIES: DOES LOCAL AGRICULTURE BENEFIT?

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Multinational supermarket chains in developing countries: Does local agriculture benefit?*

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Abstract

There is no consensus in the empirical literature on how entry of multinational supermarket chains affects farmers in developing countries. We quantify the dynamic effects of supermarket expansion on agriculture within a structural framework that clarifies the adjustment mechanisms involved. The model specification takes the potential productivity linkage between supermarkets and local suppliers into account. While econometric analyses struggle with causality issues, we analyze the endogenous interaction between supermarkets' choice of suppliers and agricultural productivity. Based on numerical simulations, two results emerge. First, we offer a possible understanding of the conflicting evidence in the empirical literature. Whether farmers benefit from supermarkets or get stuck in a low productivity trap depends on the extent of local constraints related to production capacity and market access. Second, supply chain development initiated by supermarkets can help farmers escape the low productivity trap. While supermarkets face a short run cost, they gradually gain from more productive local suppliers.

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1. Introduction

As part of the globalization process, the past decades have seen a rapid rise of multinational supermarket chains in the developing part of the world. The consequences for the agricultural sector are discussed in the literature, but with no conclusive answer. Empirical analyses tend to find that farmers supplying supermarkets are relatively more productive, but many farmers are excluded from the supermarket supply chain due to capacity constraints in production and marketing.[1] This paper analyzes the dynamic effects of supermarket expansion within a structural framework that highlights the adjustment mechanisms involved. Based on numerical simulations, we quantify the importance of local constraints and supply chain development for the impact of supermarkets on agriculture.

The model specification assumes an archetype developing economy with duality in both agriculture and the food retail sector. The modern food retail sector includes supermarkets, large discount stores and hypermarkets (to simplify the notation we use the term 'supermarkets'), while the traditional food retail sector consists of small shops and public markets. Traditional farmers supply the traditional food retail sector. Commercial farmers also deliver goods to supermarkets, and face competition from foreign farmers. The supermarkets' choice between domestic and foreign suppliers is endogenously determined in the model. Global or regional supermarket chains represent foreign direct investment, and may generate backward productivity spillovers to the domestic economy. We endogenize the productivity linkage between supermarkets and local suppliers. Productivity growth in commercial agriculture is related to the gap to the world technology frontier, the degree of interaction with supermarkets as intermediate suppliers, and the level of domestic barriers to technology adoption.

Econometric analyses of supermarkets and the productivity of suppliers struggle with causality issues. Does the productivity of farmers increase because they deliver goods to supermarkets, or do supermarkets select the most productive suppliers? We analyze the

[1] Section 2 gives an overview of the relevant literature.

endogenous dynamic interaction between supermarkets' choice of suppliers and agricultural productivity. The productivity of commercial farmers is positively related to their interaction with supermarkets, and at the same time, more productive local farmers decrease the supermarkets' dependence on foreign suppliers.

Based on the intertemporal general equilibrium model, we offer numerical simulations showing how entry of multinational supermarket chains affects the agricultural sector in alternative scenarios. The parameters of the model are set to reproduce the observed and projected supermarket expansion in developing countries during 1990-2015. The first part of the analysis focuses on the importance of local constraints for the impact of supermarkets on agriculture. We compare a well-developed agricultural sector to a scenario where farmers face constraints related to production capacity (credit access, level of education/skills, irrigation etc.) and market access (infrastructure, electricity, communication facilities etc.). In the model this is captured via the agricultural skill ratio, which can be seen as a broad measure of the level of development in agriculture. In line with the conflicting results in the empirical literature, we find that multinational supermarket chains represent both challenges and opportunities for local farmers. Depending on the extent of local constraints, farmers either benefit from supermarkets through productivity spillovers and increased demand, or they get stuck in a low productivity trap with limited interaction with the supermarket sector.

In the second part of the analysis, we show that supply chain development initiated by supermarkets can help farmers escape the low productivity trap. There is positive interaction between local agriculture and supermarkets; they benefit from each other. Supermarkets face a short run cost, but gradually gain from more productive local suppliers. Compared to the case without agricultural skill upgrading, supermarkets over time obtain a larger market share and are more dependent on local farmers. This suggests that when farmers do not meet the required standards, supermarkets have an incentive to invest in farm assistance programs that improve the productivity of its local suppliers. In light of the present analysis, entry of supermarket chains in developing countries represents an important contribution to agricultural productivity improvement, either

directly, through backward productivity spillovers, or indirectly, through farm assistance programs.

The rest of the paper is organized as follows. Section 2 offers an overview of the existing literature on supermarket expansion in developing countries. Section 3 presents the modeling of the productivity linkage between supermarkets and local farmers, while the main elements of the intertemporal general equilibrium model are given in section 4. The impact of an expanding supermarket sector, and in particular the effect of local constraints, is analyzed in section 5. Section 6 shows the consequences of supply chain development initiated by supermarkets for both local farmers and the supermarket sector. Section 7 offers concluding remarks.

2. The literature on supermarket expansion in developing countries

Reardon et al. (2003) analyze the pattern of supermarket diffusion in Africa, Asia and Latin America. The expansion started in major cities in the richest countries of Latin America, followed by East and Southeast Asia, before spreading to poorer countries and neighborhoods in the two regions. More recently, the supermarket sector is expanding in Eastern and Southern Africa, but so far, it is dominated by regional, and not multinational, chains.

In Latin America the average supermarket share of food sales increased from 10-20% in 1990 to 50-60% in 2000. This corresponds to a change in the retail sector that took about 50 years in the US (Reardon and Berdegue, 2002).[2] The expansion of supermarkets in Asia has in general been similar to the Latin American case, but the take-off started 5-7 years later (Reardon et al., 2003). According to Dries et al. (2004) the supermarket share in Central and Eastern Europe grew from about 5% in the mid-1990s to 40-50% in 2003 in 'first-wave' countries (Poland, Hungary, the Czech Republic), to 20-40% in 'second-wave' countries (Croatia, Romania, Bulgaria), and to 10% in 'third-wave' countries

[2] Latin American countries are of course at different stages of the supermarket expansion. In Argentina the supermarket share increased from 34% in 1990 to 58% in 1999 (Rodriguez et al., 2002). In Guatemala the share increased from 15% in 1994 to 36% in 2002 (Hernandez et al., 2007).

