REGIONAL TRADE OPPORTUNITIES FOR ASIAN AGRICULTURE

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ABSTRACT

Trade in food and other agricultural products is increasingly important across East and Southeast Asia, where high income Asian economies have driven significant agricultural expansion, and the People's Republic of China's (PRC) momentous growth promises more stimulus to agro-food activity in the region. The PRC is expected to become a net importer of agro-food in the coming decades, which will have significant implications within the region. As its middle class continues to emerge, the resource intensity of food consumption (e.g., meat and dairy) will lead to net imports and require expansion of agricultural capacity elsewhere. Because low income Southeast Asia is generally seen to be well below its agrofood potential, this situation suggests a significant opportunity for self-directed poverty reduction through regional agro-food market expansion. This paper reviews the history of high-income Asia and the PRC's emergence in the region's agro-food markets. Finally, the Greater Mekong Sub-region's role is analyzed for the potential of Asian agro-food trade to contribute to poverty reduction.

I. INTRODUCTION

A number of factors have improved the prospects of and the need for increased regional trade within Asia. The prospects were triggered by the loss of momentum in the latest round of multilateral trade negotiations, combined with a rise in freight costs due to higher fuel prices. This is particularly true for agriculture, a primary obstacle to the World Trade Organization (WTO) negotiations and a sector in which Asia has significant demand and supply potential. The need for enhanced regional trade has been compounded by the recession in industrial countries, which calls for rebalancing growth by creating regional demand (ADB 2009a) and to broaden openness by expanding regional trade within Asia (ADB 2009b). To elucidate the means by which Asia can improve its agricultural productivity and food security and promote economic growth, this study uses a multi-country general equilibrium (GE) model to assess agricultural trade growth between the PRC and the Greater Mekong Sub-region (GMS) countries. The PRC has over the last decade gone from being a small net exporter of agricultural products to become one of the world's largest importers, a trend that appears likely to continue. At same time, the Mekong region has agricultural capacity well beyond its current production and this sub-region encompasses some of the poorest countries in Asia. Moreover, agriculture is identified as one of the priority sectors under the GMS Economic Cooperation Program to address poverty in the GMS countries, which is largely a rural phenomenon (ADB 2007b).

As historical trends from high-income Asian (HIA) countries suggest, increased agro-food trade with the PRC could significantly contribute to growth, reduce poverty in the GMS, and contribute to two important policy objectives of the Asian Development Bank (ADB)—greater Asian cooperation, and more inclusive development. By focusing on GMS engagement, the study will also showcase one of ADB's most important infrastructure commitments, the two road corridors that transect the sub-region. The paper uses detailed information on the corridors' contributions to local development for regional agricultural trade.

The objective of this paper is to demonstrate the longer-term benefits of enhanced trade extending across and between developing Asian economies. Because indirect effects can far outweigh direct or negotiated trade effects, a GE assessment gives a more complete picture of the inclusive benefits of such cooperation. More comprehensive assessment such as this implicates a much larger universe of stakeholders, and represents an essential justification of both the policy agenda (integration, inclusion, etc.) and supporting investments like the GMS corridors.

II. MOTIVATION AND BACKGROUND

This report begins with an extensive background review of the drivers of agro-food trade in East and Southeast Asia over the last few decades. The rise of higher income Asian economies provided an early wave of demand stimulus, accompanied by agro-food supply chain development and technology transfer around the region. This was followed by rising middle class consumption in rapidly emerging Asian economies and, finally, with the dramatic emergence of demand from the PRC in the last two decades.

A. Evidence from High Income Asia

Experiences of HIA countries such as Japan, Republic of Korea (Korea), and Taiwan are useful for predicting the scope of the PRC's agro-food trade patterns for two reasons. First, these countries were also densely populated before industrialization and can therefore serve as a model of what to expect as the PRC industrializes. Second, compared to western consumption preferences, these countries have similar preferences and diets, and as the PRC industrializes, its diet is likely to shift in a similar fashion to other HIA countries.

Table 1: Annual Food Consumption in Taiwan, kg/year

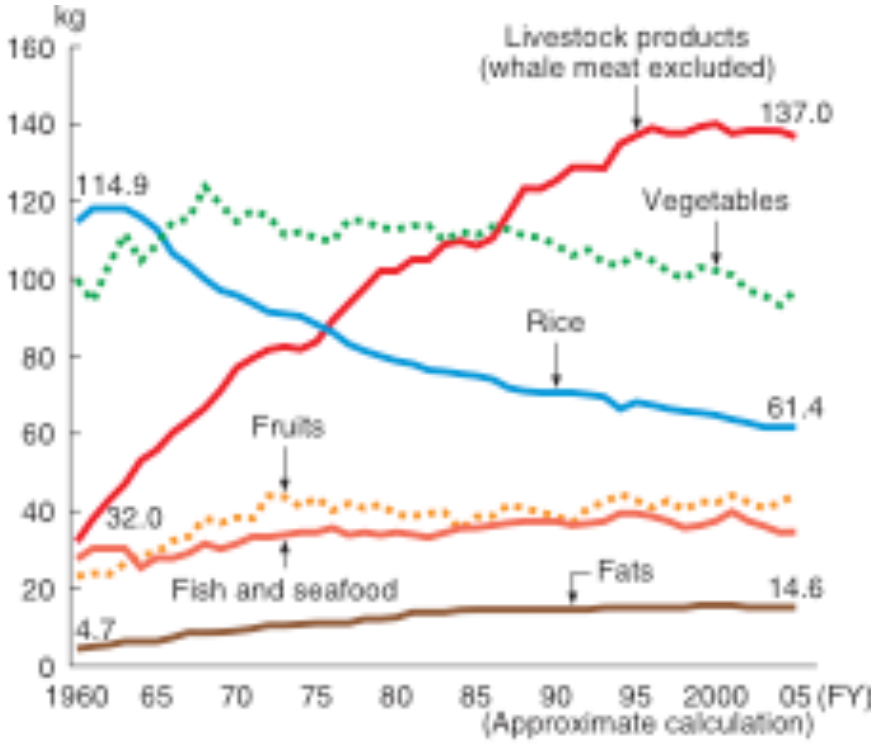
Item	1956	1960	1970	1980	1990	1995
Polished Rice	132.6	137.7	134.5	105.5	65.9	59.1
Sweet Potatoes	64.2	65.4	18.4	4.1	2.7	2.5
Wheat Flour	16.6	20	25.4	23.6	28.7	31.9
Sugar	9.4	9.4	15	24	29.8	24.2
Pulses, nuts and seeds	10.9	11.4	18.3	18.8	29	31.7
Vegetables	58.4	61.1	84.8	129.6	93.3	101.9
Fruits	14.5	22.1	45.8	70.2	131.5	137.4
Meat	17	16.2	25.3	39.6	62.9	76.1
Eggs	1.6	1.6	4.1	8	12.1	16.2
Fish	18.8	21.7	34.2	38.7	47.5	38.4
Milk	6	3.2	11	27.6	43	58.8
Oils and Fats	3.7	4.7	7.7	10.8	23.3	26.3

Source: Sun et al. 1998

There have been clear trends in changing HIA consumption patterns over the previous decades, which have subsequently altered agro-food trade. As per-capita incomes have risen, diets have diversified away from rice and other starchy staples into a more diverse offering including meats, fresh fruits and vegetables, and dairy products. HIA countries have all seen significant reductions in rice consumption. Both Japan and Taiwan's current consumption levels are approximately half their levels in the 1950s and 1960s

(Figure 1 and Table 1). Korea has seen a sharp reduction too, falling from 128.1 kg/year in 1985 to 82 kg/year in 2004 (MAFROK 2006). Looking at data on meat consumption in HIA is another strong indicator of how tastes and preferences have changed. Compared to 1960 levels in Japan, beef consumption was 7.5 times greater by 1995, and poultry and pork consumption had increased by nearly 14 times. Korea and Taiwan show similar trends as well, although their rates of growth have not been as drastic.

Figure 1: Transition of per Capita Annual Consumption of Food by Category in Japan



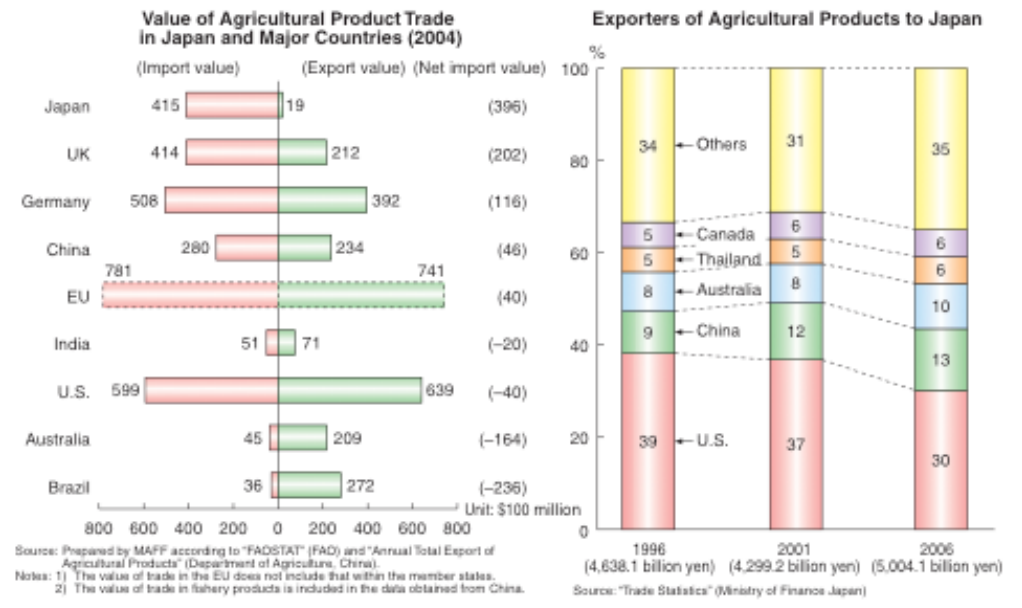
Source: MAFF of Japan 2006

These similar shifts in food consumption preferences have created profound effects on agro-food trade. Looking at Japan first, it is the world's largest importer of agricultural products, and is characterized by a heavy dependence on specified countries as demonstrated by the fact that more than 60% of imported agricultural products are from just five countries, including US, PRC, and Thailand (Figure 2). Japan's food self sufficiency ratio has also been falling for numerous years as it relies on imports of fruits, meats, milk and diary products, and vegetables to meet its growing demand.

Korea is also a net importer of agricultural products. The majority of Korea's imports are food crops such as corn, flour, and beans and represented 50.9% of the total share in 2003. The rest of the major agricultural imports are comprised of livestock products (mainly beef), forestry, and fish. Korea receives most of its agricultural imports from the US followed by PRC, Australia, and Indonesia. Due to the increase of livestock production to meet the growing demand for meat products, Korea's demand for wheat,

soybeans, and corn as feed has also been rapidly increasing, all or most of which are served by imports (Table 2).

Figure 2:



Source: MAFF, Japan 2006

Table 2: Korea's Supply & Demand of Wheat

Table Supply & demand of wheat (Unit : 1,000M/T)

Year	Carry over from the previous year	Supply			Demand					Carry over to the next year	Self-sufficiency rate(%)
		Production	Import	Total	For Food	For processing	For feed	For seed	Total		
1985	249	11	2,996	3,256	1,005	1,031	932	20	2,988	268	0.4
1990	237	1	2,239	2,477	903	992	98	12	2,005	472	0.05
1995	910	10	2,777	3,697	1,070	1,024	1,225	16	3,335	362	0.3
2000	472	2	3,266	3,740	1,363	880	1,026	20	3,279	461	0.1
2001	461	3	3,251	3,715	1,263	887	1,051	63	3,264	451	0.1
2002	451	6	3,830	4,287	1,294	884	1,661	36	3,875	412	0.2
2003	412	10	3,753	4,175	1,138	932	1,656	30	3,756	419	0.3
2004(P)	419	10	3,397	3,826	1,200	971	1,162	30	3,363	463	0.3

Source: MAF Republic of Korea 2006

Taiwan turned from a net exporter of agriculture products in the 1950s to a net importer by the 1990s. Due to large inflows of FDI, agricultural products became a key part of Taiwan's export industry, representing over 90% of all exports in the 1950s. However as the country industrialized, its share of agricultural exports decreased significantly (to

4.7% in 1996), even though the total value was increasing. The vast majority of these exports went to Japan (receiving 44.8% in 1996), which was also one of the largest donors of FDI. Concurrently, total agricultural imports began to increase rapidly as Taiwan moved into a more industrialized society. Agricultural imports increased from $75.8 million to $9,986.6 million, a 132-fold increase in a period of 36 years. The sharp rise in agricultural imports reflects the shift in Taiwan's diet, as it must import large quantities of feed grains, oilseeds, meats, fruits, and vegetables to meet changing consumer preferences. The US is Taiwan's main supplier of agricultural imports, providing 54.5% of the total in 1996. Other sources of imports come from Malaysia (9.3%), Australia (5.5%), Indonesia (4.5%), Thailand (3.4%), and Japan (2%) (Sun et al. 1998 and Table 5).

