A Theory of Standards-Driven Rural Development

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Abstract

Consumers have increasing demands for product standards. This has important implications for development. This paper develops a formal theory of the process of the introduction of high product standards in developing countries. The model endogenizes the introduction of high standards. Initial differences in income, the nature of capital constraints and transaction costs, the initial production structure and policies and institutions are shown to affect the likelihood of and the size of the high standards economy. Initial differences in some of these same factors—as well as inter-country differences in the distribution of the sizes of farmers—are also shown to determine which producers are included, and which not.

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1. Introduction

A series of recent studies have identified the spread of "high standards" as having a fundamental impact on the process of development (Farina and Reardon, 2000; Fulponi, 2007; Henson et al., 2000; McCluskey, 2007; Swinnen, 2007). Demands of well-off consumers for high quality, safety, health and ethical standards put pressure on governments to increase public regulatory standards and on private processing and retailing companies to introduce or tighten private corporate standards. While increased demand for high standards has been a natural consequence of income growth in various parts of the world, it also has been reinforced by several recent events. International campaigns against child labor and the extension of genetically modified food, NGO activities for the environment and several food safety crises, such as the food dioxin crisis and the appearance of BSE in Europe, have contributed to a rising demand for high quality, safe and traceable products in the production chains of many nations.[1]

Although high standards emerged initially in rich countries, they now affect poorer countries through several channels. First, increasing public standards in richer countries are also imposed on imports and consequently have an impact on producers and traders in exporting nations (Jaffee and Henson, 2005; Unnevehr, 2000). Second, global supply chains are playing an increasingly important role in world food markets

[1] This paper focuses on the development implications of changes in the demand for product standards. There are several related areas of the literature on standards, including a.) analyses of asymmetric information problems which may be one of the reasons for companies or public regulators to introduce standards (Fulton and Giannakas, 2004; Gardner, 2003); b.) studies on the role of standards in reducing consumption externalities (Copeland and Taylor, 1995; Besley and Ghatak, 2007); c.) the role of standards in providing non-tariff trade protection (Anderson et al., 2004; Fischer and Serra, 2000); and d) the political economy of standards (Swinnen and Vandemoortele, 2008).

and the growth of these vertically coordinated marketing channels is facilitated by increasing standards (Swinnen, 2005, 2007). For example, modern retailing companies increasingly dominate international and local markets in fruits and vegetables, including those in many poorer countries, and have begun to set standards for food quality and safety in this sector wherever they are doing business (Dolan and Humphrey, 2000; Henson et al., 2000). Third, rising investment in processing and retailing in developing countries also has begun to be translated into higher standards, as buyers are making new demands on local producers in order to serve the high-end income consumers in the domestic economy or to minimize transaction costs in their regional distribution and supply chains (Dries and Swinnen, 2004; Dries et al., 2004; Reardon et al., 2003).

Early academic studies on the development implications of the emergence of modern supply chains focused on two sets of issues. First, researchers were seeking to document the scope of the changes in developing countries. It was argued that the penetration of international marketing chains was much more widespread than people originally thought (e.g. Gulati et al., 2007; World Bank, 2005). Some observers predicted that the implications of these developments would be vast. Others even argued that a new development paradigm was emerging (Reardon and Timmer, 2005). In a standards-driven development process many of the traditional development models are no longer relevant. The original predictions of the effect of the rise of markets on growth and development were no longer valid.

Importantly, the early literature also posited that the rise of standards could have sharp negative influences on equity and poverty. Several of the studies argued that modern supply chains in developing countries would systematically exclude the poor and negatively affect the incomes of small farmers; in other words, it was being

suggested that unlike other waves of rising economic activity, the poor would suffer from this process (Farina and Reardon, 2000). The predictions from these studies included the poorest parts of the world. For example, several studies of farm communities in Latin America and Africa argued that small farmers were being left behind in the supermarket-driven horticultural marketing and trade (Dolan and Humphrey, 2000; Humphrey et al., 2004; Key and Runsten, 1999; Reardon et al., 2003; Weatherspoon et al., 2001). In a study on Kenya, Minot and Ngigi (2004) demonstrated that modern marketing chains put intense pressure on smallholders (although smallholders were still participating). Even more extreme, in the case of Côte d'Ivoire, almost all of the fruit and vegetables being produced for exports were being cultivated on large industrial estates. Likewise, Weatherspoon and Reardon (2003) argued that the rise of supermarkets in Southern Africa failed to help small producers who were almost completely excluded from dynamic urban markets due to quality and safety standards.

While there is fair degree of consensus in the literature about the increasing importance of modern marketing chains that demand producers supply quality and safe products, recent research suggests a more nuanced picture of the effect on poverty and its overall development implications. Dries and Swinnen (2004) find that high standards lead to increased vertical coordination in supply chains that is realized in their study area by the emergence of extensive contracting between processing companies and farmers. The rise of contracting, far from leading to the exclusion of poorer farmers, is shown to improve access to credit, technology and quality inputs for poor, small farmers that heretofore were faced with binding liquidity and information constraints due to poorly developed input markets. Minten et al. (2009) and Maertens and Swinnen (2009) also find increased vertical coordination in newly

emerging supply chains between buyers and poor, small farmers in African countries, such as Madagascar and Senegal. According to their work, poor rural households experienced measurable gains from supplying high standard horticulture commodities to global retail chains. In China Wang et al. (2007) found that while rising urban incomes and emergence of a relatively wealthy middle class were associated with an enormous rise in the demand for fruits and vegetables, almost all of the increased supply was being produced by small, relatively poor farmers that sell to small, relatively poor traders. Despite sharp shifts in the downstream segment of the food chain towards modern retailing (e.g., there has been a rapid increase in the share of food purchased by urban consumers in supermarkets, convenience stores and restaurants), modern marketing chains have almost zero penetration to the farm level. Finally, recent studies also show that, even where large estates are the main local production systems, poor rural households may benefit importantly from modern supply chains through the labor market (Maertens and Swinnen, 2009; Maertens et al., 2008).