(Russia). The rise of supermarkets in Africa is driven by South Africa and Kenya, but is gradually spreading to poorer countries as well. In South Africa the importance of supermarkets has been steadily rising since the end of Apartheid in 1994. Today, the supermarket sector accounts for about 55% of output in the food retail sector (Weatherspoon and Reardon, 2003). The supermarket sector in Kenya has grown rapidly since the mid 1990s and accounts for about 20% of food sales in 2003 (Neven and Reardon, 2004).

Traill (2006) analyzes the determinants of the supermarket expansion by applying cross-country regressions of 42 developed and developing countries. On the demand side, urbanization, higher income and a growing middle class are important factors, while reduction of foreign direct investment regulations is the main driver on the supply-side.[3] Based on the estimated relationship between the share of supermarkets in food retail and its main drivers of change, Traill offers projections of the spread of supermarkets to 2015. The results suggest that the supermarket expansion will continue, but not at an explosive rate. The projections for Latin American countries as well as 'first-wave' countries in Central and Eastern Europe lie in the range 40-70%.[4]

The impact of the supermarket expansion on agriculture is discussed in the literature, but there is no conclusive census among scholars. Empirical analyses tend to find that farmers supplying supermarkets are more productive than other farmers. But entry costs related to production capacity exclude many farmers from the supermarket supply chain. A special issue of *Development Policy Review* focuses on the implications of a rising supermarket sector in Latin America. The key findings are summarized in the overview article by Reardon and Berdegue (2002). The evidence is mixed, but suggests that small farmers are often excluded because they are not able to meet the quality and safety demands of supermarkets.

[3] These determinants of rising supermarkets are also emphasized by Reardon and Berdegue (2002) and Reardon et al. (2003).

[4] The projections are based on the expected development of income per capita and the urbanization rate, while the degree of openness is held at the 2002 level. The potential for supermarket expansion is somewhat larger when the economies are assumed to be completely open by 2010, but the projected shares are still below 80%.

Hernandez et al. (2007) focus on the farmer's choice between the traditional market channel and the supermarket channel, and the implications of the choice. Data on tomato growers in Guatemala shows that farmers supplying supermarkets both had more irrigation initially and also invested more in irrigation over time than farmers in the traditional channel. This has implications for product quality and productivity. The results suggest that the most capital-intensive farmers benefit from the supermarket channel, while entry costs prevent some small farmers from joining the new supply chain. Neven et al. (2006) find similar results in an analysis of the Kenyan supermarket sector. Labor productivity is about 70% higher among supermarket-channel farmers than among farmers that supply traditional retail. But a threshold level of capital (related to the access to transportation and irrigation) is necessary to supply supermarkets, and hinders the entry of some farmers to this supply chain.

Based on survey data from several Eastern European countries, Swinnen et al. (2006) find that foreign direct investment in the dairy sector has contributed to contracting and vertical coordination with farmers. Evidence show that both small and large farmers benefit from the entry of foreign retail chains. Better access to inputs, timely payments, and new investments has increased output, productivity and product quality in the farm sector. According to the empirical analysis of Minten et al. (2008), small contract farmers in Madagascar benefit from producing vegetables for supermarkets in Europe. The evidence points to higher welfare, more income stability and higher productivity. Extensive farm assistance programs contribute to this outcome.

Entry of global supermarkets chains has consequences not only for local intermediate suppliers, but also for the rest of the food retail sector. Traditional retailers (small shops and public markets) face increased competition and potentially loss of market share, but may benefit from foreign supermarkets through spillover effects of the latest retail techniques. Large supermarket chains are also likely to affect the average retail prices in the markets they enter. These issues are studied by Basker (2005, 2007) for the case of Wal-Mart, but are beyond the scope of the present paper.

3. The productivity linkage between supermarkets and local suppliers

As discussed in the previous section, empirical analyses find that farmers in the supermarket supply chain are more productive than traditional farmers. Delivering goods to supermarkets generates productivity improvements through backward linkages. The understanding is that higher quality and safety demands combined with increased competition from foreign farmers give a positive productivity effect. In the model specification we capture the productivity linkage between supermarkets and local suppliers by endogenizing productivity growth in commercial agriculture. Productivity improvements are related to the gap to the world technology frontier, the degree of interaction with the supermarket sector, and the level of domestic barriers.

The starting point of the productivity specification is the technology gap formulation offered by Nelson and Phelps (1966), and recently modified by Benhabib and Spiegel (2005). Developing countries must link up to the world technology frontier for productivity growth since they have limited capacity for own innovation. Adoption of foreign technology is related to the technological distance to the world frontier, which represents the learning potential. Cross-country evidence about the importance of the world technology frontier is supplied by Benhabib and Spiegel (1994, 2005), Caselli and Coleman (2006), and Griffith et al. (2004). Cameron et al. (2005) document a positive and significant effect of the technological distance to the frontier on productivity growth in UK manufacturing industries. Cameron (2005) finds similar results for Japanese productivity growth.