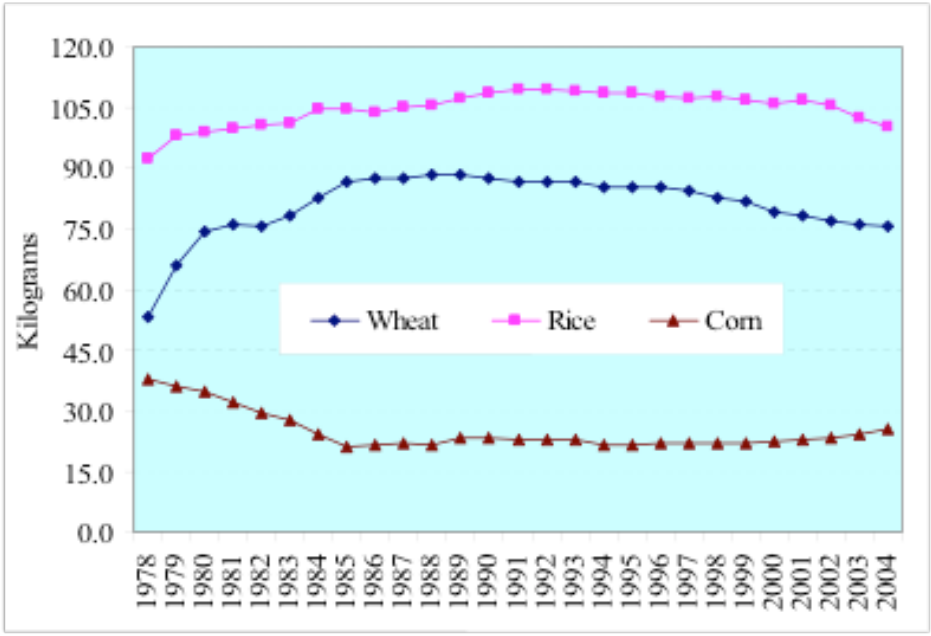
Clear trends emerge when looking at HIA agricultural trade patterns. Most noticeably, HIA countries have all had significant increases in meat imports as well as feed grains to fuel domestic production. Vast areas of farmland are needed to yield the grains necessary to raise cattle and other livestock, and as HIA countries are densely populated and industrialized, they cannot produce the necessary quantities. Therefore, HIA countries are dependent on agriculture imports and their self-sufficiency ratios have been in decline for numerous years. Another important trend has been the outsourcing of farmland from neighboring countries and the emergence of Southeast Asia and PRC as a food supplier for HIA. Traditionally, the Mekong region has been the rice basket for many of these countries, but more recently, meat has been playing an increasingly important role, especially poultry from Thailand. Thailand represents one of the most important trading partners in HIA and has had success that other Southeast Asian countries hope to attain as the PRC may transition into a large importer of agricultural products.

B. People's Republic of China

Consumption preferences in the PRC have already begun to change as the country continues to industrialize and urbanize. Much like HIA, rising incomes have increased the consumption of meats, poultry, fish, dairy products, and fruits, while the consumption of traditional staple grains have remained stable or declined (Chern 1997, Gould 2002, Guo et al. 2000, Xin et al. 2005). Looking first at food staples, the PRC exhibits similar characteristics to HIA countries. From 1978 to 1990, per capita consumption for rice and wheat increased at an average annual rate of 1.3% and 4.4% respectively, which was fueled by rising incomes allowing the poor to be able to consume more. Since the early 1990s however, per capita consumption of rice and wheat has started to decline slightly because more individuals are able to diversify their diets (Figure 3). Although these categories have stabilized somewhat in recent years, they can be expected to decline as the Chinese continue to diversify their diet. Meat consumption in the PRC has been steadily increasing for the past several decades. In 1978, per capita consumption of pork was 8 kg/year; beef, 0.3 kg/year; and poultry, 1.3 kg/year. However by 2004, these

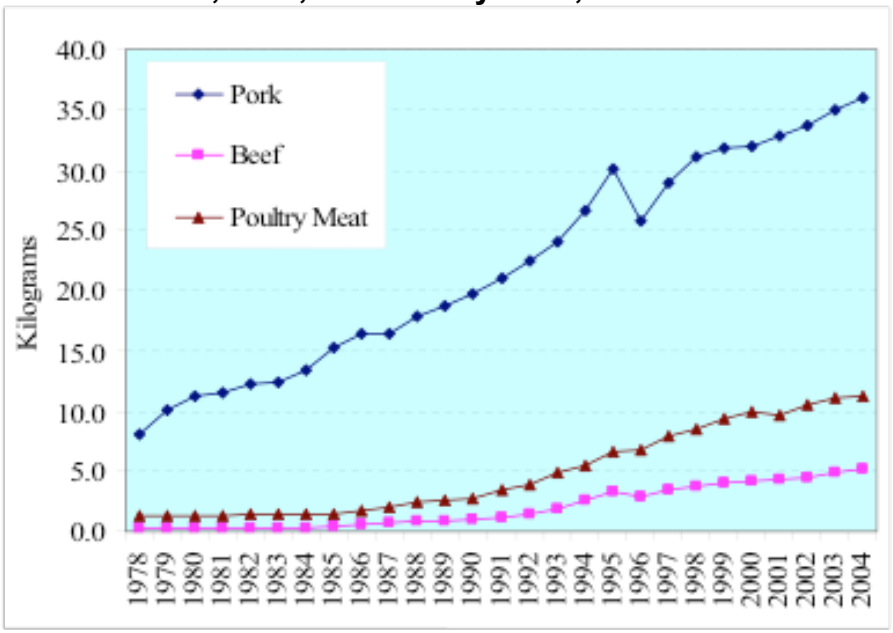
numbers increased to 35.9 kg/year for pork, 5.2 kg/year for beef, and 11.3 kg/year for poultry (Figure 4). These amounts are well within the bounds of HIA and have already begun to create massive reverberations for agricultural trade in the PRC.

Figure 3: China's Per Capita Consumption of Rice, Wheat, and Corn, 1978-2004



Source: Zhuang and Koo 2007

Figure 4: The People's Republic of China's Per Capita Consumption of Pork, Beef, and Poultry Meat, 1978–2004



Source: Zhuang and Koo 2007

However, as the PRC is a country characterized by large inequality, it is worth examining how food consumption patterns vary across income classes. The demand for quantity diminishes as income rises, and the upper-income households appear to have reached a saturation point in quantity consumed of most food items. Most additional food spending by high-income consumers is on higher quality or food in restaurants. The vast majority of households in the PRC are rural (about 60% of the population) and low-income urban households (20%) that still demand increased quantities of many foods as their income rises. These patterns suggest that the growth in the quantity of food demanded has been much slower than would be expected by the PRC's rapid economic growth. High-income households are purchasing greater value added products rather than increased quantity, which has caused much of the food expenditure growth. Low-income households have been experiencing less rapid income growth and thus growth of their food spending has been slower. This slow growth in the quantity of food demanded is one possible explanation as to how the PRC has been able to remain largely self-sufficient for many food items. However, as more and more low-income individuals' incomes continue to increase the true test of the PRC's agricultural production will be seen (Gale and Huang 2007).

Despite the PRC's self-sufficiency in many agricultural goods, its future growth creates uncertainty for global agro-food markets as the country has 25% of the world's population with only 7% of the world's arable land. While many researchers have cited the rising demand for meats to lead to an increase in PRC's agricultural imports of meat and/or feed grains, the country's agricultural imports have only really begun to take off in recent years. This happened as a result of large economic growth, lower barriers to imports, higher commodity prices, and tightening domestic commodity supplies. In total terms, agricultural imports increased from less than $11 billion in 2002 to $25.9 billion in 2004. Soybean imports were responsible for more than 30% of this growth, increasing from $2.5 billion in 2002 to $7 billion in 2004. Soybeans are used for making vegetable oil and high-protein animal and fish feed. However all these soybeans were not able to meet the PRC's demand for vegetable oil as imports of vegetable oil increased by $2.6 billion during this time period, accounting for another 17% of agricultural import growth. Wheat was another major food commodity that was responsible for the PRC's large agricultural import growth. Wheat imports rose from $100 million to $1.6 billion during 2002 to 2004, accounting for 10% of the increase in imports. Commodities used as raw materials were also significant contributors to agricultural import growth. Cotton was the biggest sector, increasing from $308 million in 2002 to $3.4 billion in 2004, representing 21% of the increase of the total import growth (Gale 2005). Imports of other food items such as meats, milk, cheese, wines and fruits have all seen sharp increases as well, but they represent a small share of the PRC's overall agricultural imports.

Looking at future agricultural import demands, the PRC is expected to continue to rely on soybean and vegetable oils, and a sharp decline in these imports is unlikely. Meat imports are expected to grow as well, due to increasing demand. Demand for imported

pork is especially strong, as domestic outbreaks of avian influenza and a ban on US beef imports have induced many consumers to substitute pork for beef and poultry products. In addition to meat imports, feed grains are also expected to rise in the coming decades, eventually reaching 25 million to 35 million tons by 2020. Although the PRC's wheat imports represent a small percentage of its total consumption, the PRC is still a very large importer of wheat in sheer quantity. In terms of global wheat markets, the PRC is responsible for nearly 15% of all wheat imports and thus predictions about world wheat markets rest heavily on the assessments of the PRC's future role. These predictions are difficult to make as the PRC's wheat markets have unique characteristics in the sense that it is the only country in East and Southeast Asia that has both a large wheat-producing and wheat-consuming rural population (Rozelle and Huang 1998). The PRC's unique characteristics have caused many analysts to make conflicting claims. Some argue that the PRC will continue to demand large quantities of imported wheat, while others forecast that the country will gradually move to a position where domestic supply will meet the nation's demand. One of the most sweeping reports conducted by Rozelle and Huang in 1998, claims that the PRC's wheat imports will rise before peaking and gradually declining through 2020.

The PRC's agricultural exports have also begun to take off in recent years, although at a slower pace than imports. During 2002–2004, exports increased by $3 billion with the most important categories being processed foods, vegetables, and fruits. Japan is the largest market for the PRC's agriculture exports, accounting for approximately one third of the total in 2004 (Huang and Gale 2006). This is not surprising given that a large number of manufacturers from Japan have invested in the PRC. From 1985 to 2003, a total number of 310 food industry subsidiaries from Japan were set up in the PRC, and it is often remarked that the PRC has become the farm of Japan (Jin et al 2006). Most of the PRC's other major markets are neighboring countries or regions and include Hong Kong and Southeast Asia (each accounted for 12% of the PRC's exports in 2004), South Korea (7%), and Russian Federation (3%). The US is also one of the PRC's largest agricultural export markets, representing 9% of the total share. The US is one of the PRC's fastest growing markets with agricultural imports increasing by 43% from 2002 to 2004 (Gale 2005).

C. Greater Mekong Sub-region

Growth in the GMS has been robust for several years, fueled in part by a very strong export sector. Exports from the GMS rose from $37 billion in 1992 to $154 billion in 2005. This corresponds to an annual rate of growth of 11.6%, which is larger than the world average of 8.4%. The vast majority of GMS trade has been in manufactured goods, although some countries have emerged as food suppliers to HIA, most notably Thailand. A variety of factors helped fuel the tremendous growth of trade in the GMS. Generally speaking, the dominance of state-owned enterprises were reduced, prices and trade of goods and services were liberalized, and restrictions on the private sector were eased encouraging FDI.