While we have learned a lot about the development implications of the emergence of modern supply chains, the literature so far has been almost uniquely empirical. Exceptions are some recent studies on the relationships between the local suppliers and modern processors/retailers in developing countries and their implications for vertical coordination and rent distribution (Marcoul and Veysierre, 2008; Swinnen and Vandeplas, 2007). However these studies do not seek to explain the variations in the structure of the modern supply chains that one observes.

In response to the relative absence of conceptual work, the first objective of our paper is to develop a formal theory of the development process where modern marketing chains and demand signals are directing producers to grow and sell high

quality and safe foods (henceforth, called *standards-driven development*—or SDD). The paper will also use this theory to analyze whether this SDD process may result in different outcomes and have different distributional effects when economies start from different sets of initial conditions. Specifically, we seek to understand if initial differences in income, farm structure, productivity and market imperfections (among other things) affect the emergence of the SDD path and its equity implications. In short, our theoretical model seeks to explain why some countries (or certain regions in a country) have begun to develop a food economy that is governed by high standards and others have not. For those countries that have not entered the process of SDD, the model also offers predications about *when* such a transition may begin.

In the last part of the paper we also analyze which farmers are most likely to be included in the SDD process, and which not. In this part of the paper, we also relate these outcomes to initial conditions of the economy, such as the productivity distribution of farms, and to characteristics of the SDD process, in particular to the nature of the transaction costs involved.

2. The Model

Demand

To model the demand side, we draw upon the vertical differentiation literature.[2] We consider the unit-demand version of the standard vertical product differentiation model whereby each consumer buys at most one unit of the good. The model is

[2] The literature started with papers explaining the emergence of endogenous quality outcomes in monopolized markets (Spence, 1975; Mussa and Rosen, 1978) and in monopolistic competition and oligopoly markets (Gabszewicz and Thisse, 1979; Shaked and Sutton, 1982, 1983; Tirole, 1988). Ellickson (2006) examines vertical differentiation in the context of grocery retailing and Roe and Sheldon (2007) examine labelling and credence features of products using a vertical differentiation model.

adjusted following Moschini et al. (2008) for a limited number of product types and relates income directly to the preferences for quality, following Tirole (1988). [3]

Assume that there are only two types of products with different qualities in this market, a basic *low standards* (ϕ_L) product and a *high standards* ($\phi_H > \phi_L$) product. When both qualities are available, consumers choose among three options:

$$(1) \qquad U = \begin{cases} i\phi_H - P_H & \text{if the high-standard good is bought} \\ i\phi_L - P_L & \text{if the low-standard good is bought} \\ 0 & \text{otherwise} \end{cases}$$

where ϕ_H and ϕ_L are the qualities and P_H and P_L are the unit consumer prices of respectively the high and low standards product; the index $i \in (I-1, I) \subseteq R_+$ represents consumer income. Consumers with higher incomes are assumed to have higher preferences for quality. The distribution of income $F(i)$ is uniform between $I-1$ and I, where the latter is the highest income among consumers. We assume that the distribution of income does not change when income grows so that an increase of aggregate income can be represented by an increase of I.

When both high standards and low standards products are bought by some consumers when available and some consumers buy nothing (i.e., there is an 'uncovered' market), the aggregate market demand functions Q_H^D and Q_L^D are:[4]

$$(2) \qquad Q_H^D = M\left(I - \frac{P_H - P_L}{\phi}\right)$$

[3] Our approach implicitly assumes that the introduction of high standards reflects consumer preferences. Another reason why a company may want to introduce private standards is to reduce transaction costs in sourcing and selling (Henson, 2006; Fulponi, 2007). Since such introduction of private standards for these purposes would also require specific investments by suppliers (hence higher production costs) and (increased) transaction costs for the processors, most of such effects would be similar to the analysis in this paper.

[4] See Moschini et al. (2008) for details.

(3) $$Q_L^D = M\left(\frac{P_H - P_L}{\phi} - \frac{P_L}{\phi_L}\right)$$

subject to $\frac{P_L}{\phi_L} + 1 > I > \frac{P_H - P_L}{\phi}$, where M is the total number of consumers in this economy and $\phi \equiv \phi_H - \phi_L$ represents the quality difference. If $I < \frac{P_H - P_L}{\phi}$ there will be no demand for high standards products $\left(Q_H^D = 0\right)$[5].

Supply

On the supply side, we assume a standard competitive industry populated by numerous producers who behave as price takers. In our model all producers are able to produce either the high standards or the low standards product. To start, we assume that producers are identical. Later in the paper we will relax this assumption and analyze how producer differences affect their integration into the SDD process.

We assume further that producers have a production technology that requires a unit cost c_H and c_L, for the high and low standards product respectively, and that $c_H = c_L + k$, where k is the per unit additional capital costs for producing the high standards product.[6] Finally, for simplicity, we assume that the other costs remain the same and that producers can produce the same number of units of the commodity regardless of whether they produce low standards or high standards commodities.[7]

[5] See Gabszewicz and Thisse (1979) and Tirole (1988) for formal derivations of these conclusions.

