University of Alberta

'Incompatible' Dependent Development in Captive Producer-driven Value Chains

by

Shawn Hashmi ©

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled **'Incompatible' Dependent Development in Captive Producer-driven Value Chains** submitted by **Shawn Hashmi** in partial fulfillment of the requirements for the degree of **Master of Arts**.

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ABSTRACT:

The effects of network organization in 'captive' PDVCs on local supplier firm-level learning are modeled for the automotive components sector. The geographic extension of a network of foreign-owned subsidiaries imparts tier 1 lead firms with greater structural power to force peripheral suppliers to integrate and 'internalize' network-level interests in a dependent exchange. Viability as a tier 2 network subsidiary is exchanged for 'parental' control of subsidiary mandate assignment, needed to organize lead firm pursuit of complementation-based offshoring advantages. Within each mVA node, between 'sister' subsidiaries manufacturing the same component part, 'major' volume component suppliers are assigned complementary technical and R&D resource mandates to guarantee sustainable, cost competitive assimilation of upgraded product technology. However, follow source 'minors' are subject to immiserizing learning, a form of 'incompatible' dependent development. This intra-nodal division of labor is the explanatory unit of analysis used to assess the competitiveness of South Africa's components industry under the MIDP.

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Dedication:

For my Mom, the only one in the family who actually doesn't mind that I never became a medical doctor and who I truly believe when she says "I only want you to be happy". Every underachieving son should be so lucky.

This world has jewels, money, land
Position, power, and mansions grand
But a mother's love more precious far
Than all these other treasures are

-Brenda Ascott Fry

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LIST OF ABBREVIATIONS

AC	Absorptive Capacity
AIDC	Auto Industry Development Centre
BDVC	Buyer Driven Value Chain
CBU	Completely Built-Up Unit
CC	Competency Creating Mandate
CE	Competency Exploiting Mandate
EAD	East Asian Development Model
EMC	Emerging Market Country
ERP	Effective Rate of Protection
FDI	Foreign Direct Investment
FOS	Foreign-Owned Subsidiary
GPN	Global Production Network
HBA	Home Base Augmenting Mandate
HBE	Home Base Exploiting Mandate
HOSS	Hechscher-Ohlin/Stolper-Samuelson
IEC	Import-Export Complementation Scheme
IIP	Infant Industry Protection Model
IQS	International Quality Standards
IRCC	Import Rebate Credit Certificates
ISI	Import-Substitution Industrialization
MIC	Middle Income Country
MIDP	Motor Industry Development Programme

mVA	Manufacturing Value-Added
OEM	Original Equipment Manufacturer (Assembler)
PDVC	Producer-driven Value Chain
TNC	Transnational Corporation

Introduction:

The Motor Industry Development Programme (MIDP) in South Africa, instituted in 1995, was intended to achieve renewed growth through a reorientation of the automotive sector towards success in the international marketplace. This new sector-specific industrial policy was designed to attract foreign direct investment (FDI) to drive the export growth of both completely built up (CBU) models as well as their locally manufactured constitutive component parts. The transition from an inward-oriented, locally-owned industry to one dominated by transnational corporations (TNCs) exporting primarily into the Triad markets was remarkably quick, facilitated by an import-export complementation scheme[1], the centerpiece of the MIDP. The Department of Trade and Industry in South Africa has hailed the MIDP as a model sector development policy[2] and the UNDP uses it as case study evidence of successful "catch-up through liberalization"[3].

However, industrial catch-up, as has been historically understood, entails more than the functional reorientation of an economy towards export promotion; rather it is associated with the development of localized, technology-based dynamic competitive advantages in order to maintain a learning trajectory commensurate with tacit product knowledge generated at the technology 'frontier'. Sanjaya Lall for example, in comparative regional development studies, uses the local manufacturing value-added of a country's export profile as a much better indicator of successful catch-up than macro-based export volumes[4].

I will use the *intranodal* division of labor between 'sister' subsidiaries manufacturing the same component part but from different country locations, organized by the lead firms of 'captive' producer driven value chains (cPDVCs), as the unit of analysis through which to make an assessment of the efficacy of the MIDP in supporting local supplier upgrading in South Africa. The appropriateness of this unit of analysis is argued based on the importance of accounting for the increased structural power of TNC 'lead' firms in the era of networked production, and from its usefulness as an explanatory unit of analysis for subsidiary-level immiserizing learning.

Building on the idea in the development literature of a tension between states and markets, my thesis specifically models the source of tension in global production networks between 'parental' lead firms and subsidiaries, understood as a difference in identifiable sets of interests as well as a difference in the bargaining power needed to pursue those interests. It is argued that because of the network-associated increase in structural power of lead firms in cPDVCs, local subsidiaries have less technical mandate autonomy controlling access to the R&D resource investments needed to ensure firm-level productive assimilation of parentally transferred technology. Instead, lead firm network-level competitive interests favor an asymmetric R&D resource distribution at the intranodal level resulting in the immiserizing learning of follow source 'minor' volume suppliers. Immiserizing learning is defined as, while still manufacturing to meet the same international quality standards as their follow source 'major' sister subsidiaries, there develops overtime a growing 'gap' between minor suppliers and the technical frontier relative to major suppliers at each node, reflecting diverging productive efficiencies.

A Dependent Development framework is used to conceptualize this shift in power relations associated with network organization and is specifically applied to an analysis of the Import-Export Complementation Scheme (IEC) of the MIDP. The IEC sets the terms of import credit earning for localized suppliers, in other words, the terms of dependent exchange for a supplier firm integrating as a subsidiary in which it relinquishes mandate autonomy in exchange for competitive protection in the form of duty-free importing. The basis of the IEC critique offered is that the terms of the dependent exchange favor lead firm network-level interests at the expense of local firm-level learning interests. South African subsidiary suppliers are in many cases 'minor' volume suppliers (relative to other-country 'major' volume sister subsidiaries), meaning they are vulnerable to mandate assignments that over time reduce the efficiency with which upgraded product technology is assimilated from the technical frontier. Specifically, then, the IEC is critiqued for not linking import credit earning to investments in local supplier upgrading, but instead linking import credit earning to export promotion, which can be artificially manipulated such that the necessary value of import credits the industry needs to remain internationally cost competitive can be achieved independent of significant firm-level investments in building local productive efficiencies. The contribution to the existing FDI literature, then, of an intranodal division of labor between 'sister' subsidiaries as a unit of analysis, is as an explanatory variable to expose situations where immiserizing backward linkages among the local content can negatively affect *real* industry-level international competitiveness as industrial policy artificial protection gradually declines.

The global economy is famously said to be 'flattening', understood as positive returns to integration reaching into parts of the world previously thought 'backward' by 'Western standards'. The theme of the 2007 World Economic Forum's annual conference in Davos was "Shaping the Global Agenda: The Shifting Power Equation", where a top organizer was quoted in *The New York Times* trumpeting the idea that "power is shifting from the center to the periphery, and from the top to the bottom"[5]. Being that the conference is typically dominated by CEOs of large TNCs, one is left to conclude, then, that transnationals must be the driving force behind the purported power shift!

It is certainly the case that TNCs are the dominant economic agents 'shaping the global agenda' today. "An estimated 64,000 TNCs now control 870,000 foreign affiliates with a value added of US$3.4 trillion (10% of the world GDP). TNCs make up two thirds of international trade and FDI stock is estimated at one third of GDP in developing countries"[6]. Even more significant "about 80 percent of all investment flows associated with technology transfer takes place within a transnational corporative conglomerate, e.g. between parent and subsidiary. TNCs thus exercise a crucial role in technology transfer"[7].

Given the wave of mergers and acquisitions which have swept through the automotive industry since the early 1990s, no economic sector more reflects the growing domination of TNCs in the world economy, with only 13 firms accounting for more than 80% of global vehicle production[8]. Once referred to as 'the industry of industries' by Peter Drucker, the auto sector is increasing looking to emerging market countries (EMCs), not simply for new customers but for low(er) cost manufacturers. According to *The McKinsey Quarterly*, by targeting production locations outside of their home countries "carmakers could cut their parts bills by up to 25%. A company that manufactures about five million vehicles a year could theoretically lighten the tab by more than $10 billion annually"[9].

Where and how South African component supplier firms fit into the international division of labor organized by automotive TNCs will determine whether they in fact function as conduits for catch-up in South Africa. I will develop my argument by focusing on majority equity owned TNC component supplier subsidiaries in South Africa which now control 70% of the local market[10]. Many of these firms were originally independently owned and remained so up until the mid 1990s, however they have since been integrated into global production networks (GPNs). As John Humphrey explains, "previously, subsidiaries of transnational assemblers developed local supply linkages. Now assemblers and first-tier suppliers form parallel global networks. This led to the rapid denationalization of locally-owned first-tier suppliers"[11].

Catching-up as a TNC subsidiary, contrary to the assumptions of the endogenous growth model, is not automatic. This is because technological learning is an 'active' process requiring R&D-based firm-level investments to develop a tacit understanding of product technology. Accumulating knowledge of product technology is understood then as an evolutionary process of cumulative investments, and as such, not that which can be easily codified and transferred from, for example, parent lead firms to subsidiaries.

Numerous FDI spillover studies support the view that existing in-house R&D efforts by subsidiaries (re: recipient firms) contribute positively to the productive transfer of external sources of technology from parent transnationals (re: donor)[12,13,14].

In other words, recipient in-house R&D and exogenously transferred technology "relate as complements, rather than substitutes"[15] and this R&D-dependent 'coupling' effect explains the *gap-dependent* increases in total factor productivity in recipient firms when transferred new product technology. Technology transfer ('spillover') is positively measured when the gap between donor and recipient, in terms of their respective knowledge of product technology, is small. An increase in the total factor productivity (TFP) of the recipient firm indicates the successful transfer and subsequent assimilation of new product technology, resulting in the recipients ability to manufacture more technology-intensive products (measured as an increase in local value added; mVA). The gap-dependent nature of successful technology transfer is the reason why understanding the determinants of subsidiary-level autonomy to invest in R&D-dependent technological catch-up is important.

Based on a literature review of published secondary sources, the outline of my argument will begin by comparing how cPDVCs differ from BDVCs and mPDVCs, with an emphasis on governance structure and lead firm competitive motivations. John Dunning's OLI 'eclectic' paradigm will be used to explain the network-associated increased structural power of lead firms, used to impose dependent terms on integrating supplier subsidiaries in the periphery. The work of Cantwell and Mudambi will be heavily drawn upon to explain the determinants of subsidiary mandate assignment in the context of lead firm competitive interests in complementing each sister supplier's volume, technical and R&D resource mandates.

As stated above, the relationship between lead firms in cPDVCs and supplier subsidiaries is a 'dependent' one, and as such can be analyzed from a center-periphery structuralist perspective, with the lead firm center in control of resources which reproduce the structure of its relationship with the periphery. The dependent relationship between an autocratic center and a dependent periphery implies an asymmetric power structure. The structural relationship between tier 1 lead firms and tier 2 suppliers in cPDVCs requires a re-conceptualization of Cardoso's[16] original understanding of this aspect of the dependent relationship, specifically of how it is that the periphery acquiesces to the 'internalization' of center interests.

The power of the center in Cardoso's understanding of dependent development came from the possession of resources (technology, capital goods) which could be used to spur the "progress of productive forces"[17] in the periphery, specifically the diversification of industrial production. It is argued here, that in the GPN 'phase' of dependent development, specifically in cPDVCs, the power of the center has increased beyond a resource-based asymmetry to a new form of structural power – the structural power to limit development 'space' in the periphery to where viability in the periphery can only be achieved through a relationship with the center.

Whereas in Cardoso's original conceptualization of dependent development the 'internalization' of center interests by the periphery was *compatibilities-based* in that it was contingent on local 'progress' to in some measure gain social/political compliance from affected classes, internalization in the GPN phase is forced, irrespective of compatible interests. This is because the structural power to limit development 'space' in the periphery redefines the terms of the dependent exchange in that the periphery does not have the development option of rejecting, in the case of cPDVCs, network integration. In other words, because supplier viability can only be achieved as a network subsidiary, the lead center has greater leverage to control the specific terms of the dependent exchange to maximize its interests. In exchange for viability as a network-integrated subsidiary, peripheral suppliers unconditionally relinquish subsidiary mandate autonomy to parental lead firm control. As mandate assignment is the key determinant of firm-level learning, integrating subsidiaries are relinquishing control of local 'progress', which then becomes subject to network-level interests. It is argued that, in the GPN 'phase' of dependent development, network-level competitive interests are not always compatible with local-level interests in subsidiary learning, and that with less development space to seek alternative development options, peripheral suppliers have less leverage to unconditionally bargain for R&D resource-dependent 'coupling'. The *viability-based* acceptance of 'incompatible' dependent development by the periphery, then, is the explanation for immiserizing learning in follow source 'minor' suppliers in cPDVCs (ie. where follow source minor 'progress' is not compatible with network/lead firm interests).

Two specific characteristics of cPDVCs are responsible for why there is less development space for periphery suppliers in the GPN phase of dependent development.

The new network-based organization of production has affected both a change in the competitive environment for supplier firms, as well as a change to a new GPN-specific governance structure. It has previously been argued elsewhere[18] that in this new competitive environment middle-income country (MIC) suppliers are in a 'race to the top' for sustainable inclusion in export-driven, technology-intensive PDVCs like those found in the automotive industry. Sustainability or viability requires access to the *advanced*, proprietary technology controlled by tier 1 lead firms, eliminating the development option of autonomous, gradual development from access to foreign licenses of *mature* technology. It is argued here that the new network-associated governance structure in 'captive' supply chains is one in which lead firms have greater bargaining power to both initiate, and control the terms of, supplier integration into GPNs, and as such it is harder for peripheral suppliers to access the advanced technology they need to viably 'race to the top' under terms that also allow them to bargain for the R&D resources needed to guarantee firm level learning or 'progress'.

The new competitive environment is characterized by a network-based organization of production in which network integrated supplier firms compete on the basis of absolute advantage. Because of trade and FDI liberalization and with increased capital mobility and product fragmentation, TNCs have sought network-organized production through integrated supplier consolidation to not only expand their global footprint by serving multiple consumer markets, but also to reap the productive advantages associated with offshoring component manufacturing. To be chosen as a nodal point in a value chain for the localization of a foreign-owned subsidiary (FOS), a particular host country market must be able to sustainably support local manufacturing to technologically advancing international product quality standards (IQSs).

In the GPN era, FOSs compete on the basis of absolute advantage for particular component 'fragment' mandates. In other words, each 'sister' FOS at the same node (manufactuing the same component part, but from different country locations) must meet the same point of 'competitive equalization' for cost efficient component production based on a combination of local labor costs and firm-specific labor productivity. Middle-income country firms in the GPN era face a competitive threat from China's labor surplus, which increasing dominates low and medium-technology manufacturing. As a result, MIC suppliers are forced to compete more on the basis of relative labor productivity for higher-technology component manufacturing. This constitutes a 'race to the top' in that the point of competitive equalization for FOS localization now requires meeting a higher absolute level of labor productivity compared to the pre-GPN era when 'whole' products were entirely manufactured in single locations. It can be argued, then, that success in the 'race' requires R&D manpower-dependent improvements in labor productivity for the sustainable localization of R&D resource-dependent manufacturing of technology-intensive components. At the local industry level for automotive components, investments in local supplier productivity will overtime reduce import-dependence and increase the possibility of closer to scale CBU production volumes.

It is the governance structure of GPNs, specifically in 'captive' PDVCs, that controls MIC supplier subsidiary access to the R&D resources needed to invest to keep pace with advancing standards in component production. As stated earlier, John Dunning's OLI 'eclectic' paradigm is used to model the increase in the structural power of lead firms and to explain the use of that power to impose a dependent relationship with peripheral supplier subsidiaries. The work of Cantwell and Mudambi on the specific determinants of subsidiary mandate assignment is used to explain the competitive motivations that impel lead firms to organize a division of labor at the intranodal level between sister subsidiaries, resulting in the immiserizing learning of follow source 'minors'.

As classically understood, Dunning's OLI paradigm is used to explain a TNC's decision to serve a particular market through a FOS, both when it establishes a FOS and why. Transnationals make the decision to serve a new market by establishing a FOS when they can monopolistically exploit possession of their "O" or ownership advantages in that market (ie. their proprietary technology advantage over indigenous firms in the new market). In other words, under such conditions where the market for TNC "O" advantages is imperfect, TNCs will choose to 'internalize' their "O" advantage by establishing a FOS and capturing monopoly rent in the new market ("I" or internalization advantage; the advantage gained from "O" advantage internalization).

It is argued that the OLI paradigm can be suitably applied to 'captive' PDVCs because the lead firms in captive supply chains are motivated to internalize their proprietary technology within FOSs, rather than subcontract component manufacturing to independent suppliers as is the case in 'modular' supply chains. The OLI paradigm then, as applied to 'captive' PDVCs, can be used to explain what motivates the choice of network organization - in other words, lead firm decisions to serve the *international market* through the establishment and coordination of a *FOS network.* At the heart of the argument is the idea that it is the actual network structure itself that is responsible for making the market imperfect for lead firm "O" advantages at the international level, and as such, is responsible for lead firm leverage or the structural power to monopolistically exploit possession of its proprietary technology advantage. This is because the tiered structure of network organization places lead firms in a bargaining position from which they can deny independent component suppliers in the periphery both "O" proprietary technology and OEM clients in their respective domestic markets. As an example consider the particular tiered structure of the auto supply industry, where each tier 1 complete module supplier organizes its multiple constitutive tier 2 component (follow source) suppliers in a geographically dispersed, globally integrated network, each a node in a hierarchically specialized value-added chain representing a particular mVA component 'fragment' of the overall module manufacturing process.

The 'power to deny' described above is a form of structural power that tier 1 lead firms use to force peripheral supplier integration and subsequent tier 2 FOS mandate assignment under threat of network exclusion (re: viability-based acceptance of dependent terms). In other words, the dependent relationship in the GPN 'phase' is now structurally imposed rather than local compliance or compatibilities-based, however, as argued below, local factors do determine the particular terms of the dependent relationship (re: subsidiary mandate assignment). It is argued then that the choice of network-organized production can be thought of as a deliberate construction to increase the bargaining power of lead firms, allowing them to pursue what can be considered network-associated "I" or internalization advantages – specifically FOS mandate assignment to exploit complementation-based offshoring advantages.

Lead firms organize a division of labor in subsidiary mandate assignment differently at the intranodal level than at the internodal level. At the *internodal level*, the division of labor between subsidiaries at different nodes is based on differences in actual manufacturing inputs, where the responsibility for manufacturing different components with different mVAs is assigned. However, at the *intranodal* level between 'sister' subsidiaries manufacturing the same component part (same mVA), there also exists a lead firm imposed division of labor, but now based on differences between each sister's relative distance from the technology frontier (ie. their respective relative manufacturing productivities).

It is in the competitive interests of lead firms in 'captive' PDVCs, at the intranodal level, to assign to those subsidiaries initially closest to the technology frontier 'major' volume supplier status. In other words, such FOSs would be 'major' volume exporters of components to import-dependent OEM assembly locations along the network. Sourcing from offshored 'major' volume FOSs allows import-dependent markets to be immediately viable without the need for tier 1/OEM investments in local supply base upgrading in those markets. To protect this offshoring-based advantage, lead firms assign 'sister' subsidiaries technical and R&D resource mandates that complement their particular volume mandates. In other words, those subsidiaries that initially integrate as follow source 'majors' are assigned a relatively greater 'complement' of R&D resources post-integration than follow source 'minors'. From the perspective of maximizing network competitive advantage, 'complementation-based' offshoring serves to ensure that follow source 'majors' are transferred the necessary resources to keep pace with advances in component technology, such that lead firms can reliably source major volumes from their initially most productive suppliers at each node. In other words, local follow source major 'progress' is *compatible* with network-level competitive interest. On the other hand, follow source minors must manufacture to the same upgraded IQSs as 'major' suppliers, but with fewer resources to dedicate to successful technology transfer ('gap' maintenance to ensure productive assimilation).

Overtime, this intranodal division of labor has the effect of exacerbating the natural hierarchy between those suppliers that initially integrate as 'majors' versus those that integrate as 'minors', in terms of their distance from the technology frontier relative to each other.

Follow source 'minors' have less leverage to resist lead firm mandate assignment, both because lead firms have the structural power to deny them access to proprietary technology and OEM clients, and because any misalignment in mandate assignment complementation negatively effects follow source 'major' firm-level learning and thus lead firm offshoring advantage exploitation. In other words, local follow source minor 'progress' is distinctly *incompatible* with network-level interests. It can be argued that those firms that integrate as follow source 'minors' in the GPN era face a kind of '*catch 22*', that is, either remain independent and be denied the proprietary technology needed to viably produce to IQSs and compete for OEM clients, or integrate and be denied the R&D resources needed to sustainably keep pace/catch-up.

The increased structural power of lead firms in the GPN era also affects the efficacy of previously identified successful industrial policy catch-up models. For example, the notion of certain positive benefits from foreign direct investment is called into question by the possibility of local firms integrating as follow source 'minor' suppliers, where firm-level autonomy to invest in needed R&D resources is subjugated to lead firm competitive interests instead. Secondly, the infant-industry protection model, associated most often with the successful catch-up of South Korea, is also less applicable to the GPN phase of dependent development. To begin with, the pressure on MIC firms to 'race to the top' to manufacture to homogenized IQSs means that suppliers in the periphery have less 'space' to gradually develop indigenous capabilities from producing to licenses of mature technology. Moreover, as described above, they have less leverage to bargain for *advanced* technology licenses given the ascendant position of lead firms in PDVCs.

An example of the paradox of 'incompatible' dependent development in the periphery is the automotive industry of South Africa under the Motor Industry Development Programme (MIDP). The design of the MIDP, influenced heavily by the interests of transnational investors, reflects the new bargaining relationship between 'center' and 'periphery'. In other words, MIDP design is an example of the structural power of lead firm transnationals to manipulate dependent terms such that they are able to pursue network competitive interests without the need to invest in 'the progress of productive forces' in the local supply base.

The centerpiece of the MIDP, the import-export complementation scheme (IEC), was instituted to allow for immediate auto industry viability in South Africa as the country transitioned away from domestic market-oriented production. At the point of this transition in 1995, South Africa was a high import-dependent assembly location due to apartheid era-associated insufficiencies in the local skill base. Therefore, to facilitate an immediate cost viable increase in local production of CBUs, requiring progressively higher absolute volumes of imported components, the IEC was introduced with a stipulation for the earning of import rebate credit certificates (IRCC) to allow for the duty free importing of component parts that could not be cost efficiently manufactured locally. The ability to earn IRCCs under the IEC provides the industry with an "effective rate of protection"[19], in essence protection in the form of cost savings to local assemblers from duty free component importing that has allowed for industry viability despite high import dependence and below scale volume CBU and local component production.

The level of IRCC supply, then, is a viability-based variable manipulated by transnational interests at the level of industrial policy design. The structural power to 'deny' (O/OEM variables) allowed transnationals to favorably negotiate the terms of this third dependent variable in their interests. In other words, IRCC supply has been artificially manipulated so that industry viability is guaranteed through the IEC scheme rather than through transnational investments to improve local FOS competitiveness, which, had they been made, would reduce the need for an artificially high effective rate of protection. However, because South Africa's supply base consists predominately of 'minor' export volume network suppliers, network-level competitive interests are better served by investing in other-country follow source 'major' sister subsidiaries instead.

The IEC scheme, it is argued then, though successful in providing for immediate industry viability, has not however encouraged local supply base upgrading but rather has instead served to facilitate lead firm pursuit of offshoring advantages at the expense of local investment. First, the IEC ties the earning of IRCCs by local component firms to exporting. In other words, for local component firms to earn IRCCs, which they need to attract the business of local OEM clients, they must integrate as network subsidiaries as network integration is the only way to access international export markets. However, as argued earlier, network integration portends lead firm mandate assignment for the purposes of advancing lead firm interests at the

GPN-level, above local FOS interests in firm-level learning. Secondly, for the majority of the first decade of MIDP operation, there has existed a *surplus* of IRCCs in the auto industry available to local OEMs. As a result, there has not been any pressure on tier 1/OEM transnationals to invest in South Africa's local supply base to either broaden the supply base or deepen firm-level labor productivities. Rather, because of the IRCC surplus, it has been possible to cost viably increase CBU volumes without either expanding or upgrading local component manufacturing. Moreover, the paucity of investments to increase labor productivity in the supply base means that there has likely been very little mandate evolution beyond those initially assigned to South African subsidiaries as they integrated. In other words, if they initially integrated as follow source 'minors', they have likely remained so.

The ready availability of IRCCs for the first decade of MIDP operation, as negotiated by transnational interests, meant that tier 1 lead firms could continue to cost viably source components in high volume from already 'established' follow source 'majors' located in other markets, at the expense of immiserizing learning in South Africa's supply base. Without the artificially high effective rate of protection, transnationals would have been forced to invest in local firm-level progress to support CBU expansion by reducing the industry's import dependence (ie. IRCC dependence).

The thesis is divided into four main chapters followed by a brief conclusion. The first chapter identifies the key determinants of firm-level catch-up that are used as markers throughout the remaining chapters, mainly compatibility with the overall global strategy of lead firms, access to proprietary technology and R&D resource mandate autonomy. Chapter two focuses on the evolution and characteristics of global 'mega' suppliers and their competitive motivation in pursuing offshoring advantages by maximizing the cost competitive component sourcing of every network country's assembly operations. Chapter three identifies the source of market power within cPDVCs, specifically how that market power is exploited in the interests of lead firms, and the determinants which regulate the effects on local firm-level learning. Chapter four outlines the case study of South Africa's automotive component supplier industry by focusing on the import-export complementation scheme of the MIDP.

Chapter 1: 'Dependent' Catch Up - Two Case Studies

This opening chapter will present a historicized understanding of the dependent exchange between 'center' and 'periphery', its characteristics and how they have changed over the years. The center-periphery divide has been conceptualized from a structuralist perspective, be it by the 'underdevelopment' school or the 'dependent development' school, with an autocratic 'center' responsible for reproducing the structure of the divide. While an evolutionary shift in determinants characterizes the dependent exchange within global production networks (GPNs), I will maintain a structuralist perspective in my analysis, characterizing network-based production as tiered between a 'center' lead firm and 'peripheral' component supplier firms.

Secondly, to properly characterize the nature of the dependent exchange within technology-intensive industries like the automotive supply industry, the determinants of R&D-dependent firm-level catch-up will first have to be elucidated. This topic will be introduced in this opening chapter, by describing the importance of firm-level absorptive capacity in recipient firms for successful technology transfer.

Lastly, two industrial catch-up models prevalent in the literature today of successful firm-level 'coupling' in the periphery will be presented. Both the East Asian development (EAD) model and the foreign direct investment (FDI)-liberalization model are examples of 'dependent development', in that both highlight a 'dependency' on access to foreign proprietary technology controlled by 'center' country interests. South Korean catch-up beginning in the 1970s is an example of successful East Asian industrialization, with a clear emphasis on the importance of development 'space' to invest in indigenous technological capacity building, as well as the importance of firm-level bargaining power to leverage access to foreign licenses. South Korea actually gained a measure of autocratic reproduction in its automotive industry in 1994 with the introduction of the Hyundai Accent, the product of nearly twenty years of investments (re: development 'space') that started with its first model, the Pony, in 1975. The automotive industry of Brazil in the 1990s is an example of industrial catch-up through FDI liberalization. Investments facilitated by TNC 'parental supervision' highlight the importance of subsidiary 'technical' mandate assignment. In the specific case of Brazil, both TNC OEMs and their suppliers were assigned 'niche' product development technical mandates that were supported with parentally mandated R&D spending autonomy to invest in the necessary R&D resources for local capacity building. The chapter will conclude by asking whether either of these catch-up models is applicable to the GPN phase of dependent development, where production is network-organized, export-oriented, and transnational tier 1 'lead' firms are competitively motivated to pursue offshoring advantages.

The dependent exchange has historically been conceptualized from a structuralist perspective, understood as a clear division between 'center' interests and 'peripheral' interests[1]. The structure is defined by an autocratic center and a dependent periphery, therefore a power asymmetry characterizes the division. The center's monopoly control of resources necessary for autocratic reproduction is responsible for reproduction of the structural divide and hence the dependent relationship[2]. *The power asymmetry of the center-periphery divide is reflected in the terms of the dependent exchange.* The terms of the dependent exchange serves the interests of the center, which is why the center is interested in protecting its monopolistic advantage. How the interests of the periphery are affected by the dependent exchange is the main point of contention between the 'underdevelopment' school and the 'dependent development' school of theorists. According to the underdevelopment school, the dependent exchange serves the interests of the center *at the expense of* peripheral interests, which is why it is argued the periphery should 'delink' from the center and pursue a completely autonomous development strategy. However, according to the dependent development school, it *is* possible for the periphery to benefit from the dependent exchange, if within the periphery itself there exists a favorable investment climate. Specifically, industrial sectors in peripheral countries can benefit from foreign investment if sufficient productive factors are available locally, and if the productive sector has the support of social and political constituencies responsible for mediating class relations. In fact, for Cardoso, underdevelopment is simply the absence of industrial diversification, and is therefore completely reversible upon development of the appropriate preconditions[3].

To start with, 'underdevelopment' has historically been used to describe the condition in the periphery when the center-periphery divide was typically characterized by an asymmetric relationship between a center country that exports manufactures to, and imports primary products from, peripheral countries. The center benefits from such a relationship by not only exploiting both cheap labor and access to cheap raw materials in the periphery, but also from an unequal terms of trade that develops overtime favoring the center (ie. the terms of the dependent exchange). For example, Baldwin has described the colonial economies as being held within a 'hub-and-spoke' structural arrangement where Europe is the hub and African countries the spokes, independent of each other but tied to the hub such that "trade between the hub and spoke is easier than trade among the spokes"[4]. The purpose of this colonial economic structure was to keep African countries from straying from their comparative advantage in the production of primary products.