FDI, in particular, has been a major facilitator of growth in many of the GMS economies. While the stories of the PRC and Thailand are particularly well known, FDI has also played important roles in less-developed countries. In Cambodia for example, FDI from HIA and the PRC helped propel its now flourishing garment export industry. This shift in production from countries with large manufacturing sectors occurred due to the eroding competitiveness of garment production with rising wages. Additionally, by shifting production to Cambodia, investors from the PRC were able to bypass the quotas in the main markets on garment imports from the PRC. FDI also played an important role in Lao PDR. Inflows in agriculture and forestry, as well mining and hydropower projects as of late, have helped contribute to export growth. In Viet Nam, FDI was originally concentrated in the extraction of crude oil and gas. However, FDI has shifted over the last decade to manufacturing. Viet Nam is becoming linked to regional production chains, which is clearly reflected in the structural shift in export composition toward assembled electrical and electronic products (ADB 2007).

With a relative abundance of agricultural resources, the GMS economies stand to benefit significantly from the globalization of processed food markets. Furthermore, as the PRC continues to grow and demand more food, the GMS economies can be an important supplier due to their close proximity and regional ties. The agricultural sector accounts for 50–70% of jobs in Cambodia, Lao PDR, and Viet Nam, and therefore growth in production and exports from this sector will be necessary to improve incomes and reduce poverty.

The PRC's growth, along with increasing integration into world markets and reduced trade barriers with GMS, is expected to have significant effects on the structure of regional production and trade. The GMS resource-abundant economies are expected to become more intensive in natural resource-based exports and transition away from the current labor-intensive manufacturing industry. This transition is expected as a result of two parts: first, through direct bilateral trade growth as the PRC demands more natural resource-based products, and second through direct competition with the PRC in global markets.

Indirect effects are also pushing this trend. The potential loss of revenue sources from garment manufacturing, and the lower wages that this will cause, could reduce labor costs in agricultural industries contributing directly to increased profitability, which will complement the direct effects from growth of PRC's demand of these products. Another indirect driver will be changes in FDI inflows. Although the evidence is ambiguous, decreases in FDI are expected in industries in Southeast Asia where competition with the PRC is intense. The PRC's growth and globalization is likely to cause GMS economies to experience negative terms of trade shocks for their manufacturers and positive shocks for agricultural produces (Coxhead 2004).

Regional cooperation can provide even further opportunities to facilitate trade growth. Most notably, Thailand, PRC, and Viet Nam all provide large markets and regional knowledge from which they can continue their own strong rates of growth, and from which other less developed GMS countries can learn. One of the most positive trends has been increased flows of intra-sub-regional trade, investment, and technology. PRC and Thailand are especially important as private capital and technology flows to the other countries can better use the abundant land and low-cost labor to produce goods efficiently for the sub-region or for export.

II. THE DYNAMIC FORECASTING MODEL

The complexities of today's global economy make it very unlikely that policy makers relying on intuition or rules-of-thumb will achieve anything approaching optimality in either the international or domestic arenas. Market interactions are so pervasive, and market forces so powerful in determining economic outcomes that more sophisticated empirical research tools are needed to improve visibility for both public and private sector decision makers. The preferred tool for detailed empirical analysis of economic policy is now the Calibrated General Equilibrium (CGE) model. It is ideally suited to trade analysis because it can detail structural adjustments within national economies and elucidate their interactions in international markets. The model is more extensively discussed in an appendix and the underlying methodology is fully documented elsewhere, but a few general comments will facilitate discussion and interpretation of the scenario results that follow.[1]

Technically, a CGE model is a system of simultaneous equations that simulate price-directed interactions between firms and households in commodity and factor markets. The role of government, capital markets, and other trading partners are also specified, with varying degrees of detail and passivity, to close the model and account for economy-wide resource allocation, production, and income determination.

The role of markets is to mediate exchange, usually with a flexible system of prices, the most important endogenous variables in a typical CGE model. As in a real market economy, commodity and factor price changes induce changes in the level and composition of supply and demand, production and income, and the remaining endogenous variables in the system. In CGE models, an equation system is solved for prices that correspond to equilibrium in markets and satisfy the accounting identities governing economic behavior. If such a system is precisely specified, equilibrium always exists and such a consistent model can be calibrated to a base period data set. The resulting calibrated general equilibrium model is then used to simulate the economy-wide (and regional) effects of alternative policies or external events.

[1] The model used here is typical of modern global models and is based on the LINKAGE model developed at the World Bank (van der Mensbrugghe: 2008).

The distinguishing feature of a general equilibrium model, applied or theoretical, is its closed-form specification of all activities in the economic system under study. This can be contrasted with more traditional partial equilibrium analysis, where linkages to other domestic markets and agents are deliberately excluded from consideration. A large and growing body of evidence suggests that indirect effects (e.g., upstream and downstream production linkages) arising from policy changes are not only substantial, but may in some cases even outweigh direct effects. Only a model that consistently specifies economy-wide interactions can fully assess the implications of economic policies or business strategies. In a multi-country model like the one used in this study, indirect effects include the trade linkages between countries and regions, which themselves can have policy implications.

The present global modeling facility has been constructed according to generally accepted specification standards, implemented in the GAMS programming language, and calibrated to Version 7 of the GTAP global economic database.[2] The result is a 13-country/region, 10-sector global CGE model, calibrated over a 16-year time path from 2005 to 2020.[3] Apart from its traditional neoclassical roots, an important feature of this model is product differentiation, where we specify that imports are differentiated by country of origin and exports are differentiated by country of. This feature allows the model to capture the pervasive phenomenon of intra-industry trade, where a country is both an importer and exporter of similar commodities, and avoids tendencies toward extreme specialization.

[2] See e.g. Hertel et al (2008) for GTAP.
[3]

III. SCENARIOS

As mentioned, the model is calibrated to a 2005 reference global database obtained from GTAP Version 7. While GTAP details global economic structure and trade flows for 57 sectors and 118 countries and regions, for tractability in the present study, we focus on a aggregation of 10 sectors and 13 countries and regions set forth in Table .

Table 3: Countries, Regions, and Sectors

Abbreviation	Name
prc	China
eur	Europe 27
hya	High Income Asia
cam	Cambodia
lac	Latin America and Caribbean
lao	Lao PDR
row	Rest of the World
tha	Thailand
usa	United States
vie	Viet Nam
roa	Rest of Asia
xsa	South Asia
xse	Other SE Asia
ric	Rice
ocr	Other Crops
lvs	Livestock
ffl	Fossil Fuels
mtd	Meat and Dairy
ofd	Other Processed Food
omf	Other Manufactures
trd	Trade and Transport Services
prv	Other Private Services
pub	Public Services

Using this aggregation, the dynamic CGE model is calibrated to a baseline time series reflecting a business-as-usual (BAU) scenario over 2006–2020. This baseline comprises consensus forecasts for real GDP obtained from independent sources (e.g. International Monetary Fund, Data Resources International, and Cambridge Econometrics). The model is then run forward to meet these targets, making average capital productivity growth for each country and/or region endogenous. This calibration yields productivity growth that would be needed to attain the macro trajectories, and these are then held fixed in the model under other policy scenarios. Other exogenous macro forecasts could have been used and compared, but this is the standard way to calibrate these models.

As outlined in the introduction, the main objective of the present forecasting exercise is to assess the potential for increased agro-food capacity to promote growth and reduce poverty in the GMS. To assess this potential, three primary drivers of growth must be considered:

1. Productivity Growth in Agriculture and Related Food Industries

   In the first category, agricultural yields and productivity in livestock production are far below their ultimate potential in lower income GMS economies. Because of relatively small-scale land tenure patterns, it is unlikely that rural households in these countries can achieve significant livelihood improvements unless output per hectare improves, and migration trends suggest that higher output per household member will also be essential.

2. Facilitation of Trade and Market Access

   Most rural agricultural households in the GMS live behind high walls of market access barriers, including high transactions and transport costs with respect to remote markets, and these are often compounded by infrastructure and information constraints. As long as distribution margins remain high, low income agro-food enterprises with relatively low value products will be prevented from accessing markets. By converse reasoning, lowering market access costs and related margins enlarges the horizon of profitable trade for all, increasing commerce, capturing value added, and promoting self-directed poverty reduction.

3. Foreign Direct Investment

   One of the defining characteristics of low-income economies everywhere is limited reserves of domestic savings, which in turn limits the progress of development by restricting investment in productive assets and enterprise expansion. The era of globalization has changed the nature of this constraint, however, with the advent of transboundary investment that permits low-income countries to leverage foreign savings for domestic investment. To help low-income GMS countries achieve their economic potential in the most timely fashion, FDI can be an essential catalyst.

4. Persistent Macroeconomic Slowdown in Industrial Countries

   While the Asian economies have exhibited a relatively robust recovery from the recent global economic downturn, industrial economies continue to experience serious credit constraints, extensive distressed asset challenges, and sluggish recovery of aggregate demand. To a significant extent, the demand shortfalls that have already been experienced have reset the growth path for the global economy. This will be compounded, however, if the largest markets are slower to recover. To give an indication of how this process might retard regional growth, we include a scenario where baseline growth rates for the Organisation for

Economic Co-operation and Development (OECD) economies fall to zero in 2009 and return to trend linearly over the next 5 years.

5. HAPI and/or other serious livestock disease outbreaks.

   Since its emergence in 1996 in the PRC, the highly pathogenic avian influenza H5N1 virus has infected 61 countries, been associated with more than 260 human fatalities, and resulted in disease mortality and culling of several hundred million domestic birds. Analogously, blue-ear disease in the PRC has killed several million swine. In each case, a large-scale animal disease outbreak has caused serious regional meat shortages, threatened livelihoods, and presented threats to public health. To assess the linkage effects of such a supply chain disruption, we examine the effects of a 20% decline in livestock productivity across Asian economies. Although we do not consider human health impacts, this is admittedly a relatively extreme scenario.

1. The main scenarios we evaluated represent the first three of these categories. As summarized below, each of these components makes an incremental contribution to agro-food development and overall economic growth. On agricultural productivity growth, based on a review of the relevant literature and international historical data, we have experimented with 1–6% annual output growth for the three agricultural sectors in the three low-income GMS countries considered (Cambodia, Lao PDR, and Viet Nam).[4] The highest rate would double output over 2008–2020 , but an upper-midrange value of 4% is probably more sustainable based on the historical evidence summarized in

[4] Unfortunately, data for Myanmar in the current version of GTAP were not deemed reliable enough to be incorporated individually in this analysis.

Table 4.

Table 4: Average Annual Growth of Agricultural Output

	1970–1979	1980–1989	1990–1999	2000–2006
Sub-Saharan Africa	1.31	2.6	3.1	2.2
LatinAmerica and Caribbean	3.07	2.37	2.87	3.13
Brazil	3.83	3.73	3.29	4.41
Middle East and North Africa	2.94	3.37	2.73	2.34
NE Asia, High	2.15	1.03	-0.01	-0.01
NE Asia, Low	3.11	4.55	5.06	3.85
PRC	3.09	4.6	5.17	3.87
SE Asia	3.68	3.59	3.13	3.54
South Asia	2.56	3.39	3	2.19
India	2.69	3.52	2.94	2
North America	2.17	0.73	2.03	1.1
Oceania	1.79	1.25	2.93	-0.04
Western Europe	1.54	0.94	0.46	-0.35
Eastern Europe	1.8	0.25	-2.18	-0.19
Russian Federation	1.32	0.98	-4.62	2.7
Developing countries	2.82	3.46	3.64	3.09
Developed countries	1.88	0.86	1.21	0.39
Russian Federation and Eastern Europe	1.47	0.77	-3.88	1.81
World	2.23	2.13	2.04	2.22

NE = northeast, SE = southeast

Sources: United States Department of Agriculture, World Bank

For trade facilitation, we recognize the important regional initiatives of ADB and GMS national governments to establish large transit corridors. These will significantly lower medium and long-distance market access costs, and can be expected to foster complementary infrastructure for feeder road and rail access that achieves more extensive participation. For the present scenario, we chose a central case that reduces trade, transport, and transit (TTT) margins for the low income GMS by 50%.