[6] We ignore standards uncertainty, so each farm can meet the processor's standards threshold with certainty if it makes a predetermined capital investment. We also ignore issues of contracting and contract enforcement in the HS chain. For more details about this, see Swinnen and Vandeplas (2007) who show that the premium itself will depend on the contract enforcement conditions.

[7] This assumption is consistent, for example, with a farmer who may produce 100 litres of non-cooled, high-bacteria milk if operating in the low standards market or, after an investment in a cooling tank is made, 100 litres of cooled, low-bacteria milk if operating in the high standards market.

Marketing and Trade

Once the products are produced in response to consumer demand, our model needs to account for the transfer of the commodities from farm to plate. For simplicity we assume that one unit of production is identical to one unit at retail (consumer) level for both high and low standards. We use different marketing assumptions for the LS products and the HS products. We assume that producers sell their low standards commodity in villages and city markets at price P_L under perfect competition. For the high standards supply chain, we assume that 'processors' (which may represent any company involved in processing, marketing or retailing) purchase the high standards commodity from producers at price p_H and resell this commodity to consumers at price P_H. We consider that these companies incur a unit transaction cost τ in sourcing from producers. Under perfect competition and free entry and exit for processors, it follows that the consumer price of the commodity is the sum of the producer price and the transaction cost, such that $P_H = p_H + \tau$.[8]

Market Equilibrium

With producers' supply of low and high standards products determined by their respective marginal costs c_L and c_H and the demand functions (2) and (3) we

[8] We ignore 'processing costs' because they only complicate the mathematics but do not affect the conclusions. We also considered an alternative model with a monopolistic market structure in processing. Again, this vastly complicated the model without yielding substantial differences in the key results regarding the issues where this paper focuses on. See Swinnen and Vandeplas (2007) for an analysis of the role and effects of competition in the emergence and growth of a high standards economy.

can derive the market equilibrium level of low standard products $\left(X_L^*\right)$ and high standard products $\left(X_H^*\right)$ as follows:

(4) $$X_L^* = M\left(\frac{k+\tau}{\phi} - \frac{c_L}{\phi_L}\right)$$

(5) $$X_H^* = M\left(I - \frac{k+\tau}{\phi}\right)$$

3. Determinants of the SDD Process

In this section we explain the emergence of the SDD process. To do so, we use the structural relationship embodied in equation (5). Equation (5) is important since it helps identify the connections between a series of the characteristics of the economy/the SDD process to both the existence of (or emergence of) and the size of the high standards economy (HSE). For each of the key variables $\left(I, k, \tau, \phi\right)$ one can identify threshold levels (either minima or maxima) for the HSE to exist, i.e. for $X_H^* > 0$. For positive levels of X_H^*, one can use simple comparative statics to show how the variables affect the size of the HSE, i.e. $\frac{\partial X_H^*}{\partial I} > 0$, $\frac{\partial X_H^*}{\partial k} < 0$, $\frac{\partial X_H^*}{\partial \tau} < 0$, $\frac{\partial X_H^*}{\partial \phi} > 0$ (for $X_H^* > 0$).

Income $\left(I\right)$. The size of the HSE is directly related to the level of income in the economy. A minimum level of income is required $I > \frac{k+\tau}{\phi}$ for a HSE to emerge. Hence, one of the basic results that falls out of our model is the finding that HS markets are more likely to found in developed countries with higher incomes than in poorer countries with lower incomes. Although relatively trivial, it is reassuring that

our model can reproduce one of the most fundamental observed facts. The positive effect of I on X_H^* can also be used to explain the observation that HS production systems tend to emerge first in export sectors in developing countries. For example in many African economies HS production is limited to supply chains targeted to (high income) EU consumer markets while production for domestic markets is limited to LS production.

Capital costs (k). In many developing countries capital constraints are important and the real cost of capital is high. According to our model this is another reason that HS markets are less likely to emerge in developing countries.

The linkage between the cost of capital and the emergence of the HSE also offers an explanation for another empirical observation. There is considerable empirical evidence that vertical coordination (VC) and foreign direct investment (FDI) play an important role in the emergence of HSEs (e.g. Dries and Swinnen, 2004). Processors have developed VC arrangements with supplying farms to provide capital inputs to farms who are capital constrained, either because of the collapse of the financial system (e.g., in transition countries – see Gow and Swinnen, 1998; World Bank, 2005) or because of general credit constraints of farmers in developing countries (e.g., Minten et al., 2009; Maertens and Swinnen, 2009). To set up such VC arrangements, processors themselves need sufficient access to capital. This is why FDI—or other institutional arrangements which enhance the access of processors to capital markets have played an important role. While FDI may have more than one effect on the emergence of a HSE, a crucial element is that, with capital market imperfections in developing countries, foreign companies frequently have lower capital costs (or face less restrictive credit constraints) than domestic companies in developing countries. Because of this, foreign firms may therefore be able to invest,

using lower cost capital when it is not possible for domestic companies to do so.[9] Through VC this, in turn, leads to reduced capital costs for farmers with FDI.

Transaction costs (τ). Higher transaction costs constrain the size (and emergence) of the HSE. It makes sourcing from suppliers more costly and therefore increases the relative cost of the HS products. The different sizes of transaction costs across nations may contribute to explain differences in the emergence and growth of HSEs across nations. While there is a lack of rigorous empirical evidence, differences in the level of transaction costs between Latin America (where there are large, well-endowed growers) and Africa (where most farmers are small, fragmented and poorly connected to domestic markets) may account for the reason that HSEs are much more advanced in Latin America than in Africa (in addition to income differences).