The genesis of the economic treatment of the center-periphery divide comes from the debates surrounding the terms of trade of Latin American countries, made famous by Hans Singer and Raul Prebisch at the United Nations Economic Commission for Latin America in the early 1950s. They were both responding to the dominant neoclassical belief at the time that "the terms of trade of primary products would show long-term improvement *vis-à-vis* manufactures", the implication being that agricultural economies "need not industrialize to enjoy the gains from technical progress taking place in manufactures; free play of international market forces will distribute the gains from industrial countries to agricultural countries through favorable terms of trade"[5].

Prebisch's first foray into the debate questioning neoclassical assumptions regarding the direction of exchange governing trade was an article he published while at the National Bank of Argentina in 1934 in which he presented his findings that "agricultural prices have fallen more profoundly than those of manufactured goods" such that "Argentina had to export 73 per cent more than before the Depression to obtain the same quantity of manufactured imports"[6]. However, at the time, Prebisch considered his findings a short-term cyclical phenomenon attributable to "Depression economics".

Singer's interest was peaked when it was discovered that following World War II, the price of capital goods had risen so much that the export surpluses agricultural economies accumulated during the war had depreciated in terms of the comparable value of imports they could purchase. Singer's seminal contribution was not accepting this as merely an "abnormal trend of the terms of trade, counter to historical drift"[7], but rather as evidence of a larger historical trend which his subsequent research would prove. In a UN publication in 1949, Singer presented his findings: "from the latter part of the nineteenth century to the eve of the Second World War, a period of well over half a century, there was a secular downward trend in prices of primary goods relative to the prices of manufactured goods"[8].

Singer's explanation for the decreasing terms of trade facing peripheral economies was based on what is now understood to be the differing income elasticity of demand between primary products and manufacturers[9]. Increases in the productivity with which manufactures are produced results in a greater demand for those products than the response of the demand function to productivity improvements to agricultural production. As a result, over time as productivity gradually improves for both manufactures and primary products, the price of manufactures will increase relative to that of agricultural products. In other words, the center will be able to capture the benefits from technological progress in producer surplus, but productivity gains in the periphery will go to consumer surplus in the center (lower prices for primary products). The dichotomy becomes clear, then, as John Toye writes, "the underdeveloped countries have the worst of both worlds, as consumers of manufactures and as producers of primary products"[10].

Prebisch's main contribution to the terms of trade debate was to theorize how it exposes the periphery to a permanent state of vulnerability, where their development is totally controlled by decisions made in the center, regardless of productivity improvements or labor organization advances in the periphery. Prebisch modeled the relationship between the center and periphery during boom and bust trade cycles to reflect productivity fluctuations. Prebisch hypothesized that even if the prices of primary products rose faster than that of manufactures during boom cycles, they would fall drastically faster than that of manufactures in bust cycles, over time leaving the periphery worse off. His explanation for the disproportionately large fall in the price of primary products vs. manufactures in the bust cycle was the fact that while the center could maintain wage 'stickiness' during hard times, the periphery could not. In Prebisch's words, there would be a "forced readjustment" down of wages in the periphery because even if labor in the periphery temporarily managed to keep wages/prices high, the higher prices of primary products would depress demand in the center for those commodities, resulting in their eventual fall. What Prebisch's argument highlights is that while the periphery is at the mercy of demand from the center, the reciprocal is not true. This is because while center economies are diversified, peripheral economies are specialized in the production of a handful of commodities[11]. As a result, from the perspective of the center, imports from any one particular peripheral country "represent only a tiny fraction of total imports, and can usually be obtained from several different sources"[12], but that that 'one' peripheral country is totally *dependent* on demand from the center. The consequences are clear: as Peter Evans writes, "economic fluctuations in the center may have severe negative consequences for the periphery, whereas an economic crisis in the periphery offers no real threat to accumulation in the center"[13].

For peripheral countries, the lack of autonomous control over their own development, regardless of internal advances made in productivity or labor relations, led Prebisch at the time to call for their exit from the current trade structure. External engagement, under a *neoclassical division of labor* based on comparative advantage, would function only to permanently relegate the periphery to a state of 'underdevelopment' or immiserizing growth[14] based on an unequal exchange of trades. Prebisch supported what came to be known as import-substitution industrialization (ISI), where industrialization in the periphery would function to "encourage the local production of industrial goods that were formally imported from abroad" such that "development would be determined by the domestic and not the foreign market"[15]. Autonomous development directed by a "dynamic domestic sector" would be "capable of generating both self-sustaining growth and the transfer of the 'decision-making center'"[16].

Cardoso and Faletto's model of dependent development, much like ISI, purported to support industrialization of the consumer goods market in the periphery, but industrialization directed by foreign interests. Specifically, it was conjectured that it is possible for peripheral countries to productively benefit from a relationship with the center because the nature of the division of labor between center and periphery was changing. As Cardoso and Faletto wrote in 1973:

> "the distinguishing feature of the new type of dependency that is evolving in countries like Brazil, Argentina, and Mexico is that it is based on a new international division of labor. Part of the industrial system of the hegemonic countries is now being transferred, under the control of international corporations, to countries that have already been able to reach a relatively advanced level of industrial production"[17].

As alluded to above, the structure of this new relationship is a product of transnational monopoly control of technology and capital goods – or what Cardoso referred to as control of the "production of the means of production"[18]. So for Cardoso and Faletto, "this is the reason why 'technology' is so important. Its 'material' aspect is less impressive than its significance as a form of maintenance of control and as a necessary step in the process of capital accumulation"[19].

In terms of the dependent exchange, the center benefits from invests made in consumer goods sectors in the periphery from the technology rents and profit remittances associated with selling mature products in a previously untapped consumer market. From the perspective of the periphery, a relationship with the center is sought when a local constituency exists in favor of foreign-directed industrial diversification. In other words, the peripheral countries consent to foreign investment when "local dominant classes"[20] specifically benefit from the dependent exchange, such that there is an actual "internalization"[21] of center interests in the periphery among these groups. However, these local dominant classes must also seek the compliance of other critical social and political forces within their country to create a true constituency for foreign investment. As an example, Cardoso and Faletto argue that in Brazil, the reason why FDI was eventually preferred over ISI was that, with decreasing world market prices for its agro-sector products, there was a larger local constituency for externally-financed industrialization. As they wrote of the situation, "foreign investment generates an industrialization that does not depend chiefly on taxes from the national export sector as a source of capital formation"[22].

Building a constituency beyond 'internalized' dominant classes is also made easier by a broadening of the benefits of foreign investment so as to "absorb social pressures from below"[23]. The implication is that the greater the "progress of productive forces"[24] in the periphery as a result of industrialization, the better the chances of social and political compliance from affected groups. As Cardoso and Faletto have noted, "the interests of the foreign corporations become *compatible* with the internal prosperity of the dependent countries. In this sense, they help promote development (emphasis added)"[25]. It is intuitive that the broader the level of industrial diversification they direct, the greater the level of remittances TNCs will be able to extract from peripheral domestic economies. In other words, 'development in dependency' implies a *progress-based compatibility of interests between center and periphery, necessary for local 'internalization'*.

To benefit from identifying points of contrast with what has been presented above as the historical understanding of the dependent exchange, I will briefly introduce what is properly the topic of discussion of Chapter Three. There I argue that the determinants of the dependent exchange described by Cardoso and Faletto need to be re-conceptualized to model dependent development in global production networks (GPNs).

There is a distinct structure associated with network-based production in the automotive industry, in that tier 1 lead firms ('center') organize multiple nodes of tier 2 component supplier firms (periphery). In the GPN 'phase' of dependent development, reproduction of the dependent relationship is not simply facilitated by lead firm monopoly control of proprietary technology, but also by an increase in the network-associated structural power of lead firms. As a result, the center-periphery divide is even more asymmetric, which is reflected in tier 1 lead firms' greater control over the terms of the dependent exchange.

Moreover, because of network organization, there is a change in the unit of analysis by which to assess 'center' interests. Center interests are no longer simply associated with remittances from domestic market expansion in peripheral countries, rather center interests are properly evaluated at the level of network competitive advantage, which requires that local production in each peripheral market be coordinated by lead firms to conform to overall network-level interests. Both because of this change in unit of analysis of center interests, and because of the increased structural power of center/lead firms, the *terms* of the dependent exchange between center and periphery have changed.

It will be argued in Chapter Three that in the GPN phase of dependent development, in some cases the conditionality of local compliance has been weakened to where, rather than being progress-based, *the periphery has less bargaining power to resist a viability-based dependent exchange imposed even when center and peripheral interest are incompatible*. In such cases, there occurs, if you will, a defining down of what constitutes 'development in dependency' in the periphery.

To assess dependent development in industrial sectors like automotives, it is necessary to identify the appropriate determinants by which to measure the 'progress of productive forces' in the periphery. In other words, catch-up in technology-intensive manufacturing is not measured in terms of prices or the capture of producer surplus, but rather in terms of the evolutionary accumulation of tacit product knowledge through the successful 'coupling' of (a) firm-level 'in-house' R&D investment with (b) access to externally sourced technology upgrades. What will be understood as successful firm-level (re: supplier-level) 'progress' is modeled below.

While firms operating at the technological frontier engage in innovation to 'push out' the frontier, firms below this level of technological competence invest in learning to move up closer to the frontier. According to Viotti, "learning is defined as the process of technical change achieved by diffusion" where "a technique is diffused only when it is effectively assimilated". Different types of exogenously generated knowledge are easier to assimilate than others; some are able to be 'passively' absorbed while others must be 'actively' absorbed, requiring endogenous investment for the effort. Learning "technological capabilities of production" is "doing-based learning" and can be passively absorbed. Assimilating new *process* technologies to increase productive capacity is an example of learning-by-doing. On the other hand, for Viotti active learning "is a consequence of deliberate efforts and investments in technology" typically associated with "in-house R&D" to gain *product* knowledge[26].

It was in Cohen and Levinthal's seminal work on "the dual role of R&D" where R&D investment directed towards learning (as opposed to innovation) was described as resulting in "the development of a stock of prior knowledge that constitutes the firm's absorptive capacity". They modeled absorptive capacity as "the fraction of knowledge in the public domain that the firm is able to assimilate and exploit"[27]. Absorptive capacity is the tacit knowledge generated within a firm that helps it to "more easily understand and assimilate the discoveries of others"[28]. In other words, when a firm invests R&D to understanding the 'know why' and not simply the 'know how' of the mature technology that it is currently using, it will more easily be able to assimilate newer improvements to that same technology when they are generated by external sources. If a firm is transferred an upgraded form of the embodied product technology that it has been using and is measurably able to "employ the external technology productively"[29], then the technology has been successfully assimilated. In other words, successful technology transfer allows the recipient to produce more technology-intensive manufactures based on the *new* product knowledge it has absorbed.

The importance of absorptive capacity to firm-level technological development is most often demonstrated in foreign direct investment (FDI) spillover case studies where the effects of foreign investment on host economies are indirectly estimated. The presumption of a positive spillover is made when new product upgrades transferred from a parent transnational to one of its' affiliates 'spills over' to host country domestic firms as well. Because technology transfer can only be detected indirectly, a production function framework is used to measure changes in the local value added of domestic firms (increase in total factor productivity growth) in the years following foreign entry into an industry. Marin and Bell, in a recent survey conducted in Argentina, devised a "composite index of absorptive capacity" which included "R&D intensity" and factors known to change with R&D investment (skill intensity of employment, investment in capital-embodied technology, etc.) and applied it to both domestic firms and transnational subsidiaries. Marin and Bell were able to show, similar to previous researchers, that spillovers to the domestic economy are not automatic. But, moreover, they were also able to show that the absorptive capacity of domestic firms was not the only key determinant for there to be positive spillover. Rather, the only significant associations between the productivity growth of domestic firms and FDI occurred when *both* the domestic firms and the transnational affiliate had high absorptive capacity[30].

In modeling technology transfer, it has been theorized that transfer will only occur when the tacit product knowledge of the recipient firm is comparable to the complexity of the external knowledge. In Cohen and Levinthal's model of absorptive capacity, they included a variable to account for "the complexity of the knowledge to be assimilated, and the degree to which the outside knowledge is targeted to the needs and concerns of the (recipient) firm"[31]. In other words, the distance between the donor firm and a recipient firm from the technology frontier *relative to one another* is important for technology transfer (ie. 'gap-dependent technology transfer').

In acknowledging the importance of the complexity of external knowledge to absorption, it became important to include in production functions a variable or "interaction term" that accounted for the fact that absorptive capacity is "cumulative"[32]. As Criscuolo and Narula describe it, "absorptive capacity increases with the firm's R&D investment but at a decreasing rate and when external knowledge becomes more complex the firm will assimilate less for a constant level of R&D investment"[33]. What this means is that not only do firms need to continually invest in in-house R&D to develop tacit product knowledge so as to position themselves to productively absorb transferred technology (coupling), but that the closer they get to the frontier, the more they will have to invest just to keep pace with product technology improvements. Moreover, that absorptive capacity is cumulative means that firm-level technological learning is necessarily evolutionary. In other words, falling into a 'low learners trap' (immiserizing learning) is prohibitively regressive over time because industrial development cannot be leapfrogged.

It is possible to identify two different catch-up strategies prominent in the academic literature today that purport a positive association with technological learning. There is the FDI-led development model and the infant industry protection model, both of which rely on access to foreign technology controlled by 'center' interests. Additionally, what both these strategies have in common is that they reject what they say is import-substitution industrialization's demand side focus on "expansion of the domestic market"[34] and instead believe in creating supply side incentives to "selectively integrate"[35] into the world economy. However, these 'neostructuralist' models, as they are referred to, differ in the types of firms they believe industrial policies ought to be designed to support. Those who support attracting transnational investment in a local sector believe that TNC subsidiaries will bring needed technological upgrades and practices and necessarily establish a positive learning trajectory for the local industry as it is integrated within a larger network of production. On the other hand, there are those who believe that local capability development can only be ensured by maintaining autonomous control of sector investment policies, which are best implemented through domestically-owned, 'independent' firms. This latter group support 'infant' industry protection (IIP).

Key supporters of the IIP model point to the diverging development paths that East Asia and Latin America have chosen over the past three decades as evidence for the success of what Sanjaya Lall calls East Asia's 'autonomous strategy'. As Lall notes, "in 1980, Latin American countries accounted for 47% of developing world mVA and East Asia for 29%; two decades later, the shares were 22% and 58% respectively"[36]. According to Rajneesh Narula, the differences between the two regions cannot be explained by looking at their tariff regimes because "at 23.5%, tariff rates were only marginally lower in East Asia than Latin America (28.1%) during 1978-80, and by the period 1981-1985, were almost identical"[37]. He goes on to point out that "non-tariff barriers were in fact almost twice as high in East Asia then in Latin America as late as 1989-1994"[38]. What accounts for East Asia's superior development since 1980 is not liberalized importing, but rather "creating incentives to export"[39], as opposed to in Latin America where manufactured exports in 1985 "were just 25.1% of all exports, less than half the level in East Asia where manufactures were about 51.7% of exports in the same year"[40]. For Narula, "East Asia can therefore be said to be both export oriented and import-substituting at the same time"[41]. Maybe the best example of a country that both protected 'infant' firms in its domestic market, while at the same time encouraging them to export, is South Korea.

South Korea can certainly be said to have followed an 'autonomous' catch-up model from the point of view of actively restricting foreign ownership in its local market and by pursuing, as the *ultimate* goal of Korean industrialization, a strategy of complete independence from foreign reliance. However, to help it move towards this ultimate goal, Korea has critically relied on associations with foreign transnationals to gain access to both foreign markets and technology. Jin Cyhn regards the role of foreign transnationals in Korea's development as being "under-estimated in the current literature"[42] and Lee and Lim concur that Korea's latecomer success was not simply "driven by endogenous generation of knowledge and skills, but by collaboration with foreign companies"[43]. Korea's catch-up can be said, then, to be the product of 'coupling': a fiercely independent ownership strategy where there is local autonomy over in-house firm investment, coupled with transnational collaboration to access foreign sources of technology.

According to Linsu Kim, Korea has made the successful "transition from 'learning by doing' to 'learning by research'"[44]. Kim is describing an evolutionary three stage process whereby Korea has, over the past three decades, progressively developed advanced technological capabilities. In the 1970s Korea went through a 'duplicative imitation' phase where Korean firms, most specifically in the consumer electronics sector, entered into subcontracting relationships with foreign transnationals to gain access to foreign markets, producing mature designs at high volume for low margins. In the 1980s, Korea when through its 'coupling' catch-up phase, what Kim has called 'creative imitation', where it heavily invested in in-house R&D to move into more advanced technologies and to bargain for foreign licenses to proprietary foreign product designs. Since the mid-1990s, Korea has been in its 'innovation' phase, producing at the frontier where it is denied access to foreign licenses by its direct competitors, having instead to rely strictly on self-designed products for its competitive advantage. In other words, South Korea has achieved a measure of autocratic reproduction, independent of 'center' resources.

Korea's development trajectory began quite indistinct in that it sold itself as a low cost production location to foreign TNCs. However, what separated Korea's early strategy from those of developing countries today was its' high tariff barriers and restrictive foreign ownership policies, both of which functioned to limit contracts with foreign transnationals to that of OEM-subcontracting. The original equipment manufacturer (OEM) transnational would subcontract the production of mature products to Korean firms, which would manufacture low cost "clones" or "knock offs"[45] (ie. duplicative imitation) for export back to the home country of the OEM, usually either Japan or the United States.

From the OEM's perspective, sharing mature product designs with Korea was of little concern from a proprietary perspective because at that point possession of the technology afforded no competitive advantage in their home markets[46]. Instead, their interest lied in the "rapid, low cost expansion of manufacturing capacity"[47] offshore and, according to Michael Hobday, "once one market leader began OEM (subcontracting), others quickly followed or suffered the consequences"[48].

From the perspective of Korean supplier firms, the OEM relationship afforded them access to product designs that they could otherwise not efficiently reverse engineer and consumer markets that they could not otherwise effectively capture. According to Cyhn, between 1962 and 1976, Korea relied mostly on the reverse engineering of imported capital goods, but as product sophistication advanced, Korean firms sought out foreign OEM partners. Samsung, for example, entered into a subcontracting arrangement with G.E., producing for them microwave ovens under the G.E. label, where G.E. "supplied ventilation motors to Samsung, and introduced many suppliers of key parts as stipulated in the OEM contract"[49]. Another important reason for wanting to produce under another company's brand label is that it allows the supplier to avoid the "economies of scale in advertising and distribution, which act as significant barriers to entry and expansion by new exporters"[50]. In fact, even as Korean suppliers developed greater in-house capabilities in product design, many of them chose to avoid pursuing 'original brand manufacturing' (OBM), content to remain producing under their foreign label. Cyhn writes that "for instance, an interview with a Korean supplier suggests that for a 19-inch color television, it makes the profit of $105 with OEM, while for OBM, it is about $95". The supplier stated, "the difference is due to the high cost involved in marketing and distribution (as well as after sales service) networks"[51] associated with establishing a new brand.

In the 1980s, Korea moved into the second stage of its' technological development, 'creative imitation', where it heavily invested in acquiring the local design capabilities to produce "facsimile products but with new performance features"[52]. These products were not based on mature designs, but required the "formal technology transfer"[53] of advanced 'proprietary' product knowledge through licensing from foreign sources. In many ways this was a necessary step up in local manufacturing value-added because, as Kim writes, it occurred "in the face of increasing local wages and emerging competitive threats in labor-intensive production from the second-tier developing countries"[54].

The defining feature of the creative imitation era of the early 1980s was the dramatic increase in both corporate R&D expenditures by Korean *chaebols* as well as their purchases of foreign licenses. Prior to the 1980s, most R&D being done in the country was limited to government research institutes (GRIs), but their most significant contribution was actually in human resource development. According to Kim, "GRIs generated a large number of experienced researchers, who later spun-off to new GRIs and emerging corporate R&D centers in the 1980s"[55]. There was only one corporate lab in 1970, but in 1990 there were 996 and by the year 2000, there were 5200 corporate labs in Korea[56]. Overall "the average annual growth rate of the nation's R&D investment as a proportion of GDP over the decade of the 1980s was the highest in the world, at 24.2 percent"[57]; similarly the annual growth rate of business R&D per GDP was also the highest in the world at 31.6 percent. This staggering escalation in in-house R&D was matched by comparable expenditures on foreign licenses, where from 1982-86 alone "royalties associated with foreign licenses increased from US$16.3 million to US$1.18 billion"[58].

Understanding the relationship between corporate R&D and the need to access foreign licenses in the creative imitation stage is key to not simply understanding Korea's overall technological upgrading, but also its sector-specific transition, in some cases, to the completely 'autonomous innovation stage' of development.

Corporate R&D functions as a means of "bargaining power"[59] or leverage to purchase foreign licenses. Foreign transnationals are understandably reluctant to license advanced proprietary technology to potential competitor firms who may in the future take market share from them. Only when the foreign holder of a license believes that a potential competitor is close to themselves designing a comparable product as theirs, will they issue that competitor a license. At that point, they want to prevent the rising competitor from patenting their own design; they would rather earn royalties from the competitor producing off of their license.

However, it is important to note that holders of patented technology are likely never to issue a foreign license to a *direct* market competitor. The smaller the producer market, the greater the number of direct market competitors and producer markets grow smaller the more sophisticated the embodied product technology. Also, by definition, the smaller the market, the fewer the possible holders of the needed level of advanced technology. For example, Samsung's semiconductor division had relatively little trouble purchasing a license for 64K DRAM (dynamic random access memory) chip technology from Micron Technologies, an independent venture firm in America, as well as licensing manufacturing technology from Japan's Sharp corporation. Samsung's version of the 64 kbit chip "hit the market…some 18 months after the first Japanese ones became commercially available"[60]. However, some years later, as Kim has described the predicament at the time:

"work on the next generation of chips – the 4M DRAM – meant exploring the frontiers of semiconductor technology but also competing neck-in-neck with Japanese and U.S. companies. As the stakes have risen in the chips game, the field of players has grown smaller worldwide, meaning that few, if any, of those left in the game can be counted on to sell state-of-the art chip design technology to Korean *chaebols*"[61].

The above example demonstrates that the cost advantages of latecomer firms dissipate as they move closer to the frontier, where they must then survive on the same competitive basis as otherwise established firms. Lower down the value chain below the sector frontier, foreign licenses are easier to come by and market share can be gained by increasing scale economies to lower production costs (a *chaebol* specialty). However, it is at this 'creative imitation' stage that it is necessary to invest in sufficient in-house R&D to both bargain for, and productively assimilate, external technology upgrades and subsequently continue to invest in furthering tacit product knowledge. This is because if a firm is commercially successful at the creative imitation stage and eventually moves up the value chain to where it is utilizing more advanced technologies closer to the frontier, it will necessarily have to autonomously produce its own commercial designs as direct competitors will be unwilling to license their proprietary technology solutions.

The semiconductor sector in Korea serves as an example of successful coupling at the creative imitation stage while the personal computer sector is an example of the failures that befall 'uncoupling'. Throughout the 1980s, chip makers in Korea invested well over $1 billion in expanding production capacity and close to $100 million in R&D. They also established 'R&D outposts' in Silicon Valley, Osaka and Sendai in Japan and elsewhere[62]. Despite direct competition from U.S. and Japanese companies, Samsung, in collaboration with two other *chaebols* and a GRI, was able to successfully design their *own* 4M DRAM in 1989 "only a few months after Japan"[63]. Overall, in terms of market share, according to Lee and Lim, "Korean shares in DRAM increased from nil to almost 30% in the mid-1990s"[64]. In contrast, Korea's personal computer industry, since it lost its' low cost advantage, has been in such sharp decline that is has "discontinued exports"[65] and now only sells into its domestic market.

It has been proposed that what accounts for the clear difference in latecomer success between the two sectors lies in the individual characteristics which define each of theirs' technological regimes. The technological regime of a particular industrial sector is a reflection of the "nature of the technology"[66] used. One of the characteristics which is used to define technological regimes is fluidity where fluidity refers to the "predictability of the technological trajectory". When the embodied product technology is highly fluid, "the more difficult it is to predict the direction of future development of the technology", making it harder for "latecomer firms to fix the

R&D target"[67] of their in-house investments.

The technological regime of the semiconductor industry can be characterized as one of low fluidity, and therefore possible to more easily predict the direction of future technological advances. Such regimes are more favorable to latecomers because they face relatively less risk in making, and therefore have greater incentive to make, large R&D investments to catch-up to established producers. The regime of the personal computer industry is highly fluid and therefore more risky to latecomers that, in the creative imitative stage of their development, must decide on which technologies to invest in. The fluid nature of the technological trajectory of the personal computer regime served as a disincentive to Korean firms to invest in the necessary R&D to leverage successfully for access to foreign licenses by increasing their in-house tacit product knowledge. The divergent paths Korea took in the semiconductor and personal computer industries highlight the importance of coupling at the creative imitative stage and that it is not possible to leapfrog this stage and remain successful solely based on cost advantages.

Maybe no industry better exemplifies the progressive evolution of latecomer firms during the three stages of development in Korea than the auto industry, especially given the success of Hyundai motors. A protected domestic market was key when Hyundai first started to produce using mature technologies, a re-orientation to the export market necessitated greater knowledge of product technology and leverage to bargain for foreign licenses, and eventually, when it was recognized as a direct threat to the existing market share of those that it had previously relied on to share their technology, it autonomously developed new product designs relying solely on the in-house capabilities it had invested in over time.

In the duplicative imitation phase of Hyundai's development, it relied on licensed mature designs to create an indigenous model, the 'Pony', which is sold primarily in its' protected home market. As per government mandate, the local content of the first model Pony in 1975 was 90 percent. According to Kim, "Hyundai approached 26 firms in five countries to acquire different technologies"[68] and hired outside technical experts from Japan and Britain to tutor Korean engineers.

In its creative imitation stage, Hyundai assumed the ambitious goal of designing a model, which came to be called Excel, with the intention of selling into the North American market. This would require "a major investment to develop the next generation FF (front engine, front wheel drive) car"[69]. Unfortunately, they were rejected licenses to proprietary FF technology from Volkswagen, Ford, Renault and Alfa Romeo - all of which wanted, in exchange for the technology, "equity and management participation"[70] which Hyundai steadfastly refused. However, as Kim describes it, "in 1981, Mitsubishi agreed to license engine, transaxle, chassis, and emission control technology to Hyundai". Moreover, "not only did Hyundai retain all managerial control, but also reserved the right to import parts and technology from Mitsubishi's competitors and to compete directly in Mitsubishi's own markets"[71]. However, in 1984, Mitsubishi abruptly ended its relationship with Hyundai, refusing to "share its state-of-the-art"[72] engine technology any longer, likely in response to the commercial success Hyundai had achieved.

Hyundai was forced to enter into its innovation phase earlier than expected, but what's important to note is that it at that point, it had the already made the necessary in-house investments for it to proceed competitively on its own. Beginning in 1973, when the Pony model was first conceptualized, Hyundai had steadily invested in expanding its R&D budget. In 1975, the number of research engineers employed by Hyundai was 197, but by 1984 that number was 1298. In 1984 "Hyundai established the Advanced Engineering and Research Institute to develop its own engines and transmissions"[73] and starting in 1986 it opened R&D outposts in Ann Arbor, Los Angeles as well as in Frankfurt Germany. Hyundai was able to design two "new electronic injection-based engines"[74], 'alpha' and 'beta' "which reduced (its) royalty payments for compact and subcompact cars to zero"[75] and in 1994 introduced the Accent model, the first Hyundai model not based on a Mitsubishi design (ie. autocratic reproduction stage).

Kim contrasts the favorable development of Hyundai with the less favorable development of Daewoo, which was in a joint venture partnership with GM. According to Kim, the independence of Hyundai forced it to invest in actively developing technological learning capacity as it alone would be forced to assume the losses associated with failing to produce competitive models. On the other hand, the approach of Daewoo was more passive because it "relied solely on GM for technological sourcing, having done relatively little in the way of developing its own technological capability and even less in designing its own products"[76]. Kim presents the contrast in terms of differing incentives to learn, writing that "the intensity of effort at Hyundai made the foreign technology transfer effective"[77], while Daewoo was "constrained by GM's global objectives"[78]. For example, it was even Daewoo's contention that "GM was reluctant to transfer core technologies to Daewoo"[79], most likely because GM only regarded Daewoo as a domestic market-oriented subsidiary. It was only after taking over majority equity control in 1983 from GM that, according to Kim, "Daewoo begun to show marked improvements in product/process development" and "established a fully fledged R&D department"[80]. It is for these reasons that Kim asserts that "for catching-up firms in developing countries, a strategy of independence is more difficult to manage but more effective in organizational learning than is joint venture with firms from advanced countries"[81].

However, while Daewoo may have been "constrained" by its association with GM, the case study of the Brazilian automotive industry since the 1990s has been cited as an example of the positive effects of FDI when local subsidiaries are integrated within their parent TNCs' overall global strategy. The identification of the large Brazilian consumer market by automotive TNCs as a possible profitable niche market for subcompact cars has resulted in their granting local subsidiaries the autonomy to actively invest in developing the product knowledge for indigenous design capabilities. With the incentive of a liberalized trade regime increasing import competition, local subsidiaries were parentally assigned a technical mandate to produce subcompact derivatives of global platforms (re: advanced technology-based models). This is in clear contrast to Kim's association of TNC subsidiaries with passive learning.