Finally, FDI has been a dramatic agent of growth elsewhere in the Asian region, and is likely to exert significant growth leverage on the low-income GMS as new opportunities arise for agro-food development and market access increases the average profitability of regional investments by reducing costs. As our reference case, we assume that FDI in each low-income GMS country rises linearly to 4% of GDP by 2020. For reference, this would place them in the world's top quartile by this metric, including both high (Singapore = 12%) and low income countries (Mongolia = 11%).

Table 5 summarizes the five core scenarios. Firstly, around the median values used for these three primary growth components, we evaluated a distribution of alternative values. Overall, simulation results are robust with respect to these differences, and what variation they exhibit is consistent with economic intuition and the results interpretation that follows. Two additional scenarios were included to illustrate the diverse scope of potential policy application for this model.

Table 5: General Scenarios

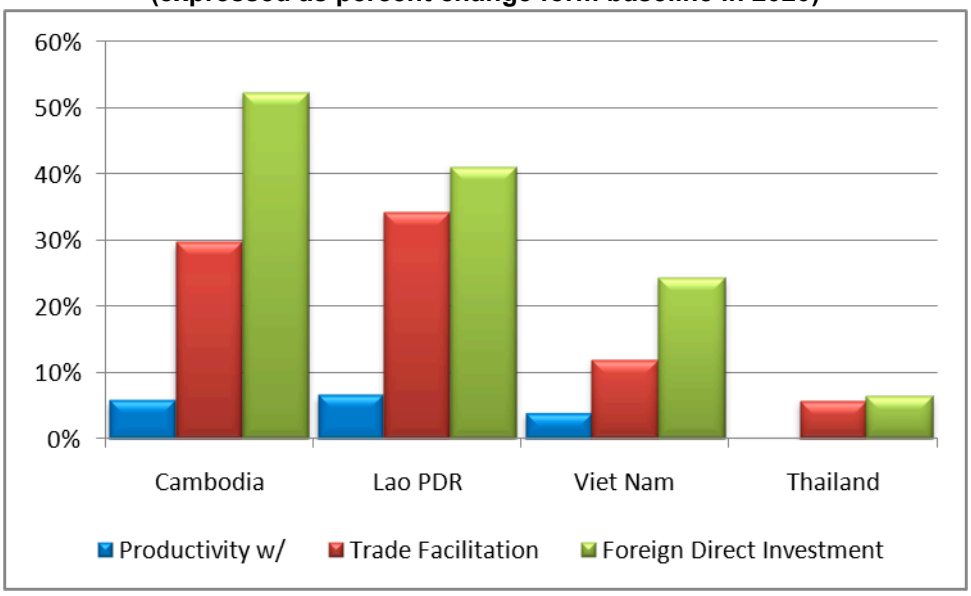
Scenario	Name	Description
1	Agro-Food Productivity	Assume that total factor productivity grows at 4% annually in agriculture and food processing sectors
2	Trade Facilitation	In addition to Scenario 1, assume trade, transport, and transit margins to and from and through low income GMS countries are reduced by 50%.
3	Foreign Direct Investment	In addition to Scenario 2, assume that FDI in the low income GMS countries rises to 4% of GDP by 2020.
4	OECD Recession	Assume OECD growth rates fall to zero in 2009 and return to baseline trends linearly in five years.
5	Livestock Epidemic	Assume 2009 livestock productivity in Asia falls 20%, returning to trend 5 years later.

GDP = gross domestic product, GMS = Greater Mekong Sub-region, FDI = foreign direct investment, OECD = Organisation for Economic Co-operation and Development.

IV. SIMULATION RESULTS

The macroeconomic results for the three archetype scenarios are summarized in the following tables, and Figure 5 illustrates the real GDP results for GMS economies considered. The most arresting feature of the GDP estimates is the pro-poor impact of the combined policies. When all three scenarios are considered together, Cambodia, the lowest-income country has the highest relative gain, the second lowest, Lao PDR is next, and finally Viet Nam, which would enjoy 20% higher real GDP in 2020. This finding is a logical consequence of several facts about low-income GMS (and indeed Asian) economies, including higher initial agro-food dependence, higher initial barriers to market access, and tighter domestic saving/investment constraints.

Figure 5: Real GDP
(expressed as percent change form baseline in 2020)



There are also several immediate general policy lessons from these findings. Firstly, the GMS in particular and many other poor agrarian economic regions can achieve self-directed poverty reduction with determined policies that yield higher agro-food productivity and improved market access, complemented with private agency that contributes in both these areas but also facilitates investment.

It is also clear from the same results that agrofood productivity alone will not achieve higher growth. Without the facilitating measures for market access and complementary investment, larger harvests and livestock production will simply translate into excessive inventories with falling prices and little net value added.

Another important insight comes from the fourth and fifth scenarios, suggesting that macroeconomic cycles are of much less long-term significance than sustained support for microeconomic determinants of productivity and market access. Even if livestock had a significant short-term setback, or if important OECD export markets experienced a 4–5 year recession, long-term growth potential will continue to be determined by detailed and localized economic fundamentals. For the lower-income GMS countries in particular, long-term growth potential depends much more on sustained modernization and market integration than on cyclical components for individual sectors or destination markets.

Finally, it is worth noting that there can be substantial benefits for neighboring intermediary economies like Thailand, which in this case achieves over 5% higher growth in the second and third scenarios by sharing the benefits of regional trade and investment. This highlights another important characteristic of complementary policies like trade and investment facilitation. Measures like these make individual development assistance incentive compatible for neighboring countries, creating new markets and

commercial partnership opportunities that promote shared—and thereby more sustained—economic growth.

Table presents more detailed results for the first agro-food productivity scenario. As one would expect, the countries targeted for productivity growth are the primary beneficiaries in the macroeconomic results of Table . Output in the lowest-income GMS countries considered, Cambodia and Lao PDR, rises by about 30% more by 2020 because of (assumed) steady improvements in the productivity of their rural sector (5% Total Factor Productivity (TFP) growth per year). Because both countries remain focused on primary agriculture, value added (real GDP) rises by less than the value of national agro-food output. Viet Nam, by contrast, is less reliant on primary agriculture across the economy, and this means aggregate output grows less from the same agricultural stimulus, but downstream food linkages permit more value added to be captured in agro-food supply chains. Thus the national GDP effect is more than double (9%) the simple output effect (4%).

Table 6: Scenario 1 – Macro Results

Percent	Cambodia	Lao PDR	Viet Nam	Thailand	Oth SEA	High Asia	PRC	S. Asia	Oth Asia
GDP	17%	23%	9%	6%	0%	0%	0%	0%	0%
Output	30%	29%	4%	6%	0%	0%	0%	0%	0%
Exports	29%	33%	8%	14%	0%	2%	0%	0%	0%
Imports	41%	48%	24%	17%	0%	2%	0%	0%	0%
Cons	53%	55%	32%	10%	0%	1%	0%	0%	0%
CPI	-6%	-4%	1%	4%	0%	0%	0%	0%	0%
EV Inc	54%	57%	32%	10%	0%	1%	0%	0%	0%
USD Millions	Cambodia	Lao PDR	Viet Nam	Thailand	Oth SEA	High Asia	the PRC	S. Asia	Oth Asia
GDP	5,194	2,717	9,704	33,130	-220	26,733	-125	588	-3
Output	68,497	18,128	75,135	208,710	-4,177	502,089	29,402	6,378	-13
Exports	26,504	4,386	51,218	148,518	-3,315	251,547	897	470	81
Imports	31,153	7,398	151,158	197,432	-5,035	270,927	-24,018	-226	79
Cons	3,917	2,440	23,966	18,847	-294	16,787	-839	475	6
EV Inc	6,393	2,612	27,470	20,980	-278	31,395	-1,019	726	7

Source: Author estimates.

In all three countries, agro-food is closely linked to export markets, and the trade impact of productivity growth strongly stimulates export competitiveness and import purchasing power (assuming small countries or low terms-of-trade effects). This new external income, combined with domestic price declines following productivity growth, supports substantial growth of Equivalent Variation (EV) real income and consumption for households. It is also worth noting that, via trade linkages, neighboring Thailand benefits less but still significantly. Thailand participates indirectly in low-income GMS growth via discounted imports and export demand expansions.

Table 7: Scenario 1 – Sector Output Results

Percent	Cambodia	Lao PDR	Viet Nam	Thailand	Oth SEA	High Asia	PRC	S. Asia	Oth Asia
Rice	56%	51%	80%	-8%	-2%	0%	0%	0%	2%
Oth Crops	55%	93%	155%	-2%	0%	-1%	0%	0%	0%
Livestock	58%	72%	63%	2%	0%	0%	0%	0%	0%
Fuels	32%	15%	9%	11%	0%	1%	0%	0%	0%
Meat, Dairy	61%	101%	70%	1%	0%	0%	0%	0%	0%
Oth PrFood	74%	65%	113%	-7%	0%	0%	0%	0%	1%
Manufactures	24%	5%	-10%	10%	0%	1%	0%	0%	0%
Trade Transp	19%	7%	3%	3%	0%	0%	0%	0%	0%
Priv Service	42%	21%	11%	6%	0%	1%	0%	0%	0%
Pub Service	26%	21%	7%	3%	0%	0%	0%	0%	0%
Total	30%	27%	6%	6%	0%	0%	0%	0%	0%
$ Million	Cambodia	Lao PDR	Viet Nam	Thailand	Oth SEA	High Asia	the PRC	S. Asia	Oth Asia
Rice	446	549	5,736	-1,142	-758	-165	98	-1	12
Oth Crops	403	445	9,252	-448	64	-1,257	-219	-214	-1
Livestock	450	385	1,497	89	52	585	30	55	-2
Fuels	315	54	794	4,949	409	4,748	2,232	189	-4
Meat, Dairy	280	202	3,750	123	32	-110	57	13	-3
Oth PrFood	1,319	835	12,465	-2,067	92	-175	-1,053	55	118
Manufactures	4,896	161	-19,926	23,448	-538	51,218	3,846	501	-115
Trade Transp	1,517	139	465	2,713	-8	14,521	-1,339	191	-12
Priv Service	2,355	223	5,419	6,978	-232	23,360	-218	205	-1
Pub Service	1,143	629	1,841	2,158	87	2,117	322	217	2
Total	13,125	3,621	21,294	36,801	-799	94,843	3,756	1,213	-6

Source: Author estimates.

The sector results in Table give a clearer indication of how each country adapts to higher productivity potential in the three major primary agricultural products. Recalling that our model treats crops and livestock differently, it is not surprising that different countries respond differently to uniform TFP growth. In particular, because Viet Nam has a more advance food processing sector, it is able to more completely absorb new agricultural potential, and thus we see the highest average output growth in crops and livestock. Perhaps ironically, this new potential pulls resources away from manufacturing to support dramatic expansion of the food processing sector. Given that Viet Nam's poor majority is firmly embedded in the rural sector, this resource reallocation may have greater anti-poverty potential than traditional urban industrialization at this stage of the country's development.

Sector results in food processing suggest that Lao PDR is still constrained in its ability to expand agriculture with productivity. Thus it will release resources to other sectors when marginal costs rise enough in agricultural production, even though expansion is below that of Viet Nam. Without improved market access or complementary investment, agro-food cannot take full direct advantage of productivity improvements and ends up subsidizing a shift of resources to other sectors as they are liberated by higher productivity in agriculture.

Table 8: Scenario 1 – Trade Flows

Percent	Cambodia	Lao PDR	Viet Nam	Thailand	Oth SEA	PRC	High Asia	S. Asia	Oth Asia
Cambodia			747%	446%	18%	459%	13%	4%	5%
Lao PDR			589%	547%	-14%	460%	-13%	-17%	
Viet Nam	512%	453%		699%	14%	798%	-3%	63%	10%
Thailand	96%	94%	168%		-7%	116%	-6%	-7%	-9%
Oth SEA	-25%	-28%	-8%	1%	0%	0%	0%	0%	0%
the PRC	146%	133%	179%	203%	0%		0%	0%	0%
High Asia	-20%	-20%	-3%	-1%	0%	0%	0%	0%	0%
S. Asia	-16%	-21%	-5%	1%	0%	0%	0%	0%	0%
Oth Asia	-16%		-5%	12%	0%	-1%	0%	0%	0%
$ Million	Cambodia	Lao PDR	Viet Nam	Thailand	Oth SEA	the PRC	High Asia	S. Asia	Oth Asia
Cambodia	0	0	757	178	19	439	128	2	0
Lao PDR	0	0	381	435	-2	134	-19	-2	0
Viet Nam	1,453	269	0	2,163	574	14,931	-540	784	8
Thailand	994	657	2,844	0	-1,542	31,613	-2,081	-340	-53
Oth SEA	-297	-6	-515	182	76	-599	233	25	3
PRC	2,875	304	16,982	22,046	-139	0	-909	-104	-2
High Asia	-541	-43	-849	-345	526	-2,134	653	78	21
S. Asia	-67	-6	-147	20	16	-158	26	9	2
Oth Asia	-4	0	-7	148	-2	-36	-17	-2	1

Source: Author estimates.