Policies and institutions. While policies and institutions are not explicitly in our model, they do affect the equilibrium indirectly through their effect on the various factors which we have just discussed (and some which we have not yet motivated). Because of space limitations we will not derive these in detail, but a few examples may indicate how an extended version of our model could be used to capture such policy effects. For example, if foreign investment rules were liberalized, they could stimulate the HSE through their effect on the inflow of FDI and reduced capital costs for producers. Public investments in infrastructure and institutions that promote quality control and food safety institutions could stimulate the HSE by reducing transaction costs in the HS market. Economic and institutional reforms could also have non-linear dynamic effects on the HSE if they initially increased the cost of

[9] In some cases, access to capital has also come from (domestic) company investments which have other sources of capital (such as the case of Russia in which there are energy firms that are willing to invest in domestic firms) or through supply contracts with international traders (as in cotton markets in Central Asia—Swinnen, 2007).

capital because of disruptions (as they did during the early years of the transition in Eastern Europe). In the longer run, however, institutional reform reduces the cost of capital as the more efficient, post-liberalization economic system develops. More generally, policies which affect macro-economic uncertainty and the security of property rights for investors are likely to affect the emergence and size of the HSE through their effects on the cost of capital for producers, either directly or through the profitability of VC arrangements.

4. Production Structure, Transaction Costs and HS Integration

In addition to being able to predict the factors that underlie the emergence of the HSE, our model can also be used to gain insights on what types of farmers are most likely to join the HSE (when it emerges) and what types of farmers will likely be left out. As discussed in the introduction, this issue has attracted a lot of policy attention and academic debate. Some studies have argued that smallholders are excluded from HSE due to scale diseconomies and higher transaction costs; others have argued that this is not (necessarily) the case.

The arguments used in the literature are often quite simplistic. In fact, they may also be *too* simplistic. For example, the impact of scale economies is not as trivial as often argued. [10] Scale economies can differ strongly between activities (e.g.

[10] There is an extensive literature showing how farm productivity, and in particular the relationship between size and productivity, tends to differ importantly by commodity (e.g. Allen and Lueck, 1998; Pollak, 1985). For example, while large producers may have scale advantages in land intensive commodities, such as wheat or corn, this is typically much less the case in labor intensive commodities, such as fruits and vegetables. In fact, there are cases in which small-scale producers may have advantages over larger farmers. In the production of some HS commodities, small farmers may have an advantage over larger farmers because of the importance of labor governance and the quality of the labor input. This implies that the inclusion or exclusion of small farms is likely to depend importantly on the type of the commodity. This is consistent with findings from Wang et al. (2007) on China and Minten et al. (2009) on Madagascar who find that smallholders are extensively included in labor intensive fruits and vegetable production.

extensive grain farming compared to intensive vegetable or dairy production). Scale economies also may be influenced by local institutions and market constraints.

While scale economies can be important, in our analysis here we focus on two other factors, the initial production structure of the economy and the nature of the transaction costs. We will show that both factors have an important impact on the size of the HSE and on who is included in the HSE. Because of this, both the efficiency and equity dimensions of the SDD process.

4.1 Production Structure

One of our key arguments is that initial conditions matter. One might expect different outcomes from the emergence of the HSE in rural settings that have highly unequal distributions of land resources (such as, in some nations in Latin America and parts of the former Soviet Union—which have some individuals holding massive estates and many smaller, relatively poor farmers), compared to rural societies characterized by more egalitarian distributions of cultivated land (e.g., China, Vietnam and Poland). In the rest of the analysis we call this the *production structure* of the rural economy. In this section we will formally show that the initial production structure indeed matters: the share of smallholders in the production system—and the existence of large holdings amongst the smallholders—will affect both the size of the HSE and the integration of smallholders into the HSE. To analyze this we relax the assumption of a homogenous producer structure. This means that k is not necessarily identical for all producers. In line with our general model, we introduce producer heterogeneity by varying the capital cost k.

We assume that capital cost k_j for producer *j* is uniformly distributed across N producers with $k_j \in [k-\gamma_k, k+\gamma_k] \ \forall j = \{1,...,N\}$ and $\gamma_k \in [0,k]$ with $k \geq 0$. For

simplicity, we assume that individual producers only produce one unit of the high standards product, when they are involved in the HSE.[11] Producers with lower capital costs are the more efficient.

We can now consider variation in the production structure by considering changes in γ_k. Specifically, the extreme case of homogeneous farms—which was the assumption in the first part of the paper—is represented by $\gamma_k = 0$. The efficiency distribution is increasingly unequal as γ_k increases. With any given distribution, the average efficiency is represented by capital cost *k* (as in the general model).

The supply curves for heterogeneous and homogeneous production structures are shown in Figure 1. In this graphical representation $X_H^S\left(\gamma_k = 0\right)$ represents the supply function for homogeneous producers. Likewise, $X_H^S\left(\gamma_k > 0\right)$ is the supply function for heterogeneous producers.

When producers choose to produce the HS products, under the assumption that one producer produces only one unit of output in the HSE, their profits are $p_H - c_H$, with $c_H = c_L + k$ where k is the capital cost capital cost of the producer that is indifferent between producing for the HSE and the LSE. Using this, we can then derive the aggregate supply of HS products as:

$$(6) \qquad X_H^S = \frac{N}{2\gamma_k}\int_{k-\gamma_k}^{k} dk_j = \frac{N\left(k+\gamma_k-k\right)}{2\gamma_k}.$$ [12]

[11] Alternatively, one could fix the inputs and consider variation in output, or consider variations in input and/or output size. Our specification is closer to the basic model specification and allows to derive the key results.