Decentralization of product development responsibilities to regional subsidiaries will only be approved if it is consistent with the overall strategic goals of the parent transnational. Only if the TNC regards product differentiation as a form a competitive advantage that it can profitably exploit, will it be willing to consider a niche product market mandate for particular regional subsidiaries. However, if a transnational's overall strategy is one of marketing standardized products, then decentralization will not be favored because it would likely only increase development costs. According to Quadros *et al.*, "Today all major assemblers, which are long established in Brazil – Fiat, Ford, GM and VW – have adopted decentralized product strategies…designing regional derivatives from global platforms"[82]. Decentralization is understood to involve the "real move of some product development activities to the local facilities, as well as the attribution of responsibilities and a certain degree of project autonomy to the local development teams"[83].

With overcapacity in Triad markets, automotive producers are turning their sights to emerging markets. The Brazilian market produced two million cars in 2004, with close to 80% being sold domestically. Of the cars sold in Brazil, 70% are of the subcompact or 'popular' car variety, which would seem to indicate that a lucrative niche market exists[84]. The Brazilian government has in fact supported the popular car strategy by lowering to zero the "Industrialised Product Tax (IPI) on vehicles powered by engines up to 1000cc"[85].

Given the possibilities that exist in the Brazilian market for selling derivative subcompacts based on global models, decentralization makes sense from a development cost standpoint. According to Carneiro-Dias and Salerno, home country-based development centers are responsible for new platform design, but if the demand for low cost derivatives of these new platforms is high – as would be expected in a country such as Brazil with a population of 175 million – than "an excess of tasks"[86] at the development center would raise overall development costs. When the demand for derivatives is high, it is better to decentralize these tasks to regional subsidiaries. The failure of Ford in Brazil to recognize this when developing its 'Amazon project' serves as an important example. The Amazon is a global platform designed by Ford. According to Consoni and Quadros:

"The original plan was centralizing the whole project in Ford's England technology centre, including the design of derivatives for emerging markets. Brazilian engineers were expected to participate marginally, providing inputs related to market requirements. However, it became clear along the project that the differences between emerging market and Europe cost and technical requirements were so great that they could not be dealt with in a unique project"[87]

The failure to pursue a decentralized derivative design strategy resulted in a "major delay in the Brazilian launching of the new Fiesta and the consequent (and further) reduction in Ford's market share"[88]. That it is in the parent TNCs interest to decentralize derivative design to regional subsidiaries would imply that it is also in the parent TNCs interest to afford its' subsidiaries the necessary autonomy and R&D resources to invest in enhancing their indigenous design capabilities.

Liberalization of the Brazilian market in the 1990s has additionally served as an impetus for local subsidiaries to be given greater autonomy, specifically so that they may upgrade their technological capabilities in response to both increased import competition and a more technically demanding mandate to design derivatives for the local market based on *new* global platforms. The Brazilian government's new sector specific industrial policy, the 'Automotive Regime', instituted in 1996, stipulated that "firms assembling vehicles in Brazil were allowed to import vehicles at half the normal tariff level up to 1999"[89].

Prior to liberalization, models manufactured in Brazil were based on "obsolete"[90] European designs, which likely explains why the share of engineers in the auto sector in the 1980s was "less than 1%"[91]. However, in the 1990s, according to Consoni and Quadros, "the sudden explosion in vehicle imports intensified domestic competition and turned evident the need to update products and improve productivity rates and quality standards in car manufacturing in the country"[92]. Specifically, TNCs began "upgrading product portfolios, which were strongly obsolete in relation to international quality standards"[93]. This required integrating the product mandates of Brazilian subsidiaries to more closely reflect the overall product profile of parent country subsidiaries. As a result, Brazilian subsidiaries were to base their derivative model designs on new global platforms, the same platforms currently used in models sold in Europe. New platforms are now simultaneously launched in Europe as well as in Brazil, which has meant a shortening of the product cycle in Brazil. "Indeed, the number of new car platforms launched and manufactured in Brazil in the 1990s (a total of 22) was more than three times the launchings observed in the 1980s"[94]. These new platforms are a source of external technology upgrades to the Brazilian industry. Their introduction has forced Brazilian subsidiaries to keep pace with the technological frontier "to narrow the gap between the local and European product portfolios"[95]. Narrowing the gap requires investing in not simply the 'know how' of new manufacturing process technologies, but also the 'know why' of the upgraded embodied product technology in new platforms, so that low cost derivative design solutions can be carried out locally by Brazilian engineers.

The decentralization of product development responsibilities to Brazilian subsidiaries has necessitated new investment to help local subsidiaries meet the requirements of their new mandates. For example, investments by auto makers increased from "$US5.4 billion in the 1980s to $US16.6 billion in the 1990s"[96]. R&D personnel have been key to the auto industry's success post-liberalization. For example, as Quadros and Queiroz write, the auto industry "accounts for the largest staff of graduates employed in R&D activities in the Sao Paulo industry, as compared to other sectors. In fact, 31 percent of graduate staff in R&D activities in the manufacturing industry is employed in the motor vehicle segment"[97]. Maybe the specific company example most often cited is Fiat,which has both increased its "local engineering employment" as well as broken ground on a new $US150 million design facility in Brazil, the first of its kind outside of Italy, where it hopes to specialize in subcompacts aimed at EMC export markets. According to Consoni and Quadros, Fiat's "announced objective is to carry out a '100% Brazilian vehicle'" where "all the phases of product development will be performed in Brazil, from design and product concept definition to production process"[98].

There have been a number of success stories of Brazilian subsidiaries meeting their new product development mandates. For example, along with the local Brazilian subsidiary of Magneti Marelli, a TNC supplier company, VW of Brazil co-designed a new engine for their Gol model, "with a flex-fuel injection system, capable of working with gasoline, ethanol or any mix of them"[99]. The above example highlights that the "increasing product development activity in assembler subsidiaries has entailed a similar process in Brazilian global supplier subsidiaries"[100]. In fact, beyond their regional specialization in subcompacts, some local TNC supplier subsidiaries have been raised to the "status of global 'Centers of Excellence'"[101]; for instance, the local Bosch subsidiary that specializes in electrical engines was given "the global mandate for the design and manufacturing of starters applicable to vehicles up to 1,600 cc"[102].

The most encompassing new product design project in Brazil to date has been the 'Meriva' project of GM in Brazil (GMB) because its successful completion is evidence of an evolutionary progression from possessing 'partial derivative' design competence to obtaining 'compete derivative' design competencies. The Meriva project of GM is "the first case of a global product development project proposed by the Brazilian subsidiary in Brazil, coordinated from the subsidiary and later incorporated into the global corporation's product portfolio"[103]. The Meriva is a minivan derivative, and it was the Brazilian subsidiary that identified local market demand for a smaller 5-seat 'monocab' version of a previously sold 7-seat minivan. The Meriva is now also exported to Europe. The uniqueness of the Meriva project was the "extensive reengineering of platform dimensions"[104] that were required and the fact that the "largest part of the engineering tasks"[105] were pereformed by the Brazilian subsidiary.

Unlike previous 'partial derivative' designs based on modifying an existing global platform, the Meriva derivative has a completely new 'hybrid' platform. The original Corsa platform of GM was modified so that it could be integrated with the back suspension of another original GM platform, the Astra. While partial derivatives generally share 70-85% of their component parts with their original global platforms, "Meriva shares only 55%", reflecting a "significant product modification at a level of complexity that GMB had never performed before"[106]. According to Consoni and Quadros, the success of the Meriva project is an indication that GM's Brazilian subsidiary is "ready to become headquarter partners in global product development"[107].

Much as the Korean case study highlighted the importance of coupling in-house

R&D with access to external sources of technology upgrades, the Brazilian case study additionally highlights the importance, in the instance of FDI-led development, of a parent TNC's overall competitive strategy and how it reflects on subsidiary mandate autonomy and the opportunity to invest in upgrading. The question then becomes, how are the determinants of successful catch-up identified in this chapter applicable to facilitating the successful integration of the South African components industry into the competitive parameters and governance structures which define the new economy.

It will be argued that GPN organization limits the possibility of successfully replicating the two case study models of dependent development described above. The East Asian Development model assumes both development 'space' and sufficient firm-level leverage, while the FDI-liberalization model assumes parentally assigned technical mandates that are automatically complemented with R&D resource mandates that promote firm-level learning. Both these assumptions are called into question, first by the competitive demands of the 'race to the top' era which reduces development space in the periphery (Chapter Two) and second, by the increased structural power of lead firms to control the terms of the dependent exchange, which has the effect of both reducing bargaining power in the periphery and cedes mandate assignment to network-level interest rather than subsidiary-level interests (Chapter Three).

CHAPTER 2: The New Organization of Production - GPNs

The focus of this chapter will be the new catch-up environment for industrial production in the post-liberal era, namely within global production networks (GPNs), with a specific interest in the competitive parameters governing the opportunities for upgrading of firms from middle-income countries (MICs) as they integrate within producer-driven value chains (PDVCs). It will be argued that integrated supplier subsidiaries in the automotive components value chain are in a 'race to the top' to meet homogenized international quality standards, requiring access to advanced, proprietary technology. The chapter will be divided between three main sections.

The first section will describe the origins of network-led production from the perspective of viewing GPN organization as a competitive response by transnationals to productive advantages opened up from changes in the transactions costs associated with the offshoring of supply. The main set of characteristics of auto industry supply chains will be introduced, particularly the hierarchical organization of supplier tiers in response to original equipment manufacturer (OEM) demands for complete subsystem (module) delivery to assembly locations world-wide.

The second section of the chapter will focus on how networked production has affected the competitive environment of MICs, in other words which productive activities allow MIC firms to sustainably capture economic rent. It will be argued that MIC firms in the post-liberal era are caught in a 'structural squeeze', unable to compete in labor-intensive manufacturing, yet forced to compete in PDVCs with higher-income country firms which currently hold a productivity advantage in technology-intensive manufacturing.

The final section of the chapter will look to categorize the governance structure of PDVCs by highlighting industry-specific variations, specifically between the auto industry and the electronics industry. The governance structure of PDVCs can be analyzed through the lens of center-periphery structuralism, with lead firms organizing a division of labor within peripheral supply chains to maximize network (the lead's/center's) competitive advantage. The differences seen in the governance structure between the auto and electronics industries is directly related to differences in their product architecture. It will be argued that the functional interdependencies between constitutive component parts of automotive subsystems requires overall module/subsystem design be integrally conceptualized and upgraded. In other words, organization of the inter-firm relations between internalized 'tier II' peripheral component suppliers is coordinated by their 'tier I' lead firm (complete subsystem supplier to OEMs). As a result, tier II supplier firms integrating into an automotive GPN will be forced to catch-up/upgrade under tier I 'parental supervision'[1].

This first section of the chapter is concerned with the origins and characteristics of global production networks (GPNs). GPNs constitute a "new form of industrial organization that is deeply transforming the way value is created and distributed within global industries"[2]. This is because the network organization of production presents firms with a new competitive environment and a new governance structure, different than the pre-liberal era of vertically integrated firms competing within nationally tariff-protected boundaries.

The deverticalization of Chandlerian firms specifically entails the sourcing of supply inputs from offshored, geographically dispersed suppliers. This offshored supply base is vertically specialized "to optimize production, marketing and innovation by locating products, processes or functions in different countries to benefit from cost, technological, marketing, logistics and other differences"[3]. According to Langlois, "vertical disintegration and specialization is perhaps the most significant organizational development of the 1990s"[4]. How the division of labor should best be organized across a supply chain, which is what functionally defines a particular governance structure, is the responsibility of lead firms, whose "ability to master the logistic task of sourcing inputs from different producers with specific locational advantages…is decisive for the competitiveness of the whole value chain"[5]. As will be described at the end of this section, automotive tier I complete subsystem supplier lead firms organize the sourcing of constitutive subsystem components from geographically dispersed tier II supplier firms – what shall be considered the unit of analysis when referring to the automotive GPN or supply chain.

The origin of network organization, like any form of competitive industrial production, is linked to the search for new competitive advantages and the economic feasibility of any proposed changes to production organization to gain such advantages.

The feasibility of offshoring supply is linked to the increase in service costs associated with coordinating a dispersed supply base. In other words, the production cost savings from offshoring must be greater than the increase in coordination costs that necessarily accompany (a) the fragmentation of the production process and (b) the geographic dimensions of this fragmentation. More specifically, the fragmentation of supply must not negatively affect the efficiency of final product assembly. Additionally, excessive trade-related costs associated with geographic fragmentation must be considered prohibitive. Recent changes to these two 'service cost' variables related to fragmentation have been, from a systemic perspective, responsible for the paradigmatic shift to offshoring.

Both the codification of explicit forms of knowledge into standardized product interfaces, along with the liberalization of trade and foreign direct investment (FDI), have together changed the organizing principles of industrial competition. Technical advances, such that those needed to "isolate tacit knowledge away from the interfaces among components at the supplier level"[6] have made it possible to offshore the production of separate product modules or fragments to multiple suppliers in multiple locations and yet still ensure efficient final assembly. This is because the standardization of interfaces reduces transaction costs at the inter-firm level[7], as the presence of common interfaces or linkages allows the disintegration of independent production processes without exponentially increasing the complexity of coordinating final assembly. As shall be discussed in section three of this chapter, standard interfaces separate *functionally independent* product modules, which in the auto industry exist at the complete module/subassembly level, whereas in electronics they exist at the individual component level. Secondly, according to Feenstra, "in the global economy, the disintegration of production has built upon the integration of trade"[8]. Moreover, internationally sanctioned national treatment for foreign supplier subsidiaries has also been important, along with lower tariffs, to reduce the logistics costs associated with the new geographic dispersion of production. Reductions to both of these associated service costs have made fragmentation a more feasible competitive response by allowing firms to, for example, benefit from trade-related production cost savings associated with offshoring.

According to Felker, the advantage gained from an offshored supply network, from the perspective of lead firms, is the increased "capacity to arbitrage the cost and productivity advantages of manufacturing capacity in different locations"[9]. For example, following "Heckscher-Ohlin lines for the basis for trade", lead firms have the option of sourcing from locations where, due to the relative abundance of particular factors of production, they can benefit from production cost savings. As Jones *et al.* describe it, "it might be the case that different fragments require inputs in different proportions, and relative factor supplies and prices could differ from region to region"[10]. Additionally, following the "Ricardian view of differing relative productivities of labor"[11] as a basis for trade, lead firms can choose to access an outside supply of skilled labor that they otherwise could not if they were confined to one production location, as is the case when supply is vertically integrated within a single firm.

By offshoring supply, a lead firm is able to avoid what Porter has labeled "the strategic costs of vertical integration", including "higher fixed costs, reduced ability to change partners, non-access to suppliers' and customers' know-how, as well as reduced incentives to innovate as buying and selling occur through a captive relationship"[12]. As Ernst and Kim have noted, "no firm, not even a dominant market leader, can generate all the different capabilities internally that are necessary to cope with the requirements of global competition"[13]. Steinfeld similarly argues that "from a product architecture perspective, it may be impossible to determine the exact boundaries of a given industry". For example, he asks, "for a country to be strong in autos, aerospace, or telecommunications, what fundamentally does it need? Software companies? Semiconductor design houses? Handset manufacturers? Steel firms? Marketing firms?". It is because the "organizational mechanism of change" is now "spread across ostensibly unrelated firms and industries" that Steinfeld warns of the "risks entailed in forcing the vertical integration of industries"[14]. Moreover, in keeping with the Ricardian notion of benefiting from a trade-related division of labor, each node in a vertically specialized supply chain, given the likely mandate of exporting to multiple assembly locations, has a better chance of achieving scale economies compared to the previous dynamic of a series of vertically integrated firms, each limited to producing for their national market only.

Some industries are more amenable to exploiting fragmentation-based advantages than others. For example, the chemical industry requires a more integrated production process, and so is not a good candidate. According to Lall *et al.*, fragmented production is seen "particularly in technologically advanced activities" and that that is one of the reasons why the electronics and auto industries "lead in setting up GPNs in the developing world"[15]. However, as will be discussed in the final section of this chapter, a distinction can be made between the two industries based on the relative complexities of their product architectures, with the electronics sector generally characterized as having a more modular architecture, explaining why it "is fragmenting faster world-wide than the auto industry"[16]. However, the auto industry is advantaged by the fact that it is a capital-intensive industry and thus dependent on scale economies and according to Jones *et al.*, "greater levels of output encourage greater degrees of fragmentation"[17].

Scale economies are important because they effect the 'service costs' side of the fragmentation equation, while the production savings side is unitary with regards to scale. As noted earlier, with each additional product fragment sourced from an offshored supplier, there is both an associated production cost savings but also a rise in attendant coordination costs. According to Jones *et al.*, marginal production cost savings remain level with each additional unit volume imported from an outside, vertically specialized supplier source (unitary accumulation of savings). However, as they argue, from the service cost side of the equation, "for example, the costs of communication to allow coordinated shipments of two production blocks (re: fragments) would not be much different for outputs of one thousand units and those of ten thousand units". In other words, marginal coordination costs decrease with volume, which is why overall, production fragmentation exhibits "strong increasing returns to scale" as opposed to vertically integrated firms where in-house production costs rise relative to output (constant returns to scale)[18].

The marginal decrease in coordination costs with output is best understood by remembering that offshored production is coordinated via specific inter-linking 'interfaces' that separate product modules and the identification of which make possible the exogenous sourcing of such fragments. And so, while coordination costs increase with each additional outsourced fragment, once a specific interface is established that ensures eventual functional association with the whole, the marginal cost of coordinating final assembly decreases with each additional unit imported as the initial cost of designing the linking parameters is spread over an ever greater volume. In other words, there is no need to reestablish another interface link with every additional volume sourced, rather, by definition, the specific interface remains the same.

In order to arrive at a timeline to pinpoint the origin of network-led production, it is necessary to demonstrate the positive link between trade liberalization and fragmentation, or more precisely, when the specific 'critical tariff' was reached which made vertical specialization a feasible competitive response. To begin with, the prohibitive relationship between tariffs and imports has been firmly established. For example, Hanson *et al.* use "firm-level data on U.S. multinationals to examine trade in intermediate inputs between parent firms and their foreign affiliates" and not surprisingly they find that imports are "strongly negatively correlated with host-country tariffs"[19]. However, the notion of being able to identify a critical tariff level -- the precise point at which trade in inputs between a deverticalized lead firm and its vertically specialized supply base becomes the dominant organizational paradigm – initially became important in order to explain the fact that "tariff declines were much larger prior to the mid-1980s than after, and yet, trade growth was smaller in the earlier period compared to the later period"[20]. In other words, the elasticity of trade growth with respect to tariffs increased; Yi estimates that "between 1962 and 1985 the elasticity of trade with respect to tariffs was 7, while between 1986 an 1999 it was 50". Normal elasticity based on trade in final goods cannot explain such a "non-linear trade response to tariff reductions". Instead, the explanation is based on the reaching of a critical (low) tariff at which point disintegration occurred and the increased trade volume is trade in intermediates (fragments/product modules). As Yi describes it,

"At first, tariffs are still sufficiently high that vertical specialization does not occur. Nevertheless, trade still increases for the standard reasons (re: '7' elasticity). As tariffs continue to fall, vertical specialization becomes more of a possibility. Eventually a critical tariff is reached at which vertical specialization starts to occur. At this point, trade surges, generating a non-linear response (re: '50' elasticity)"[21]

Trade in intermediate inputs is now the dominant feature of today's version of globalization, proceeding "at a rate exceeding that of trade in final goods"[22]. According to Athukorala and Yamashita, "world trade in parts and components increased from about $440 billion in 1992 to nearly $1000 billion in 2003; components accounted for nearly a third of the total increase in world manufacturing exports between these two years"[22]. Highlighting the importance of emerging markets to GPN organization, the share of developing countries in components trade has also increased sharply, "from 14.3 percent to 31.3 percent on the export side and 25.2 percent to 40.8 percent on the import side between 1992 and 2003"[23].

Given this phenomenon of the high percentage of imported inputs in production, it becomes important to distinguish between the gross value of a country's merchandise trade/exports and the actual ratio of local value added to total production value, the latter being a truer reflection of a country's point of integration along a value chain. It is for this reason that UNIDO's Competitive Performance Index has as its key variables "dollar value of manufacturing value added per capita (mVA)" and "the share of medium-and-high-technology activities in mVA"[24]. Take, for example, the case of China. According to one description, "within a period of about one-and-a-half decades, China has ended up with an export basket that is significantly more sophisticated than what would be normally indicated for a country of its income level"[25]. This paradox can be explained by analyzing China's trade deficit within South East Asia, where its' dependence on high value added intermediate good imports from countries like Japan and South Korea is evident. It is for this reason that Steinfeld refers to China's integration into the global economy as "extensive but shallow"[26].

The first section of this chapter will conclude with a discussion specific to the characteristics of the auto industry supply chain. In many ways, changes in the auto industry have mirrored changes in the global economy in general. For example, Nolan and Zhang describe the current era as one of "explosive M&A and consolidation" where "in sector after sector, the 'first-tier' suppliers are themselves multibillion dollar companies with global reach"[27]. The auto industry is representative of this overall general trend, with consolidation arguably being the defining feature of, and key determinant to explaining, the structure of the auto industry's supply base. Supplier consolidation in the auto industry can be viewed as a response to two interrelated demands on supplier firms, the need to supply OEM assemblers on a global scale and the increased demand by assemblers for complete subsystem (module) supply.

Supplier consolidation can be fairly characterized as a necessary complement to OEM assembler consolidation and as OEMs have expanded their global reach as a result of consolidation, so have their suppliers had to. The auto industry is highly capital-intensive, requiring massive investment in sunk costs. "Consequently, even the very largest of firms are involved in collaborative joint ventures with other manufacturers"[28], but even more so in the age of reduced model life cycles where there is an even greater imperative to share development costs. Moreover, as the industry in its primary Triad markets continues to suffer from overcapacity, OEM consolidation has been looked on as a necessary means of market rationalization. In addition, OEMs have recently sought expansion into emerging market countries both in search of untapped markets as well as new, low cost production locations. Consolidation has been an effective means of expanding their "geographic scope of operations" as, for example, "Mazda and Isuzu have provided Ford and GM with a much larger and badly needed presence in Asia"[29].

OEM assembler consolidation has forced supplier consolidation. Unique to the auto industry, many automotive parts tend to be bulky and therefore less amenable to shipping, especially shipping long distances. Therefore, there is a general preference in the industry for co-localization of suppliers, when at all possible, with OEM assemblers in final consumer markets where final assembly is undertaken. This is why, for example, despite the 'Ricardian' advantages of vertical specialization and lower host country tariff barriers, local content in the auto industry still tends to be higher than in the electronics industry. As a result, consolidation has been necessary for suppliers to achieve a similar (final consumer) market presence and global reach as their OEM buyers. As Humphrey and Memedovic state, as OEMs began expanding their operations in emerging market countries, "they increasingly expected their suppliers to follow them. This meant that the component manufacturers with pretensions to be lead suppliers in the industry had to extend their operations rapidly, through a mixture of acquisitions and FDI"[30]. For example, "between 1989 and July 2003, the 30 largest first-tier suppliers were involved in 957 take-overs"[31]. "The consequence has been a growth in very large first-tier component suppliers with global buying power of considerable significance – each of the largest eight component suppliers had global turnovers exceeding $10bn"[32].

One aspect of the "internationalization"[33] of supplier companies is that with consolidation has come the need for specialization. It makes sense that as a firm seeks to expand globally, it is simply impossible to do so on the basis of a broad product range. It is more feasible to expand scale operations in a limited product range to "generate market-dominant positions"[34], than try to command market power in multiple products. It is essentially the difference between oligopoly and monopoly, where market buyers and competitors will accept oligopoly, but not monopoly. In the industry today, "within certain product ranges, a very small number of leading system suppliers now dominate"[35], making the point that consolidation occurred along specialized product lines. For example, according to Sadler, when Lucas merged with Varity, "the major impetus behind the merger lay in the scope for integration in braking systems, as Lucas linked with Varity's Kelsey-Hayes division, the world leader in anti-lock braking systems for rear-wheel drive and four-wheel drive vehicles"[36].

On top of world-wide delivery service, the second of the OEM buyer demands which has resulted in supplier consolidation is for the world-wide delivery of *complete* modules or fully-assembled subsystems. According to Sturgeon and Florida, "automakers are striving to aggregate functionally related or physically continuous parts into subassemblies that are integrated from an engineering point of view"[37]. So, for example, the drive train complete module consists of the engine, axels, and transmission fully preassembled, ready for delivery to a final assembly OEM plant where it will be mounted together with other subassemblies. Module sub-assembly usually takes place in 'supplier parks' co-located close to the final assembly plants. In fact, when broken down at the subassembly/preassembly level, "fifteen modules represent about 75% of vehicle value"[38]. In response to these new demands for complete module delivery, "there has been consolidation in the supply chain as first-tier suppliers buy second-tier suppliers to create systems capability"[39].

Module supply can be looked at as interrelated to the drive for component specialization described above. The specialization can more properly be viewed now as a desire to gain competency in the delivery of a specific module. For example, "in 2000, Siemens Automotive acquired another German firm, VDO, which added cockpit instrumentation capability to Siemens climate control and interior plastics capability. This has allowed the firm to bid on completely built-up dashboard modules[40]".

OEM's prefer this new supplier service because it constitutes a transfer of investment risk from assemblers to suppliers. Now "assembly plants can be smaller and simpler"[41] with minimum efficient scale assembly achievable at lower volumes. As an example, the 'Smart Car' of Mercedes-Benz is assembled from supplier-provided module subassemblies, and "while a typical car is likely to necessitate the coordination of around 200 first-tier suppliers, the Smart Car collaboration has been engineered and designed using only 25 module suppliers"[42]. Consistent with this setup is "the transfer of a higher percentage of value-added to upstream suppliers; at the Smart Car assembly plant only 20 percent of value-added relates to activities undertaken within the vehicle (final) assembly plant"[43]. In other words, the supply and coordination of the 25 modules is the responsibility of what can now be properly understood as tier I complete module suppliers ('first-tier'). These tier I module 'mega-suppliers' are responsible for constitutive component sourcing from their base of vertically specialized tier II suppliers. The tier I suppliers generally share module design responsibilities with their OEM contractors, in what is known as 'black box' design. As Humphrey describes it, "while the assembler provides overall performance specifications and information about the interface with the rest of the car, the supplier (tier I) designs a solution using its own technology"[44].

As shall be discussed in the third section of this chapter, transnational tier I module suppliers internalize their tier II component suppliers as subsidiaries in order to properly integrate constitutive component design to maintain overall module functionality. However, it should be understood that while inter-firm tier II constitutive component design is integrated, and that these tier II component suppliers are internalized, component *production* is disintegrated/deverticalized. As mentioned above, co-localization of suppliers with final assembly plants is favored in the auto industry, however co-localization is limited by the feasibility of cost effectively sourcing all necessary components in a particular host country. Those components that are best sourced in the form of imports, made possible in the era of liberalization and technical fragmentation, are chosen because of the production advantages offered from a geographically dispersed, vertically specialized tier II supply chain.

Maybe the best characterization of automotive tier II supply chain governance is that of their being under 'vertical supervision'. Taking from Theodore H. Moran's conception of transnational subsidiaries being under 'parental supervision'[45], parent tier I's supervise the integration of design activities across the supply chain, along with the inter-firm division of labor, but actual component manufacturing takes place in multiple locations depending upon the particular location advantages associated with production specialization. An example may best serve to clarify this explanation.

Denso International Asia (DIAS) is a leading Japanese tier I supplier which has organized an intricate division of labor to source components from within South East Asia. The organization of this division of labor has been greatly facilitated by the Common Effective Preferential Tariff Scheme (CEPT) administered under the ASEAN Industry Cooperative Organization (AICO), highlighting once again the positive link between trade liberalization and fragmentation. The AICO mandates a "bilateral complementation scheme"[46] allowing "reciprocal tariff reductions on mutual transactions"[47]. It was instituted to increase "foreign market penetration" and "to reap the benefits of scale economies in production"[48]. When the CEPT addendum was instituted in 2003, liberalization was accelerated, contingent on participants proving trade reciprocity, to where "firms pay only 0-5 percent tariffs if 40 percent of the product's value originates in another, participating ASEAN country"[49]. These participating countries then became nature locations through which to expand Denso's production network. Today, for example, in Thailand Denso manufactures starters, alternators and wiper motors, in Indonesia, compressors and spark plugs, and in Taiwan, heat exchanges.

According to one report regarding Denso's operations, "the leading ASEAN countries export significant proportions of their output (Malaysia 30%, Thailand 24%, Indonesia 20%). Some of this is for the world market but a significant proportion is designed for inclusion in the complementation scheme"[50].(insert P.Dicken, 2003, p.51, figures 14,15)

The second section of this chapter will look to explain some of the possible consequences of network-led production for middle-income country development. As with any change in how production is organized, there evolves a new competitive environment. More specifically, the question to be addressed in this section is where within GPNs can middle income countries sustainably capture economic rent to reap the benefits of their productive investments. It will be argued that the new organization of production has affected both a 'race to the bottom' and a 'race to the top', leaving middle income countries with less of a natural competitive advantage.

The integration of China and its massive labor force into the global economy has altered the competitive environment, seen most profoundly to date in the negative effect China's 'race to the bottom' has had on the ability of less developed and emerging market countries to sustainably compete in labor-intensive manufacturing. To examine this hypothesis, the key determinants of rent capture will be used as proxies to gauge which sectors (and subsectors) have been most affected since China's industrial rebirth and turn to the export of manufactures.

It was Joseph Schumpeter who – in his explanation of the natural dynamism in a competitive economy and its association to his notion of 'gales of creative destruction' - first related the importance of barriers to entry. According to Schumpeter, barriers to entry function to protect producer income from being competed away, without which producer surplus eventually turns into consumer surplus[51,52]. Schumpeter described innovation simply as 'the carrying out of new combinations' and the returns to these new combinations as 'superprofits', or that which could be charged above the cost of innovation[53]. These superprofits, then, are the economic rent or the return to a productive activity which remains scarce, "but as Schumpeter showed, scarcity can be constructed"[54]. The s*ustainable* capture of economic rent, therefore, is the product of *both* producer innovation plus an effective barrier to entry.