Findlay (1978) emphasizes the importance of technological contagion to benefit from the technology gap, and relates technology transfer to the degree of foreign direct investments (FDI) in the domestic economy. There is a broad empirical literature on productivity effects of FDI. Javorcik (2004) applies firm-level data from Lithuania during 1996-2000 and offers empirical support for the existence of backward productivity spillovers from FDI. Girma et al. (2008) find similar results in an analysis of UK

manufacturing industries. The empirical studies referred to in section 2 (for instance Minten et al., 2008) show that backward productivity spillovers also apply to the agricultural and food sector. Supermarkets in developing countries are mainly global chains, and in this respect their entry represents foreign direct investment and acts as a transmission channel of foreign technology.[5]

The empirical literature suggests that local barriers related to production capacity and market access might exclude farmers from the supermarket supply chain. We take this into account by including a broad measure of domestic barriers in the productivity specification, measured by the share of skilled workers in commercial agriculture. [6]

We specify productivity growth in commercial agriculture in period t ($\hat{A}_{c,t}$) as follows:

$$\hat{A}_{c,t} = \lambda B_t^{\theta_1} \left(\frac{ND_t}{N_t} \right)^{\theta_2} \left(1 - \frac{A_{c,t}}{A_t^*} \right) \quad (1)$$

where $A_{c,t}$ and A_t^* represent the productivity levels of commercial agriculture and the world technology frontier, respectively, $\frac{A_{c,t}}{A_t^*}$ is relative productivity, and B_t is the level of domestic barriers. The productivity linkage to supermarkets is captured by the degree of interaction at the intermediate market. ND_t is intermediate deliveries from domestic commercial farmers to supermarkets, while N_t is total intermediate demand by the supermarket sector.[7] λ, θ_1 and θ_2 are constant parameters.

The productivity dynamics are illustrated in Figure 1. The horizontal axis shows the relative position to the world frontier, while the productivity growth rate is given on the

[5] According to data on Latin American countries the average share of multinationals in the supermarket sector is 56%, and about 60-80% of the top five supermarket chains are global multinationals (Reardon and Berdegue, 2002).

[6] The supply of rural skilled labor grows at an exogenous rate and is only applied in commercial agriculture. The supply of unskilled rural labor also grows at an exogenous rate, but it is endogenously allocated between the two agricultural sectors based on marginal productivities. This implies that the skill ratio in commercial agriculture is endogenously determined. See section 4 for further descriptions of the labor markets in the model.

[7] A related specification with productivity spillovers from the export sector to its intermediate suppliers is applied by Diao et al. (2006) for the case of Thailand.

vertical axis. The further to the left the economy is positioned, the larger is the technology gap. Productivity growth at the frontier is set exogenously equal to g. When the productivity growth rate in commercial agriculture exceeds the growth rate of the frontier, the sector is catching up and the gap decreases. Equivalent, lower productivity growth than the frontier increases the gap, as illustrated with arrows in the figure.

Figure 1 about here.

The productivity dynamics may generate both technological catching up and divergence (illustrated by curve *i* and *ii*, respectively). The extent of productivity spillovers is determined by the degree of interaction with supermarkets, while the ability to take advantage of these spillovers depends on the level of domestic barriers. With strong links to the supermarket sector and/or low domestic barriers, the productivity dynamics are consistent with technological convergence. Long-run productivity growth is given by the exogenous growth rate of the world frontier, and the technology gap is constant (marked as $(A_c/A^*)^E$ in Figure 1). The degree of catch-up depends on the extent of barriers and the linkage to the supermarket sector. Lack of interaction with supermarkets and/or high domestic barriers may generate technological divergence with increasing technology gap over time. Since the level of barriers and the degree of interaction with supermarkets are endogenous, switching between the two development paths is possible.

4. A Ramsey model of an archetype developing economy[8]

To study the impact of an expanding supermarket sector on local agriculture the productivity dynamics are placed in an intertemporal general equilibrium setting. The main advantage of this methodology is to separate between short-run and long-run effects, and to clarify the adjustment mechanisms involved. Existing Ramsey analyses with focus on agricultural issues typically model the interaction between a traditional agricultural sector and a modern industrial sector (see for instance Love, 1997; Stifel and

[8] This section presents the main equations of the model, while the full model documentation is given in a separate appendix available from the author.

Thorbecke, 2003). General equilibrium modeling of supermarkets and local agriculture is scarce, and the recent contribution by Roe and Diao (2004) is the only analysis to our knowledge. In a Ramsey growth framework they show that the supermarket expansion can be understood as a natural process of economy-wide economic growth. The results are driven by differences in capital intensity between supermarkets and the traditional food retail sector. The analysis includes a vertical linkage between the retail sector and agriculture in the sense that commercial farmers deliver goods to supermarkets, while traditional farmers supply the traditional retail sector. But the analysis does not capture the potential productivity linkage between supermarkets and commercial agriculture, which is the main focus of the present paper. The importance of agricultural productivity for overall economic growth is illustrated by Irz and Roe (2005), while Diao et al. (2005) discuss the interplay between productivity and capital accumulation.

The model represents an archetype developing economy with duality in both agriculture and the food retail sector. The economy is disaggregated into five sectors: Traditional and commercial agriculture, traditional and modern food retail sectors, and the rest of the economy. The modern food retail sector includes supermarkets, large discount stores and hypermarkets (to simplify the notation we use the term 'supermarkets'), while the traditional food retail sector consists of small shops and public markets. We separate between rural and urban labor, where the first is employed in agricultural sectors and the second in the three other sectors. Since the focus of the analysis is on agriculture the rural labor force is further divided into skilled and unskilled workers.

Traditional and commercial agriculture differ with respect to skill level, extent of foreign competition and potential markets. We assume that traditional farmers only supply the traditional food retail sector. Commercial farmers deliver goods to both traditional retail and supermarkets, and face competition from foreign farmers. The specification is consistent with farm surveys in Guatemala showing that one group of farmers supply only traditional retail, while another group of farmers supply both traditional retail and supermarkets (Hernandez et al., 2007). The supermarkets' choice between domestic commercial farmers and foreign suppliers is endogenously determined, and depends on

factors like relative productivity and relative prices. The model specification captures the endogenous dynamic interaction between supermarkets' choice of suppliers and agricultural productivity. The productivity of farmers increase with their interaction with supermarkets, and at the same time, more productive local farmers decrease the supermarkets' dependence on foreign suppliers.