[12] When $\gamma_k = 0$, the high standards output X_H^S is completely determined by demand in the equilibrium (perfectly elastic supply) and equation (7) is irrelevant.

This, in turn, leads to a new expression for the equilibrium quantity in the HS market:

$$(7) \qquad X_H^* = M\left(I - \frac{\left(k - \gamma_k + \tau\right)}{\phi}\right)\left(\frac{1}{1 + \frac{M/\phi}{N/2\gamma_k}}\right).$$

Comparing (5) and (7) yields some important insights. The second term of the RHS of condition (7) shows that the HSE will emerge at lower income levels with a heterogeneous production structure than with a more homogeneous structure. Specifically, $I > \frac{k - \gamma_k + \tau}{\phi}$ is the condition for the HSE to emerge. With $\gamma_k > 0$ the required income level is lower than when $\gamma_k = 0$. In addition, the required income level (for the emergence of a HSE) declines when the distribution is more unequal (that is, when γ_k is higher). The intuitive reason for this finding is that when an economy faces a more heterogeneous production structure, this implies that there are more efficient producers among the entire set of producers, ceteris paribus. As a result of this, these producers will be able to produce HS products when it is not possible when the economy is characterized by a homogeneous production structure.

However, the third term of the right hand side (RHS) of condition (7) implies that the expansion of HS production—once it exists—proceeds more gradually when there is a heterogeneous distribution of farms. To see this, define $B = 2M\gamma_k / N\phi$. The third term then equals $1/(1+B)$, which is less than 1 with $B > 0$. Formally, $\partial X_H^* / \partial I = \frac{M}{1+B}$. With $B = 0$ when $\gamma_k = 0$, and $\partial B / \partial \gamma_k > 0$, it follows that the growth in X_H^* with increasing income will be more gradual when there is a more heterogeneous set of producers—given that $X_H^* > 0$. These results are illustrated in Figure 1.

In Figure 1 $X_H^S(\gamma_k = 0)$ represents the supply function for homogeneous producers and $X_H^S(\gamma_k > 0)$ the supply function for heterogeneous producers. For low income, represented by demand function Q_{H1}^D for high standards products, the equilibrium output in the high standards market is zero with homogeneously distributed producers i.e. $X_{H1}^*(\gamma_k = 0) = 0$. In contrast, under a heterogeneous producer structure, the HSE does emerge and the equilibrium is at point A. HS output is equal to $X_{H1}^*(\gamma_k > 0)$. For increasing higher income levels, represented by demand curves Q_{H2}^D and Q_{H3}^D, the market equilibrium with the heterogeneous structure shifts to points B and C, respectively. For the homogeneous production structure, there will also be positive HS output at Q_{H2}^D and Q_{H3}^D, represented by points D and E, respectively.

Figure 1 thus illustrates that HS production emerges at lower levels of income for heterogeneous structure (represented by point A). However, once the HS emerges in an economy characterized by a more homogeneous structure, the growth of HSE is more rapid as income grows. When examining Figure 1, note that the growth of production is represented by the shift from point D to E is larger than for the shift from B to C.

These results are further illustrated in Figure 2. When income is too low $\left(I < \frac{k + \tau - \gamma_k}{\phi}\right)$ as illustrated by point G, there is no HSE under either the heterogeneous or homogeneous structure. As income increases, however, the HSE emerges first in the economy characterized by a heterogeneous production structure for $I > \frac{k + \tau - \gamma_k}{\phi}$, shown by point A. Under the assumption that a nation's

production structure is more homogeneous, the minimum income requirement for the emergence of a HSE is higher $\left(I > \frac{k+\tau}{\phi} \right)$. When income is low $\left(\frac{k+\tau-\gamma_k}{\phi} < I < \frac{k+\tau}{\phi} \right)$, a HSE exists under the heterogeneous structure (point A), but does not (yet) exist under the homogeneous structure (point F). At higher incomes, HS production is also positive for the homogeneous structure, but output remains higher for heterogeneous production structure, as long as income does not reach the level $I = \frac{k+\tau}{\phi} + \frac{N}{2M}$ (Point H). At higher incomes, the homogeneous producer structure produces higher output. Finally, when income is larger than $\frac{k+\tau}{\phi} + \frac{N}{M}$ but lower than $\frac{k+\tau+\gamma_k}{\phi} + \frac{N}{M}$, the HSE will include all producers under the homogeneous structure in contrast to the heterogeneous structure, shown respectively by points K and J.

This approach also allows to analyze *who is included in the HSE*. With a heterogeneous production structure, the most productive farms will start producing HS at low income levels. However, given the same set of incomes and other factors, the less productive farms will be excluded. When the production structure of an economy is more homogeneous, HS production will only start at higher income levels. Although beginning later in the development process, once started the process will be more inclusive. More producers will be included. This insight can be seen graphically in Figure 3. The line that divides the graph between the LSE and the HSE is characterized by $\frac{k-\gamma_k+\tau}{\phi}$, which is the minimum income level required for a HSE to emerge under given producer heterogeneity γ_k. It illustrates again that when

producers are more heterogeneous, there is a more rapid emergence of the HSE—given certain levels of income growth. In addition, under our assumption that more productive producers have lower capital costs k_j, Figure 3 also illustrates that when income increases, a homogeneous producer structure is more inclusive towards low productivity producers. At high levels of income, all producers will be included under any distribution.