The question then becomes, how has the new competitive environment altered the above equation of that which constitutes successful rent capture? It will be argued that the new competitive environment has altered, *in certain sectors*, the ability to construct effective barriers to entry. Why certain sectors? Once again, sustainable economic rent is the product of both innovation + barriers to entry. This innovation could be of either a low technology product or a high technology product. Alternately, product classes or sectors that experience pricing pressure due to competition (ie. no sustainable economic rent for their producers) are those that are either of low innovative-intensity (similarly, this contention applies to either low technology or high technology products) or have low barriers to entry.

A distinction between low technology and high technology products should, however, be noted at this point. Products within high technology sectors can be regarded as possessing an endogenous barrier to entry to protect innovation rent. This is because competition in the manufacture of these products effectively necessitates reaching a minimum competency-level that excludes many producers that lack the needed skill sets. On the other hand, low technology product sectors, where there exists a much lower skill set requirement to enter, require an exogenous barrier to entry to protect innovation rent.

It is argued here that the new organization of production, now within GPNs, has effectively eroded many *exogenous* barriers to entry. For example, trade liberalization and product fragmentation, the two hallmarks of network-led production, has resulted in the deverticalization of production and eroded the previous competitive advantage of Chandlerian firms manufacturing whole/integrated final products behind nationally tariff-protected walls. Cheap imports of low technology component fragments, produced within labor-abundant countries (Heckscher-Ohlin basis for trade), is now a competitive reality in many countries. Moreover, apart from the removal of tariff barriers, productive barriers in the actual manufacture of low technology products have fallen. Automation and digitization have standardized many manufacturing processes, lowering the necessary skill set for entry in many product classes. According to Steinfeld, prior to standardization, it was possible "to compete on the basis of process innovation", where "because manufacturing processes remained uncodified and integral within the firm, shopfloor innovations were truly proprietary". Today, however, digitization has facilitated the diffusion of what used to be proprietary knowledge, thus lowering the barrier to entry into manufacturing low technology, standardized products.

As evidence that the competitive environment has been altered by the lowering of exogenous barriers to entry in the new liberal era of production, Kaplinsky and Santos-Paulino's analysis of the unit price trends of products from various sectors that were imported into Europe between 1988 and 2001 proves most enlightening. The data set includes "seven sets of sectoral classifications involving more than 12000 product groups"[56] imported into Europe from low, middle, and high income countries. Product sectors which show precipitous unit price decreases can be assumed to be the sectors facing the greatest volume of competitive entrants from a production standpoint. According to Kaplinsky and Santos-Paulino, "the rationale for using unit prices as an indicator of competitiveness is that it harks back to Schumpeter's discussion of innovation"[57] where "falling unit prices reflect the inability to erect barriers to entry and/or to augment products"[58].

Four key observations can be made from the data set produced by Kaplinsky and Santos-Paulino, which they disaggregated on the bases of product technology and exporting country income level (insert table 4, figure 1)[59]. The first is that the most precipitous fall in unit prices has been in the low technology sectors. The percentage of low technology sectors with negative price trends was 71%, while for the medium technology sector it was 59%, with only 51% for the high technology sector. It would appear, as theorized above, that the low technology sectors have experienced a reduction in their exogenous barriers to entry, preventing them from capturing rent from their innovations (failure to protect against pricing pressures from new competitors).

The second observation is that "the degree of price competition is closely and inversely related to the per capita income of the exporting country – the lower-income the group of exporting economies, the more likely their prices will fall"[60]. In other words, the product classes within *each* sector grouping (low, medium, and high technology) that have experienced the largest price falls have been those produced by low income countries. Within the low technology sectors, we can surmise an erosion of barriers to entry, similar to point one. In the medium and high technology sectors, it would appear that low income countries were manufacturing exports that were "not innovation-intensive"[61] and therefore subject to greater pricing pressure than more innovation-intensive product classes from within the same technology grouping. As Kaplinsky and Santos-Paulino write, "*within* each of these broad sectoral categories, there is an association between low per capita income and clustering in niches (sub-sectors) of low innovation intensity"[62].

The third observation that can be made is that, as a corollary to point two, high income countries are producing within innovation-intense subsectors of the medium and high technology groupings (they did not register, to any level of significance, exports that could be classified in the low technology sectors).

The fourth observation is that China, the only country specifically distinguished by Kaplinsky and Santos-Paulino, exports products which are more similar to those of low income countries than to products of high income countries, in that their unit pricing trends more similarly parallel those of low income countries. In other words, the exports from China have also experienced large unit price decreases, in each sector grouping, compared to the exports of high income countries.

What can be said of this? On possible inference is that the exports of China and that of low income countries are more in direct competition with each other than the exports of China and high income countries. Such an explanation could provide context to the first observation mentioned, that the most precipitous fall in unit prices has been in product classes clustered in the lower technology grouping. From a Schumpeterian perspective, we know that the greater the level of (direct) competition, the more negative the pricing trend one would expect to observe. In other words, China has taken advantage of the lower barriers to entry in low technology sectors in the post-liberal era, which would explain the decreasing terms of trade of low technology product classes relative to that of high technology product classes. According to Kaplinsky, "the greater China's participation in global markets, the more likely prices will fall. And, second, this seems to have a disproportionate impact on the low income country group which faces intense competition from Chinese producers"[63].

It has been argued that the reason that the entry of China into the global marketplace figures most prominently in low technology product sectors is because of China's surplus labor force. Low technology sectors are characterized by labor-intensive manufacturing, which has made China the "workshop of the world"[64] and the chief promulgator of a 'race to the bottom', not only in prices but also wages. In other words, what is being argued regarding China's surplus labor is that it has so changed the competitive environment that the predictions of standard trade theory "in the Heckscher-Ohlin/Stolper Samuelson (HOSS) tradition"[65] no longer apply because they are based on assumptions of full employment. With the entry of China, we are now in "a world of surplus production capacity, in which labor markets do not clear"[66]. The effects of this wage/price trap is most apparent in buyer driven value chains where China now dominates much of the consumer products sector.

Buyer driven value chains (BDVCs) are very different from producer driven value chains (PDVCs). PDVCs tend to be very capital-intensive and scale-dependent, with lead firm 'drivers' earning rent from technology-based investments. In BDVCs, the lead firm drivers are large buyers that specialize in retailing and marketing competencies as manufacturing rents are low in sectors such as textiles, consumer products and food processing. Because their core competencies are found more in product development and branding, lead firms in BDVCs "do not, themselves, own production facilities; rather they coordinate dispersed networks of independent and quasi-independent manufacturers"[67]. It is at the level of these independent, subcontracted suppliers that the entry of China's massive production base has had its greatest effect.

In the context of a generalized BDVC, the expected returns to a subcontracted supplier can be predicted from standard trade theory. According to the Heckscher-Ohlin theorem, the expectation is that the "strongest product price changes should occur in sectors using the abundant factor of production" and as a consequence, according to Stolper-Samuelson, the expectation is that such "output price changes come to be translated into changes in the earnings of abundant factors of production"[68]. In other words, a reduction in final product price as a result of production cost savings in labor-intensive manufacturing should translate, through increased consumer demand for the product, to a return to wages (a return to the abundant factor, labor). However, as noted above, this assumption only holds under situations of full employment. With the entry of China, and the subsequent over-saturation of the supply base, the prediction of a producer surplus breaks down as the bargaining power of large buyers increases over their suppliers.

Consider the following scenario of a wage/price trap in a surplus labor environment, in which producer surplus is lost to both consumer surplus and branding rents captured by a large buyer. If a subcontracted supplier to a large lead firm buyer increases its productivity as a result of an in-house process innovation (ie. increase in labor productivity), it can offer its product to the buyer at a reduced price, and the buyer can subsequently reduce retail prices. Assuming an elastic demand curve, this should increase demand across the supply base. Standard Stolper-Samuelson theorem would predict a return to wages at this point, but with a surplus labor force the ability of any one individual supplier to demand a wage increase is diminished (loss of relative bargaining power).

First of all, in the age of standardized manufacturing, the process innovation is quickly disseminated to the over-saturated supply base. This lowers the switching costs away from any one subcontracted supplier, giving the large buyer greater flexibility to be a price-setter, forcing all suppliers to be price-takers[69]. Secondly, as Heintz states, "the price of labor in a labor surplus economy corresponds to the subsistence wage and labor demand can increase substantially without bidding up wages"[70]. Rather, the main beneficiaries of supplier productivity are the large buyers who can then further invest in, and earn returns on, branding and identification. At what can be considered the *initial* retail price (pre-supplier innovation), an investment in branding would have the effect of depressing consumer demand to unprofitable levels. This would defeat the whole purpose of marketing a 'name brand' product which is to be able to charge a higher price, without having consumer demand fall below profit-taking levels, simply based on the increased marketing of an identifiable label. However, post-supplier innovation, with higher supplier productivity and the possibility of increased consumer demand from a lower retail price, the returns to branding increase[71]. As consumer demand is more inelastic to the price of a branded product, if further investments in branding are made, subsequent volume demand would not fall back down all the way to pre-supplier innovation levels. In the end, the buyer would be earning profits from a branded product, sold at a price higher than the initial retail price (at volumes *above* what would be expected for the price level, were it not for the product being successfully marketed as a 'brand name').

From the perspective of a supplier, then, the only returns to an increase in labor productivity are dependent on the possibility of increased consumer demand. As Heintz writes, "the primary benefits accrue from the expansion of the volume of exports, not increases in per-unit value-added"[72]. With decreasing terms of trade and stagnant wages, suppliers hoping to compete in BDVCs dominated by Chinese exports will at best experience what Kaplinsky calls "immiserizing growth – that is, an expansion of economic activity which coincides with a decline in real incomes"[73].

The substantive effect of this 'race to the bottom' on the competitive environment is that it means that in the new liberal era, it is easier to be undercut on a *cost basis alone* in low technology manufacturing. In other words, the standard response of lowering production costs (labor costs) to protect against increased competition is not a sustainable form of competitive advantage any more in a surplus labor economy. This is especially the case given that "China has 'space capacity' in that its per capita exports are still relatively small"[74] and "indications are that wages are unlikely to grow in China in the medium run, at least in the export-oriented manufacturing industries which have the capacity to move into the interior and be serviced by the mass of rural unemployed and underemployed"[75].

The integration of China not only changes the competitive environment for low income countries, but also for middle income countries as well. According to one report in the *McKinsey Quarterly* entitled 'Beyond Cheap Labor', "in middle income countries such as Brazil, Poland, Portugal, and South Korea, a rising standard of living makes their position as low-wage producers and exporters increasingly tenuous"[76]. We have seen this already happen in countries such as Mexico where "some 500 of 3700 plants in the Mexican *maquilas*, mainly in electronics and apparel, shifted to China, with 218,000 job losses"[77]. It is because of such examples that, according to one UNCTAD report,

> "It is imperative that middle income countries upgrade rapidly from low-skill to more market-dynamic, technology-intensive products with a view to successfully competing with industrialized countries and the first-tier NICs. If not, they risk being squeezed between the bottom and top ends of the markets for manufactured exports"[78].

A UNIDO report uses the example of the Malaysian electronics industry, writing that "it is caught between low-wage rivals that are imitating Malaysia's present production capabilities and higher-performance rivals with superior production and innovation capabilities"[79]. The report suggests, in essence, that Malaysia should 'race to the top': "Raising per capital income depends upon developing higher value-adding production activities"[80]. In South Africa, the desire to 'race to the top' seems to have been adopted at the highest government levels. In a recent *New York Times* article detailing the negative effects of Chinese imports on South Africa's clothing and textiles industry, the deputy minister of South Africa's Department of Trade and Industry is quoted saying: "in an era of ruthless global capitalism, Africa should stop trying to compete with China at what it does best, producing cheap goods for export, and find other ways to compete instead".

Presumably the 'other way' to compete is integration into producer-driven value chains. PDVCs do offer a different competitive environment than BDVCs. Suppliers in PDVCs are engaged in technology-intensive manufacturing and innovation-intensive product development. Take, for example, the automotive industry where "the modern vehicle is designed and manufactured today through the use of advanced manufacturing-and-design systems that match or exceed the technical intensity of those employed in any other industry"[82]. Suppliers within such an industry benefit from both endogenous and exogenous barriers to entry. The tacit-knowledge-dependent nature of auto component manufacturing means that competition is limited on a competency-level basis. Tacit knowledge is, by definition, complex and therefore difficult to codify and disseminate to potential new competitive entrants. Moreover, from an exogenous standpoint, proprietary knowledge is closely guarded in the auto industry, and with recent attempts to expand intellectual property protection in international agreements (TRIPs; WTO) such barriers look only to be getting higher. The tacit-knowledge dependent nature of manufacturing in PDVCs means that suppliers require both access to the advanced technology needed to meet homogenized international product quality standards, as well as the firm-level autonomy to invest in successful assimilation of that technology.

The necessity of developing higher value-added competencies is complicated, however, by the fact that liberalization and fragmentation also effect the competitive environment of middle income countries attempting to 'race to the top'. Trade-related deverticalization has redefined the parameters of competition, opening up the possibility for location advantages being sought not only on the basis of relative comparative advantage but also absolute advantage. It will be argued that the ability of firms to maximize the efficiency of their sourcing from locations which offer absolute productive advantages has eliminated a previous 'niche' comparative advantage that middle income countries held over 'top' income countries prior to fragmented, liberalized trade. The loss of this niche market competitive edge is one potential explanation for why, for example, Geoffrey Garrett argues that "middle income countries have not done nearly as well under globalized markets as either richer or poor countries"[83]. The removal of their natural niche comparative advantage, defined in terms of relative factor endowments, has forced middle income countries to, colloquially speaking, race *all* the way up to the top and compete for technology-intensive product mandates with top income countries that possess productive advantages more complementary to those mandates.

In order to demonstrate how the post-liberal era change in competitive environment has made the transition to higher value-added manufacturing harder for middle income countries, a representative analysis comparing their product mandates pre- and post-liberalization/fragmentation will be made. By highlighting the change in product mandates - changes affected by sourcing decisions on the basis of absolute advantage - it is possible to understand the nature of the disadvantage confronting middle income countries as they attempt to compete internationally with top income countries.

In the pre-liberal era with low capital mobility and high levels of tariff protection, trade in integrated/whole products took place strictly on the basis of relative comparative advantage. In other words, firms would focus their resources on what they did 'most best' in order to minimize their opportunity costs and maximize their productive edge over potential new entrants. Holding a comparative advantage in a particular product mandate meant that "firms could afford to charge lower prices or produce higher quality for any given wage"[84]. In other words, their productivity advantage gave them such a production cost advantage that they could, as a matter of competitive response, either cut prices or use top quality, expensive inputs to produce to the highest industry standards and still operate profitably.

From a nation-state perspective, competition on the basis of relative comparative advantage is the hallmark of the 'flying geese theory', which describes how a mutually beneficial regional division of labor could dynamically develop as Japan gradually "sheds" industries, where it has lost its comparative advantage (industries which were dragging their average productivity down), to less developed countries in the region. "Overtime, these developing countries master the new technology, upgrade their own industrial structures, and themselves begin shedding outdated industries"[85,86].

The reason for a firm to make a competitive readjustment upwards to a new product mandate ('shedding' its old product mandate) would be that it had lost its comparative advantage and needed to move to a point where it was once again maximizing its productive edge. From an analytical perspective, the relative comparative advantage comparison between an incumbent producer and a possible new entrant, that would justify a readjustment upwards by the incumbent, comes from identifying the point at which the two firms are equally competitive in terms of production costs – in other words, the point at which between them "the wage gap just equals the productivity gap"[87]. The incumbent still holds a productivity edge, but the cost of labor is cheaper in the new entrant by the same margin as the productivity gap.

At this point of competitive equalization, the incumbent is better served by moving to a new product mandate more appropriate to its superior level of productivity – in other words, a comparative advantage readjustment upwards to where its average productivity is maximized.

Consider the following representation of a comparison between the comparative advantage of middle income country firms (MICs) to that of 'top' income country firms (TICs) in the pre-liberal era. We begin by assuming that an incumbent TIC is initially in what shall be called "sector 1" manufacturing the integrated/whole product "medium-high", a designation based on the product's particular level of technological complexity (production of the whole product is integrated; the integrated/whole product has elements of both medium and high levels of technological complexity). Now assume that a MIC potential new entrant into sector 1 has increased its average factor productivity such that it is approaching the point of competitive equalization with the incumbent TIC (where the TIC's productivity advantage over the MIC just equals the MIC's labor cost advantage over the TIC). At this point, the TIC is no longer maximizing its productive edge; rather the drag on its average productivity from using its productive resources in the manufacture of the 'medium' elements of the integrated product has reached such a level that the opportunity costs of producing in sector 1 become untenable. The TIC would be better served to make a comparative advantage readjustment to what shall be called "sector 2", where it can produce "high-high" integrated/whole products. The MIC then moves into sector 1, while the TIC has now maximized its average productivity in sector 2.

However, what should be noted at this point is that, as a function of the integrated nature of production in the pre-liberal era, with the move into sector 2 the TIC is giving up producing the "high" elements of the "medium-high" integrated product in sector 1, even though its productivity edge in the manufacture of these elements is still significant over that of the new MIC entrant. Now consider how this particular scenario changes in the era of fragmentation and liberalization.

With the disintegration of production and increased capital mobility in the post-liberal era, the manufacture of product fragments for sourcing by lead firms is now determined on the basis of absolute advantage, where locations that afford the most cost efficient production are privileged . According to Ronald Jones, "once international mobility in an input is allowed, *absolute advantage* becomes a concept that takes its rightful place alongside *comparative advantage*"[88]. Comparative advantage is still an important determinant from the perspective of minimizing opportunity costs, but where absolute advantage becomes a factor is that it allows TICs to take full advantage of their productivity edge over potential MIC entrants. In other words, unlike in the pre-liberal era, TICs are not in jeopardy of losing "high" technology product mandates because of the integrated nature of production. Of this new competitive environment, Athukorala writes:

"This process permits firms in countries at upper rungs of the growth ladder to remain internationally competitive in some segments of the production process (such as in product/component design, production of skill- and technology intensive components, and various head-quarter functions) even when rising incomes and the related domestic cost pressure begin to erode their competitiveness in integrated production of the whole product at home"[89]

In keeping with our representative example from above, MICs now must compete on the basis of absolute advantage for the production of "high" technology fragments belonging to sector 1 (and sector 2), instead of being able to compete on the basis of comparative advantage for the integrated/whole "medium-high" product. And, as already noted, for "high" product mandates the productivity advantage of TICs over MICs is much greater than their respective wage gap. In the auto sector, what this means is that suppliers in MICs are competing on the basis of absolute productive advantage for the localization of component manufacturing. In other words, if MICs hope to increase their percent local content, they will have to improve their relative productivity in the manufacture of "high" technology component parts (reach point of competitive equalization), or else they will be forced to rely on the importation of these components from competitor locations.

In the post-liberal era, then, MICs have lost their "medium-high" integrated/whole product niche and instead must compete, from a position of competitive disadvantage, with TICs for "high" technology manufacturing. Looking at the situation from a Heckscher-Ohlin perspective, comparative advantage in a particular product mandate is determined on the basis of relative abundant factor endowments, where an abundant factor is presumed relatively cheap such that when productivity improves factor costs stay comparatively flat and there is a better chance of reaching a point of competitive equalization with an incumbent. For middle income countries, however, an assessment of their relative abundant factor endowments wouldn't dictate that they should be competing for the manufacture of "high" product mandates, and yet competition on the basis of absolute advantage in the new post-liberal forces them to do just that.

It is possible to conclude the second section of this chapter, then, by reiterating the general thesis that liberalization and fragmentation have affected both a 'race to the bottom' and a 'race to the top', leaving middle income countries "with an increasingly challenging task of finding ways to 'tech up' and enter the global economy, so as to escape the trap of having to dumb down to compete in standardized manufacturing"[90]. In other words, MICs are in a race to invest to expand their overall factor productivity in high technology-based manufacturing to compete at the top, before they are undercut from the bottom on labor cost terms by China as 'middle-technology' production becomes increasingly standardized. As Lall and Albaladejo argue, with the integration of China into the global economy, "it is clear that only countries able to keep a technological edge over China will benefit"[90]. For middle-income country firms, this will require investing in product tacit knowledge development as integrated suppliers in producer-driven value chains. It is imperative, then, to evaluate the governance structure of PDVCs to assess what effect lead firm decisions have on the autonomy of suppliers to make such investments.

The third and final section of this chapter will focus on the governance structure of global production networks where governance, from a functional perspective, is understood as the exercise of control over inter-firm relationships within a network. It will be argued that network governance can be analyzed using the center-periphery structuralist paradigm discussed in chapter 1; in this way, the inter-firm relations that structure the network are between the lead 'center' and its 'peripheral' suppliers, as well as the inter-firm divisions which exist among the peripheral suppliers themselves.

The justification for using center-periphery structuralism to explain GPN governance comes from the fact that (a) lead firms possess the structural power to exert control over the network and (b) that they base their decisions solely on what is in their own best interests. The decisions of the center have definite consequences for the periphery; it will be argued that the center best benefits from asymmetries in the periphery because, from the perspective of the lead, not all suppliers are 'created equal' in terms of the benefits they confer on the competitive advantage of the lead.

Lead firms exercise control in two distinct areas of governance, first in their decisions regarding supplier sourcing and secondly in their decisions regarding the appropriateness of direct 'parental supervision'. In the first instance, the choice of supplier sourcing has consequences for sustainable rent capture and hence income distribution in the periphery. In terms of lead firm decisions whether to internalize their suppliers ('captive' supply chain) or subcontract to independent suppliers ('modular' supply chain), the consequences for the periphery are in the area of supplier upgrading, specifically with respect to the firm-level autonomy of internalized/captive suppliers to invest in tacit product knowledge development. Both sets of lead firm governance functions will be dealt with, in order, below.

The sourcing decisions of lead firms can be seen to structure the supply base at the *inter-nodal* level of governance, where each node of a supply chain is understood to represent both a separate geographic location and a separate component with a distinct level of technological intensity. In other words, inter-nodal governance decisions can be explained in the context of the appropriate structuring an offshored, vertically-specialized supply chain of constitutive component suppliers to a deverticalized lead firm responsible for final product assembly. As discussed in section one, lead firms seeking to gain a competitive edge in cost-efficient component sourcing will organize their supply chain to take advantage of both Ricardian and Heckscher-Ohlin-based cross-border trade.

To understand what effect lead firm decisions regarding sourcing have on suppliers in the periphery, it helps to see network relations "as being both structural and relational"[91]. Because of the differing technological intensities of the components sourced from each location, quantifiable in terms of relative local manufacturing value-added (mVA), rent capture from the sale of the final product will be uneven across the chain. What Smith *et al.* refer to as the "unequal flows of economic value"[92] is the consequence of rent transfer up the chain to nodes where high endogenous barriers to entry exist, and it is the structure of the supply chain, taken as the inter-nodal division of labor (mVA), which determines the direction of the transfer. Those suppliers at nodes with high barriers to entry, in relation to other suppliers at nodes where barriers to entry are lower, are more likely to sustainably earn an income stream from product sales.

Suppliers which have been internalized by their lead transnational buyers become subject to an additional governance structure and a different set of lead decisions, this time decisions made by the lead at the *intra-nodal* level of governance. At the intra-nodal level, internalized supplier subsidiaries are all manufacturing the same component (same mVA, but from different country locations), hence capture the same rent. However, lead firm decisions, made in the interests of the lead, are responsible for a division of labor among intra-nodal 'sister' subsidiaries as well. As eluded to, unlike at the inter-nodal level of governance, lead firm decisions at the intra-nodal level do not effect rent capture in the periphery, rather the effect is on the opportunity individual sister subsidiaries have to invest in their own firm-level upgrading (tacit product knowledge development). The asymmetry which emerges from the division of labor between sister subsidiaries is the result of the differing level of autonomy each sister is granted by the lead 'parent' to make such investments – this, despite the fact that they all manufacture the exact same component at the same supply chain node.

The precise nature of, and reason for, the division of labor among sister supplier subsidiaries is the subject of Chapter 3, however, the rest of this chapter is dedicated to explaining when a lead firm decides to internalize its suppliers and when it doesn't. Subcontracted, independent suppliers are not subject to intra-nodal governance, rather intra-nodal governance is strictly a function of parental/hierarchical lead firm control over its 'captive' or internalized subsidiaries. Therefore, it is important to understand what factors influence lead firms to decide that supplier internalization is in their best interests, and what factors influence lead firms to decide that having a competitive or 'modular' supply chain of independent suppliers is in their best interest. To internalize, or not to internalize, that is the question!

Whether the lead decides on a hierarchical or a modular governance structure is a function of two key determinants, the independence of component functionality and the ownership of proprietary design innovations. The link between these determinants and the governance structure chosen by the lead is best understood if each of the two determinants is viewed in terms of whether either function as "constraints"[93] preventing the lead firm from being able to take advantage of *independent* sources of innovation. In other words, having an open, modular, competitive supply chain of independent suppliers is the optimum governance structure because it allows lead firms to tap into design solutions originating from the periphery. However, there are two possible 'constraints' which would force the lead to have to opt for the sub-optimum solution, that being a hierarchical governance structure. According to Kitschelt, "industrial sectors...efficiently operate only if governance structures match technological constraints"[94]. It is important to note, once again, that with each particular governance structure comes specific attendant consequences for peripheral suppliers. We will begin by addressing the optimal situation first, that of a modular supply chain.

If components are independently functional and if peripheral suppliers are the source of proprietary design solutions, then lead firms will opt for a modular governance structure. Both of these key determinants are maybe best understood in relation to each other, in that when components are independently functional, there are no 'constraints' in terms of transaction costs preventing lead firms from being able to take advantage of outside sources of innovation[95].

When components are independently functional, it is possible to establish industry dominant standard interfaces to coordinate component supply from independent sources. At the component level, functional independence implies a "one-to-one mapping of functional elements onto physical components"[96] and "specifies decoupled interfaces between components"[97]. The purpose of codifying standard interfaces is to ensure not only efficient final assembly but more importantly to ensure interoperability between individual components, such that even if they were sourced from independent suppliers that were each constantly altering their component designs, upon final assembly all the components would function together. Interoperability is specifically understood as the "ability of components of a system to communicate with each other using standard interfaces and protocols while operating in a common environment. The scope of the interoperability is at the system level, not just at the component level"[98].

The important qualification to note is that, it is only when components are independently functional that it is possible for dominant industry standards to be set and disseminated to suppliers. This is because independent functionality means that design innovation at the component level has no effect on interoperability. That is, a design alteration in one component as a result of innovation does not affect that components' interoperability with other components. Moreover, the other components are independently functional, so a design change in another component does not alter their particular function.

When components function independently, and as such are not affected by innovation-induced design alterations in other components, standard interfaces can be established that link components together. The interfaces can be standardized because an interface that links independently functional components does not alter the function of either of the components. This means that it is possible to standardize that interface to ensure efficient final assembly, but more importantly, because the interface is standardized it does not change with component design changes. Interfaces affect interoperability only, they are not part of any one components' specific design or function. Standard interfaces allow for interoperability by the very fact that they exist as industry-wide standards which suppliers conform to, but standardization would not be possible without functional independence at the component level.

When components are functionally independent, standard interfaces can be agreed upon which make it possible for lead firms to take advantage of exogenous, supplier-generated innovations. With interoperability ensured because of the standard interfaces, lead firm final assemblers are not restricted from a transactions cost perspective; in other words, the presence of the standard interfaces allows for 'arms-length' coordination of supply. This means that lead firms can take full advantage of a competitive supply base and any new component design innovations generated within. As Langlois and Robertson state, "a network with a standard of compatibility promotes autonomous innovation, that is, innovation requiring little coordination among stages"[99]. Such networks are called 'modular', taken from the classic definition of modularization as "the building of a product from small subsystems that can be *designed independently*, yet function together as a whole"[100].

Interestingly, it does not matter, from the standpoint of the feasibility of organizing a modular governance structure, if it is lead firm buyers or independent suppliers that establish the dominant industry standards. Regardless of whether it is a buyer or a supplier that sets the standards, it is in the interest of both to mutually agree upon the same parameters to ensure interoperability; buyers because it allows them to take advantage of outside sources of innovation and suppliers because they benefit from having their proprietary design solutions used in the final marketed products.

The Asian electronics supply network of U.S. lead buyers is one example of where the lead firm sets the dominant industry standards that independent suppliers conform their design solutions to (to ensure interoperability). According to Michael Borrus, as opposed to the captive network of Japanese buyers, U.S. buyers "rely on an open, competitive supply architecture" where suppliers contribute "significant value-added"[101]. U.S. lead firms "specialize in especially 'soft' competencies (definition, architecture, design – standards areas) and Asian firms specialize in hard competencies (components, manufacturing stages and design/development thereof)"[102]. Borrus states that "the U.S. networks could be highly decentralized because control over standards enabled devolution of responsibility for significant value-added to partners without fear of losing the ability to orchestrate the network"[103].

However, the personal computer (PC) sector is an example of where it is still possible to have a 'decentralized' network and 'devolution' of design solutions to suppliers, even though the lead buyer does not set industry standards. In the PC sector, it is by and large suppliers that set the dominant standards that ensure system interoperability – standards that lead buyers accept because, as in the Borrus example from above, it allows them to benefit from independent sources of innovation.