The trade implications of higher productivity are summarized in Table 8. Here we see a sector and regional breakdown of trade by origin and destination.[5] Even without complementary policies that facilitate market access and investment, agro-food productivity growth has a potent effect on trade competitiveness. The three low-income GMS countries see dramatic percentage increases in export opportunities with respect to their neighbors. To the PRC, for example, each country increases exports by more

than 450%. Although in many cases this change is with respect to a small baseline trade flow, the impetus is strong enough to suggest the potential for long-term growth leverage for the low income exporter. Looking at level changes in the second sub-table, we see that trade diversion (negative elements) plays a relatively minor role, and is far outweighed by trade creation. This is an essential characteristic of productivity-based competitiveness and is very important to multilateral promotion of this approach for regional poverty reduction. Beggar-thy-neighbor policies must be avoided as countries expand bilateral trade.

Table 9: Scenario 2 – Macro Results

Percent	Cambodia	Lao PDR	Viet Nam	Thailand	Oth SEA	High Asia	PRC	S. Asia	Oth Asia
GDP	30%	30%	14%	6%	0%	1%	0%	0%	0%
Output	50%	31%	12%	9%	0%	1%	0%	0%	0%
Exports	74%	63%	34%	20%	0%	3%	0%	0%	0%
Imports	87%	82%	58%	31%	0%	4%	0%	0%	0%
Cons	68%	66%	48%	19%	0%	1%	0%	0%	0%
CPI	-4%	4%	5%	7%	0%	1%	0%	0%	0%
EV Inc	70%	65%	48%	18%	0%	1%	0%	0%	0%
$ Million	Cambodia	Lao PDR	Viet Nam	Thailand	Oth SEA	High Asia	PRC	S. Asia	Oth Asia
GDP	9,046	3,524	15,125	32,395	-380	47,859	126	1,028	-13
Output	116,570	19,742	228,670	297,902	-9,427	1,027,483	59,601	7,538	-115
Exports	66,816	8,214	207,636	221,610	-9,319	530,824	7,795	-1,524	31
Imports	65,878	12,698	364,527	358,554	-12,603	495,095	-45,002	-3,442	-49
Cons	5,101	2,896	36,152	36,467	-605	27,807	-1,363	658	-1
EV Inc	8,215	2,999	40,568	40,419	-674	53,552	-1,758	810	-4

Source: Author estimates.

The next set of tables summarizes impacts for the intermediate scenario, including both agro-food productivity and trade facilitation. As the macroeconomic results demonstrate, the full potential of higher productivity in primary sectors cannot be realized without reducing trade and transport margins to expand eligible markets. Interestingly, output growth increases moderately, but trade in both directions and value added are nearly double that of the productivity only scenario. In other words, trade facilitation takes a similar amount of productive potential and articulates these goods into longer supply chains, including both higher exports and imports, stimulating trade as well as a broad array of intermediate services.

[5] An element T_{ij} of the trade table measures annual changes from baseline in exports from country i (row) to country j, in the terminal year (2020).

Table 10: Scenario 2 – Sector Results

Percent	Cambodia	Lao PDR	Viet Nam	Thailand	Oth SEA	High Asia	PRC	S. Asia	Oth Asia
Rice	53%	49%	124%	-23%	-4%	-1%	0%	0%	5%
Oth Crops	61%	132%	204%	33%	1%	-2%	0%	0%	0%
Livestock	65%	65%	61%	-3%	0%	1%	0%	0%	0%
Fuels	100%	24%	-7%	32%	1%	2%	0%	0%	0%
Meat, Dairy	54%	95%	71%	0%	0%	0%	0%	0%	0%
Oth Pr Food	54%	51%	92%	-11%	0%	1%	0%	0%	2%
Manufactures	52%	12%	0%	10%	0%	1%	0%	0%	0%
Trade Transp	27%	5%	7%	5%	0%	1%	0%	0%	0%
Priv Service	61%	26%	18%	10%	0%	1%	0%	0%	0%
Pub Service	26%	28%	7%	4%	0%	0%	0%	0%	0%
Total	48%	30%	14%	9%	0%	1%	0%	0%	0%
$ Million	Cambodia	Lao PDR	Viet Nam	Thailand	Oth SEA	High Asia	PRC	S. Asia	Oth Asia
Rice	425	538	8,900	-3,440	-1,137	-441	291	8	31
Oth Crops	441	632	12,156	6,136	226	-4,514	-148	-127	-4
Livestock	502	350	1,459	-161	87	1,662	114	44	-3
Fuels	987	87	-611	14,262	679	12,971	2,844	179	-9
Meat, Dairy	249	190	3,806	-39	59	100	118	12	-6
Oth PrFood	955	661	10,227	-3,051	435	3,102	-202	74	186
Manufactures	10,781	381	-338	23,479	-1,662	106,222	7,156	396	-196
Trade Transp	2,210	104	1,277	4,667	-96	22,338	-3,354	279	-24
Priv Service	3,412	271	8,841	12,935	-394	39,805	-122	374	-7
Pub Service	1,163	834	1,900	3,422	163	3,070	674	458	6
Total	21,125	4,048	47,617	58,209	-1,640	184,315	7,372	1,697	-26

Source: Author estimates.

This trade-driven supply chain expansion is evident in the sector results of Table 10, which shows both up and downstream increases in sectors related to agro-food production, processing, and trade. Each of these contributes to higher value added, more broad based employment growth, and more rapidly rising incomes in these low income economies.

Table 2 reveal the catalytic impact of trade facilitation. Again on relatively low initial conditions, we see very dramatic bilateral trade expansion in both directions for GMS neighbors. Again, because this trade stimulus is productivity driven, trade growth far outweighs trade diversion. This means not only that established trade relations suffer very little from the improved circumstances of lower-income countries, but several of their neighbors are distinctly better off. Thailand sees 6% higher real GDP because of

the improved fortunes of its neighbors, without sharing the productivity gains directly. Even HIA countries sees 1% higher GDP growth by 2020, despite the small size of the GMS economies, their increased dependence on higher tech imports from HIA, as well as access to lower cost food products, benefits the latter and provides important incentives for regional cooperation to promote self-directed, trade-oriented poverty reduction.

Table 2: Scenario 2 – Trade Flows

Percent	Cambodia	Lao PDR	Viet Nam	Thailand	Oth SEA	PRC	High Asia	S. Asia	Oth Asia
Cambodia			1255%	1836%	45%	710%	39%	17%	19%
Lao PDR			829%	1246%	-19%	688%	-9%	-23%	
Viet Nam	876%	634%		1028%	40%	1510%	11%	65%	37%
Thailand	315%	185%	337%		-16%	238%	-15%	-16%	-21%
Oth SEA	-37%	-40%	-19%	0%	1%	0%	0%	0%	1%
PRC	303%	242%	530%	415%	-1%		-1%	-1%	0%
High Asia	-34%	-14%	-13%	-3%	1%	0%	0%	0%	1%
S. Asia	-32%	-33%	-14%	-1%	0%	0%	0%	0%	1%
Oth Asia	-30%		-8%	19%	0%	-1%	0%	0%	1%

$ Million	Cambodia	Lao PDR	Viet Nam	Thailand	Oth SEA	the PRC	High Asia	S. Asia	Oth Asia
Cambodia	0	0	1,272	735	48	680	372	10	1
Lao PDR	0	0	536	992	-3	201	-14	-3	0
Viet Nam	2,487	377	0	3,183	1,652	28,256	2,005	807	32
Thailand	3,253	1,291	5,700	0	-3,589	65,196	-4,873	-794	-127
Oth SEA	-450	-9	-1,277	-95	175	-91	316	74	5
PRC	5,982	553	50,390	45,050	-582	0	-3,796	-399	-28
High Asia	-936	-30	-3,957	-1,469	1,094	1,850	1,161	162	42
S. Asia	-133	-9	-397	-32	43	73	49	39	4
Oth Asia	-8	0	-12	226	-2	-35	-16	-3	1

Source: Author estimates.

The third and final scenario encompasses both productivity growth and trade facilitation, but adds the FDI needed to help low income countries overcome domestic saving insufficiency. As intuition would suggest and as the macroeconomic results of Table 3 clearly demonstrate, expanding investment opportunities in the presence of higher productivity and expanded market access yields both dramatic output growth and explosive trade expansion. Both of these responses translate into higher value added (though less dramatic because of lower rental rates under capital expansion) and much higher real domestic incomes and consumption. These effects are very dramatic for the target economies, increasing real GDP between 24 and 52% by 2020, but they also

directly benefit immediate neighbors like Thailand (6% GDP and 9% real income) and the PRC (1%).

Table 3: Scenario 3 – Macro Results

Percent	Cambodia	Lao PDR	Viet Nam	Thailand	Oth SEA	High Asia	PRC	High Asia	S. Asia	Oth Asia
GDP	52%	41%	24%	6%	0%	0%	1%	0%	0%	0%
Output	123%	60%	26%	10%	0%	0%	1%	0%	0%	0%
Exports	139%	100%	47%	21%	0%	0%	3%	0%	0%	0%
Imports	160%	114%	74%	32%	0%	0%	4%	0%	0%	0%
Cons	121%	94%	57%	20%	0%	0%	1%	0%	0%	0%
CPI	-7%	5%	5%	7%	0%	0%	1%	0%	0%	0%
EV Inc	119%	91%	57%	19%	0%	0%	1%	0%	0%	0%
$ Million	Cambodia	Lao PDR	Viet Nam	Thailand	Oth SEA	High Asia	PRC	High Asia	S. Asia	Oth Asia
GDP	15,795	4,786	26,808	35,214	-285	277	49,665	277	885	-13
Output	284,453	38,335	509,129	312,275	-7,744	75,304	1,066,830	75,304	6,253	-52
Exports	125,344	13,140	284,063	228,970	-8,299	18,501	552,364	18,501	-1,649	70
Imports	120,805	17,687	466,043	368,287	-11,185	-29,972	516,988	-29,972	-3,494	-24
Cons	9,026	4,124	42,844	37,647	-491	-647	29,003	-647	556	0
EV Inc	14,006	4,186	47,884	41,715	-554	-780	55,667	-780	675	-3

Source: Author estimates.

Increased access to capital, formerly severely constrained in these countries, also means that growth will be more broad-based. Sectors participating in all supply chains (i.e., both exports and imports) experience less competitive pressure for resources and can expand at lower marginal cost. In this way, alleviating capital constraints increases the number of winners within each economy. In the previous scenarios, growth of some sectors imposed scarcity costs on others, inducing reduced average profitability and even contraction.

FDI in this way facilitates not only output expansion in the higher productivity sectors, along their supply chains, but also in sectors that would otherwise fail to capture the multiplier effects of target sector expansion. This is particularly apparent when agro-food productivity and trade facilitation combined to increase competitiveness of selected primary and tertiary sectors. Without external capital inflows, this process induced stagnation or even contraction on other sectors (Table), while we see more robust and balanced growth when FDI is available.