4.2 Transaction costs

The nature of transaction costs is another fundamental feature of an economy that can effect the emergence and size of the HSE. Transaction costs will not only affect the overall size of HS production—as we already demonstrated, but also *who is included*. In the literature, a standard argument is that there are fixed transaction costs per supplier for processors. This implies that transaction costs per unit of output are lower for large producers and hence small producers will be excluded. We will argue that such conclusion is overly simplistic and depends on the specific assumptions on the nature of the transaction costs.

Although we have already referred to transaction costs and analyzed their general impact on the HSE (in the section above), we have not defined them in a detailed way. In reality there are different types of transaction costs that might be important when processors source HS commodities from farmers. For example, one common type of transaction costs might include costs of search (by company procurement agents that are looking for farmers that are willing to supply to the HSE), supervision costs, quality and process control costs and the costs of enforcement of agreements. As an illustration, consider the following example from Minten et al (2009), which studies processor-farmer interactions in a HS vegetable

production region which produce horticultural exports in Madagascar for the European Union:

> *"To monitor the correct implementation of the [HS] conditions, the [processor] has …around 300 extension agents who are permanently on the payroll of the company. Every extension agent is responsible for about thirty farmers. To supervise these, (s)he coordinates [another] five or six extension assistants ... that live in the village itself. During the cultivation period of the [HS] vegetables, the farmer is visited on average more than once a week …to ensure correct production management as well as to avoid 'side-selling'. …99% of the farmers say that the firm knows the exact location of the plot; 92% of the farmers say that the firm even knows …the number of plants on the plot. For crucial aspects of the production process, such as pesticide application, representatives of the company will even intervene in the production management to ensure it is rightly done. [One-third] of the farmers report that representatives of the firm will themselves put the pesticides on the crops to ensure that it is rightly done."* (p. 14).

This example clearly illustrates that the notion of fixed transaction costs per supplier is not (necessarily) consistent with reality. For conceptual purposes, one could distinguish three types of transaction costs: those which are fixed per supplier (e.g. contract negotiation costs), those which are fixed per unit of output (e.g. output control costs) and those which are fixed per unit of production input (e.g. monitoring of plots and production activities).

To show that these different types of transaction costs will have different effects in the emergence, size and composition of the HSE, we compare two types of transaction costs. Specifically, we assume that τ_j is a producer specific transaction costs. It is uniformly distributed over the interval $\left[\tau-\gamma_\tau, \tau+\gamma_\tau\right]$ with $\gamma_\tau \in \left[0, \tau\right]$ and $\tau \geq 0$. With transaction costs defined in this way, we first consider the case when transaction costs are fixed per producer. This means that transaction costs are identical for all producers (or, $\gamma_\tau = 0$ and $\tau_j = \tau$). In the second case, we consider transaction costs which are fixed per unit of input. This implies that transaction costs are negatively related to producer productivity, i.e. $\partial \tau_j / \partial k_j > 0$.

It is immediately clear that these different types of transaction costs will have fundamentally different implications for which producers will be included in the HSE. In one case, the transaction costs will be 'neutral' regarding productivity heterogeneity; in the other case, they will reinforce the productivity-bias. Formally this can be seen from the new condition for the equilibrium output of HS products with producer specific transaction costs:

$$(8) \qquad X_H^* = M\left[I - \frac{(k-\gamma_k)+(\tau-\gamma_\tau)}{\phi}\right]\left(\frac{1}{1+\frac{M/\phi}{N/2(\gamma_k+\gamma_\tau)}}\right).$$

It follows from equation (8) that the structure with heterogeneous transaction costs, i.e. $\gamma_\tau \neq 0$, will induce earlier emergence of HSE for increasing income levels. The HSE arises when $I > \frac{\tau + k - \gamma_k - \gamma_\tau}{\phi}$, which is less restrictive for higher γ_τ (more heterogeneity in transaction costs).

Figure 4 illustrates this effect. The HS supply function with fixed transaction costs ($\gamma_\tau = 0$) per supplier is identical to that of Figure 1 with heterogeneous suppliers.[13] It follows from equation (8) that with heterogeneous transaction costs, the HS supply function pivots around point H. This implies more HS supply at lower levels of income (represented by $Q_{H1}{}^D$) but less supply at higher levels of income. As is illustrated in Figure 4, the negative relation of transaction costs with productivity reinforces the productivity effect in this pivot of the supply function.

The impact on who gets included when considering the nature of transaction costs is also analogous to the discussion over the production structure of the economy. Low productive suppliers will be less likely included with transaction costs fixed per

[13] Note that in case of homogeneous suppliers, there is no effect of the nature of the transaction costs on who get included since all suppliers (and thus their transaction costs) are identical.

unit of input, and vice versa. In this way, transaction costs reinforce the productivity effect, in the sense that they reduce the purchasing costs for processors from more productive farms. Farms with higher productivity will have even more cost advantages because the per unit transaction costs are lower. However, this result depends on the nature of "transaction costs." If fixed transaction costs are per farm, this is not the case.

Notice that one should be careful in interpreting these findings. Our specific findings are conditional on our model specification, which assumes there is a fixed output per farm. However, our main result, i.e. that the impact on the inclusion in the HSE depends on the nature of the transaction costs, holds in general. In reality, some transaction costs are fixed per farm, such as those for bargaining and search. Other costs however, such as product or process control costs, would at least have a component that is better modelled as per unit of output or input cost. To the extent that these variable transaction costs are more important, the cost advantage of large and more productive farms will change.