From the lead buyers' perspective, however, if powerful suppliers are setting the dominant standards, it is in the buyers' interest that those standards be shared with both complementary and competitor suppliers to preserve the competitive nature of the supply base. For example, Rosenau and Singh write that "All IBM-compatible PC manufacturers buy Intel-designed microprocessors or clones of Intel microprocessors to build machines that run DOS/Windows operating systems"[104,105]. It is in the interest of both PC assemblers and of Intel and Microsoft that Intel and Microsoft license the interoperability standards they control to suppliers that design complementary PC components. For Intel and Microsoft, licensing their standards is a way of ensuring that all new innovations in complementary components will be interoperable with their own proprietary designs, and thus it serves to actually not only solidify the market share of their designs but also propagates their interoperability parameters as the dominant industry standards to follow. However, suppliers that achieve positions of market power, as Microsoft and Intel have, are often reluctant to license interoperability standards to competitors, competitors who could one day not only compete for design solutions with Microsoft and Intel, but compete with them over who sets the interoperability standards that the rest of the industry must comply with.[106,107]

It is in the strategic interest of lead firms to organize open, competitive supply chains to maximize their access to independent sources of innovation, however, a modular governance structure also has consequences for peripheral suppliers. Because of the very nature of an open system, made possible by standard interfaces that allow for arms-length supplier coordination, lead buyers in their sourcing decisions will tend to "favor established subcontractors who are possessed of autonomous technological capabilities, massive production scale, and regional or global production presence"[108]. Only suppliers capable of offering design solutions most favored by lead buyers will benefit. Greg Felker contends that an open network structure reflects lead firms' "greater willingness to tap into *pre-existing* clusters of manufacturing and technological expertise, while simultaneously reflecting their *reduced* commitment to developing *new* capabilities and linkages in their traditional production locations"[109]. In other words, in modular supply chains a division of labor favoring 'existing assets' will emerge. As an example, Felker uses the Southeast Asian electronics network:

"Systemic globalization may enhance Singapore's efforts to shift its economy into innovation-driven producer services and R&D, while diminishing the chances of lower-tier economies like Thailand and the Philippines to augment their manufacturing roles with co-located design and development capabilities"[110].

If a modular supply chain represents the optimum governance structure from the perspective of lead firms, a hierarchical governance structure, where the lead firm internalizes its suppliers, is the sub-optimum alternative. The modular supply structure was optimum because it allowed lead firms to maximize their access to independent sources of innovation. For lead firms to make the decision to internalize their suppliers, it would have to be because they are in some way 'constrained' from being able to take proper advantage of the benefits of a competitive supply base.

Two possible constraints exist which force lead firms to opt for a captive supply relationship, (1) where lead firms need to protect *their* proprietary solutions, and (2) when components are functionally *interdependent* rather then independent and therefore lead firms are prevented, on a transactions costs basis, from sourcing design solutions in the 'open' market. Both cases will be dealt with, in order, below.

In industrial sectors where component suppliers are not the primary source of proprietary design solutions but rather lead assembler firms are, lead firms will internalize their suppliers to protect against the loss of innovation rent. When subcontracted suppliers are engaged in standardized, automated manufacturing, then only explicit forms of knowledge are being exchanged between lead designers and their subcontracted suppliers. However, when what is being produced is more technologically complex and manufacturing is tacit knowledge-dependent, lead designers will necessarily be sharing with their suppliers more of their "core", proprietary assets. According to Gereffi *et al.*, "closer collaboration in the realm of product design requires contractors to receive fully blown computer-aided-design files for their customer's new products; files that can contain core intellectual property"[111]. The authors give the example of circuit board assembly technology, which used to be subcontracted to suppliers using "standardized protocols", but with the innovation of new "optical components, the hand-off of design specifications is becoming more complex and less standardized". As a result, in that particular sector Gereffi *et* al. predict that lead firms will move away from a modular governance structure out of concern for "intellectual property leakage"[112].

We have dealt with the governance implications in industrial sectors where components are independently functional, but now consider the alternative, where components are *not* independently functional. If components are part of larger functional units, then the 'natural' interfaces that each constitutive component in the larger unit shares with other components in that unit are, in fact, 'functional' interfaces or 'coupled interfaces'. The interfaces transmit functional operations that link the components together, and to the larger functional unit as a whole. In other words, the interfaces are essential to the function of the larger unit. Innovation at the component level will alter the functional interfaces which link components together and therefore affect the function of the unit as a whole. A design alteration in one component *does* alter the integrally-related functional characteristics of other components and hence of the unit as a whole[113]. Because the interfaces which link functionally interdependent components are 'functional' interfaces, they cannot be standardized. Interoperability of the whole functional unit requires that they remain as they are, in their 'natural' or 'functional' state, as it were. What this means, ultimately, is that to both benefit from technological progress (design innovation) and to ensure that the whole/larger unit continues to function post-innovation, innovation among the constitutive components must be coordinated so as to "address the mutual fit of all system components"[114].

As an exercise, consider the alternative to the mutual coordination of design in an industrial sector where components are functionally interdependent. Interfaces are functional not standardized, therefore it is not possible to coordinate new design innovations at 'arms-length'. Each functional interface is specific to the components it 'couples' and to the larger functional unit that those coupled components belong to. If supply of such components was subcontracted to take advantage of exogenously-generated innovation, and the choice of suppliers determined on the 'open', competitive market, than with every new design solution independently arrived at in the supply base, each functional interface would have to be re-programmed on an individual supplier basis to ensure the continued interoperability of the larger functional unit. The lead assembler firm responsible for coordination of the entire functional unit, from an inter-firm transactions cost perspective, would be overwhelmed. According to Araujo, "coordination tasks implicit in specific product designs largely determine the feasible organizational designs for developing and producing those products". When components are functionally interdependent, the lack of standard interfaces constrains the ability of the lead firm to take advantage of independent sources of innovation. Instead, they are limited in the number of suppliers they can effectively coordinate. As a matter of a default option then, if you will, lead assembler firms in such situations will chose to internalize their suppliers. If they cannot benefit from the advantages of competitive supply, then internalization at least affords them the one added benefit of being able to protect their proprietary design solutions, as discussed earlier in point (1).

In the automotive industry, modularity exists at the subassembly level, not at the component level. In other words, auto components are not independently functional. It is only possible to codify standard interfaces between separate subassemblies, not between the constitutive components of individual subassemblies. According to Gary Herrigel, at the component level in the auto industry, the lack of a one-to-to mapping of functional elements to physical components "renders their separate design almost impossible without sacrificing performance"[116]. Moreover, it isn't just that the functional elements between auto components are specific to their particular subassembly, but there is model to model variation between subassemblies. Compared to more modular industries like electronics, Frigant and Talbot point out that in automotives "the identity between component and function is weaker and the interfaces unstable and reworked from one model to another"[117]. It can be said then, that there are actually two dimensions of asset specificity preventing the codification of standard interfaces within automotive subassemblies, first between functionally coupled constitutive components and secondly between one model to another for the same functional subassembly. Because of the high asset specificity in the auto industry, and as it is in their interest to protect their 'black box' proprietary design solutions, tier 1 complete module/subassembly lead firms choose to internalize their tier II component suppliers. Because subassemblies are functionally whole, standard interfaces can be codified between them, which explains why OEMs source their tier 1 subassemblies on a competitive basis. However, at the subassembly level, component suppliers are 'captive' to their tier 1 buyers. This means that individual tier II component suppliers in the periphery, if they hope to increase their relative firm-level productivity to better compete internationally on the basis of absolute advantage, will have to 'catch up' under the parental supervision of their tier 1 lead buyers.

The intranodal governance structure between integrated 'sister' subsidiaries is the subject of chapter 3. As shall be discussed, integration not only benefits tier 1 lead firms from the perspective of being able to protect their proprietary assets, but it also allows them to rationalize the R&D expenditures of sister subsidiaries, favoring once again 'established' or 'existing', technologically advanced supplier firms. As a result, lead firms organize an intranodal division of labor between sister subsidiaries, to the benefit of tier II follow source 'majors', but to the detriment of follow source 'minors'. Unlike the division of labor between independent suppliers in a modular supply chain where firm-level autonomy allows suppliers to make the necessary investments to upgrade, it will be argued that the intranodal division of labor is more hierarchical.

CHAPTER 3:

THE INCREASED STRUCTURAL POWER TO FORCE INTERNALIZATION

The first thesis chapter described two successful catch-up models of firm-level coupling, while the second thesis chapter described the new, liberal era catch-up environment within global production networks (GPNs). This final chapter will look to answer exactly how the new catch-up environment alters the efficacy of the catch-up models, specifically as it applies to the automotive supplier industry. To make this judgment, the sources of power in the new catch-up environment will be elucidated to determine their effect on the opportunity for successful coupling in the periphery.

In chapter two it was argued that because of the integral nature of complete module design, and because of the desire of tier 1 lead firms to protect their proprietary technology, lead firms *favor* the integration of their tier 2 suppliers within captive, 'parentally supervised' supply chains. This final chapter will provide an accounting of the *power* of tier 1 firms to not only force the integration of tier 2 suppliers but to also force their integration on terms that strictly serve 'parental' interests.

What distinguishes the GPN 'phase' of dependent development from the 'monopoly capitalism' phase originally described by Cardoso is that transnationals in the GPN phase have even greater bargaining power over the terms of the dependent exchange with the periphery. This is because, apart from the monopoly power to limit access to technology needed to autocratically industrialize, TNC lead firms in the GPN phase have increased *network-associated* structural power to actually limit development 'space' in the periphery for suppliers to seek alternative development options independent of a relationship with the center. In other words, it is not simply that a relationship with the center is the *best* way to industrialize, it is that it is the *only* way to industrialize, because in the 'race to the top' era technology-intensive manufacturing means producing to homogenized international product quality standards (IQSs). Specific to the auto components captive PDVC (cPDVC), lead firms have the structural power to deny suppliers in the periphery access to both advanced proprietary technology and local transnational OEM assembler clients, meaning that they not simply control the prospects for the 'progress of productive forces' in the periphery, but they control actual industry viability in peripheral countries hoping to develop a successful export-driven automotive industry.

The structural power to 'deny' translates into greater power for tier 1 leads to control the terms of the dependent exchange with tier 2 component suppliers in the periphery. Specifically, the conditionality of political and social compliance is loosened with TNC investment in the periphery because the 'internalization' of center interests that accompanies foreign investment is now viability-based rather than compatibilities-based. In other words, rather than a mutual (compatible) set of interests between center and periphery conditioning investment, transnationals have greater structural power to make their local investments conform to network-level competitive interests, irrespective of the effects on supplier subsidiary 'progress' in the periphery.

It is important to understand the different set of interests involved in foreign transnational investment to understand the consequences of the increased bargaining power of tier 1 leads in component supply chains. Peripheral tier 2 supply base interests are in local firm-level 'progress', which can be defined as the autonomy to make the necessary R&D investments in absorptive capacity (AC) development needed for successful technology transfer of advanced IQSs (from 'parent' tier 1). In contrast, tier 1 lead firm interests lie in the organization of overall network competitive advantage, specifically offshoring advantage maximization, requiring the sourcing of 'major' volume component parts from the network's most efficient tier 2 subsidiaries to supply import-dependent OEM assembly locations. Tier 1 leads, then, must organize an efficient sourcing arrangement at *each* node, from among 'sister' subsidiaries manufacturing the *same* component part, but from different country locations. The terms of the dependent exchange is what controls which set of interests is served -- center or periphery or both.

In the GPN phase of dependent development, tier 2 supplier viability is exchanged for mandate assignment autonomy. In other words, tier 2 supplier integration as a network subsidiary, and access to advanced proprietary technology and OEM clients, is exchanged for tier 1 control of subsidiary mandate assignment upon integration (volume, technical and R&D resource mandates). Given that subsidiary mandate assignment is what controls subsidiary learning (AC development), the dependent exchange has the effect of making subsidiary 'progress' contingent on its compatibility with center interests. In other words, lead firms assign to subsidiaries mandates which serve network-level interests, which as will be argued below, require organizing a division of labor (re: division in mandate assignments) at the intranodal level between sister subsidiaries to maximize network offshoring advantages.

Given the above, it can be stated, then, that GPN organization is more than simply the product of technical advances in trade liberalization and product fragmentation, but that network organization is the deliberate construction of lead firms. Originally applied to the characterization of modular supply chains by Felker, the favoring of 'established' producers by lead firms is also found to characterize the division of labor within captive supply chains -- but now understood within the context of a deliberate construction to advance network interests with potentially negative consequences for supplier upgrading locally in the periphery.

John Dunning's 'OLI eclectic paradigm' will be used to analyze lead firm power and motivations within the captive value chains they organize. Dunning's particular modeling of multinational behavior is especially applicable to captive value chains organized by tier 1, globally-active, lead firms because Dunning's assumptions regarding multinational behavior are specific to situations where the multinational is able to exert monopoly power over its' "O" or ownership advantages. As described in Chapter 2, lead firms that organize captive value chains are sensitive to the possibility of proprietary technology (an "O" advantage) leakage to rival multinationals, which is why they prefer 'captive' suppliers. Dunning's OLI paradigm ascribes the power to force subsidiary integration to particular market conditions under which multinationals have the market power to protect their firm-specific "O" competitive advantages. I will apply this understanding to the international market and to the center-periphery bargaining conditions within PDVCs. Within such value chains, then, this market power is best understood as the structural power of lead firms over their international network of suppliers, with the source of that power being the actual network structure deliberately organized by the lead.

According to Dunning, when the market for a multinational's O-advantages (ie. proprietary technology) is imperfect, the multinational has the monopoly power to internalize its' O-advantages and exploit the gains from internalization – what Dunning calls "I-advantages". Under such imperfect market situations, then, when multinationals are able to protect the competitive advantages responsible for their market share, they will choose to serve new markets ("L" locations) by establishing foreign-owned subsidiaries (FOSs) rather than licensing their proprietary technology ("O" advantages; market competitive advantages) to host country firms. It will be argued in the first section of this final chapter that the GPN structure is an imperfect market for lead firm O-advantages, with the result that independent suppliers in the periphery have less leverage to be licensed multinational proprietary technology, rather they instead face an 'integration or exclusion ultimatum' from tier 1's consistent with the eclectic paradigm's modeling of the (imperfect) market conditions under which multinationals have the monopoly power to establish FOSs. The threat of 'exclusion' is why peripheral suppliers are forced to accept network integration on terms that only guarantee subsidiary viability, rather than a guarantee of 'progress'. As a network of integrated FOSs, captive supply chains can now be understood in the context of lead firms' increased market-associated 'structural' power to exert monopoly power over the possession of their proprietary technology to take advantage of network-associated internalization (I)-advantages.

In addition to being motivated to exploit the gains from monopoly rent associated with the network internalization of proprietary technology within FOSs, lead firms are also motivated to exploit gains from the coordination of their integrated FOSs that serve to maximize the network's competitive advantage. It will be argued in the second section of this chapter that because of GPN structure, lead firms have the monopoly power to pursue offshoring advantages, or more specifically, 'complementation-based' offshoring advantages specific to parentally supervised captive supply chains. Exploiting GPN-associated offshoring advantages requires that, at the intranodal level between sister subsidiaries manufacturing the *same* component part (but from different country locations, ie. differing local labor productivities), the sister subsidiary closest to the technology frontier (the most 'productive assimilator' sister FOS) be given a 'follow source *major*' volume mandate where it will be responsible for supplying the largest share of the particular component to the tier 1 parent. By utilizing the most efficient component manufacturer (at the intra-nodal level) as its major volume supplier, the tier 1 lead firm is able to maximize its' competitive advantage. To ensure the sustainability of this advantage, it is in the lead's best interest that its follow source major FOS keep pace with product technology advances at the frontier. It will be argued that lead firms assign *complementary* volume and technical mandates, where major volume producers are given technical mandates (new process solutions, new product design) commensurate with their relatively advanced capabilities (closeness to the technology frontier ie. 'established producer'). Lead firms impose complementation by rationalizing R&D expenditures *up* to their 'most productive assimilators', thereby ensuring that they are able to sustainably invest in the 'active learning' needed to execute their more advanced technical mandates. In other words, post-integration, follow source major FOSs are given larger R&D mandates at the expense of follow source minor volume producers, which are given smaller R&D expenditure mandates commensurate with their greater distance from the technology frontier and *relatively* less demanding technical mandates (no product design responsibilities). It is argued, then, that because of GPN structure, the lead firm's greater monopoly power to pursue complementation-based offshoring internalization advantages comes *at the expense of follow source minor FOSs* that have less leverage to resist a parentally imposed division of labor in mandate assignments that leaves them with less R&D to invest in sustainable productive assimilation or coupling. In the GPN phase of dependent development, then, follow source major firm-level 'progress' is compatible with 'center' interests, but follow source minors experience 'incompatible' dependent development. In other words, 'center' interests are served by a division of labor that results in follow source minor immiserizing learning, defined as a diminishing absorptive capacity overtime (relative to follow source majors).

That independent supplier firms in the periphery have less bargaining power - both to resist integration and less bargaining power to resist the terms (ie. mandate assignment) of their network integration as FOSs - has implications for the efficacy of the catch-up models described in chapter 1. The infant-industry protection model associated with the successful development of Korean firms, while based primarily on indigenous R&D investment, assumed the necessary developmental 'space' to benefit from access to technically graduated (re: mature technology) foreign licenses over time. The FDI-led development model associated with TNC investment in Brazil, while based on easy access to advanced 'parental' proprietary technology, assumed the autonomy to couple technology transfer with investments in firm-level learning. Both of these assumptions are called into question in this final chapter.

This first section of the chapter will begin with an introduction to Dunning's 'OLI eclectic paradigm' and its applicability to the analysis of lead firm power and motivations in GPNs. The specific nature of the imperfect market qualification in the eclectic paradigm, as applied to GPNs, will be argued to be an imperfect market for lead firm advanced proprietary technology at the *international market level*. As a result, internalization advantages should be evaluated at the network level, with the advantages, then, attributable to the establishment of an entire FOS network. The specific nature of network-based market structure is responsible for both lead firm monopoly power, the greater incentive for lead firms to pursue internalization advantages, and is the reason for why independent supplier firms' previous forms of leverage over multinationals are less effective in the GPN era. The new advantages of lead firms in their bargaining relationships with independent supplier firms in the periphery is argued to negatively effect the efficacy of the infant-industry protection model when applied to the liberal era of network-based production.

According to John Dunning, the OLI paradigm is "best regarded as a framework for analyzing the determinants of international production rather than as a predictive theory of the MNE *qua* MNE"[1]. It essentially describes the conditions under which a multinational decides to serve a particular market through the establishment of a foreign-owned subsidiary (FOS). It is an 'eclectic' paradigm because, as Dunning states:

"its analytical foundation rests on three sets of economic theory, viz the theory of industrial organization (including market structure), which seeks to explain *how it is* *possible* for one group of firms to acquire and sustain a competitive advantage (or set of advantages) relative to another group of firms; the theory of the firm, which aims to explain the organizational mode by which firms create, augment or use these advantages; and the theory of location which explains *where* firms choose to locate their value-adding activities"[2].

The framework "posits that multinational activities are driven by three sets of advantages, namely ownership (O), location (L), and internalization (I) advantages" and that it is "the particular configuration of these sets of advantages that either encourages or discourages a firm from undertaking foreign activities and becoming an MNE"[3].

Ownership advantages come from the proprietary ownership of firm-specific assets (ie. advanced technology) in a competitive market. According to Tolentino, "asset ownership advantages are both competitive advantages and monopolistic advantages"[4]. More specifically, multinationals will only establish affiliates in foreign markets if, in those markets, they are able to *monopolistically exploit their ownership advantages* to their competitive advantage over host country firms. In other words, if there are competitive gains from the internalization of their ownership advantages (I-advantages), and if it is *possible to exploit such I-advantages* in a foreign market, than they will decide to serve that market through foreign direct investment (where the multinational's O-advantage is 'internalized' in a FOS, as opposed to if the multinational licensed its O-advantage to an independent firm in the host country as its chosen means of serving that foreign market). That there are competitive gains from O-advantage internalization is the reason why a multinational would rather *not* license its O-advantage to host country firms, but as stated above, only if the multinational can monopolistically/competitively exploit the possession of its O-advantages will it be able to avoid such an option.

The key determinant of a multinationals' ability to monopolistically exploit its O-advantages is operating in an *imperfect market for the O-advantage.* The eclectic paradigm borrows heavily from industrial organization theory in the specific characterization of multinationals by their "ownership of specific assets unique to that firm that can be transferred relatively costlessly within the firm, but cannot easily be acquired by other firms because the markets for the assets are either imperfect or non-existent"[5]. Stephen Hymer, in his 'market failure approach', was the first to associate foreign direct investment with the presence of imperfect markets. For Hymer, under conditions of market failure, multinationals could protect what he called their 'special advantages' to overcome the otherwise competitive disadvantage they faced from operating in foreign markets, compared to indigenous firms in those markets[6]. Market failure allows multinationals to protect their O-advantages because it enables them to "exercise monopoly power or market power in final product markets"[7].

As a point of clarification, a functional definition of an imperfect market would be any market where independent firms lack the competitive leverage or bargaining power to be licensed the O-advantage of a multinational vying to serve the same clients as the independents. One such example of an imperfect market would be a market where, if a multinational were to invest (new 'greenfield' investment), its foreign affiliate would have a technological edge over indigenous/independent firms to such an extent that the multinational could assume no future competitive threats from the indigenous firms in the market (ie. its market share would be reliably high) and therefore would find no reason to make the decision to service the market by subcontracting (licensing) to local firms when it could instead earn monopoly rent as a FOS. Under such circumstances, indigenous firms may submit to being taken over by the multinational ('brownfield' investment) rather than go out of business. Alternately, competitive markets are markets where independent firms have the necessary bargaining power to extract a foreign license because they possess a threshold level of comparable technological competence to potential investing foreign affiliates such that a multinational makes the decision to subcontract, because were it to service the market as a FOS, it could find its market share competed away in the future as comparably efficient indigenous firms successfully competed for the same clients as its FOS.

Multinationals favor foreign direct investment when there exist returns to serving a market through a FOS. Internalization advantages refer to the competitive gains from the monopolistic exploitation of O-advantages. The most obvious return to a multinational from investing in a host country as a FOS (with the assumption of operating under imperfect market conditions), rather than licensing its O-advantage to an indigenous firm in that market, is that the multinational is able to then "appropriate a full return on its ownership of distinctive assets"[8] – in other words, earn monopoly rent. However, Dunning distinguishes a second I-advantage, which he identifies as those advantages to the multinational gained from the coordination of its FOSs (post-brownfield investment/takeover), or as he has put it, "gains…that arise from coordinating existing assets with new assets"[9]. Dunning identified this second I-advantage based on an understanding of FOSs (network of FOSs) as a source of competitive advantage (CA) for multinationals, and as such their most effective coordination as an opportunity for a multinational to maximize its CA. Dunning's conception of coordination advantages is consistent with Manolopoulos' *et als*. "view that technology in MNEs is no longer simply the responsibility of the corporate center. The parent seems to have been transformed from a 'technology creator' to a 'technology organizer' in global operations"[10].

The OLI eclectic paradigm is a useful framework through which to analyze the power and motivations of lead firms within GPNs because the GPN structure is an imperfect market for lead firm O-advantages. However, the definition of 'imperfect market' changes within GPNs in that the imperfect market is now at the level of the *international market* rather than within any one particular host country market. Put another way, functionally the GPN market is imperfect because independent firms that would use a license to manufacture products for export would in fact be denied access to that license by lead firms wanting to protect the established international market share already controlled by the network. Even independent firms with relatively comparable levels of technical capabilities as a potential multinational subsidiary operating in a host market would be denied a license because the multinational/lead firm is not concerned about losing host country market share in the future to the independent, but is rather concerned about losing *international market share* to the independent if it exports.

The fact that even technically advanced independent firms lack the necessary competitive leverage to bargain for a license indicates how even 'more' 'imperfect' a market the GPN structure is compared to the pre-liberal competitive environment (ie.

are fewer competitive markets for O-advantages in GPN era). It also indicates that the nature of the power of the lead extends beyond its possession of superior/advanced technology relative to independent firms, but that the lead firm is able to exert a new form of structural power as a function of its control of the network organization. The lead uses that enhanced structural power to monopolistically exploit the returns to internalizing its superior technology within a network of FOSs – namely, the protection of its international market share.

The second internalization advantage associated with GPN structure motivating lead firm activity is the opportunity to exploit trade-related offshoring advantages or advantages gained from coordinating the export volumes of its network constituent FOSs. In the case of captive value chains such as the automotive GPN, lead firms exert parental supervision over not only volume but also technical and R&D expenditure mandates to exploit complementation-based offshoring advantages to ensure a sustainable maximization of the network's competitive advantage. It can be argued, then, that in the GPN era, the returns to FOS coordination-associated internalization are even greater. For example, according to Miozzo, "with the creation of trade blocs like Mercusor, TNCs are in a more privileged position, more easily able to reorganize subsidiaries in a new integrated market"[11].

Given the existence of internalization advantages, the imperfect GPN market structure can be looked upon as a deliberate, endogenously-arrived at construction to empower lead firms to pursue their interests with less resistance from competing interests in the periphery. Tolentino regards multinationals as "active agents" in the "creation of endogenous structural imperfections in final product markets"[12].

As alluded to, the exploitation of internalization advantages involves two separate but related bargaining relationships between lead firms and peripheral suppliers. In the first bargaining relationship, lead firms are bargaining with independent suppliers over the licensing of lead firm O-advantages. The independent suppliers are bargaining to export products manufactured with licensed (advanced) technology while the lead firms are bargaining to protect their international market share by forcing the independent firms to integrate as network subsidiaries. The second bargaining relationship is between parental lead firms and their newly integrated FOSs (post-brownfield investment) over mandate assignments. The integrated supplier subsidiaries are bargaining for mandate autonomy while the lead firms are bargaining to impose intranodal mandate complementation to maximize network offshoring advantages. It is argued below that lead firms within GPNs have the structural power to both force the integration of independent peripheral suppliers and to control the terms of integration (terms of dependent exchange) to strictly serve lead firm interests (I-advantages), irrespective of the consequences to integrated FOS upgrading. In other words, with less development space in the periphery, social/political compliance is forced on a 'viability' basis, rather than equitably bargained for on a 'progress' basis. The remainder of the first section of the chapter will deal with the first bargaining relationship, while section two will detail the second bargaining relationship.

Independent suppliers in the periphery, using the example of the auto industry, are bargaining to be licensed the *technically advanced frontier* technology of tier 1 lead firms responsible for the competitive success of network subsidiaries in other markets. The nature of the technology is key in that being licensed mature technology will not help independent suppliers win contracts to supply OEMs, either in their home markets or from potential international OEM clients. Taking from one example, Barnes and Lorentzen point out that the demands on local supplier firms in Mexico supplying foreign OEMs have increased substantially because, while in the past they may have been manufacturing parts for a "substandard" older model Beetle "mainly aimed at the domestic market, the new Beetle is primarily exported and must meet the same standards of quality and delivery as its model cousins manufactured in one of VW's European plants"[13]. Similarly Sadowski explains that when foreign OEMs began investing in Poland in the late 1990s, "this led to a situation where locally owned component manufactures had the choice of being taken over by global automotive suppliers or facing declining markets as car manufactures gradually started to phase out outmoded car models"[14]. As described in chapter 1, even the derivative models manufactured in Brazil are based on global platforms and are updated with greater frequency given the increase in import competition in the Brazilian market.

That independent suppliers are bargaining for advanced frontier technology is complicated by the fact that in the market liberalized GPN era, host countries in the periphery have less leverage to bargain with market access stipulations as compared to the past given the "erosion of the kind of L-advantages associated with potential trade and investment regimes"[15]. In other words, multinationals are no longer obligated to license technology to indigenous host country firms as their only means of serving a particular market. Multinationals now have the option of protecting their proprietary technology and instead supplying a market with imports or, given sufficient local factor endowments, a greenfield investment.

As discussed in chapter 1, Hyundai of Korea developed its first model using licensed technology in a protected domestic market environment. Today, with increased import competition, there are fewer host markets where the Hyundai Pony could be successfully sold. As an example, consider the state owned Malaysian auto manufacturer Proton. Proton has rejected any equity tie-ups with foreign OEMs which would result in the loss of its majority-ownership status. For example, in 2006 Proton rejected a much needed technology-sharing partnership with VW because reportedly Proton "wouldn't cede management control to its prospective partner"[16]. With a history of not having to compete technologically on the basis of product quality because of tax privileges and tariff protection guaranteeing them a dominant market position domestically, Proton has recently suffered mounting losses which can only be expected to get worse when its waiver from AFTA compliance ends in 2008. According to *The Economist,* Proton's "domestic market share has fallen from over 60% to 23% in the past five years after a cut in import tariffs, and the firm appears to be heading for the industry's exit ramp"[17]. In the GPN era, without the leverage to bargain for advanced technology from existing foreign producers like VW, and with increasing import competition from such producers, Proton and its locally-owned suppliers may have no choice but to accept a minority partnership position because, as one local industry analyst has put it, "going forward on its own is not an option"[18](viability-based acceptance).

Only large market countries like China can impose investment restrictions in an otherwise competitive, liberalized global economy and still be able to attract foreign investors relative to other countries without such restrictions. The 'swap market for technology' investment regime of China allows its indigenous domestic firms to gain access to the advanced proprietary technology of foreign manufacturers through joint ventures, but joint ventures in which the Chinese partner maintains a controlling interest. Foreign OEMs and their multinational suppliers who 'follow' (ie. follow sourcing) their clients into the Chinese market agree to invest as minority partners in joint ventures because they want the advantage of having a local presence in the market as the market expands, rather than simply serving the market through imports. In other words, foreign investors are willing to accept the trade-off of losing their O-advantage to gain the advantage of privileged access to what will one day be the largest consumer market in the world.