Value added in traditional and commercial agriculture ($X_{i,t}$) is specified as follows:

$$X_{a,t} = A_{a,t}^{\alpha_1} AD_{a,t}^{\alpha_2} Lu_{a,t}^{\alpha_1} LD_{a,t}^{\alpha_2} K_{a,t}^{\alpha_3} \tag{2}$$

$$X_{c,t} = A_{c,t}^{\beta_1+\beta_2} AD_{c,t}^{\beta_3} Lu_{c,t}^{\beta_1} Ls_t^{\beta_2} LD_{c,t}^{\beta_3} K_{c,t}^{\beta_4} \tag{3}$$

where $Lu_{i,t}$ and Ls_t are unskilled and skilled rural labor, respectively, $LD_{i,t}$ is land, and $K_{i,t}$ is capital ($i = a, c$). The subscripts a and c represent traditional and commercial agriculture, respectively. Unskilled rural labor is perfectly mobile and is allocated between the two agricultural sectors based on marginal productivities, while skilled rural labor is only employed in commercial agriculture. Given aggregate land supply being constant over time, exogenous land augmenting technical change ($AD_{i,t}$) is assumed in order to have balanced growth in the long run. As explained in the previous section, labor augmenting technical progress in commercial agriculture ($A_{c,t}$) is endogenized to capture the potential productivity linkage with supermarkets. In all other sectors productivity grows exogenously at the long run rate.

Consumption goods are produced by the food retail sectors and the rest of economy, while capital is produced in the rest of the economy. Value added in the food retail sectors and the rest of the economy is specified as Cobb-Douglas functions of urban labor ($L_{j,t}$) and capital ($K_{j,t}$):

$$X_{j,t} = A_{j,t}^{\gamma_j} L_{j,t}^{\gamma_j} K_{j,t}^{1-\gamma_j} \qquad j = m, tr \tag{4}$$

$$X_{s,t} = cst_t A_{s,t}^{\gamma_s} L_{s,t}^{\gamma_s} K_{s,t}^{1-\gamma_s} \tag{5}$$

where the subscripts m, tr and s represent the rest of the economy, traditional retail, and supermarkets, respectively. The production function for supermarkets takes into account the potential costs related to supply chain development. If local farmers do not meet the required standards, supermarkets may contribute to skill upgrading in agriculture so that

the supply of rural skilled workers temporarily grows at a higher rate than the long-run growth rate. Costs related to supply chain development depends on the growth rate of rural skilled labor ($\hat{Ls}_t$) relative to the long-run labor growth rate (n):

$$cst_t = \left(\frac{n}{\hat{Ls}_t} \right)^{\nu} \tag{6}$$

where ν is a constant parameter. We do not consider the case of skill downgrading, so $cst_t \leq 1$ and gives the share of supermarket production value remaining after costs to supply chain development are paid. If supermarkets invest in agricultural skill upgrading, $cst_t < 1$ and the value of production in supermarkets decreases. The lower cst_t is, the higher are the skill upgrading costs.

The retail sectors and traditional agriculture are non-traded, and the price levels are determined endogenously at the domestic market. The rest of economy good and the commercial intermediate good are imported, and the modeling assumes imperfect substitution between domestic and foreign goods through an Armington composite system. To simplify the analysis agricultural exports are ignored. All exports are done by the rest of economy sector, where we assume imperfect substitution between sales to domestic markets and export markets.

The economy faces a perfect capital market with the interest rate exogenously given from the world market. Investments can be financed through foreign borrowing, and the decisions about savings and investment can therefore be separated, although with a long-run restriction on foreign debt. Increase in foreign capital inflows (i.e., trade deficits) in the current period, together with interest payments on existing debt, augments foreign debt in the next period.

The representative household receives income from labor, capital and land, and pays interests on its foreign debt. Within-period consumption is modeled through a Stone-Geary demand system with minimum consumption levels for each good. In this way the household has non-homothetic preferences, and the income elasticity may differ between

goods. Aggregate consumption (beyond minimum consumption) for each time period is defined as:

$$Q_t = cs \cdot \prod_j (C_{j,t} - \bar{C}_j)^{\alpha c_j} \qquad j = m, s, tr \tag{7}$$

where $C_{j,t}$ is consumption of each final good and $\bar{C}_j$ is the minimum consumption level. αc_j and cs are constant parameters.

It follows that the household demand for each commodity is given by:

$$P_{j,t} \cdot (C_{j,t} - \bar{C}_j) = \alpha c_j \cdot PQ_t \cdot Q_t \qquad j = m, s, tr \tag{8}$$

In the model calibration the minimum consumption level is assumed to be relatively higher for traditional retail goods, which means that the income elasticity is lower here. When the income increases, demand is gradually shifted towards goods from the supermarket sector and the rest of economy at the cost of traditional retail goods. As illustrated by the numerical simulations the change in the consumption pattern drives the expansion of the supermarket sector.

The household is forward looking and maximizes an intertemporal utility function subject to the intertemporal budget constraint:

$$Max \ \sum_{t=1}^{\infty} (1+\rho)^{-t} U(Q_t) \tag{9}$$

$$s.t. \sum_{t=1}^{\infty} (1+r)^{-t} \left(PQ_t \cdot Q_t + \sum_j P_{j,t} \bar{C}_j \right) = \sum_{t=1}^{\infty} (1+r)^{-t} \left(Y_t - SAV_t \right) \tag{10}$$

Assuming constant intertemporal elasticity of substitution, the isoelastic utility function is defined as $U(Q_t) = \frac{Q_t^{1-1/\sigma}}{1-1/\sigma}$, where Q_t is aggregate household consumption beyond minimum consumption in period t and σ is the intertemporal elasticity of substitution. Y_t is household income, SAV_t is private savings, PQ_t is the aggregate price, r is the exogenous world market interest rate and ρ is the positive rate of time preference. The utility maximization gives the Euler equation for optimal allocation of consumption over time:

$$\frac{Q_{t+1}}{Q_t}\frac{PQ_{t+1}}{PQ_t} = \left(\frac{1+r}{1+\rho}\right)^{\sigma} \tag{11}$$

Consumption growth depends on the interest rate, the time preference rate, the intertemporal elasticity of substitution, and the price path.