5. Conclusions

In this paper we have developed a formal theory of the process of standards-driven development (SDD). We use our theoretical model to analyze how differences in initial conditions and characteristics of the economy will affect the efficiency and equity outcomes of SDD. The model endogenizes the introduction of a HSE during the process of development. We also demonstrate how development in a world that is being penetrated and increasingly dominated by modern supply chains with high standards will result in different outcomes and have different distributional effects when an economy is starting from different sets of initial conditions. Initial

differences in the form of the level of income, the relative cost of capital, the nature of transaction costs and whether the production structure is homogeneous or heterogeneous will affect the timing of the emergence and the size of the HSE. These results can be used to gain insights on how institutional reforms, including macro-economic stabilization, liberalization of trade and foreign investment regulations can have important impacts on the growth of the HSE. In particular, these and any other policy change that reduces the cost of capital, according to our model, will play an important role in stimulating the growth of the HSE.

We also examine which factors affect who is able to participate in the HSE as it is emerging. Not surprisingly, we find that the most productive farms switch first to producing for the HS market. Transaction costs also play an important role as they may or may not reinforce the disadvantaged position of less productive producers. Reducing these transaction costs, for example by investments in infrastructure, producer associations, third party quality control and monitoring institutions, could also play a role in reducing the bias against small and less efficient producers and speed their integration into the HSE.

Importantly, our analysis shows how the nature of the initial farm structure can affect both the size and distributional effects of the HSE. In countries with a mixed production structure, combining large and medium size commercial farms with small-scale household farms, such as in Latin America and parts of Eastern Europe and the former Soviet Union, the process is more likely to lead to an initial exclusion of smallholders from the HSE. In contrast, in countries such as China and Vietnam, India and parts of Africa, Eastern Europe and Central Asia, where the farm sector is more uniform and dominated by small farms, the emergence of the HSE, although delayed, can be expected to be more inclusive.

While this paper is the first attempt to model the SDD process, we realize that our analysis is only the first step. Several issues in the SDD process require more analysis. First, the farm heterogeneity issue and its relation with the HSE which has been the subject of extensive empirical analysis and debate, requires more extensive analysis. Second, the interactions between the processor and the farmer in the HSE are modelled as spot market transactions. However, there is substantial empirical evidence that this relationship is often more complicated, taking the form of contracts or other forms of vertical integration. These different governance forms that are observed in the HS supply chain will affect both the welfare effect and the likelihood that a HS chain will develop. While we have discussed how these governance forms would affect the outcomes, we have not formally modelled these in this paper.

Finally, to further complete the analysis one should also look at the interaction with labor markets. HS investments will affect labor markets as the new investments create off-farm employment both inside the processing facility, as well as in the service sector (e.g., in the areas of extension, packaging, supervision, controlling, marketing and transport). Some—or most—of these jobs are low skilled and may be taken by the poorest of the poor. Empirical studies indicate that if HS production takes place through vertically integrated company-owned farms, this may have different effects on rural households than when they can start producing HS commodities themselves (see e.g. Maertens and Swinnen, 2009; Maertens et al., 2008).

In summary, all these factors should be considered when attempting to analyze the effect of the emergence of HS markets on households in developing and transition countries. These combined effects are likely to be complex. These and other

issues should be the focus of future research and we hope that such models can build upon the theoretical framework that is developed in this paper.

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Figure 1. HS Production under Different Production Structures