However, there have already been noticeable negative ramifications for those investors who have bet on this trade-off. For example GM has partnered with the Shanghai Automotive Industry Corporation (SAIC) to serve the Chinese market with, initially at least, GM derivative models. However, SAIC is exploiting the benefits of its technology sharing arrangement with GM to "introduce new vehicles under its own brands". Quoting one industry analyst: "it will be some time before SAIC's own brands are a match for Buick, but through its Chinese partnership GM is 'supplying bullets to the enemy'"[19]. BMW, along with other foreign manufacturers, face a similar problem in the Chinese market in that their JVs are a source of proprietary technology leakage to competitor Chinese firms outside of their particular partnerships. But according to many analysts, "European manufacturers need to accept copying as the price of doing business in China" because "with the web of alliances between Chinese and Western automakers, there are plenty of opportunities for European innovations to turn up in Chinese cars that are then peddled to Europeans"[20].

This danger of potentially 'supplying bullets' to *future international competitors* is precisely why multinationals are otherwise reluctant to part with their proprietary O-advantages – in other words, the Chinese market is the exception, not the rule. As Pack and Saggi write, "the growing Chinese market provides it with a level of bargaining power not enjoyed by other countries"[21] and that the actual general tendency in other markets is one where multinationals opt to invest as stand alone FOSs rather than enter into technology sharing arrangements because they want to "avoid the risk of opportunistic behavior on the part of the licensee"[22]. Mytelka similarly observes that "when a developing country firm is a potential competitor or the technology is close to the frontier, technology transfer through the multinational firm has proven to be elusive"[23].

Considering that there are fewer markets for products based on mature technologies, and that with greater market liberalization and subsequent import competition market access offers less leverage against multinationals, earlier models of 'latecomer' development need to be reassessed to account for the changes in the now global, competitive environment. For example, the applicability of the 'reverse product lifecycle model' - used by Michael Hobday and others to analyze the "incremental process"[24] of successful East Asian development in the past - needs to be questioned given the emerging "conflicting motivations between MNCs and host countries in early stages of the product life cyle"[25] when industry front runners are reluctant to license their "core competitive advantages"[26].

Without the developmental 'space' to make use of mature technology licenses, and without the leverage of protected markets, the efficacy of promoting technological catch-up via indigenous firms would seem to be in question. Previously, host country firms were also able to successfully bargain for licenses based on their comparable levels of in-house technological competence to what would be the greenfield affiliate of a multinational pondering the possibility of achieving success as a foreign investor given the level of domestic market competition they would face from indigenous firms. I will argue below that this previous form of leverage is also not applicable in the current era because the GPN structure of interconnected, export-oriented FOSs is an imperfect market for lead firm O-advantages. The monopoly power that the lead firm in the GPN organization is able to exert over the possession of its advanced proprietary technology is not simply a factor of the technological edge a potential network affiliate might have over competing indigenous firms in a particular host country market. Rather, it is a factor of the structural or market power the lead firm is able to exert in the protection of its international market share. With the expansion of the network structure to include an increasing number of international markets served by its affiliates, indigenous firms hoping to export using licensed technology would be identified by the lead network organizer to be in *direct competition* with established network affiliates already supplying the same export market and as such be denied a license. It can be argued further then that, with each new FOS 'link' in the global value chain, there will be more international markets open to competition such that if indigenous firms were to export, they would find themselves in direct competition with network interests. In other words, as the network expands, the structural power of lead firms will increase, leaving indigenous firms with less leverage to compete with FOSs in either host country markets or internationally. Lead firms use their power to monopolistically exploit their O-advantages by forcing the integration of indigenous firms as FOSs (brownfield takeover).

The endogenous construction of the GPN structure responsible for lead firm monopoly power will be described, using the example of the automotive industry, to explain why there is an increase in lead firm bargaining power as the network expands to serve an increasing number of international markets. The nature of the imperfect market specific to the automotive supply chain is best seen by first understanding the origins of what are now tier 2 supplier networks.

The intention behind investing in various strategic market locations was to create an interconnected network of export oriented subsidiaries such that supplying OEM clients did not require 100% local content in each particular market. Rather, each market could then be served with a certain percentage of imported components from network subsidiaries manufacturing in other markets where the particular factor endowments were most amenable to the production of the particular component being exported from that location. Strategic markets are then defined as those markets from which localized FOSs export significant ('major') production volumes to other markets. Of concern, then, when investing in a particular host country market was not simply producing to meet local market demand alone, but was to expand the geography of potential network suppliers to serve OEM assembly clients on a global basis from multiple country locations. In the initial construction of this network of tier 2 component suppliers, multinationals would not issue foreign licenses to non-affiliated suppliers, instead export-oriented greenfield affiliates would be established in strategic markets even if there existed a significant presence of technically competent indigenous firms competing to supply localized OEM assemblers. As John Humphrey states, "as developing country markets become more strategic, transnational companies prefer to set up their own operations rather than license to local companies"[27]. In other words, the prospects of not *initially* holding a dominant local market position due to indigenous competitors would not deter greenfield investments from being made because the real reason for the strategic establishment of a FOS was, in fact, to further network control of international markets through which the tier 1 lead could ensure the efficient supply of necessary components to OEM assembler clients as the OEMs themselves expanded their global operations. Holding a dominant position in international supply markets simply means that the FOS network has extended into enough markets to where it is able, either through local production or from imports from affiliated network subsidiaries at other nodes, to fulfill the global demand requirements of its OEM customers in any of their markets. Any indigenous firm, were it to be in a position to successfully export on license into an international market domain that the network had already extended to cover, would be directing competing with established network affiliates and necessary, then, be denied the license on the possibility of such 'opportunistic' behavior on its part. As explained below, it was through the gradual expansion and consolidation of international market control that network affiliates were ultimately able to achieve positions of dominance locally in emerging markets.

It was with the expansion of global OEM assembly operations and their growing preference for tier 1-organized tier 2 follow sourcing that the structural power of lead firms increased to where they were able to deny indigenous firms not only proprietary technology but also OEM clients. As OEMs, with their move into new markets, began assembling the same model automobile in multiple locations (ie. VW Beetle in Mexico), they looked to reduce their monitoring costs by sourcing components in these new markets from the same multinational supplier companies (ie. tier 1s) which had serviced their assembly operations in their home markets where the models were first co-designed and manufactured. "This preference for using the same suppliers in many different locations is known as follow sourcing"[28]. The assembler benefits because this way "instead of dealing with a large number of local suppliers whose designs and prototypes have to be homologated, and whose production and quality systems have to be audited and improved, the assembler deals with a limited number of follow sources"[29].

The sourcing arrangements, covering multiple markets, between OEM assemblers and their tier 1 suppliers are agreed upon in global contracts. It is then the tier 1 lead firms' responsibility to assign specific exporting mandates to its globally dispersed network of tier 2 subsidiaries given the specific import-dependence (% local content) of each OEM assembly market stipulated in the contract. It is "through bilateral MNC negotiations"[30] now, with component sourcing being negotiated at the level of lead firms arranging for the global supply of OEM global demand, that tier 2 emerging market country suppliers have been integrated into automotive GPNs. Moreover, given the evolution of OEM demand towards complete module supply, it is possible to see why when it comes to OEM preferences, "the least preferred option is for a local company to produce the part, either under license or using its own design"[31].

The exclusivity of the OEM-tier 1 relationship in global contracts imparts lead firms with the structural power to force the network integration of indigenous supplier firms in the periphery as brownfield FOSs. With global sourcing arrangements, Barnes and Morris write that "new nodal points of control emerge with the lead source MNC component suppliers accorded more leverage by the assemblers"[32]. Because of their privileged relationship with their OEM clients in other markets, lead firms looking to expand network operations can leverage same company foreign OEM operations in emerging markets they target to reject the services of local indigenous firms. As a result of network expansion then, lead firms are found not only to be in a position to deny local indigenous firms advanced proprietary technology to protect their established international market share from direct competition, but they can also deny them the business of local OEM clients, with the intension of leaving the indigenous suppliers no option but to submit to being taken over . By forcing a brownfield-type FOS investment the network is able to guarantee itself a dominant market position locally, in addition to avoiding the higher cost of making a greenfield investment.

To get a clearer picture of the constraints facing indigenous suppliers from the extension of the global supply networks of foreign OEM multinationals into their markets, the example below of local South African suppliers to ToyotaSA is quite representative. When Toyota took a majority stake in its local OEM affiliate in 2002 and announced plans to begin exporting CBUs ('completely built up' models) from

South Africa, the new demands placed on ToyotaSA's local supply base was immediate. Consider the following description of events by Lorentzen *et al.* of what followed Toyota's decision to assume majority ownership:

"The impact of this new strategic orientation was significant for many local Toyota suppliers. Delivery specifications became more onerous and relationships in the supply network had to move to approved systems. The price for non-compliance was the prospect of losing local Toyota business to other global suppliers. Some firms struggled to adjust, while others were willingly or *unwillingly* drawn into becoming local plants of multinational component firms (emphasis added)[33].

The reason why those local suppliers, who were "unwilling" to be integrated, had less leverage to resist being taken over and so nonetheless then had to submit, was because lead firm organizers had the structural power to deny them ToyotaSA's business locally, in addition to withholding technology licenses they needed to "improve product and process standards" to meet Toyota's strict international quality standards for exported CBUs.

Similarly, from an analysis of survey data compiled from interviews with supplier firms operating in Eastern Europe, Lorentzen *et al.* were able to conclude that "affiliation with networks centered around MNCs greatly increases the transfer of change-generating technology. Ownership matters because technology transfer is dependent on the degree of control MNCs exercise over the use of their assets"[35]. In other words, "suppliers outside of these networks are out of the loop – they participate in a different value chain that is localized and that has *no long term viability* (emphasis added)"[36]. The fact that unaffiliated suppliers have very little chance of remaining viable outside of the network structure gives lead firms the leverage to integrate indigenous suppliers, even those otherwise initially "unwilling". That those indigenous suppliers may possess significant technical capabilities is not a significant form of leverage in the bargaining relationship with lead firms, as demonstrated in the survey data from Eastern Europe where network affiliation was the *only* determinant that controlled technology transfer. For example, because Lorentzen *et al.* found that "R&D activity is not a significant condition for receiving technology" they were left to conclude the following: "that domestically owned firms who do not benefit from technology transfer engage in R&D underlines that automotive components is an industry in which relying on one's production capacity only is not a safe strategy"[37]. In other words, in-house R&D is not sufficient to leverage technology transfer-associated coupling if the supplier is outside of the network structure. This highlights the big difference between the GPN phase of dependent development and the East Asian Development model 'phase' of South Korea's catch-up described in Chapter One.

According to Humphrey and Memedovic, indigenous firms have three options: (1) agree to submit to network affiliation if they have been targeted by lead firms hoping to establish a strategic, export-oriented brownfield FOS, (2) resign themselves to manufacturing mature components for outmoded models in the aftermarket, or (3) if they happen to be located in a non-strategic market, they could be granted a license for advanced proprietary technology by lead firms if they agree to confine production to only supplying domestic market OEMs[38]. Lead firms agree to the latter arrangement because, by definition of being a non-strategic market, were they to actually establish a foreign affiliate in the market it would not have a large export volume mandate anyway because the international market for the particular component would already be saturated with exports from FOSs situated in more strategic markets.

Section one above described the GPN-related structural power of lead firms to protect their international market share and capture monopoly rent from the internalization of their O-advantages within a network of brownfield FOSs. The second section of the chapter will look to explain the second internalization advantage associated with GPN structure, that being the advantage to the lead firm from the coordination of its FOSs. Lead firm governance decisions will be modeled to explain the specific motivations driving their pursuit of coordination-related I-advantages. Moreover, the possible consequences to FOS upgrading in the periphery, as a result of lead firm 'parental supervision', will be examined. As Wad argues, "the overall governance of the global value chain or of the specific links of the chain is all important for controlling the opportunities to appropriate added value and upgrading"[39]. Governance decisions in captive value chains, like those that define the automotive supplier industry, extend *within* 'links' or at the *intra-nodal* level between 'sister' subsidiaries manufacturing the same component part, from different country locations, to supply the same parent tier 1 module supplier.

As discussed in section one, tier 2 supplier FOSs are now expected to develop the necessary competencies to manufacture components using advanced technologies for export to international (Triad) markets. In the liberal trade era, then, because FOSs serve as sources of competitive advantage, their effective coordination is a means of maximizing network returns. In recognition of the resources needed to meet the advanced technical mandates now expected of FOSs, Fuchs writes that "headquarters have very intensively decentralized competencies, including R&D", because they understand that "they require high qualifications on the decentralized level in foreign plants"[40]. In fact, "UNCTAD (2005) reports that the developing countries' share of R&D of foreign affiliates rose from 2% in 1996 to 18% in 2002"[41]. Implicit in this recent organizational evolution is that the (selective) 'decentralization of competencies' has to be coordinated by 'headquarters'. For example, Gammeltoft states that "the ability to better manage and coordinate networks of dispersed R&D units has become increasingly important and is developing into a cornerstone in global learning and innovation processes and an important competitive advantage"[42].

As a function of GPN structure, lead firms coordinate the distribution of resources within their network of FOSs with an end towards *sustainably* exploiting trade-related offshoring advantages. In the automotive industry, trade in components between geographically dispersed tier 2 suppliers allows countries which otherwise lack the necessary skill base for high local content manufacturing to nonetheless remain viable assembly locations. Moreover, tier 1 lead firms avoid having to invest in supply base broadening in each such location, instead opting to import a certain percent of components from network FOSs in other countries. Global sourcing arrangements intended to cover multiple import-dependent markets, specified in the types of global contracts described in section one, rely on differently located FOSs and therefore necessarily portend a division between 'major' volume suppliers and 'minor' volumes suppliers of the *same* component part, depending on relative location-specific factor productivities that makes some locations more efficient producers than others. It is in the competitive advantage of the network for the tier 1 lead firm to source the greatest volume (major volume) of a particular component from the network's most efficient FOS manufacturer at each node ('follow source major').

To ensure the *sustainable* supply of major volumes from its' initially most productive tier 2 suppliers, lead firms at the intra-nodal level coordinate *complementary* volume, technical and R&D mandates among 'sister' subsidiaries manufacturing the same component, such that the follow source majors at each node are transferred by mandate the necessary (R&D) resources to invest in understanding product technology at the technology frontier. With every subsequent technical advance, then, lead firms are ensured of follow source majors remaining a reliable source of efficiently produced component parts for the network. It will be argued in this second chapter section that every newly integrated, export-oriented FOS is subject to a cascade of complementary mandate assignments based on its relative distance from the technological frontier, as compared to its other sister subsidiaries – mandate assignments that reflect the lead firms assessment of the FOS's value to the network in terms of volume and potential technological contributions to competitive advantage.

The pursuit of complementation-based offshoring advantages is specific to the lead firms of captive supply chains, as the power to impose mandate assignments is specific to a supervisory-type relationship. As described in section one, lead firms have the structural power to deny independent suppliers both proprietary technology and local OEM clients if they resist network integration. Implicit in this bargaining relationship is the power of lead firms to additionally control the terms of supplier integration, in other words, mandate assignment. For example, in reference to the automotive industry in India, Humphrey's writes that "equity-tie ups are increasingly necessary for Indian companies wanting access to technology and designs that are essential for gaining contracts, but the price for this technology is frequently the ceding of a majority stake to the foreign partner"[43]. The unwillingness of lead firms to accept minority-partner status in joint ventures is an indication of the importance they place in having parental supervisory authority to coordinate export volumes and complementary resource allocation. According to Humphrey, "the more the joint venture is integrated into the global sourcing strategy of the transnational partner (re: the FOS exports), the greater the incentive to increase control"[44]. In other words, tier 1 lead firms are not simply concerned about the appropriation of monopoly rent, but about being able to ensure the appropriate integration of a FOS within the division of labor of mandate assignments that it coordinates between sister subsidiaries at each node.

The structural power of lead firms to control the terms of supplier integration in the pursuit of complementation-based offshoring advantages has consequences for supplier upgrading in the periphery. Because FOSs are unable to control the assignment of their technical mandates or complementary R&D mandates, they lack the governance autonomy to ensure appropriate levels of in-house absorptive capacity for R&D-dependent, technology transfer-associated coupling. Network tier 2 suppliers are instead dependent on tier 1 lead firms' assessment of their value to network competitive advantage, which controls whether they are assigned mandates that bring with them the resources needed to keep apace of product technology at the frontier. It will be argued that FOSs that integrate as follow source *minor* volume suppliers are assigned technical and complementary R&D mandates that potentially deny them, over time, the resources necessary to facilitate the successful coupling required to competitively manufacture technologically upgraded components incorporating embodied product technology innovations from the technology frontier. It will be argued that the assignment of such mandates to follow source minor suppliers is a direct consequence of follow source major suppliers being assigned more demanding technology mandates which are complemented with the necessary resources (R&D mandate) to ensure the 'active learning' needed to carry out those more advanced technology mandates. In other words, the upgrading of follow source majors at each node, coordinated by lead firms in their pursuit to sustainably exploit GPN-related offshoring advantages, comes at the expense of follow source minor upgrading. Supplier firms integrating as follow source minors face what can colloquially be described as a sort of 'catch 22 of catch-up' – either integrate and be potentially denied the resources needed for successful coupling, or refuse to integrate and be denied proprietary technology and OEM clients. Because FDI-led development models don't account for the possibility of peripheral suppliers integrating as follow source minors, they don't acknowledge any negative consequences from losing mandate autonomy when integrating as a multinational's foreign affiliate.

The remainder of this chapter section will detail lead firm governance decisions that create a division of labor in mandate assignments between follow source majors and follow source minors. Mandate or 'charter' assignment in general is based on a 'capabilities approach' where the most capable subsidiary is chosen to perform the most demanding (technical) mandates. By definition, "the charter is typically a shared understanding between the subsidiary and the headquarters regarding the subsidiary's scope of responsibilities"[45], such that that the particulars of an assigned charter "reflect the underlying capabilities of the subsidiary"[46]. Moreover, given an intra-nodal unit of analysis, sister capabilities are assessed relative to each other (relative to tier 2 subsidiaries manufacturing the same component part, but from different countries). For example, according to Andersson *et al.*, "corporate HQ identifies leading-edge subsidiaries…based on internal benchmarking"[47]. Given the implications for firm-level FOS upgrading, "in most corporations there is internal competition for charters"[48] in what Birkinshaw and Hood refer to as an "internal market system"[49] for corporate resources.

As will be described below in greater detail, with the integration of a supplier into the network organization, the lead firm assigns that FOS a technical mandate, followed by complementary volume and R&D mandates. The technical mandate is assigned commensurate with the subsidiaries capabilities, as assessed from its relative distance from the technology frontier as compared to its other sister subsidiaries. Because tier 1 module suppliers are motivated to exploit trade-related offshoring advantages, it is in their competitive interest to assign 'major' volume supplier responsibilities to the sister supplier operating closest to the technology frontier – in other words, the supplier utilizing the most efficient production process. It is argued that the competitive advantage of the network is maximized when the lead firm assigns its subsidiaries volume mandates that correspond to their technical mandates. Implicit in the assignment of technical mandates is the need for the necessary (R&D) resources to execute the competency-based requirements of the particular mandate. It follows then that the selective 'decentralization' of resources should reflect the specific technical demands of each mandate. In other words, the lead firm assigns its subsidiaries R&D mandates that correspond to their technical mandates. Consistent with their pursuit of offshoring advantages, it is argued that the overall effect of the cascade of complementary mandate assignments by lead firms is the sustainable firm-level learning of follow source majors, as they are transferred the necessary R&D resources to fulfill the relatively more demanding competency requirements of their 'advanced' technical mandates. Each mandate assignment decision will be dealt with in order below.

Technical mandates are assigned to integrating subsidiaries based on their initial distance from the technology frontier, relative to other sister subsidiaries manufacturing the same component. Intuitively, subsidiaries should only be given particular technical mandates if they possess the necessary competencies to execute them. Moreover, by assigning the most demanding technical mandates to the most capable sister subsidiaries, the 'capabilities approach' to mandate assignment effectively serves to maximize network competitive advantage.

What Forbes and Wield refer to as 'follower' subsidiaries[50] can be assigned one of two possible generalized technical mandates – either what I will call the 'basic' mandate or the 'advanced' mandate. Follower subsidiaries or 'home base exploiting (HBE)' subsidiaries function as sources of competitive advantage for the network by exploiting the multinationals "existing stock of knowledge"[51] in new markets. Follower subsidiaries are typically found in emerging market countries, as opposed to 'frontier' subsidiaries found in Triad markets[52]. Frontier subsidiaries or 'home base augmenting (HBA)' subsidiaries, instead of simply exploiting existing firm knowledge, are defined as subsidiaries that tap into local innovation networks to create "entirely new products"[53] not in use anywhere else in the industry. Simply put, frontier subsidiaries 'augment' the firms existing stock of knowledge by directing their resources at "blue sky developments"[54] that push out the technology frontier, while follower subsidiaries, by definition, direct their resources at following the technology frontier. This is not to say that follower subsidiaries do not add value to the network, but rather that their innovations are based on technology developed elsewhere ie. at the technology frontier by frontier subsidiaries.

Follower subsidiaries, properly the subject of my discussion, are the recipients of network proprietary technology transfers of product innovations developed at the frontier. To reiterate, depending on their relative distances from the technology frontier, followers are assigned either 'HBE' basic mandates or 'HBE' advanced mandates, with advanced mandates going to those sister subsidiaries initially closest to the frontier.

The 'basic' mandate assigned to a FOS is in many ways a mandate of necessity, as it must be executed or else the subsidiary will be replaced by another supplier at the same node. The basic mandate requires that the FOS keep pace with product technology upgrades, transferred from 'parent' lead firms, in order to meet new, more demanding product quality standards set by OEMs hoping to save on homologation costs by sourcing from tier 1-affiliated suppliers. In other words, it is a mandate that requires "the ability to manufacture more technically demanding products" to meet ever stringent international quality and cost standards (IQS) in exporting. The productive assimilation by followers, of technology developed at the frontier, requires first that the FOS possess the necessary absorptive capacity for successful technology transfer, and then that it be able to adapt local productive factors to cost competitively manufacture the upgraded product. As Forbes and Wield state, the "innovative task" of follower subsidiaries is "one of adapting imported technology to local conditions"[56]. The efficacy of a follower's new process engineering innovations necessarily depends on their understanding of the embodied technology in the 'more technically demanding product' mandate assigned to them. As Fuchs argues, "product and process innovations are interrelated – new products need new processes"[57]. As described in chapter one, it is because productive assimilation is 'gap-dependent' that a follower subsidiary's distance from the technology frontier ultimately determines the productive efficiency with which it manufactures the new product, as compared with other sister subsidiaries at the same node.

Advanced 'HBE' mandates require, by definition, a follower subsidiary with a higher level of technological competence in order to execute the more demanding mandate. Advanced mandates, then, go to followers that are relatively closer to the technology frontier - the 'most productive assimilator' FOS at each node, if you will. Advanced mandates, in addition to requiring new process engineering to meet new IQSs, require a second 'innovation task' of followers, namely that of "independently conceptualizing and developing new product designs"[58]. New design innovations still constitute a 'home-base exploiting' activity because the designs are based on product technology assimilated from the technology frontier. This understanding is based on the "premise that the design and technology frontiers are distinct"[59] and therefore "it is possible for firms to push out the design frontier without pushing out the technology frontier"[60]. For example, while pushing out the technology frontier involves "a technical advance in the known state-of-the-art of a particular field", pushing out the design frontier instead "involves making variations on that known state-of-the-art"[61]. In other words, advanced 'HBE' mandates require the "development of functionally advanced products"[62], but based on the same embodied product technology that was assimilated from the technology frontier.

It bears noting at this point that the assignment of technology mandates to subsidiaries modeled above is not as restrictive as their definitional topologies would indicate. In other words, in practice subsidiaries classified as executing a basic mandate generally direct *most* of their resources at process engineering, but they may also invest in some design innovations. Similarly, subsidiaries classified as executing an advanced 'HBE' mandate may in fact be directing some nominal level of resources to home-base augmenting innovations at the technology frontier, depending on the complexity of the national innovation system of the country they are producing from[63]. Mandate topology, then, is simply reflective of the relative level of activities being preformed by follower subsidiaries, with the specific topology representing the general capability level of the subsidiary's activities[64]. However, as shall be discussed further on, the (R&D) resources that a lead firm makes available to its subsidiaries *is* directly related to the mandate topology assigned to them, irrespective of what other activities the subsidiary engages in beyond the specificities of that particular technical mandate.

As stated above, lead firms assign technical mandates based on the integrating subsidiary's relative distance from the technology frontier as compared to other suppliers at the same node. In practice, subsidiary capability is assessed based on the availability of R&D manpower to a FOS in its specific country location. In other words, the presence of a threshold level of R&D manpower, sufficient to execute the specific technical demands of a mandate, functions as a proxy for 'distance from the technology frontier' when assigning mandates. For example, supplier firms in Poland have been awarded 'advanced' HBE mandates based on the attraction of "high quality engineering resources linked to low labor costs and a well-prepared work force"[65]. According to Winter, "mega-suppliers such as Delphi, Remy and TRW have decentralized engineering competencies to Poland"[66] in what has been described as "attempts to combine high technology with lower engineering and manufacturing costs"[67]. Delphi, for example, established the Technical Centre Krakow (TCK) in 2000 and "today, about 450 engineers and technicians support the development and design of components and modules for half a dozen OEMs"[68], with 80 percent of the staff being "graduates of regional universities such as Krakow University of Technology"[69]. Consistent with an advanced 'HBE' mandate, "the TCK is involved in application engineering and design, but not in core development"[70].

However, just as suppliers in Poland have been awarded product design responsibilities based on meeting a threshold level of local R&D manpower supply, subsidiaries can be assigned 'basic' mandates *post-integration* based on a lack of sufficient R&D manpower locally to continue product design activities they preformed as indigenous suppliers. This is because the product design they invested in as indigenous suppliers involved the use of locally-based technologies below the technology frontier, not the more advanced proprietary technology they are transferred upon network integration. In other words, to efficiently engage in design innovations using frontier technology requires a higher local supply of R&D manpower than previously required to meet minimum threshold levels when the embodied product technology used as a template was locally derived. For example, based on their case work covering the auto industry in Mercosur, Quadros and Queiroz write that:

"the integration of the Argentinean and Brazilian operations has led to the displacement of Argentinean design activities towards Brazil, the largest operation within the area. Our survey has found approximately 1,900 engineers working in design activities in the Brazilian sample, as compared to a few tens in Argentine"[71].

What can be concluded from the Poland and Mercosur examples is that following integration, and based on their relative distances from the technology frontier, some subsidiaries gain competency-based responsibilities and others lose them, as reflected in their assigned technical mandates. However, it is very important to understand that even 'basic' mandates require meeting stringent technical requirements of productive assimilation of advanced, frontier-generated product technology, and therefore should not be seen as a diminution of overall competency-level requirements, but rather just of the range of activities preformed. In fact, competency-level requirements increase post-integration for all suppliers, regardless of subsequent mandate assignment, because every network supplier must meet internationally standardized quality and cost standards comparatively more demanding to when they were producing to local standards.

The next set of decisions made by tier 1 lead firms is the assignment of volume mandates between the sister subsidiaries producing at the same component node. It is to the competitive advantage of the network if volume level assignments among the suppliers are complemented to the efficiency with which the suppliers meet their technical mandate requirements of productive assimilation. In other words, the most productive assimilator FOSs are given 'major' volume mandate assignments in global contracts, while the least productive assimilator FOSs are given 'minor' volume mandates. Volume mandate assignments are obviously very competitive between sister subsidiaries. Consider the following quote from Barnes and Morris regarding the constraints facing network suppliers, in this instance, a South African follow source:

"a South African subsidiary's most intense external competitor is not a supplier from another MNC, but another subsidiary of its own parent MNC located elsewhere in the world. For, it the parent first-tier supplier is allocated *a specific quantity of units* (re: global contract), then growing the local South African manufacturer's market share depends on taking market share from another subsidiary located in another (more than likely) developing country and visa versa (emphasis added)"[72].

Despite the individual goals of a particular follow source, from the perspective of lead firms looking to exploit offshoring advantages, the division of labor of mandate assignments between volume and technical mandates cannot be misaligned, because it is in the leads' interest that only its most capable sister suppliers be contracted as 'major' volume producers. Direct control over mandate assignments prevents against their misalignment and, as previously mentioned, it is the reason why lead firms reject minority partnerships in joint ventures. For example, opportunistic exporting by a locally-controlled JV supplier, in volume levels beyond what their productive efficiency would otherwise mandate than if parentally-controlled, would be at the expense of more efficient network-integrated follow sources as well as network competitive advantage overall.

The final governance decision made by 'parent' lead firms is the decision to complement subsidiary technical/volume mandates with the allocation of R&D resources or R&D mandate assignment. Those subsidiaries assigned advanced 'HBE' technical mandates are allocated greater R&D resources than those subsidiaries assigned basic 'HBE' mandates. This asymmetric division in R&D mandate assignment between sister subsidiaries at each node serves a specific purpose from the perspective of lead firms - that is, to ensure the continued firm-level learning of follow source major FOSs. By providing 'major' FOSs with the necessary resource capacity to productively assimilate product technology innovations from the frontier, a lead firm functionally guarantees the network a stable supply of component parts from the sister subsidiary it relies on most at each node to service its global contract obligations. In doing so the lead firm, essentially then, ensures itself of the ability to sustainably exploit trade-related offshoring advantages as industry technology is upgraded overtime. In other words, follow source major 'progress' is compatible with 'center' interests ('compatible dependent development). However, as the seminal research of Cantwell and Mudambi[73] illustrates, the asymmetry between sister subsidiaries organized by lead firms is not simply one of allocating a greater share of R&D resources to follow source majors, but rather it is one of favoring a greater allocation of R&D to 'major' FOSs at *the expense of* 'minor' FOSs. In other words, post-acquisition, R&D resources are '*rationalized up*' from those FOS's integrating as follow source minors to those FOS's integrating as follow source majors. So, while there are asymmetries in rent capture at the *internodal* level, there are asymmetries in R&D resource allocation at the *intranodal* level. Follow source minor 'progress', then, is in fact incompatible with 'center' interests because it would necessarily require a misalignment of resource allocation away from an ideal where network competitive advantage is maximized (ie. 'incompatible' dependent development).