The capital stock is managed by an independent investor who makes its investment decision based on intertemporal profit maximization, subject to the accumulation of the capital stock over time:

$$\underset{I,K}{Max} \sum_{t=1}^{\infty}(1+r)^{-t}\left[Rk_t \cdot K_t - (P_{m,t} \cdot I_t + ADJ_t)\right] \tag{12}$$

$$s.t.\ \ K_{t+1} = K_t \cdot (1-\delta) + I_t \tag{13}$$

where Rk_t is the capital rental rate, K_t is the aggregate capital stock, I_t is investment, $P_{m,t}$ the price for the good produced by the rest of economy, ADJ_t is investment adjustment costs, and δ is the rate of depreciation. Following the common practice in the literature, unit adjustment costs are specified as a positive function of the investment-capital ratio. Hence, total adjustment costs are given as:

$$ADJ_t = \mu \cdot P_{m,t} \cdot \frac{I_t^2}{K_t} \tag{14}$$

where μ is a constant parameter.

Differentiating the intertemporal profit function with respect to capital gives the following no-arbitrage condition:

$$rq_{t-1} = Rk_t + P_{m,t} \cdot \mu \cdot \left(\frac{I_t}{K_t}\right)^2 - \delta \cdot q_t + \dot{q} \tag{15}$$

Equation (15) states that the marginal return to capital must equal the interest payments on a perfectly substitutable asset with a value of q_{t-1}, where q is the shadow price of capital. The first term on the right-hand side is the capital rental rate, while the second term is the partial derivative of the adjustment cost function with respect to capital. The marginal return to capital must be adjusted by the depreciation rate and by the capital gain or loss, $\dot{q}$.

Given strong linkage between supermarkets and local suppliers and/or low domestic barriers, the long-run equilibrium is characterized by balanced growth. The growth rate is exogenously given as the sum of the rate of labor augmenting technical progress and the labor growth rate, while transition growth is endogenous. The capital stock and the foreign debt both grow at the constant rate in the long run. Productivity growth is given by the exogenous growth rate of the world technological frontier, and the technology gap is constant. The degree of catch up in commercial agriculture depends on the level of barriers and the extent of spillovers from the supermarket sector. These dynamics are consistent with the common understanding that differences in income and productivity levels are permanent, while differences in growth rates are transitory (Acemoglu and Ventura, 2002).

5. Supermarket expansion and local constraints

Based on the general equilibrium model developed in the previous section we study the impact of an expanding supermarket sector on local agriculture, and in particular focus on the importance of local constraints. The analysis offers numerical simulations of two cases dependent on the level of development in agriculture. The first scenario represents an economy with a well-developed agricultural sector, while in the second scenario farmers face constraints related to production capacity (credit access, level of education/skills, irrigation etc.) and market access (infrastructure, electricity, communication facilities etc.). In the model this is captured via the agricultural skill ratio, which can be seen as a broad measure of the level of development in agriculture. The aggregate skill ratio is exogenous and is set to 25% and 3% in the well-developed and domestic constraints scenario, respectively.[9]

[9] Rural skilled labor is employed in commercial agriculture only, while rural unskilled labor is allocated between the agricultural sectors based on marginal productivities. This implies that even though the aggregate rural skill ratio is exogenous, the skill ratio in commercial agriculture (which affects productivity) is endogenous. Inflows of poorly educated workers from traditional agriculture lower the skill ratio and increase the barriers to technology adoption in commercial agriculture.

The model is calibrated based on a prototype Social Accounting Matrix (SAM) for a developing economy. [10] Since the SAM represents the long-run equilibrium it reflects an economy with an established supermarket sector. Supermarkets account for 80% of the food retail sector, which is broadly consistent with the current share in many Western European countries. Following data in Roe and Diao (2004), the supermarket sector is assumed to be more capital intensive than the traditional retail sector. The model parameters are consistent with long run equilibrium, where the long run growth rate is assumed to equal 4% (2% technological progress rate and 2% labor growth[11]). The long run growth path must be consistent with the macroeconomic equilibrium as represented by the Euler equation: $r = (1+\rho)(1+g+n)^{1/\sigma} - 1$, where $g+n$ is the exogenous long-run growth rate.

Along the steady state path growth and relative productivity are constant, and the economic structure is stable. To get transition dynamics the initial capital and productivity levels are scaled down. This takes the economy outside the steady state path, and economic growth and structural change are driven by endogenous adjustment back to equilibrium growth. We focus on a 25-year period, and parameters are set to reproduce the observed and projected supermarket expansion in developing countries during 1990-2015.

Along the transition path the supermarket sector is expanding, and contributes to a structural shift away from traditional food retail. Supermarkets initially account for 23% of total retail production, but increase its market share to about 65% during 25 years.[12] This development is broadly consistent with the supermarket expansion seen in many Latin American and Eastern European countries since 1990, and projected to 2015 by Traill (2006). In the model simulations the expansion of supermarkets is driven by both demand and supply factors. The demand side effect follows from non-homothetic

[10] The calibration and the SAM are documented in a separate appendix available from the author.
[11] The assumption of 2% labor growth is consistent with data on average annual population growth in low income countries during 1991-2006 (World Bank, 2007).
[12] These numbers correspond to the scenario with well-developed agriculture. In the alternative constraint scenario supermarkets initially account for a smaller share of food sales, but the degree of expansion over time is about the same (from 10% to 60% over 25 years).

preferences. The demand for the traditional retail good is income inelastic, and the share of the traditional good in total consumer spending is gradually declining from 50% to 20%. The consumption share of the rest of economy good is constant over time at 40%, while the share going to supermarket goods increases from 10% to 40% during 25 years. At the supply side capital accumulation above steady state rate generates decreasing capital rental rate, while the wage rate is increasing at above steady state rate. Since the supermarket sector is relatively more capital intensive than traditional retail, it benefits from relatively lower unit costs.