Table 4: Scenario 3 – Sector Results

Percent	Cambodia	Lao PDR	Viet Nam	Thailand	Oth SEA	High Asia	PRC	High Asia	S. Asia	Oth Asia
Rice	78%	69%	121%	-22%	-3%	0%	0%	0%	0%	5%
Oth Crops	88%	108%	191%	32%	1%	0%	-2%	0%	0%	0%
Livestock	116%	93%	67%	-2%	0%	0%	1%	0%	0%	0%
Fuels	158%	67%	10%	34%	1%	1%	2%	1%	0%	0%
Meat, Dairy	93%	115%	81%	1%	0%	0%	0%	0%	0%	-1%
Oth PrFood	120%	82%	109%	-11%	0%	0%	1%	0%	0%	2%
Manufactures	128%	53%	15%	10%	0%	0%	1%	0%	0%	0%
Trade Transp	104%	30%	20%	5%	0%	0%	1%	0%	0%	0%
Priv Service	170%	63%	41%	11%	0%	0%	1%	0%	0%	0%
Pub Service	54%	42%	11%	4%	0%	0%	0%	0%	0%	0%
Total	120%	57%	28%	9%	0%	0%	1%	0%	0%	0%
$ Million	Cambodia	Lao PDR	Viet Nam	Thailand	Oth SEA	High Asia	PRC	High Asia	S. Asia	Oth Asia
Rice	624	747	8,678	-3,363	-970	298	-353	298	27	33
Oth Crops	643	517	11,355	5,993	218	-127	-4,432	-127	-98	-3
Livestock	896	497	1,603	-92	82	124	1,636	124	36	-3
Fuels	1,556	237	882	15,568	621	6,156	13,826	6,156	132	-11
Meat, Dairy	424	230	4,332	80	55	109	77	109	10	-6
Oth PrFood	2,145	1,055	12,048	-3,079	396	-304	2,998	-304	69	198
Manufactures	26,591	1,722	30,523	24,005	-1,469	6,469	110,216	6,469	305	-195
Trade Transp	8,365	626	3,551	4,832	-103	-3,300	22,860	-3,300	220	-28
Priv Service	9,504	658	19,693	13,353	-299	274	41,332	274	363	-8
Pub Service	2,409	1,240	2,988	3,521	145	640	3,188	640	368	5
Total	53,156	7,530	95,652	60,820	-1,324	10,340	191,350	10,340	1,432	-20

Source: Author estimates.

As the macroeconomic export and import results suggest for this scenario, bilateral trade growth is explosive when policies can achieve combined productivity, market access, and external investment. The simple leveraging of external savings can increase domestic capacity for export, along with commensurate import purchasing power, but a multiple of three or four for these small economies. This provides not only an important source of new market income, but also permits access to essential imports of higher technology capital goods, consumer products, and services. Such technology transfer can in turn be expected to generate endogenous growth benefits that will further advance the progress of these low-income countries.

Finally despite the dramatic expansion of bilateral trade across this region, trade diversion is a small fraction of trade creation. Once again, we see that constructive trade promotion policies, ones that enhance productivity, market access, and investment opportunities, can advance the welfare of more needy economies without threatening

established trade or livelihoods in more advanced economies. On the contrary, all Asian economies or regions considered here are better off (or at least not worse off) in this scenario, which returns dramatic trade-induced poverty reduction in low-income GMS economies.

Table 14: Scenario 3 – Trade Flows

Percent	Cambodia	Lao PDR	Viet Nam	Thailand	Oth SEA	PRC	High Asia	S. Asia	Oth Asia
Cambodia			1743%	2053%	88%	977%	83%	55%	66%
Lao PDR			1130%	1277%	-14%	695%	4%	-18%	
Viet Nam	1425%	871%		1128%	43%	1539%	20%	61%	43%
Thailand	488%	238%	386%		-17%	236%	-15%	-17%	-21%
Oth SEA	-14%	-29%	-10%	0%	1%	0%	0%	0%	1%
the PRC	476%	309%	599%	417%	-1%		-1%	-1%	0%
High Asia	-5%	-1%	-3%	-3%	1%	0%	0%	0%	1%
S. Asia	-3%	-21%	-4%	0%	0%	0%	0%	0%	1%
Oth Asia	-1%		0%	20%	0%	0%	0%	-1%	1%

$ Million	Cambodia	Lao PDR	Viet Nam	Thailand	Oth SEA	PRC	High Asia	S. Asia	Oth Asia
Cambodia	0	0	1,767	821	93	936	801	32	4
Lao PDR	0	0	730	1,017	-2	203	6	-2	0
Viet Nam	4,047	518	0	3,492	1,768	28,801	3,698	754	38
Thailand	5,046	1,662	6,532	0	-3,698	64,657	-5,062	-823	-131
Oth SEA	-166	-7	-686	-21	175	4	255	55	5
the PRC	9,375	704	56,960	45,240	-663	0	-4,391	-473	-37
High Asia	-150	-2	-907	-1,314	1,091	2,136	1,052	145	41
S. Asia	-11	-6	-129	-12	51	144	54	42	5
Oth Asia	0	0	-1	238	-2	-27	-15	-3	1

Source: Author estimates.

V. CONCLUSIONS AND POLICY IMPLICATIONS

Trade in food and other agricultural products is increasingly important across East and Southeast Asia, where high income Asian economies have driven significant agricultural expansion and the PRC's momentous growth promises more stimulus to agro-food activity in the region. The PRC is expected to become a net importer of agro-food in the coming decades, which will have significant implications within the region. As its middle class continues to emerge, the resource intensity of food consumption (e.g., meat and dairy) will lead to net imports and require expansion of agricultural capacity elsewhere.

Because low-income Southeast Asia is generally seen to be well below its agro-food potential, this situation suggests a significant opportunity for self-directed poverty reduction through regional agro-food market expansion. This paper reviews the history of HIA and PRC's emergence in region's agro-food markets. Finally, GMS's role is analyzed for the potential of Asian agro-food trade to contribute to poverty reduction.

After an extensive review of historical and initial conditions, we use a new dynamic simulation model to assess the prospects for rapid growth among low-income GMS economies. In particular, we examine empirically the potential contributions of agro-food productivity growth, trade facilitation, and FDI in these countries. Our results suggest that such potential is very significant, but it can only be fully realized if policies are integrated and complementary.

In particular, productivity growth alone will only generate low-value surpluses. Combining this with trade facilitation measures, including infrastructure investments like the GMS corridors, will amplify benefits but also lead to domestic resource rivalry. Finally, complementing the first two advantages with access to external investment funds achieves the highest benefit.

The estimated gains from these policies are very substantial for the low-income economies considered, and moreover they benefit neighboring countries that do not share the direct benefits. Just as importantly, dramatic trade expansion by the beneficiaries induces significant regional trade growth, but relatively minor trade diversion. This result supports the essential argument that trade-oriented, self-directed poverty reduction policies among low income GMS countries are incentive-compatible for their wealthier neighbors. Intuition might suggest this, but trade rivalry has a long history in this region and elsewhere. For this reason, we believe it is important to develop empirical evidence that growth dividends propagate across the region and trade growth can be shared among regional partners without the need for intervention, trading rules, or even unrequited transfers.

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APPENDIX 1 - MODEL SUMMARY

This paper uses a version of the World Bank's LINKAGE Model, a global, multiregion, multisector, dynamic applied general equilibrium model. The base data set—GTAP Version 7.0—is defined across 118 country and/or region groupings, and 57 economic sectors. For this paper, the model has been defined for an aggregation of 13 country and/or regions and 10 sectors, including sectors of importance to the poorer developing countries—grains, textiles, and apparel. The regional and sectoral concordances can be found in Table in the main text. The remainder of this section outlines briefly the main characteristics of supply, demand, and the policy instruments of the model.

Production

All sectors are assumed to operate under constant returns to scale and perfect competition. Production in each sector is modeled by a series of nested CES production functions that are intended to represent the different substitution and complementarity relations across the various inputs in each sector. There are material inputs that generate the input/output table, as well as factor inputs representing value added.

Three different production archetypes are defined in the model—crops, livestock, and all other goods and services. The CES nests of the three archetypes are graphically depicted in Figures A-1 through A-3. Within each production archetype, sectors will be differentiated by different input combinations (share parameters) and different substitution elasticities. Share structures are largely determined by base year data, and the elasticities are given values by the modeler.

The key feature of the crop production structure is the substitution between intensive cropping versus extensive cropping, i.e., between fertilizer and land (Figure A-1). Livestock production captures the important role played by feed versus land, i.e., between ranch- versus range-fed production (Figure A-2). Production in the other sectors more closely matches the traditional role of capital/labor substitution, with energy introduced as an additional factor of production (Figure A-3).

In each period, the supply of **primary** factors—capital, labor, and land—is usually predetermined. However, the supply of land is assumed to be sensitive to the contemporaneous price of land. Land is assumed to be partially mobile across agricultural sectors. Given the comparative static nature of the simulations that assume a longer-term horizon, both labor and capital are assumed to be perfectly mobile across sectors (though not internationally).

Model current specification has an innovation in the treatment of labor resources. The GTAP data set identifies two types of labor skills—skilled and unskilled. Under the standard specification, both types of labor are combined together in a CES bundle to form aggregate sectoral labor demand, i.e., the two types of labor skills are directly substitutable. In the new specification, a new factor of production has been inserted, which we call *human* capital. It is combined with capital to form a physical *cum* human capital bundle, with an assumption that they are complements. On input, the user can specify the percentage of the skilled labor factor to allocate to the human capital factor.

Once the optimal combination of inputs is determined, sectoral output prices are calculated assuming competitive supply (zero-profit) conditions in all markets.

Consumption and Closure Rules

All income generated by economic activity is assumed to be distributed to a single representative household. The single consumer allocates optimally his or her disposable income among the consumer goods and saving. The consumption/saving decision is completely static: saving is treated as a "good" and its amount is determined simultaneously with the demands for the other goods, the price of saving being set arbitrarily equal to the average price of consumer goods.

Government collects income taxes, indirect taxes on intermediate and final consumption, taxes on production, tariffs, and export taxes and/or subsidies. Aggregate government expenditures are linked to changes in real GDP. The real government deficit is exogenous. Closure therefore implies that some fiscal instrument is endogenous in order to achieve a given government deficit. The standard fiscal closure rule is that the marginal income tax rate adjusts to maintain a given government fiscal stance. For example, a reduction or elimination of tariff rates is compensated by an increase in household direct taxation, ceteris paribus.

Each region runs a current-account surplus (deficit) that is fixed (in terms of the model numéraire). The counterpart of these imbalances is a net outflow (inflow) of capital, subtracted from (added to) the domestic flow of saving. In each period, the model equates gross investment to net saving (equal to the sum of saving by households, the net budget position of the government, and foreign capital inflows). This particular closure rule implies that investment is driven by saving. The fixed-trade balance implies an endogenous real exchange rate. For example, removal of tariffs, which induces increased demand for imports, is compensated by increasing exports—which is achieved through a real depreciation.

Foreign Trade

The world trade block is based on a set of regional bilateral flows. The basic assumption in LINKAGE is that imports originating in different regions are imperfect substitutes (Figure A-4). Therefore in each region, total import demand for each good is allocated across trading partners according to the relationship between their export prices. This specification of imports—commonly referred to as the Armington specification—implies that each region faces a downward-sloping demand curve for its exports. The Armington specification is implemented using two CES nests. At the top nest, domestic agents choose the optimal combination of the domestic good and an aggregate import good consistent with the agent's preference function. At the second nest, agents optimally allocate demand for the aggregate import good across the range of trading partners.

The bilateral supply of exports is specified in parallel fashion using a nesting of constant-elasticity-of-transformation (CET) functions. At the top level, domestic suppliers optimally allocate aggregate supply across the domestic market and the

aggregate export market. At the second level, aggregate export supply is optimally allocated across each trading region as a function of relative prices.

Trade variables are fully bilateral and include both export and import taxes and/or subsidies. Trade and transport margins are also included; therefore world prices reflect the difference between FOB and CIF pricing.

Prices

The LINKAGE model is fully homogeneous in prices, i.e., only relative prices are identified in the equilibrium solution. The price of a single good, or of a basket of goods, is arbitrarily chosen as the anchor to the price system. The price (index) of the Organisation for Economic Co-operation and Development (OECD) manufacturing exports has been chosen as the numéraire, and is set to 1.

Elasticities

Production elasticities are relatively standard and are available from the authors. Aggregate labor and capital supplies are fixed, and within each economy they are perfectly mobile across sectors.

Equivalent Variation Aggregate National Income

Aggregate income gains and/or losses summarize the extent to which trade distortions are hindering growth prospects and the ability of economies to use the gains to help those whose income could potentially decline.