Cantwell and Mudambi, by both quantitatively and qualitatively analyzing R&D spending in multinational subsidiaries post-acquisition, were able to demonstrate a quantitative difference in R&D spending pre- and post-acquisition in subsidiaries that directly complemented their technical mandate assignments upon integration. The data complied were taken from subsidiaries located in the U.K., operating in "engineering and engineering-related industries"[74]. Cantwell and Mudambi began by classifying the technical mandates of subsidiaries based on *qualitative* differences in their R&D spending patterns. Then, *quantitative* differences in R&D spending of each subsidiary in the data set was measured post-acquisition. The researchers found that the directionality of quantitative R&D spending changes in subsidiaries (ie. increase or decrease), measured post-acquisition, significantly correlated to the specific subsidiary topology used to create separate classifications in technical mandate assignments based on qualitative R&D spending differences.

Cantwell and Mudambi used differences in demand-dependent R&D spending patterns between subsidiaries, along with whether or not the subsidiaries engaged in significant "product development"[75] activities post-acquisition, to create distinct subsidiary topologies corresponding to two separate technical mandates assigned to integrating FOSs which they classified as either "competency-exploiting" or "competency-creating"[76]. If the *majority* of R&D spending in a subsidiary was found to be responsive to changes in local demand, than the researchers classified such subsidiaries as holding competence-exploiting (CE) mandates. If the majority of R&D spending in a subsidiary was found *not* to be responsive to changes in local demand, than the researchers classified such subsidiaries as holding competence-creating (CC) mandates. Cantwell and Mudambi then compiled a second data set to demonstrate that most 'CE' subsidiaries did *not* engage in significant product development activities post-acquisition while most 'CC' subsidiaries did[77]. The correlation between significant product development activity post-acquisition and whether or not R&D spending in a subsidiary is responsive to changes in local demand is intuitive, when one models the type of R&D spending used to direct 'product development' or 'competence-creating' activity.

To begin with, a subsidiary that significantly increases its R&D spending in response to an increase in local demand for the product it manufactures can be assumed to spend the majority of its R&D on process engineering solutions to increase productive efficiencies. In other words, in such subsidiaries greater local demand motivates greater spending to improve the cost efficiency of product manufacturing. Subsidiaries spending the majority of their resources on local 'adaptive-type' innovations can then be assumed to be spending a non-significant amount on product development, hence their competence-exploiting classification by Cantwell and Mudambi. In direct contrast, a subsidiary that doesn't significantly increase its R&D spending in response to an increase in local demand can be assumed to spend the majority of its R&D on new product development activities. R&D spending in such subsidiaries is correctly classified as being supply-driven, where subsidiary R&D spending only increases significantly in response to an increase in the supply of local R&D manpower. By definition, then, in subsidiaries classified as competence-creating, the majority of R&D spending is supply-driven and directed towards product development activities. As Cantwell and Mudambi write, the "R&D in competence-creating subsidiaries will be differently motivated than the locally adaptive kind of R&D that still predominates in purely competence-exploiting subsidiaries, and so it is qualitatively distinct in its determinants"[78].

At this point it is necessary to untangle the differences in the nomenclatures used by Cantwell and Mudambi (C&M) and the technical mandate topology I used earlier in the chapter, namely that of basic and advanced 'HBE' technical mandates. The reason for my decision to use a different classification system than Cantwell and Mudambi's is to make the important distinction between emerging market 'follower' subsidiaries and Triad market 'frontier' subsidiaries. While my 'basic' mandate classification can be viewed similarly to C&M's competence-exploiting mandate topology, my 'advanced' mandate classification corresponds to product development activity that is properly seen as home-based exploiting, as explained earlier in the chapter. However, the product development activity associated with C&M's competence-creating mandate topology is, by their description, one that is properly seen as home-base augmenting[79]. Despite this distinction, I argue that it is possible to transpose my classification system upon C&M's, without further prejudice, because the majority of R&D spending in both subsidiary types - those that I have premised as executing advanced 'HBE' technical mandates and the subsidiaries that C&M have labeled as executing CC mandates - is similarly supply-driven R&D spending. In other words, to be classified in either grouping, qualifying subsidiaries require a minimum threshold level of R&D manpower to efficiently engage in a 'second innovative task' beyond local adaptive manufacturing, namely that of product development, whether it be at the design frontier or at the technology frontier.

Beyond qualitative differences in R&D spending patterns and product development activity, Cantwell and Mudambi make a further delineation between subsidiaries given competence-exploiting mandates and those given competence-creating mandates, one based on differences in *quantitative* R&D spending levels pre- and post-integration. Cantwell and Mudambi's analysis importantly reveals that "being part of an acquired group reduces R&D intensity for subsidiaries without competence-creating mandates, but increases it for subsidiaries with competence-creating mandates"[80]. The explanation the researchers offer for what motivates multinational 'parents' to reduce R&D spending in 'CE' subsidiaries is that funding for competence-based activities undertaken by acquired subsidiaries, that are not assessed as being "novel"[81], will be discontinued post-acquisition because they are already being executed elsewhere within the multinational group. In fact, consistent with the notion of coordination-based I-advantages, Cantwell and Piscitello make the point that for multinationals, one aspect of maximizing "the innovativeness of the corporate group as a whole depends upon…the degree to which it can choose to site activity so as to reduce overlapping duplication"[82]. Intuitively, the parent makes the decision to eliminate funding for duplicative activities specific to those subsidiaries engaging in those activities *least efficiently* at the intra-nodal level when assessed across all sister subsidiaries.

Following this same logic then, and as Cantwell and Mudambi's analysis indicates, R&D spending actually increases in CC subsidiaries post-acquisition for the purpose of complementing, we can assume, competence-based activities newly mandated on the basis of the advantages gained from supporting 'innovation tasks' where they are *most efficiently* executed. As Foss and Pedersen argue, multinationals "obtain competitive advantages from orchestrating knowledge flows between MNC units in such a way that knowledge is transferred to those MNC units where it will increase value-added"[83]. In other words, lead firms favor the transfer of resources to subsidiaries producing the highest quality functional designs, manufactured using the most efficient process solutions, as it is these subsidiaries from which they plan to sustainably source 'major' quantity volumes to service their global contract obligations.

Based on the above suppositions, it makes sense now to argue that the reason why the majority of R&D spending in 'CE/basic' subsidiaries is found to be demand-dependent is because funding for product development investments have been reduced post-acquisition. The product development investments of 'CE/basic' subsidiaries are assessed by lead firms to be preformed far less efficiently than similar investments made in product development by 'CC/advanced' subsidiaries, which is why the majority of R&D spending in such subsidiaries is supply-dependent and found to increase post-acquisition.

For Mudambi and Pedersen, "inter-unit transfers" between subsidiaries are best understood as "the headquarters of multi-divisional enterprises re-distributing resources from laggard to leading constituent units"[84]. Investments continue to be made in product development in 'CE/basic' subsidiaries, as mentioned earlier in the chapter, however, what the complementation analysis illustrates is that 'parent' lead firms choose not to support those activities with R&D resources because it is not in their competitive interests to do so. Rather, it is the case that R&D resources directed at product development in 'CE/basic' subsidiaries prior to their integration and subsequent mandate assignments are, following their acquisition, *re-directed at the intra-nodal level* to 'CC/advanced' sister subsidiaries in support of 'officially' mandated product development activities. Prior to their network integration, 'CC/advanced' subsidiaries were also investing in product development activities, however, it was using locally-derived technologies. We assume now that post-acquisition, these subsidiaries are transferred proprietary network technologies in order to execute their officially mandated product development responsibilities and hence the need to support 'CC/advanced' subsidiaries with increased levels of R&D spending.

The very function of the complementation scheme employed by lead firms is to favor the development of established producers, those supplier firms that integrate *initially* closest to the technology frontier relative to other suppliers. Similar to Felker's observation of multinational behavior in modular supply chains, it can be argued that the favoring of established suppliers in captive supply chains is a reflection of the unwillingness of lead firms to invest the necessary resources needed to ensure the upgrading of *all* their constitutive subsidiaries. Instead, lead firms favor the complementation scheme where R&D resources are rationalized up to follow source 'majors', the suppliers the lead firms rely on most to maximize their competitive interests. However, as will be argued below, the complementation scheme comes at the expense of increased 'gap vulnerability' for suppliers integrating as follow source 'minors'.

By favoring the transfer of resources to suppliers integrating as follow source majors, at the expense of the transfer of resources to suppliers integrating as follow source minors, the imposition of the complementation scheme has the effect of exacerbating the natural hierarchy that exists at the intra-nodal level between sister FOSs. This is because by denying subsidiaries *initially* integrating as follow source minors the full complement of R&D resources they would otherwise have control over had they not been acquired, lead firms reduce the possibility that follow source minors can make the transition to 'advanced' mandate assignments based on efficiency gains in productive assimilation relative to other suppliers that integrated when initially closer to the frontier and thus are supported with a larger complement of R&D resources. Instead, with fewer resources to invest to meet increasingly stringent international cost and quality standards (IQSs), follow source minors struggle just to competitively keep pace, let alone 'catch-up', given the pace of new product technology upgrades made at the frontier. As Lorentzen states, "their main challenge is to marshal the resources necessary for the upgrading of their technological capabilities, aligning their process competence with the production requirements of advanced technology"[85].

Follow source minors can overtime become 'gap vulnerable' if there are not local supply-side developments in the availability of R&D manpower that would merit the transfer of a higher complement of resources from lead firms. As discussed in Chapter One, productive assimilation is gap-dependent, and if the necessary investments have not been made to ensure efficient 'coupling', follow source minors become vulnerable to not being able to competitively manufacture to upgraded IQSs. Lorentzen has labeled such subsidiaries as 'cliffhangers' because, as he argues, "they do not understand the technology that they are working with"[86]. As previously mentioned, because the ability to make efficient local process adaptations requires knowledge of the embodied product technology transferred by lead firms as standards are upgraded, these 'cliffhanger' subsidiaries are susceptible to being replace by competitors at the same node that do possess the necessary complement of resources to cost efficiently produce the component part to meet its newly upgraded quality standards.

Additionally, the very fact that follow source minors are assigned limited technical mandates ('basic') makes them more vulnerable to being undercut on cost terms alone. As Barnes and Lorentzen note, "a global supply mandate based exclusively on cost advantages is dangerous in that it may last no longer than the next model change"[87]. Follow source majors, by way of contrast, are valued for not only for their relatively superior manufacturing efficiencies but also for the quality of their design innovations at the design frontier. As Carneiro-Dias and Salerno argue, "it is easier to shut down a simply productive facility than a development centre, which may own some competencies that are important to the company as a whole"[88].

It is this fact that subsidiaries with only 'basic' technical mandates are less valued in terms of their contribution to network competitive advantage that accounts for why they have less leverage to resist the imposition of complementation by lead firms. Apart from the structural power of lead firms to limit the viability of independent suppliers by denying them both proprietary technology and OEM clients, follows source minors have less leverage when integrating to bargain for misaligned mandates that would allot them greater R&D resources than their 'basic' technical mandates would otherwise dictate. This is because the opportunity cost of their particular exclusion from network integration is low from the perspective of lead firms, who can be argued to utilize a "resource-based analysis"[89] when evaluating potential supplier value.

"A central proposition of the resource-based view is that not all resources are of equal importance in terms of the attainment of advantages and that differences in achievement can be attributed to the height of barriers to duplication"[90]. The potential value to network competitive advantage, of a supplier designated to integrate as a follow source minor but which resists integration because it is unwilling to accept its mandated role, is relative low. This is because, were the supplier to integrate, it would only be a minor volume contributor to global contracts and its design competencies, due to supply-side limitations in local R&D manpower, would find it operating well below the design frontier and as such providing a relatively easily 'duplicated' advantage[91]. As a result, follow source minors have very little leverage to bargain for R&D mandate autonomy, especially given that a misalignment in resource allocation favoring a follow source minor would necessarily mean, given the nature of the complementation scheme, a misalignment in resource allocation that potentially could affect the sustainability of 'major' volume supply. That lead firms in the GPN era have the structural power to pursue coordination-based offshoring advantages militates against such a scenario being tolerated.

It can be concluded, then, from this second chapter section, that supplier firms that integrate as follow source minors lack the leverage to alter lead firm-imposed mandate complementation, which denies them the R&D mandate autonomy to guarantee sustainable 'coupling' overtime as product technology is upgraded. It can be argued, then, that suppliers that are targeted to be integrated as follow source minors face a kind of 'catch-22' – industry exclusion or viability-based acceptance of immiserizing 'progress'. They can resist integration and be denied proprietary technology and local

OEM clients, or they can acquiesce to integration and be denied the R&D mandate autonomy necessary to protect against 'gap vulnerability'. Most FDI-led development models don't acknowledge the structural power of lead firms in the GPN era to pursue *complementation-based* offshoring advantages and the possibility of 'incompatible' dependent development in the periphery. What emerges from the above analysis is that subsidiary mandate assignment controls the efficacy of FDI-led development, with follow source 'major' mandates being the preferred option. As Narula and Dunning write, "it is not FDI per se that is hard to attract, but rather the right kind of FDI"[92].

CHAPTER 4:

MIDP DESIGN – AT THE EXPENSE OF LOCAL 'PROGRESS'

In the last chapter, the structural power of lead firms to impose a division of labor in the periphery that serves network competitive interests was described. Given the above, this final chapter will argue that, for emerging market countries (EMCs), an ideal industrial policy should be designed with the idea of counterbalancing the increased structural power of lead firms in the GPN era to ensure that EMCs attract 'the right kind of FDI'. The Motor Industry Development Programme (MIDP) of South Africa, introduced in 1995, will be used as an example of a sector-specific industrial policy that, rather than containing provisions to ensure local supplier firm-level learning, instead contains design elements that facilitate lead firm pursuit of complementation-based offshoring advantages. Specifically, the MIDP has relegated South Africa to high import-dependence and increased the likelihood that local suppliers integrate with only 'basic' mandate assignments.

It can be deduced from MIDP design that transnational interests were over-represented in the drafting process, a reflection of the increased structural power of network interests to impose viability-based acceptance of dependent terms in local industry actors. An ideal industrial policy would have made transnational investment contingent on a guarantee of local supply base 'progress'. Instead, it is argued that in the specific case of South Africa, MIDP design was specifically manipulated to provide for *overall* industry viability, through the IEC scheme, rather than through investments to improve local FOS firm-level competitiveness. In other words, CBU expansion is artificially supported through the industrial policy, instead of the industrial policy encouraging local supply base investments that would, absent artificial support, be required to support CBU expansion.

Specifically, it is argued that the surplus availability of import rebate credit certificates (IRCCs) in South Africa has functioned to offset any need for tier 1/OEMs to invest in local skill development. Moreover, because South Africa is generally considered a minor volume supplier of component parts to global contracts, it is not in lead firm interests to 'misalign' their resource expenditures by investing locally at the expense of major volume 'sister' subsidiaries located in more strategic markets. The high 'effective rate of protection' in the industry may have been construed by local indusry actors as strictly a profit-taking measure that allows investors to charge duty-inclusive prices in the domestic market, and as such, not as something that would discourage local supply base investments in support of CBU scale volume expansion. However, as indicated above, lead firm decisions are motivated by network-level competitive interests, leaving local 'progress' contingent on the particulars of the intranodal division of labor.

It will be argued that the MIDP, or more specifically its import-export complementation scheme (IEC), fails on two different levels to alter lead firm governance decisions that, as modeled in Chapter Three, serve 'center' interests at the expense of 'periphery' interests. The IEC scheme was designed with the intent of increasing Original Equipment Manufacturer (OEM) assembler production of completely built-up (CBU) vehicle models, which also then necessarily portends the development of a local supply base to support the increased CBU production. In other words, the prospects of greater CBU volumes would necessarily serve as an incentive for both local OEMs and their tier 1 lead supplier firms to invest in local tier 2 supply base upgrading. The IEC scheme provides an export incentive to encourage increased CBU production by complementing exporting with the earning of IRCCs. In this way, by increasing export volumes of both CBUs and component parts (ie. those volumes component firms export, independent of what they supply to their local OEM clients), OEMs and their suppliers would be able to earn IRCCs to import components, not manufactured locally, duty-free from other network-affilated suppliers located in other countries. The IEC scheme, therefore, lowers the overall cost to OEMs/tier 1s of locally sourcing components, allowing for a *cost viable* increase in CBU production volumes aimed primarily for the international export market.

While the IEC scheme is an effective export incentive, it will be argued that it contains two major flaws that have ultimately limited CBU production capacity and overtime may jeopardize industry viability. Both flaws are centered around the fact that earning IRCCs is tied to exporting. The first flaw in IEC design is that, given the parameters governing the earning of IRCCs, it has in effect functionally operated as a disincentive to invest in local skill development. Firstly, considering the exclusivity of global contract arrangements between tier 1 lead firms and their OEM clients, it is possible for South African suppliers to be given export contracts simply on the basis of the need to satisfy local OEM/tier 1 demand for IRCCs, rather than from their achieving any real measure of international competitiveness. Secondly, the fact that it has been possible to earn a disproportionate share of IRCCs simply from the export of catalytic converters (based on their high precious metal content) has meant that their hasn't been any need to invest to improve the productive efficiencies of suppliers manufacturing other, more value-added intensive components for export . The ease with which it has been possible for local actors to accumulate IRCCs has meant that the industry has been able to expand CBU production volumes despite remaining highly import-dependent, though cost viability constraints associated with the importing of a wide range of components ultimately limits CBU levels to far below capacity. That the auto industry hasn't been forced to increase local content as it has expanded CBU production is consistent with lead firm objectives of exploiting trade-related offshoring advantages where, instead of investing to upgrade the local supply base in non-strategic markets, lead firms rely on sourcing through imports from 'established' follow source major suppliers located in other markets.

The second major flaw in IEC design is that local suppliers are forced to integrate under lead firm supervision to earn IRCCs, a necessity by virtue of the fact that earning IRCCs is tied to successful exporting to international markets controlled through OEM-tier1 global contract arrangements. Couple the typical EMC experience of transitioning from previous decades of an auto industry borne of protected domestic markets, with the atypical legacy of apartheid-based structural inequalities, and South African supplier firms can be understood to face a huge deficit in skilled labor. By forcing their immediate network integration, likely when operating at production efficiencies far below the technology frontier, South Africa suppliers are made vulnerable to parentally imposed, complementation-based mandate assignments that have the effect of exacerbating local disadvantages in terms of access to resources needed to invest in firm-level FOS learning. The remainder of the chapter will describe in more detail the IEC scheme, its intent, the positive role of IRCCs in providing for immediate industry viability despite an initially underdeveloped skill base, and the negative effects associated with the two major design flaws as described above.

By way of a brief general introduction to the automotive industry in South Africa, it "comprises almost 8 percent of South Africa's gross domestic product, including 4 percent for vehicle and parts production"[1]. "Automotive exports have risen to around 15 percent of total exports by value, from just 4 percent in 1995, and have overtaken that of South Africa's exports of gold"[2]. Overall production levels are around 650,000 CBUs per year, with exports totally over 200,000 CBUs[3,4]. "All of the major vehicle makers are represented in South Africa, as well as eight of the world's top 10 auto component manufacturers"[5], with investments to date "estimated at R30bn"[6].

The initial intent of the MIDP was to increase CBU production levels through a reorientation of the industry in favor of exporting. Previous to the implementation of the MIDP, the auto industry in South Africa was predominantly locally owned, producing low volumes for a protected domestic market ("115% tariff protection in mid-1995"[7]). The domestic consumer market was, and remains to date, too small to support increased CBU production, and so export expansion was seen as the only way to facilitate a move towards scale volumes[8]. The IEC scheme was made the centerpiece of the MIDP in 1995, with the incentive to export designed to encourage model rationalization, with fewer platforms each produced at higher levels. The number of platforms has in fact been "reduced from 31 platforms with an average annual volume of 9,500 units per platform in 1996 to 18 platforms with an average annual volume of 24,500 units per platform in 2004"[9]. The number of models produced in excess of 40,000 units a year has increased from zero to five over the same time period[10]. Increased (foreign multinational) investment in CBU production capacity was thought to necessarily stimulate similar investments in the local supply base. According to Black, "higher vehicle volumes allow for the attainment of economies of scale for component producers moving them further down their respective cost curves and enabling a higher level of localization on an economic basis"[11].

Moreover, specific stipulations were written into the IEC scheme with the intent towards increasing supplier localization in response to the new export initiative. The earning of IRCCs from exports was made contingent on the *percent local content* in the vehicle or component exported. As Flatters describes, "exporters can earn tradable import credits that grant a reduction in the dutiable value of components or vehicles in proportion to the value of the local content of goods exported"[12]. I will return to its importance in a later discussion, but it bares noting at this point that the raw material value of an export was also allowed to be considered as 'local content' along with local mVA. Specifically, then, the IEC stipulates that:

"for every rand of local value added/raw material in a completely built up vehicle (CBU) exported, a rand of CBU or components can be imported duty free. For every rand of local value added/raw material in components exported either 75 cents of CBU or 1 rand of components can be imported duty free"[13].

Frank Flatters gives the following example to highlight the specific functioning of the IEC scheme:

"Under this facility, automobile exports with local content value of R100 million, for instance, generate the (tradable) right to import the same value of vehicles or components free of duty (or to reduce the dutiable value of imports by this amount). With a 40 percent duty on imported vehicles, this would provide a duty reduction of 40 million on imported vehicles. This is 40 percent of the value of the domestic content of exports that generated the duty credit"[14].

The MIDP is largely considered a success because the ability to earn IRCCs made for *immediate* industry viability in 1995, despite the otherwise local cost disadvantages of producing from South Africa. In other words, the earning of IRCCs functioned to compensate for local production costs that were uncompetitive by international standards, and thus made it possible to *cost viably* increase CBU production volumes and compete successfully both in international export markets and against CBU imports from other markets. Most obviously, production costs are much higher in South Africa because of its geographic isolation, which raises the cost of importing components not manufactured locally. According to Justin Barnes, "logistics cost blow South Africa out of the water by some 15%, so there must be an incentive to offset that"[15].

The expense of shipping large distances is further compounded by the fact that South Africa is a high-import dependent location for component parts. Local content is low in South Africa because, like many transitioning countries, it has a weak skill base from decades of producing behind a protected domestic market. Moreover, South Africa faces the monumental task of having to overcome "the apartheid policy of human resource under-development"[16]. According to Blankley and Kahn, "South Africa offers the curious case of a middle-income economy that is growing while its' R&D expenditure and human resources are lagging"[17]. This is specifically debilitating considering the fact that the auto industry is highly skill intensive. For example, "only 50.3% of total employment in the sector is semi-skilled or unskilled while 31.4% of the workforce is in mid-level occupations, and 18.3% of jobs require high-level skills"[18]. This is why cases like VW Golf 4 production in South Africa are the norm, where, although it is "being produced in volumes exceeding 40,000 units per annum, it currently has extremely low levels of domestic content partly because it was introduced very quickly and also because of exacting technology requirements"[19].

When local content is low for a particular model, than increasing production is only feasible if producers are granted some form of import credit. This is because low local content means that a wide range of components will have to be imported, the cost of which increases proportionally with production volumes. Consider an example where the local content of a particular vehicle model is 80% (20% of components are imported) and CBU production volumes, including whatever percentage of CBUs are exported, are doubled from say 25,000 units to 50,000. The doubling of CBU production means that the volume of imported components must also double, but because local content is high the absolute volume of imported components remains relatively low. Now consider the cost ramifications if the local content of the vehicle model was only 60% instead. A doubling of CBU unit volumes requires a doubling of imported component volumes, but this time of a much *wider range* of component parts such that the *absolute volume* of components that would have to be imported to reach 50,000 CBUs now becomes cost prohibitive.

However, if import credits could be earned by OEMs and their local component suppliers from exporting, as is the case under the IEC scheme, than as their exports double so does the amount of import credits earned, allowing for the duty-free importing of the doubled volume of imported components needed to meet the doubled CBU volume. *In other words, the earning of IRCCs allows local OEMs to cost viably* *double production levels without having to increase local content.* As Barnes *et al.* write:

"on the face of it, an import regime which has high rates of tariffs of 30 percent on components would not suggest itself as a low input cost regime. But the nature of the MIDP with its import-for-export provisions is that *de facto* the auto assemblers can import on a virtually duty-free basis"[20].

It can be said then, that the South African market has been liberalized under the MIDP, but on an IRCC-contingent basis only, in that the benefits of duty-free importing go exclusively to those able to earn sufficient import credits to support local production.

There are two important limitations on the maximum level of CBU production for export that can be reached under the IEC scheme that should be noted. The first limitation on production volumes is simply the demand for CBUs in the international export market. It follows, then, that the second limitation is the level of component export volumes that can be attained (ie. production independent of what component firms supply to satisfy local OEM demand), which affects the amount of IRCCs that can be earned and hence the level of CBUs that can be cost viably produced locally from South Africa. In other words, a doubling of CBU production in South Africa necessarily requires a doubling of component exports, to double the IRCCs earned to meet the demand for imported components, which has similarly doubled. As discussed in Chapter Three, component demand in export markets is controlled through tier 1 lead firms, which means that for CBU production to double locally, South African component firms' would have to be parentally mandated double their previous contribution in global contracts. However, as we know, global contracts are for finite volumes and so for South African firms to 'win' larger mandates it requires that, relative to other sister suppliers, they be chosen as preferred network suppliers.

The ability, or lack thereof, of local component firms to 'win' these assignments is what functionally limits CBU production levels in South Africa[21].

The value of the IEC scheme to industry viability can be measured from the 'effective rate of protection (ERP)' it offers local manufacturers. According to Flatters, the ERP "is a measure of the amount of inefficiency that is possible to maintain in domestic production and yet still remain competitive and profitable in South Africa"[22]. In other words, it is a measure of the level of compensation that duty-free importing affords local producers that ensures they remain viable despite high logistics cost, high import-dependence and, as eluded to above, below minimum efficient scale manufacturing by component firms that are unable to win 'major' volume global contracts. By Flatters calculations, "after 10 years of operation, effective protection remains high – 29 percent in the case of vehicle exports, 52 to 83 percent for domestic vehicle sales"[23]. An ERP for exports means that local OEMs can "assemble vehicles at 29 per cent higher cost than producers elsewhere and still be able to export profitably"[24]. The ERP from import competition under the MIDP is even higher because the tariff on CBUs remains high at 30 percent. In other words, local producers don't face import competition at international prices, but rather they continue to produce behind a protected domestic market. South Africa has been, under the MIDP, a very profitable location for foreign investors precisely because local producers are able to charge "a duty inclusive price"[25] in the domestic market.

Since the inception of the MIDP, there has been far greater foreign investment in the South African market to the point where today, foreign OEMs completely dominate the local auto industry. According to Barnes *et al.*, "the key development here was the decision of BMW to include its South African subsidiary in its global expansion plans", which "not only drew-in key component suppliers but led to competitive reactions from VW and Daimler Chrysler"[26]. Ford and Toyota have since followed and have negotiated substantial export programmes similar to the German OEMs. As to be expected, "the German assemblers, through their value chain governance, have forced their MNC first-tier suppliers to enter the South African components sector, in the process radically reshaping its configuration"[27], such that 70 percent[28] of supplier firms are now majority foreign-owned as well. However, apart from homologation cost concerns, it can be argued that the main reason that foreign suppliers were 'forced' to invest in South Africa was because of the specific design of the IEC.

It is precisely because the earning of IRCC credits is tied to exporting that foreign investments were made in South Africa's supply base. Exporting by component firms, above what they supply to their local OEM clients, constitute approximately half of all IRCCs earned in South Africa[29] and so are a major reason for overall industry viability. As explained in Chapter Three, to protect rent earned in international markets, tier 1 lead firms do not license to independent firms that export. Therefore, because *IEC benefits are contingent on supplier firms that export,* encouraging follow sourcing was the only option for foreign OEMs needing to earn enough IRCC credits to expand their local operations. The import credits earned by tier 2 FOSs are passed onto their local OEM clients, as part of the global arrangement guaranteeing the suppliers' inclusion in export contracts, thereby allowing the OEM assembler to import in, duty-free, components not manufactured locally. As Barnes and Morris explain:

"The following steps capture a typical export deal secured by (MNC-owned) South African-based component manufacturers: the European parent assembler agrees to a global supply contract with an MNC supplier, and requires as part of the global deal that a certain percentage of its demand must be supplied by the MNC supplier's South African plant and that the IRCC (import/export credits) earned must be ceded to their South African assembly operation at no cost"[30].

The exclusive nature of these deals is evidenced by the fact that very few of the IRCCs earned in South Africa are traded. "There is a well-established spot market for arms-length sales of IRCCs known as the Export Credit Exchange (ECE)" but, for example, "in 2002, only R550 million of IRCCs issued were sold through the ECE out of a total of some R21 billion. Thus only 2.6% of total IRCCs are sold on the ECE"[31].