In the first scenario the agricultural sector is well-developed and local constraints related to market access and production capacity are limited. In this case, commercial agriculture takes advantage of the productivity spillovers from the expanding supermarket sector, and experiences technological catch-up. The labor augmenting technical progress rate is initially 3.7%, which is well above the frontier rate of 2%. As the commercial sector catches up relative to the world technological frontier, the productivity growth rate gradually decreases due to lower learning potential, consistent with standard technological convergence theory. During 25 years the average labor augmenting technical progress rate equals 3.2%, which corresponds to total factor productivity (TFP) growth of 1.6%.[13]

The degree of catch-up depends on the sector's absorptive capacity, which is measured by the skill-ratio in commercial agriculture and the interaction with supermarkets at the intermediate market. Supermarkets choose between domestic and foreign farmers as intermediate suppliers. Over time, foreign intermediate goods become relatively less expensive, but this is counteracted by the increase in relative productivity of domestic farmers. Domestic commercial farmers account for 65-75% of intermediate deliveries during the entire period of study. The strong linkage with the supermarket sector stimulates productivity spillovers and strengthens the degree of catch-up. Higher productivity growth together with increasing demand from supermarkets generates a structural shift from traditional to commercial agriculture, which implies movements of

[13] The average TFP growth rate is calculated based on a labor share of 0.5 in commercial agriculture.

unskilled labor towards commercial agriculture.[14] Since the supply of skilled labor grows at a constant rate, inflows of unskilled labor lowers the skill ratio in commercial production from 77% to 52% along the transition path. This decreases the sector's ability to take advantage of productivity spillovers, and limits the degree of catch up towards the world frontier. Hence, the two factors affecting absorptive capacity work in opposite directions, but the net effect is an increase in commercial productivity relative to the productivity level at the world frontier from 33% to 44% (illustrated in Figure 2).

Figure 2 about here.

So far we have seen that when the agricultural sector is well-developed, commercial farmers benefit from an expanding supermarket sector through productivity spillovers and increased demand. To identify the importance of local constraints for the impact of supermarkets on agriculture we compare this to a scenario with lower agricultural development level. In this second scenario commercial farmers face constraints related to production capacity and market access (modeled as lower rural skill ratio).

Local constraints act as entry costs and prevent local farmers from taking advantage of the productivity linkage to the supermarket sector. They get stuck in a low productivity trap with technological divergence, as illustrated in Figure 2. The average labor augmenting technical progress rate equals 1.7% (corresponding to TFP growth of 0.85%) and relative productivity falls from 33% to about 30% during 25 years. Compared to the scenario with a well-developed agricultural sector, the average annual productivity growth rate has dropped 1.5%-points, and the 2015 productivity level relative to the world frontier is 14%-points lower. The productivity growth rate is initially higher than the world frontier rate, but decreases over time (see Figure 3 in section 6). We observe an endogenous switch from the high-growth catching up path to the low growth divergence path driven by a gradual decline in the sector's absorptive capacity. The commercial skill ratio is relatively low and falls over time due to inflows of unskilled traditional farmers.

[14] The commercial sector increases its share of agricultural production from 25% to about 60% along the transition path.

The relative price of foreign intermediate goods decreases over time and the technology gap between domestic and foreign farmers increases (technological divergence). Based on this, supermarkets become increasingly dependent on foreign intermediate goods. The share of intermediate deliveries from domestic commercial farmers decreases from about 60% to 35% (see Figure 4 in section 6), and this further weakens the commercial sector's chances of escaping the low productivity trap.

Based on numerical simulations, we have seen how the agricultural level of development affects the impact of supermarket expansion on local farmers. Depending on the extent of local constraints related to market access and production capacity, entry of supermarket chains may be good or bad news for agriculture. With limited constraints, there is positive dynamic interaction between local farmers and the supermarket sector. Farmers benefit from the supermarket expansion through productivity spillovers and increased demand, while supermarkets take advantage of relatively productive local suppliers. When the agricultural sector is less developed and faces local constraints, farmers do not meet the required standards of supermarkets and get stuck in a low productivity trap with technological divergence. In this case, supermarkets are highly dependent on foreign intermediate suppliers. The mechanisms emphasized in this section offer a possible understanding of the conflicting evidence in the empirical literature with respect to the impact of supermarkets on local agriculture.

6. Supply chain development initiated by supermarkets

The starting point of this section is a less developed agricultural sector where farmers face constraints with respect to production capacity and market access. Local farmers are stuck in a low productivity trap, and supermarkets are highly dependent on foreign suppliers (as illustrated in the previous section). To avoid transportation costs related to the use of foreign intermediate goods, supermarkets have an incentive to improve the productivity of local farmers. Supply chain development driven by the supermarket sector may include sub-contracting, training, credit access and improvement of organizational structure, among other factors. Farm assistance programs obviously involve costs for the

supermarkets. In this section we identify the consequences of such investments for both supermarkets and local farmers. Supply chain development is modeled as an exogenous increase in the agricultural skill ratio, from an initial level of 3% which stabilizes at 25% after 30 years. To quantify the macroeconomic effects of agricultural skill upgrading, we compare this scenario to the local constraints case where the skill ratio is constant at 3%.