Real income is summarized by Hicksian equivalent variation (EV). This represents the income consumers would be willing to forego to achieve post-reform well-being (u^p) compared to baseline well-being (u^b) at baseline prices (p^b):

$$EV = E\left(p^b, u^p\right) - E\left(p^b, u^b\right)$$

where E represents the expenditure function to achieve utility level u given a vector of prices p (the b superscript represents baseline levels, and p the post-reform levels). The model uses the extended linear expenditure system (ELES), which incorporates savings in the consumer's utility function. The discounted real income uses the following formula:

$$CEV = \sum_{t=2005}^{2015} \beta^{(t-2004)} EV_t^a \; / \; \sum_{t=2005}^{2015} \beta^{(t-2004)} Y_t^d$$

where CEV is the cumulative measure of real income (as a percent of baseline income), β is the discount factor (equal to $1/(1+r)$ where r is the subjective discount rate), Y^d is real disposable income, and EV^a is adjusted equivalent variation. The adjustment to EV extracts the component measuring the contribution of household saving, since this represents future consumption. Without the adjustment, the EV measure would be double counting. The saving component is included in the EV evaluation for the terminal year. Similar to the OECD, a subjective discount rate of 1.5% is assumed in the cumulative expressions.

Specification of Endogenous Productivity Growth

Productivity in manufacturing and services is the sum of three components:

- a uniform factor used as an instrument to target gross domestic product growth in the baseline simulation
- a sector-specific fixed shifter which allows for relative differentials across sectors (for example, manufacturing productivity two percentage points higher than productivity in the services sectors)
- a component linked to sectoral openness as measured by the export-to-output ratio

The openness component takes the following functional form:

$$(1) \qquad \gamma_i^e = \chi_i^0 \left(\frac{E_i}{X_i} \right)^{\eta}$$

where γ^e is the growth in sectoral productivity due to the change in openness, χ^0 is a calibrated parameter, E and X represent respectively sectoral export and output, and η is the elasticity. The parameter χ^0 has been calibrated so that (on average) openness determines roughly 40% of productivity growth in the baseline simulation, and the elasticity has been set to 1.

In agriculture, productivity is fixed in the baseline, set to 2.5% per annum in most developing countries. However, a share of the fixed productivity is attributed to openness, using equation (1).

In the baseline, GDP growth is given. Agricultural productivity is similarly given, and equation (1) is simply used to calibrate the shift parameter, χ^0, so that a share of agricultural productivity is determined by sectoral openness. Average productivity in the manufacturing and services sectors is endogenous and is calibrated in the baseline to achieve the given GDP growth target. The economy-wide (excluding agriculture) productivity parameter is endogenous. Equation (1) is used to calibrate the same χ^0 parameter, under the assumption that some share of sectoral productivity is determined by openness, for example 40%.

In policy simulations, the economy-wide productivity factor, along with other exogenous productivity factors (sector-specific shifters) are held fixed, but the openness-related part of productivity is endogenous and responds to changes in the sectoral export-to-output ratio. In the manufacturing and services sectors, the elasticity is set at 1. In the agricultural sectors it is set to 0.5.

Say sectoral productivity is 2.5%, and that 40% of it can be explained by openness, i.e., 1.0%, with the residual 1.5% explained by other factors. Assume sectoral openness increases by 10%. If the elasticity is 1, this implies that the openness-related productivity component will increase to 1.1% and total sectoral productivity will increase to 2.6% (implying that the total sectoral productivity increases by 4% with respect to the 10% increase in sectoral openness).