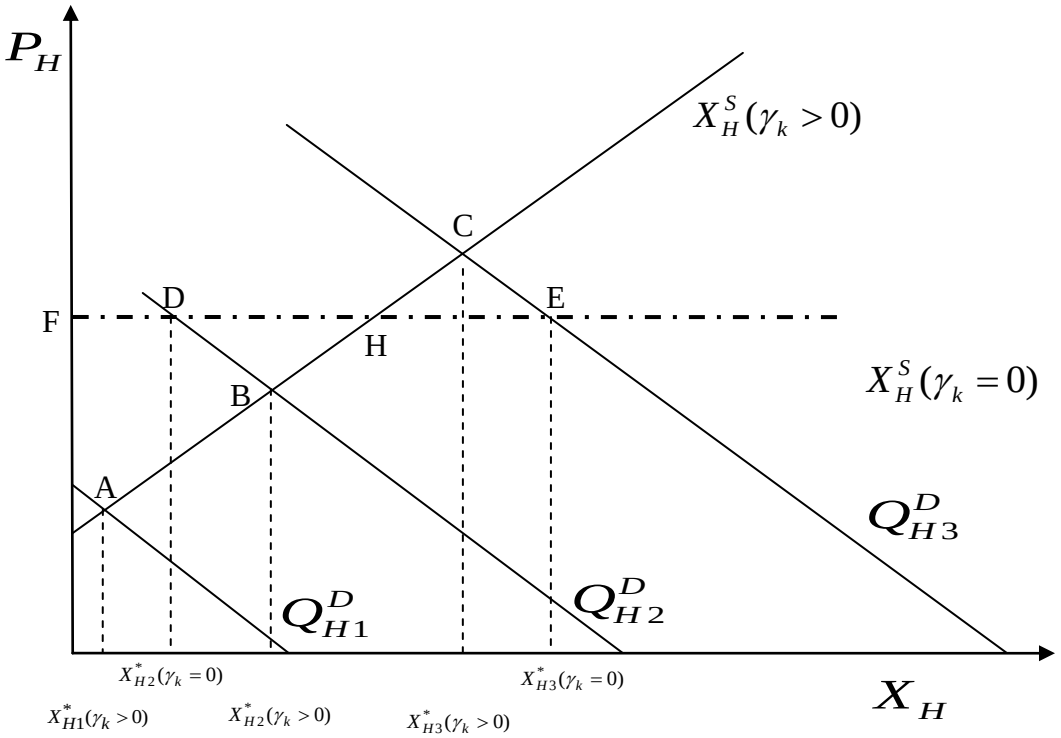

Figure 2. Size of the HSE under Different Production Structures

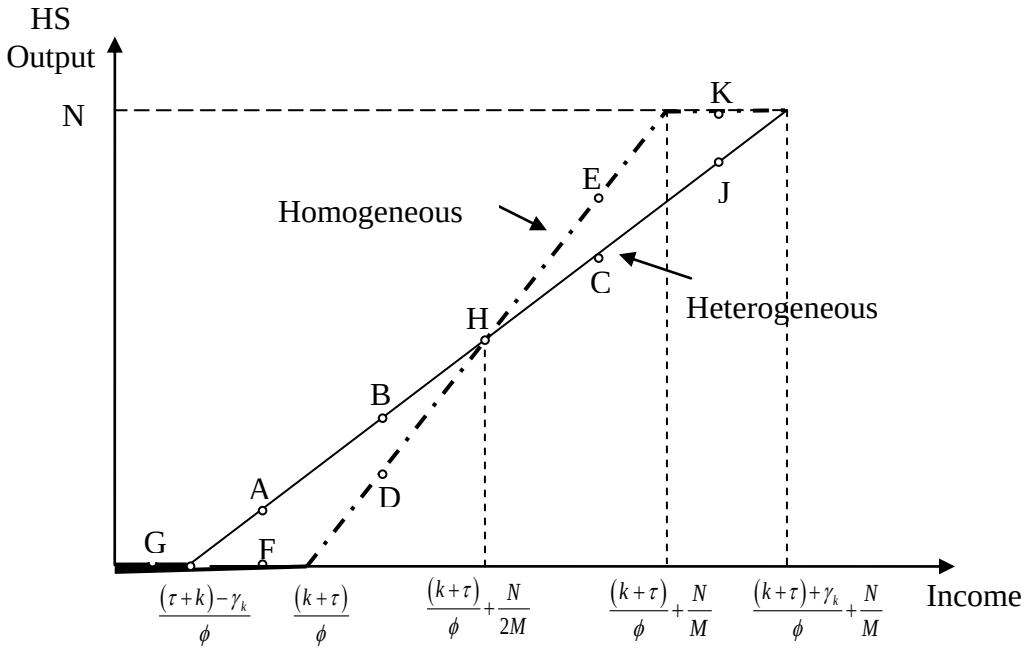

Figure 3. Combined Impact of Production Structure and Income on HSE

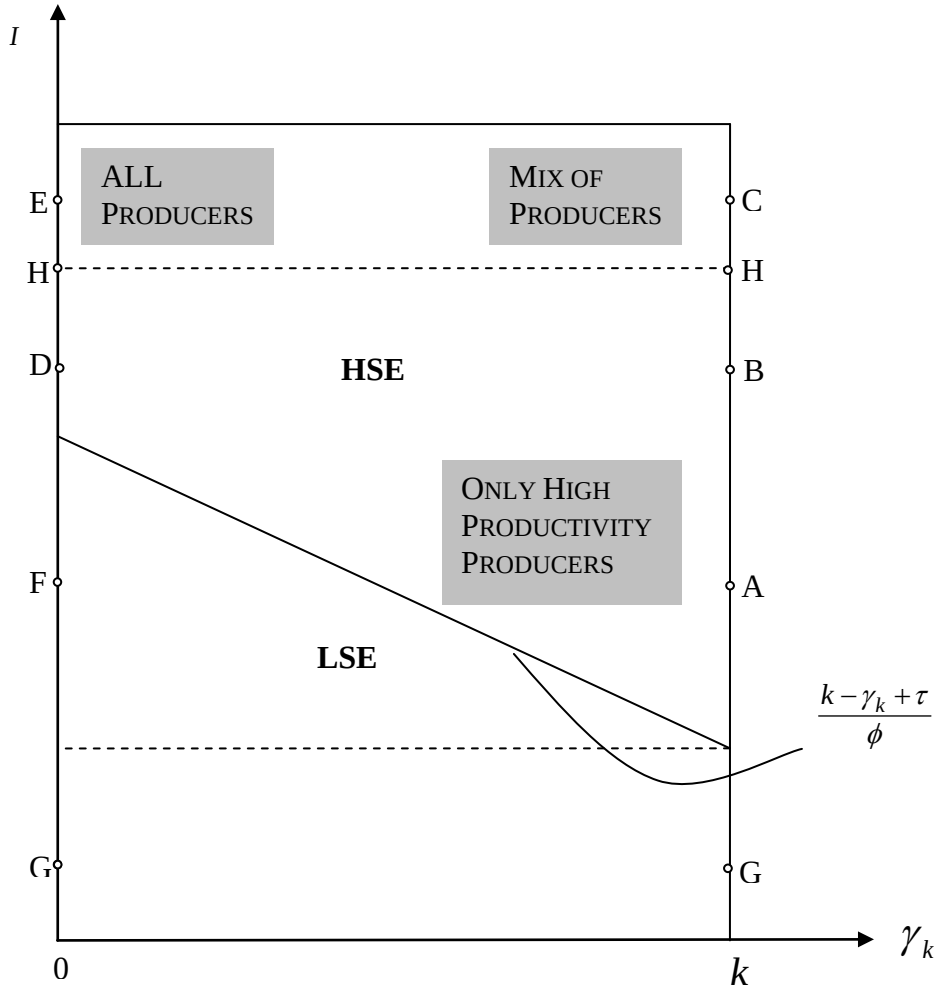

Figure 4. HS Production under Different Types of Transaction Costs