The impact on productivity growth in commercial agriculture is illustrated in Figure 3. Supply chain development lowers the barriers to learning and improves the commercial sector's ability to benefit from productivity spillovers. Without skill upgrading the sector is stuck in a low productivity trap with technological divergence (see also Figure 2 in section 5). When supermarkets contribute to supply chain development the productivity growth rate gradually increases and we observe technological catch-up towards the world frontier. Relative productivity increases from an initial level of 33% to 38% after 25 years, compared to 30% in the case without skill upgrading. As seen in Figure 4, the improvement in the relative productivity of domestic farmers affects the supermarket's choice of intermediate suppliers. With supply chain development the shift towards foreign suppliers is avoided and the dependence on local farmers remains high throughout the period (above 60%). This further strengthens the linkage between supermarkets and commercial agriculture, and contributes to the growth out of the low productivity trap.

Figure 3 and 4 about here.

It is not surprising that commercial farmers benefit from farm assistance programs initiated by supermarkets. The consequences for the supermarket sector are more complicated. One the one hand, agricultural skill upgrading involves costs[15], but on the other hand, supermarkets may benefit from more productive local farmers. Figure 5 illustrates the market share of supermarkets in food retail production in the two scenarios. While supply chain development implies a short run cost, supermarkets gradually gain from more productive local suppliers. The supermarket expansion is initially held back

[15] See equations (5) and (6) in section 4.

by increased costs, but the long-run effect of agricultural skill upgrading is positive for the supermarket sector. After 25 years the market share is about 6 percentage points higher than in the scenario without skill upgrading. This shows that supermarkets benefit from more productive commercial farmers domestically, and supports the assumption that the sector has an incentive to invest in programs that improve the productivity of its local suppliers.

Figure 5 about here.

The main findings in this section are consistent with existing empirical evidence. Weatherspoon and Reardon (2003) discuss the procurement system of South African supermarket chains dominating the African market. First, they find that supermarkets prefer to use large farmers as suppliers, because they are likely to be more productive and familiar with quality and safety standards from own exporting activity. When such large suppliers are not available and small farmers do not meet the required standards, supermarkets tend to import necessary intermediate goods. Second, the analysis supports the skill upgrading incentive of the supermarket sector: "Where projects can be put in place to 'upgrade' the small farmers to meet the needs of supermarkets, the chains appear to be eager to participate in these schemes" (page 352). As discussed by Minten et al. (2008), the agricultural sector in Madagascar is characterized by significant local constraints including bad infrastructure, low rural education, and high transaction costs. Their analysis shows that farm assistance programs have made farmers capable of supplying foreign supermarkets. Dries and Swinnen (2004) find that contracting and supplier assistance programs led to improvements in investments, productivity and product quality of small farmers in the dairy sector in Poland. The analysis documents a positive interaction between the foreign company and local suppliers, consistent with the results in the present paper.

7. Conclusion

As part of the globalization process, multinational supermarket chains enter the markets of developing countries, both in Latin America, Asia and most recently in Africa. There is no consensus in the empirical literature on the consequences for the agricultural sector. Empirical analyses find that supermarkets represent both opportunities and challenges for local farmers. In this paper we quantify the dynamic effects of supermarket expansion on agriculture within a structural framework that clarifies the adjustment mechanisms involved. The model specification takes the potential productivity linkage between supermarkets and local suppliers into account. The understanding is that higher quality and safety demands combined with increased competition from foreign farmers give a positive productivity effect from delivering intermediate goods to supermarkets. While econometric analyses of supermarkets and the productivity of suppliers struggle with causality issues, we analyze the endogenous dynamic interaction between supermarkets' choice of suppliers and agricultural productivity.

Based on numerical simulations, two results emerge. First, the entry of supermarkets in developing countries may be good or bad news for local farmers. Whether farmers benefit from supermarkets or get stuck in a low productivity trap depends on the agricultural level of development and the extent of local constraints related to production capacity and market access. Second, supply chain development initiated by supermarkets can help farmers escape the low productivity trap. Supermarkets face a short run cost, but gradually benefit from the agricultural skill upgrading in terms of increased market share. This suggests that when farmers do not meet the required standards, supermarkets have an incentive to invest in farm assistance programs that improve the productivity of its local suppliers. The main findings are consistent with case studies in the literature.

This analysis has focused on the potential productivity gain from delivering intermediate goods to multinational supermarket chains. Based on the productivity linkage between supermarkets and local farmers we are able to explain the conflicting results in the empirical literature. Depending on the extent of domestic constraints, farmers either

benefit from supermarkets through productivity spillovers and increased demand, or they get stuck in a low productivity trap with limited interaction with the supermarket sector. Of course, other factors than the productivity linkage might be important to identify the full effect of supermarket expansion on local agriculture. Future research should take other mechanisms into account and quantify the relative importance of the productivity channel.

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Figure 1: Productivity dynamics.
i) Strong links with supermarkets and/or low barriers: Technological catch-up and constant long-run gap
ii) Weak links with supermarkets and/or high barriers: Technological divergence and increasing gap

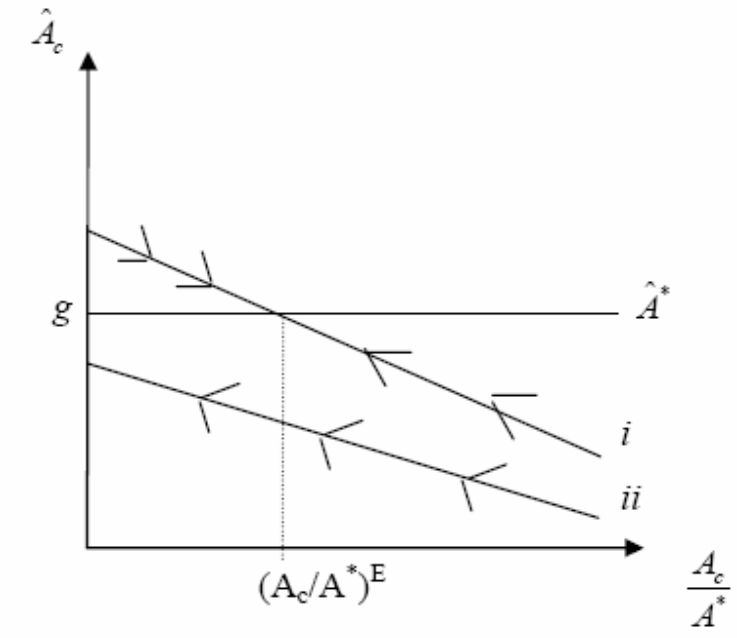

Figure 2. Productivity level in commercial agriculture relative to the world frontier productivity level: Well-developed agricultural sector vs. farmers facing local constraints.