Figure A1.1: Production Function for Crops

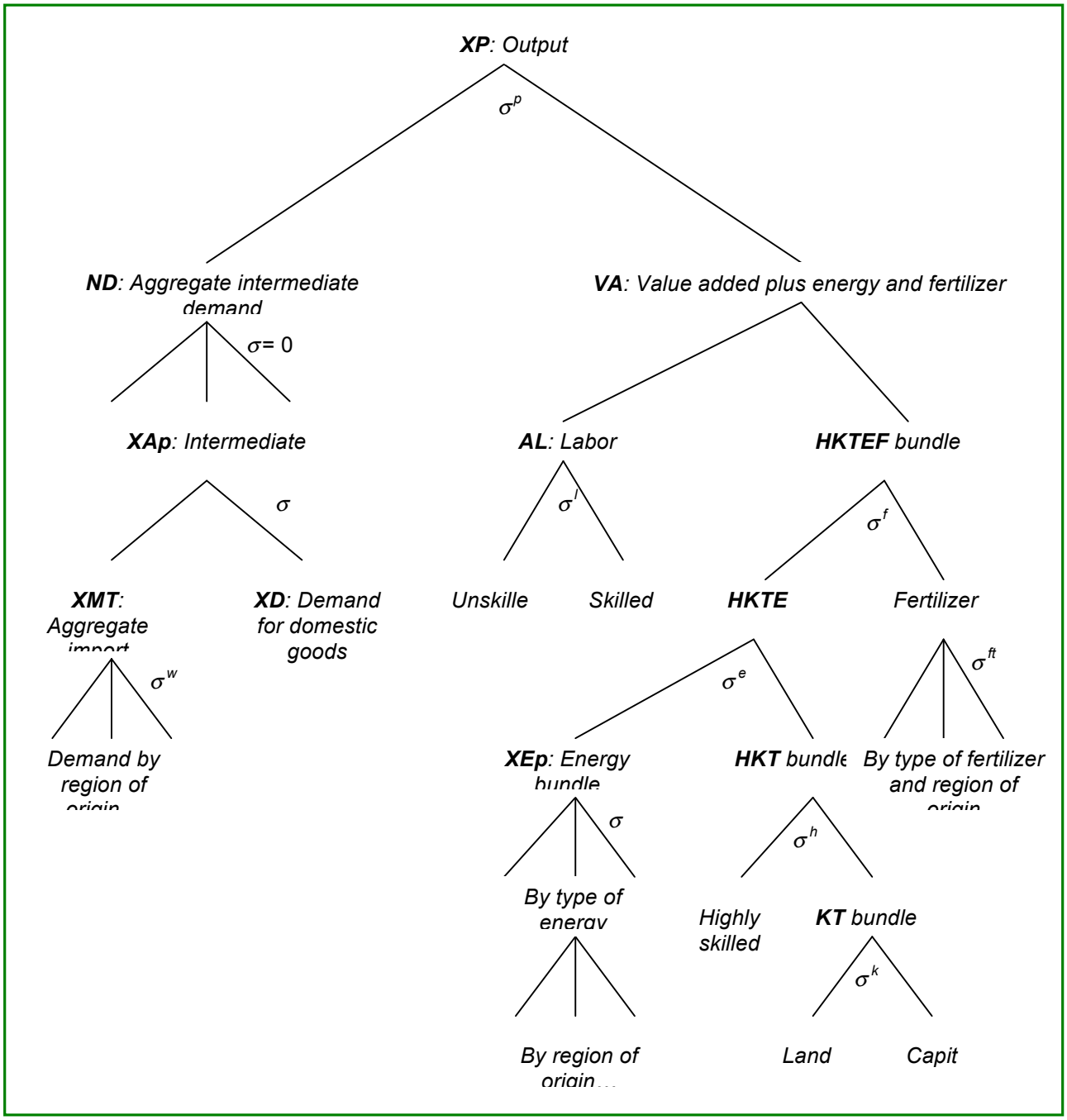


Figure A1.2: Production Function for Livestock

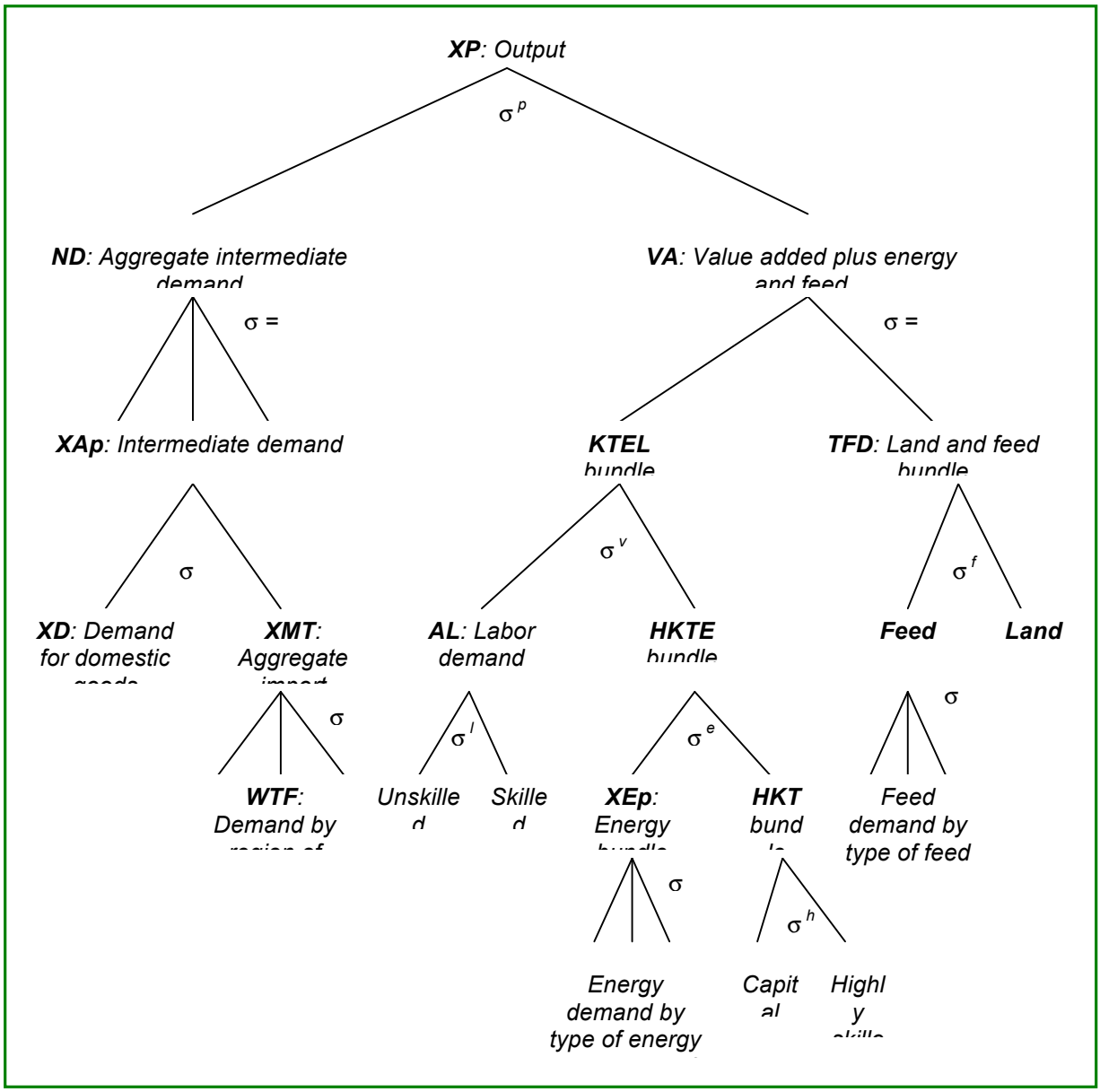


Figure A1.3: Production Function for Non-agriculture

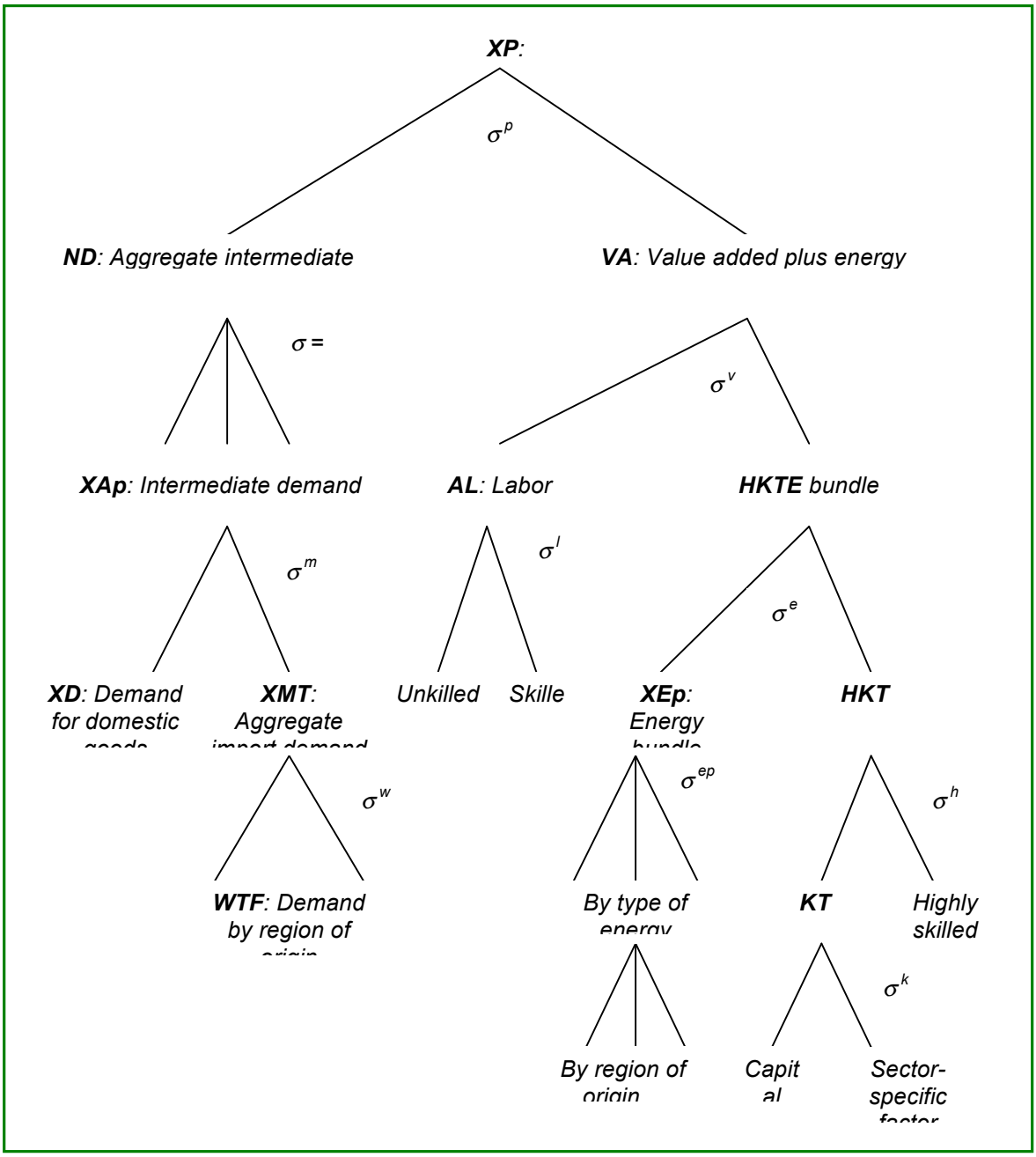
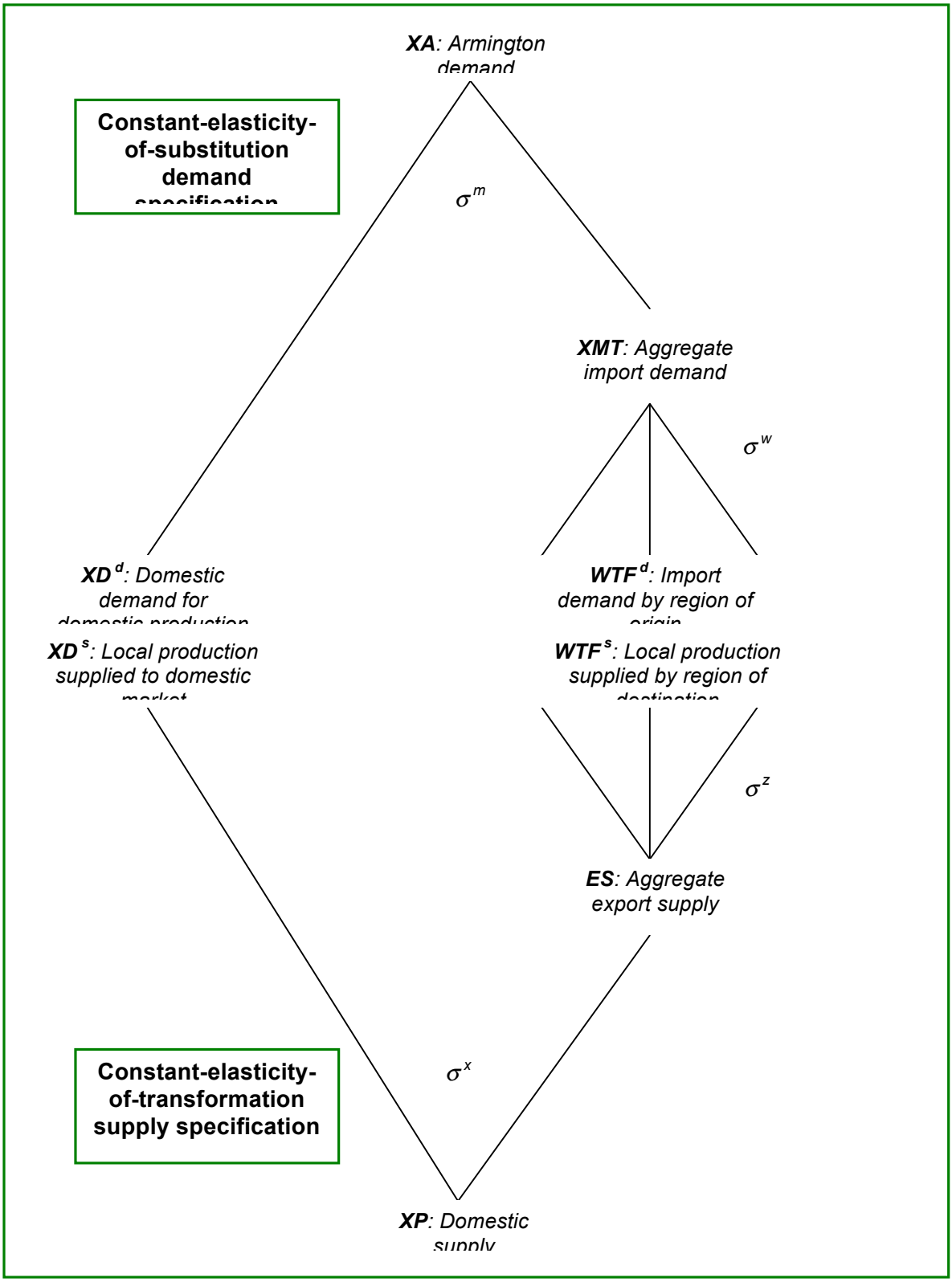


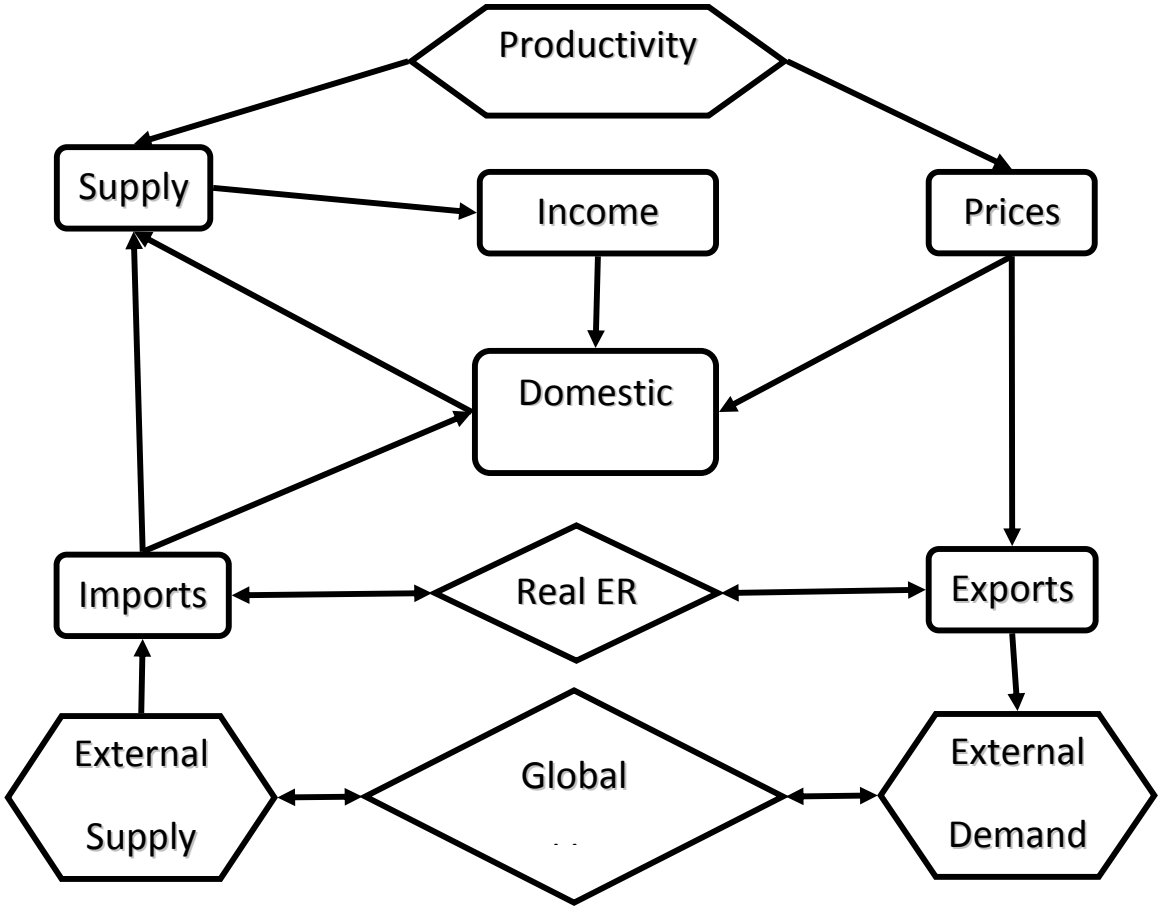
Figure A1.4: Trade Aggregation



APPENDIX 2 – MODEL CALIBRATION

The model is calibrated to country and regional real gross domestic product growth rates, obtained as consensus estimates from independent sources (Data Resources International, International Monetary Fund, Cambridge Econometrics). Using exogenous rates of implied TFP growth, the model computes supply, demand, and trade patterns compatible with domestic and global equilibrium conditions. Equilibrium is achieved by adjustments in the relative prices of domestic resources and commodities, while international equilibrium is achieved by adjusting trade patterns and real exchange rates to satisfy fixed real balance of payments constraints. The general process is schematically represented in Figure A2.

Figure A2: General Equilibrium Calibration Mechanism



APPENDIX 3 - NOTES ON THE ADJUSTMENT PROCESS

The calibration procedure highlights the two salient adjustment mechanisms in the model (as well as the real economies), domestic and international prices. General equilibrium price adjustments are generally well understood by professional economists but, in the multilateral context, the role of exchange rates can be a source of confusion. Generally, in a neoclassical model like this one, there are no nominal or financial variables and the function of the exchange rate is only to equalize real purchasing power between different economies.

Because models like this do not capture the aggregate price level or other nominal quantities, there is no nominal exchange rate in the sense of traditional macroeconomics or finance. Since there is no money metric in the model, all prices are relative prices, and the exchange rate (the composite relative price of foreign goods) is no exception. If there were financial assets in the model, one could define a nominal exchange rate as the relative price of two international financial assets (e.g., money and bonds). Without them, the exchange rate is defined in terms of real international purchasing power, i.e., the relative price of tradeable to nontradeable goods. In a multisector setting, the real exchange rate is defined as the ratio of an index of the value of all tradeables (on world markets) to an index of the value of all nontradeables.

Since any tax (or other price elevating distortion) on an import is an implicit tax on all tradeable goods, trade liberalization causes tradeable goods prices to fall and the real exchange rate depreciates. Real exchange rate depreciation also makes exports more competitive, one of the principal motives for unilateral liberalization. The general implication of this is that trade will expand rapidly for a country removing significant import protection, and more rapidly for countries removing more protection. The pattern of trade expansion, and the domestic demand and supply shifts that accompany it, depend upon initial conditions and adjustments among trading partners.

It should also be noted that even in a second-best world, removing price distortions also confers efficiency gains, increasing output potential and real incomes.