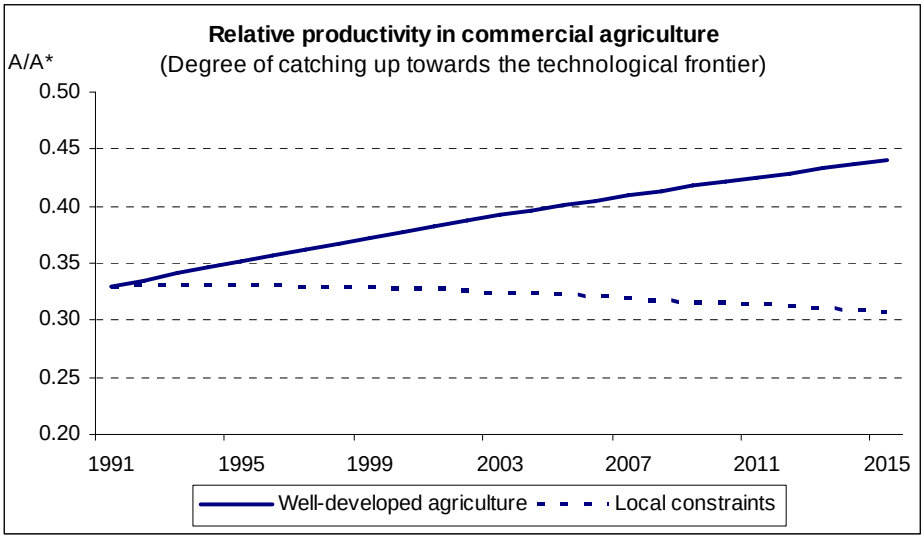

Figure 3. Productivity growth in commercial agriculture: Farmers facing local constraints vs. supply chain development initiated by supermarkets.

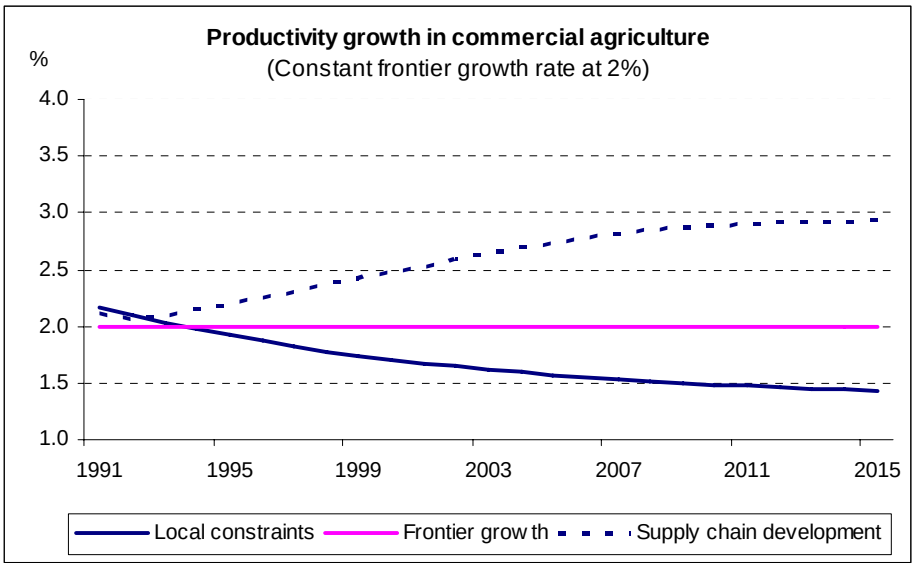

Figure 4. Share of intermediate supply to supermarkets from domestic farmers: Farmers facing local constraints vs. supply chain development initiated by supermarkets.

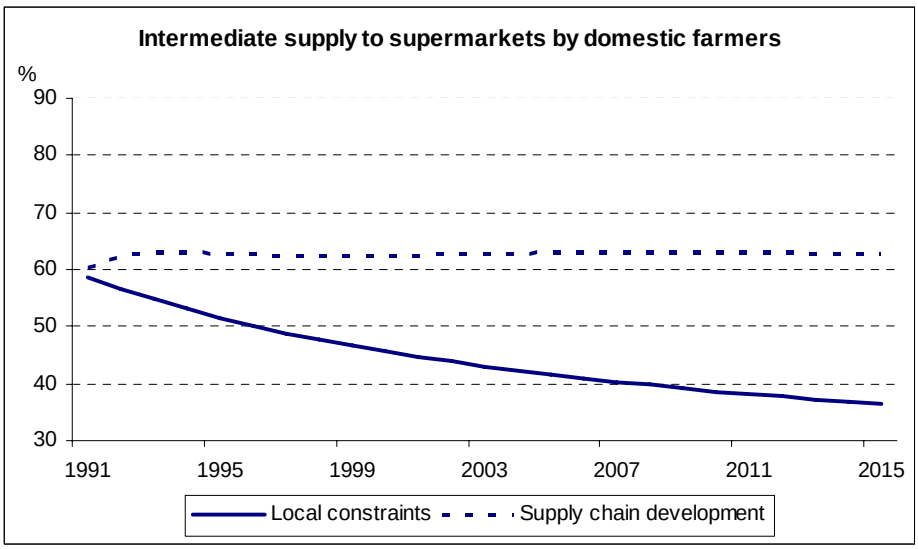

Figure 5. Supermarket expansion: Farmers facing local constraints vs. supply chain development initiated by supermarkets.