That arrangements for the local transferring of import credits have been introduced into global contract negotiations means that non-affiliated independent suppliers are even less viable in South Africa than what would otherwise be expected. Because independent suppliers are not included in export contracts and thus cannot earn IRCCs, they have little chance of attracting the business of local OEM clients even if they promise to limit their output for domestic market supply only. Independent suppliers "face the 'stick' of the MIDP" in terms of greater import competition "without having any access to the 'carrot'" from inclusion in export contracts[32]. Unlike network affiliated FOSs, then, they cannot earn IRCCs to transfer to local OEMs as a form of compensation for high production costs (below minimum efficient scale volumes) associated with local inefficiencies in manufacturing. In other words, independent firms in South Africa are not viable under the MIDP because they don't contribute to overall industry viability. As Barnes and Lorentzen argue, "domestic firms no longer have the luxury of domestic go-it-alone strategies and must confront the challenge of export success. This means that they either manage to join global supply chains or resign to bidding the automotive industry farewell"[33].

While there has been an increase in foreign investment in the local supply base and component exporting has subsequently increased substantially since the inception of the MIDP, local content remains low in South Africa, especially for the "newer, more sophisticated models"[34]. In 2006, "the local content of the top-selling models as reported in the TISA annual OEM survey amounted to 56.5%"[35]. Another indication that the industry remains heavily import-dependent is the sector-specific trade deficit, which in 2006 amounted to 32.3 billion[36]. That local content remains low is an indication that most foreign investment has been in the form of brownfield-type takeover investments rather than new greenfield plants.

The question than becomes, why haven't there been efforts to expand local content in South Africa? In other words, why haven't foreign investors made the necessary investments in the supply base to fully take advantage of the opportunity to expand CBU production through the IEC, most especially given that the earning of IRCC credits is tied to the percent local content of vehicle exports? Within the parameters of cost-viable component importing, increasing CBU production to meet *scale volume* capacity necessarily requires that tier 1s/OEMs invest in local skill development to either increase local content or to increase the productive efficiencies of already localized suppliers. Increasing local content would reduce the range of components needed to be imported to support CBU expansion and increasing productive efficiencies would help local suppliers win 'major' export contracts and hence earn more IRCCs, allowing for a larger absolute volume of component imports to support

CBU expansion. It will be argued that the reason for why sufficient investments in skill development have not been made in South Africa's auto industry is because the IEC scheme, though seemingly counter intuitive to the stipulated need to meet local content targets, actually functions to *reduce* pressure on foreign multinationals to actively invest in local R&D manpower development. That the IEC works to dissuade such investment constitutes a major flaw in MIDP design, from the perspective of local interests. Two separate factors, which together control how the IEC operates, effect lead firm decision making on skill upgrading. First, because FOSs not only supply components but also import credits to their local OEM clients, local supply is organized through global contracts primarily on the basis of IRCC demand. Secondly, based on how the determinents which condition the earning of import credits have been set relative to IRCC demand, in the years of its' operation there has existed a surplus of IRCCs available to OEMs under the MIDP in South Africa. Both of these points are addressed in order below.

As previously mentioned, the fact that earning import credits is directly tied to exporting has meant that the transfer of IRCCs between component firms and their local OEM clients is arranged between transnational suppliers and assemblers in global contracts. In other words, ensuring that local OEMs have sufficient import credits available to them to finance CBU production is arranged at the international level. Therefore, component exporting becomes less a matter of 'winning' global contracts on the basis of productive competitiveness, as it is being 'assigned' volumes solely on the basis of satisfying local IRCC demand. As Barnes and Morris state, "from the perspective of the local component firm, the ability to succeed or fail in the global marketplace is delinked from the usual competitive criteria"[37]. Network suppliers in South Africa merely have to meet international product quality standards, rather than meet them cost efficiently. In terms of volume mandates, then, otherwise uncompetitive suppliers are assigned contracts only in proportion to local IRCC demand. For example, in a survey of local component suppliers, Barnes found that "sufficient MIDP export rebates are already being earned by the OEMs facilitating the export contracts for many of the firms, thus *demotivating* them from facilitating further contracts (emphasis added)"[38]. In other words, that South African component suppliers can be placed in global export contracts, independent of firm-level efficiency concerns, reduces the incentive to invest in local supplier upgrading to increase their 'true' international competitiveness and hence global mandates relative to other sister subsidiaries. In fact, despite an unquestionable growth in exports since 1995, according to Barnes, "there is no indication that South Africa is emerging as a source destination leader amongst developing economies"[39]. For example, he points to the fact that "whilst South Africa exporting growth has been impressive against its own previous exporting performance, the growth rates recorded amongst the Eastern European countries has been far more rapid"[40]. That South African component firms are not gaining market share internationally is consistent with the notion that the IEC operates merely as an "artificial inducement to export"[41] rather than as an actual incentive for local supplier upgrading.

Barnes' survey of the local auto industry is consistent with other data suggesting that, for most of the years since the inception of the MIDP, there has been a surplus of IRCCs available to OEM assemblers in South Africa. For example, according to

Flatters, 95% of components and CBUs enter South Africa duty-free[42]. Moreover, IRCCs have been traded on the EDE at considerable discount, similarly suggesting a surplus of supply[43,44]. That IRCCs are readily available to tier 1/OEMs in the South African market for duty-free importing, to compensate for otherwise high local manufacturing costs (below minimum efficient scale component firm production), means that the 'effective rate of protection' for the industry remains high. In other words, as long as OEM assemblers have access to sufficient IRCCs for the expansion of CBU volumes to a profitable maximum, there is no need to invest either to expand local content or increase local productive efficiencies. For example, most vehicle models predominately destined for export markets are produced at between 30-50,000 units/year, production levels considered *below scale* by international standards but made profitable in South Africa under the MIDP.

A surplus of import credits has prevailed over the years in the South African market as a direct result of the initial guidelines in the IEC that define the earning of IRCCs. As previously mentioned, the effective supply of IRCCs is a function of the value of components that can be imported duty-free as a percent of the local content value of exports. The effective demand for IRCCs is a function of the tariff on component imports. The tariff schedule reflects the need for IRCCs, with the higher the tariff the greater the need for IRCCs to reduce the cost of importing. In its original incarnation in 1995, the determinants controlling effective supply and demand in the IEC were valued relative to each other to guarantee an initially high ERP for the industry (for example, the ERP for vehicle exports was initially 60%, whereas it is 29% today[45]). In the years since 1995, component firms have expanded their output and become relatively more productive, allowing for a decline in ERP, but there remains a surplus of IRCCs to compensate for the fact that below minimum efficient scale volumes still prevail in the South African market. In other words, while the tariff on component imports has fallen since 1995 (decreasing IRCC demand), the supply of IRCCs in the market has not fallen below demand, even though the value of components that can be imported duty-free as a percent of the local content value of exports has also fallen relative to where it was in 1995[46]. However, the change in the 'qualifying value' of components that could be imported duty-free occurred a full seven years into the MIDP, in 2002. As Black and Bhanisi write, "while exports of components with a local content value of R100 would allow the exporter to import R100 of components on a duty free basis in 2002, from 2003 a gradually declining value of components could be imported duty free"[47]. Instead of 100% in 2002, only 78% of the local content value of exports can be imported duty free in 2007. However, over the exact same time period, the tariff on component imports has also fallen, from 30% to 25%.

In other words, what can be discerned from the above discussion is that industry actors have not had to make the kind of investments in skill development needed to avert a possible future scenario where IRCCs are not readily available. Instead, they have relied on the fact that the demand and supply of import credits over the life of the MIDP has been strictly regulated for the purposes of ensuring that the industry remains viable under static conditions where import dependence remains high.

There is no better example of the MIDP functioning to protect industry viability, at the expense of encouraging broader skill development, than the specific provision in the IEC allowing for the inclusion of raw materials in the valuation of local content in exports. With the inclusion of raw material content, the components sector has been able to disproportionately rely on the export of catalytic converters to earn IRCCs. This is because catalytic converters are Platinum Group Metal (PGM)-rich, where "materials as a percentage of cost of sales range from 85% to 95%"[48] for exporting firms. As a result, by specializing in the expansion of catalytic converters, it has been possible to satisfy a large percentage of the industry's demand for IRCCs. In 2006, for example, catalytic converters "accounted for half of all car components exported"[49], this despite the fact that the value of components that can be imported duty free as a percent of PGM value in exports has been falling, from 90% in 1999 to only 40% in 2006[50].

Given the above, that the components industry to date continues to be dominated by catalytic converter exports is an indictment of the paucity of investments that have been made to increase the proficiency of other component exports. By being able to rely on raw-material rich exports, industry actors have not been *forced* to invest to increase the productive efficiencies and high volume exports of other component manufacturers to earn IRCCs. As Anthony Black states, "while a wide range of components are exported, much of the expansion has been in a small range of products such as catalytic converters, automotive leathers, tyres and wheels"[51]. In other words, though a 'wide range' of components other than catalytic converters are in fact exported, they are exported in relatively low volumes, providing further evidence of the overall low level of 'true' international competitiveness of the components sector in South Africa.

While the emphasis on protecting industry viability is understandable, and the initially high ERP justifiable as it allowed for immediate industry viability through a period of transition, it would have been preferable (from the perspective of local interests) to both sooner and more precipitously decrease the level of duty-free importing possible relative to IRCC demand. By doing so, foreign multinational lead suppliers and assemblers would have been forced to more substantially invest in R&D manpower development in South Africa, serving to subsequently both reduce their import dependence and broaden their export reliance beyond raw-material rich components. According to Black and Bhanisi, "insufficient investment has occurred to upgrade technology in this sector"[52]. In other words, that it has been possible to viably operate under the MIDP with high import-dependence, producing below scale volumes of both CBUs and components (ie. 30-50000 units/yr), has, however, removed any incentive for industry actors to incur the costs associated with expanding their already profitable operations any further. Tier 1 lead firms, with the power to exploit trade-related offshoring advantages, prefer to source components through imports from more 'established' major volume FOSs located in other markets, rather than invest to expand the supply base in initially low local content locations like South Africa.

A second major flaw in MIDP design, similarly tied to the IEC scheme, stems from the fact that only component firms with access to export markets can earn import credits. Suppliers that are initially operating far from the technology frontier are forced to integrate as network subsidiaries to earn IRCCs, at which point they are vulnerable to being assigned follow source 'minor' mandates. This vulnerability is especially tangible for suppliers in an EMC like South Africa, where the skill base for a technology-intensive sector like automotives was likely underdeveloped in 1995 when the industry made the transition away from domestic-market orientation. And so, while the MIDP provided for an initially high level of competitive protection for the industry (ie. high ERP), it did not protect its suppliers from potentially being assigned mandates that serve lead firm interests (complementation-based offshoring advantage exploitation) at the expense of firm-level upgrading locally. Moreover, as argued above, the fact that the MIDP has actually functioned to lessen the need for industry actors to invest in R&D manpower development means that most supplier firms have likely not experienced an evolution to more 'advanced' mandate assignments in the years since 1995. In other words, the first major flaw in MIDP design actually serves to compound the negative effects of the second major flaw in MIDP design.

The evidence for FOSs in South Africa having been assigned 'basic' mandates is of course circumstantial without the benefit of specific case studies. However, the research that has emerged from the auto sector since 1995 points to certain general trends which can be interpreted as the industry having made the adjustment to conforming its' objectives to better serve overall network competitive advantage. For example, as mentioned previously, with the exception of raw material-rich component exports, most component firms in South Africa are only 'minor' volume suppliers to global contracts, presumably so as to not subtract from the 'major' volumes able to be supplied by more efficient network subsidiaries located in other markets. In terms of technology mandates, according to Barnes and Morris, the trend towards follow sourcing has meant "the death of the technologically independent locally owned firm"[53]. The emphasis now is on "the need to raise the technical and process operating levels" of local FOSs, such that in their words, the industry has essentially "become a 'technology colony' driven by rigid and detailed externally generated technical specifications of an increasingly higher order, which have to be met by local producers"[54]. In keeping with the assumption that design innovations are likely more productively sourced from 'established' network subsidiaries located in external markets, Barnes and Morris argue that in general, "the product development process is excluded from the ambit of South African firm activity, which was previously not the case"[55] prior to follow sourcing and the subsequent elimination of least valued redundancies at the intranodal level.

As it appears that 'basic' technical mandates are the norm, the question becomes does R&D resource allocation similarly conform to the general trend in the components sector. Based on benchmarking surveys, in terms of "R&D spending as a percent of sales"[56], local suppliers do trail the international average, however there is no available data to confirm whether the majority of R&D spending by component firms in South Africa is demand-side motivated or not. Interestingly, in their assessment of the effectiveness of the Productive Asset Allowance (PAA) in South Africa, a government subsidy designed to specifically increase investment in the auto sector, Pouris *et al.* found the following:

"since the inception of the PAA, investment in the industry has accelerated. Between 2000 and 2004 total investment increased more than two fold. However, corresponding investment in R&D activities has been minimal. Most importantly, there seems to be no evidence that the incentive is supporting industry innovation activities"[57].

The modeling of complementation-based FOS mandate assignment informs these results, as it is unsurprising that a *production* subsidy would not stimulate an increase in R&D spending. As described in Chapter Three, an increase in local R&D spending is mandated only when a threshold level of R&D manpower sufficient to execute an 'advanced' technical mandate is met. Expecting an increase in R&D spending from either the MIDP or PAA subsidies is a case of proverbially 'putting the cart before the horse'. Production (the 'cart') does not lead to greater R&D spending (the 'horse') in the absence of the necessary R&D manpower to support R&D-intensive projects, especially in South Africa where, because of a high ERP, the industry is viable despite being highly import dependent. Instead, it is the case that the 'horse' *must* lead the 'cart' - R&D manpower will attract R&D-intensive technical mandates, and overtime allow for *scale volumes* to be reached in production as local supplier capabilities are upgraded.

I have argued that a decrease in the level of duty-free importing possible relative to IRCC demand would force multinational suppliers and assemblers to invest more in local R&D manpower development in South Africa. There is also the argument for sector-specific skill development incentives to similarly spur greater industry participation. For example, David Kaplan's bases his criticism of the MIDP on the fact that its initial draft it didn't specifically address the need for skill development in the automotive sector, which is why he has labeled the MIDP "a trade facilitation mechanism" that "falls short of a comprehensive industrial policy"[58]. And so, neither has the MIDP *forced*, nor does it contain *incentives* to encourage, the development of sector-specific skill sets needed to complement what it subsidizes in production.

Regardless of the initial standing of the auto sector in 1995, the 'flaw within a flaw' described above is the reason for why there has likely not been an evolution of subsidiary mandates in South Africa to those requiring more advanced competences or to those supported by greater R&D resources.

There are government initiatives like the Technology & Human Resources for Industry Programme (THRIP) in South Africa, but they are generally underfunded and therefore underutilized. The "THRIP matches investment by industry in innovative research projects where researchers/experts from Science, Engineering and Technology Institutions (SETIs) serve as project leaders and students are trained through the projects"[59]. Generally speaking, if it were possible for the government to foster greater collaboration between the private sector and academia, the 'high skills/low skills' dilemma could be largely avoided in South Africa in that industry could focus on investing in 'high skills' development, significantly relieving the public sector's burden in this area. The government could then focus on tackling unemployment by, for example, sponsoring 'low skills' learnerships through Further Education and Training Institutions (FETs)[60].

A full five years after the MIDP was instituted, the government established the Automotive Industry Development Centre (AIDC) in 2000 with a mandate to "assist in increasing the global competitiveness of the South African automotive industry"[61]. As part of its role in "addressing the technology needs"[62] of the industry, the AIDC began sponsoring learnerships in conjunction with the 'Sector Skills Plan' of MERSETA, the manufacturing and engineering education and training authority. More recently, as of 2003, the AIDC entered into a partnership with a number of Tertiary and Further

Education Institutions (TEIs) to focus on the development of advanced engineering skills. Importantly, the AIDC's Tertiary Education Institution Programme has received significant support from industry actors such as BWW and Daimler Chrysler SA. For example, in association with the AIDC, Technicon Pretoria (TUT) opened The Automotive Technology Centre, through which courses are offered in "Manufacturing and Mechatronic Engineering". According to industry analysts, TUT served as "a strategic training partner for BMW for the launch of its new BMW 3-Series in 2005"[63]. Similarly, by securing funding from THRIP, MERSETA, the AIDC and Daimler Chrysler, in 2005 Nelson Mandela Metropolitan University established "the first engineering degree in the Eastern Cape, namely a Bachelor of Engineering in Mechatronics"[64] and has since developed plans for what will be called The Automotive Components Technology Centre. However, recent budget cuts in 2006, by some 70%, have unfortunately jeopardized the progress of the AIDC's Tertiary Education Institution Programme[65]. It will be up to industry actors like BMW and Daimler Chrysler SA to compensate for the loss of government support.

One reason why multinational firms in South Africa may *now* see it as in their interest to devote more resources to R&D manpower development is because, 12 years into the MIDP, the industry's ERP is starting to decline. In other words, with the artificially manipulated means of contorting viability-based acceptance through the IEC breaking down, it becomes imperative for transnationals to actually invest in local 'progress' to, on a firm-level competitiveness basis, actually secure industry viability. With a declining ERP, what this means is that local component suppliers are soon going to be forced to have to improve the actual level of their international competitiveness, not only so that they and their OEM clients continue to be awarded export contracts, but also to ensure that the industry remains viable domestically. As previously mentioned, the value of components that can be imported duty free as a percent of PGM value in exports has fallen to only 40%, making it less feasible to satisfy the majority of industry demand for IRCCS by relying predominately on catalytic converter exports. In other words, if fewer imported components enter South Africa duty free because IRCC demand begins to exceed supply, there will be a pronounced increase in local assembly costs. To counter such a trend, apart from catalytic converter suppliers, there will have to be an improvement in the productive efficiency with which components are manufactured locally, to allow for movement down their cost curves as they win larger export contracts.

Moreover, if local assembly costs increase at the same time that the tariff on CBU imports are falling, there could in time be a convergence at such a point where it may in fact be cheaper to simply import CBUs than manufacture them locally in South Africa. Anthony Black hints at this possibility when he argues that:

"if multinational vehicle manufacturers select the strategy of developing large scale exports of 'peripheral components' instead of reducing their cost base by expanding vehicle exports and localizing major components, not only will this not contribute to lowering the cost base of the automotive industry nationally, but it could create question marks over their own viability in the future"[66].

Such a scenario, in fact, may not be such a distant possibility. For example, "sales of imported vehicles grew by 31 percent in 2006 while locally produced sales improved by about one percent"[67]. It is no surprise then, that Roy Cokayne of *Business Report* has written that "automotive component manufacturers in South Africa have expressed alarm at the dramatic increase in imported vehicle sales at the expense of local production and job creation"[68]. It is not likely that import competition will abate any time soon, especially as China and India start to ramp up production in their auto industries. For example, India's Tata Motors already has subsidiaries in South Africa from which it imports commercial vehicles and according to one report, by 2010 China is "projected to manufacture 11 million vehicles, 2 million of which will be for the export market"[69].

The *need* to increase local supplier capabilities, with an end to lowering local assembly costs, is the likely reason behind the announcement in 2006 that auto industry stakeholders in South Africa plan to "invest more than R1 billion in technical skills development over the next six years in an effort to realize a vision of selling a million vehicles in the local market by 2015"[70]. Similarly, both Ford and VW have made major investments in engine plants in South Africa and have secured large export contracts. In fact, engines and engine parts, next to catalytic converters and leather seat covers, are now the components industry's third largest export. Because the local content of Ford's RoCam engines is 82%[71], their exports can generate the *needed* IRCC credits to safely protect Ford's local assembly operations from price competition. These new investments in 'technical skills' and to broaden the profile of component exports can be considered '*need*-based' investments, a forcing of the hand of industry actors if you will, brought on by a gradually declining ERP, as opposed to the type of *incentive* measures promoted by the AIDC. Both are important, and both should have been ideally encouraged sooner in the life of the MIDP.

Conclusion:

The thesis is meant to address a specific gap in the existing literature regarding the modeling of technological catch-up in the periphery, specifically the effects of global production network (GPN) organization on firm-level supplier upgrading. The intranodal division of labor in 'captive' producer driven value chains (PDVCs) was chosen as the unit of analysis for the purposes of specifically modeling the effects of lead firm 'parental supervision' on 'sister' subsidiary upgrading. The automotive industry was chosen as the specific industry of interest to study, both for its tiered, 'captive' supply network architecture as well as because the tacit knowledge-dependent nature of auto component manufacturing means that it is possible to model subsidiary catch-up from the perspective of gap-dependent productive assimilation or 'coupling'.

It is argued that the specific structural organization of networked production increases the bargaining power of lead firms in 'captive' PDVCs relative to their integrated supplier subsidiaries. As a result, the analysis lends itself to a center-periphery structuralist perspective in that lead firm governance decisions directly affect the autonomy of peripheral suppliers to invest in firm-level catch-up, the implication being that peripheral suppliers have less leverage relative to lead firms to control the terms of their integration. With less development space in cPDVCs for peripheral suppliers in the 'race to the top' era to meet homogenized international quality standards, internalization of the dependent exchange is now viability-based from the perspective of the periphery, rather than contingent on the firm-level 'progress of productive forces'. That the power to impose an 'integration or exclusion' ultimatum on peripheral suppliers has weakened the conditionality of social/political compliance means that Cardoso's original conception of dependent development needs to be expanded to include the possibility of firm-level 'incompatible' dependent development in GPNs, in that a high prevalence of follow source 'minor' subsidiaries in the supply base is accepted by social/political forces in exchange for the guarantee of overall industry viability that only comes with network integration.

Dunning's 'eclectic' paradigm is used to model the source of lead firm structural power and the competitive motivations behind lead firm governance decisions. Specifically, the productive coordination of its integrated subsidiaries is argued to be a network-associated lead firm "I" or internalization advantage. The work of Cantwell and Mudambi is heavily drawn upon, in the context of lead firm competitive motivations, to

understand how it is that initial firm-level technological characteristics influence lead firm governance decisions regarding the terms of supplier integration. Of specific interest is an assessment of the determinants of subsidiary mandate assignment and the practice of mandate complementation to eliminate least valued redundancies at the intranodal level and maximize offshoring-related productivities. Taken together, the modeling of lead firm power and competitive motivations, along with specific subsidiary-level technological determinants, helps to provide an explanation for the negative consequences on firm-level learning for those 'sister' subsidiaries in the periphery that integrate as follow source 'minors'.

An increase in the bargaining power of lead firms is found in both buyer-driven value chains and producer-driven value chains. Because of changes in exogenous barriers to entry in the supply base of BDVCs, lead firms have gained greater leverage as price setters. China's labor surplus has resulted in wage inelasticity relative to demand in many BDVCs, leaving peripheral suppliers vulnerable to the effects of immiserizing growth. Even though suppliers in PDVCs, unlike the suppliers in BDVCs, are important sources of competitive advantage due to the tacit knowledge-dependent nature of component manufacturing in technology-intensive GPNs, they too have less leverage compared to lead firms and therefore their upgrading is similarly vulnerable to the exigencies associated with lead firm governance decisions.

The increased bargaining power of lead firms in 'captive' PDVCs is attributable to the tiered and transnational organization of the supply chain structure itself, which imparts lead firms in the auto industry with the power to deny peripheral suppliers both proprietary technology and local OEM clients. As a result, lead firms are in a position to control the terms of supplier integration, in other words, the terms of the dependent exchange in which supplier viability upon integration is exchanged for center control of subsidiary mandate assignment. The decreased bargaining power of peripheral suppliers leaves them with less leverage to resist mandate assignments that do not provide for firm-level 'progress'.

It is argued that network organization should be looked upon as a deliberate construction because lead firms use their enhanced bargaining position to coordinate a division of labor among integrated FOSs that best serves network competitive interests, regardless of the consequences to firm-level subsidiary upgrading in the periphery.

Greg Felker's observation of asymmetry in the periphery of modular supply chains is taken as a starting point to explain asymmetry in the periphery of 'captive' supply chains. It is argued that in 'captive' PDVCs, lead firms organize a division of labor in mandate assignments among their integrated 'sister' subsidiaries at the intranodal level, but a division that is not only asymmetric, but one that in fact exacerbates the asymmetry between subsidiaries overtime. The explanation for the exacerbation of the intranodal hierarchy is argued to be lead firm pursuit of complementation-based offshoring advantages.

In order to sustainably supply low local content locations with components from offshore subsidiaries, lead firms see to it that it is possible to efficiently source sufficient component volumes at each particular mVA node. To accomplish this, follow source subsidiaries are assigned volume mandates that complement their particular technical and R&D resource mandates such that the firm-level learning of the most productive export-oriented subsidiaries at each node is provided for. Those suppliers closest to the technology frontier when they initially integrate are given follow source 'major' volume status and assigned a greater 'complement' of R&D resources (relative to follow source 'minors') to guarantee their productive assimilation of updated product technology overtime. In other words, follow source major firm-level learning is compatible with network-level competitive interests.

In contrast, suppliers forced to integrate as follow source 'minors' to avoid being denied by lead firms the proprietary technology necessary to attract local OEM clients (re: viability-based acceptance of dependent terms), face the 'catch 22' of 'immiserizing learning' when they integrate, as they then instead become vulnerable to being denied the necessary R&D resources to keep pace with advancing international product quality standards. In other words, follow source 'minor' firm-level learning is incompatible with network-level competitive interests, and in the GPN 'phase' of dependent development, peripheral suppliers has less development space to resist the forced 'internalization' of center interests. It can be said, then, that while there exists an asymmetry between subsidiaries manufacturing different components at the internodal level in terms of rent capture, there also exists an asymmetry between 'sister' subsidiaries at the intranodal level – one that increases overtime because of the growing gap in the relative distance from the technology frontier between follow source 'majors' and follow source 'minors'.

The South African automotive industry under the MIDP is used as an example of the increased structural power of transnationals to control the terms of the dependent exchange to maximize their interests. Because South Africa is not a major volume supplier of automotive components, it is not in lead firm interests (complementation-based offshoring advantage) to invest in either local supply base upgrading or broadening at the expense of directing R&D resources to other-country sister subsidiaries ('established', follow source majors). As a result, it can be deduced that transnational interests manipulated the design of the IEC scheme, specifically IRCC supply levels, to allow for a cost-viable increase in CBU production volumes without any requirement to invest in R&D manpower development to support CBU expansion. In other words, CBU expansion was artificially supported by a high effective rate of protection at the industry level, instead of increasing local follow source minor competitiveness.

ENDNOTES:

INTRODUCTION:

(1) Lorentzen, J. and Barnes, J., 2004, "Learning, Upgrading and Innovation in the South African Automotive Industry", *European Journal of Development Research*, Volume 16(3), pp. 472

(2) Le Roux, Mathabo, "UN Calls for Subsidized Job Creation", *Business Day* (Johannesberg), October 24, 2006

(3) Hartzenberg, T. and Muradzikwa, S., 2002, "Transfer of Technology for Successful Integration into the Global Economy – A Case Study of the South African Automotive Industry", UNCTAD/UNDP

(4) Lall, S., 2003, "Reinventing Industrial Strategy: The Role of Government Policy in Building International Competitiveness", The Intergovernmental Group on Monetary Affairs and Development (G24)

(5) Landler, Mark, "Reworking the A-list", *New York Times*, January 24, 2007

(6) Sumner, Andrew, 2005, "Is Foreign Direct Investment Good For the Poor? A Review and Stocktake", *Development in Practice,* Volume 15(3&4), p. 271

(7) Amann, I. and Anger, N., 2006, "Crossing the Border: The Structure of Transnational Corporate Activities", Hamburg Institute of International Economics (www.hwwa.de/), p. 29

(8) Humphrey, J. and Memedovic, O., 2003, "The Global Automotive Industry Value Chain: What Prospects for Upgrading by Developing Countries", UNIDO Sectoral Studies

(9) Bergmann, M., Mangaleswaran, R., and Mercer, G.A., 2004, "Global Sourcing in the Auto Industry", *The Mckinsey Quarterly*, Special Edition: China Today

(10) Barnes, J. and Morris, M., 2004, "The German Connection: Shifting Hegemony in the Political Economy of the South African Automotive Industry", *Industrial and Corporate Change*, Volume 13(5), p. 797

(11) Humphrey, J., 2003, "Globalisation and Supply Chain Networks: The Auto Industry in Brazil and India", *Global Networks*, Volume 3(2), p. 138

(12) Liu, X., and Wang, C., 2003, "Does Foreign Direct Investment Facilitate Technological Progress? Evidence from Chinese Industries", *Research Policy*, Volume 32, pp. 945-53

(13) Archibugi, D. and Pietrobelli, C., 2003, "The Globalization of Technology and its Implications for Developing Countries Windows of Opportunity or Further Burden?", *Technological Forecasting & Social Change*, Volume 70, pp. 861-83

(14) Soubbotina, T.P., 2006, "Generic Models of Technological Learning by Developing Countries", World Bank Science and Technology Program

(15) Liu, X., and Wang, C., 2003, "Does Foreign Direct Investment Facilitate Technological Progress? Evidence from Chinese Industries", *Research Policy*, Volume 32, pp. 945-53

(16) Cardoso, F.H. and Faletto, E., 1979, Dependency and Development in Latin America, Berkeley: University of California Press, p. 3

(17) Cardoso, F.H. and Faletto, E., 1979, Dependency and Development in Latin America, Berkeley: University of California Press, p. xxiv

(18) Kaplan, D., 2004, "Technology and the Growth of Manufactured Exports: Assessing South Africa's Performance and Policy", DRUID Summer Conference on 'Industrial Dynamics, Innovation and Development', Elsinore, Denmark, June 14-16, 2004, p. 3, www.druid.dk/index.php?id=21

(19) Flatter, F., 2005, "The Economics of the MIDP and the South African Motor Industry", Support for Economic Growth and Analysis, p. 9, www.sega.2.org.za/studies.php

CHAPTER 1:

(1) Kay, C. and Gwynne, R.N., 2000, "Relevance of Structuralist and Dependency Theories in the Neoliberal Period: A Latin American Perspective", *Journal of Development Studies*, Volume 16(1), p. 50

(2) Cardoso, F.H., 1972, "Dependency and Development in Latin America", *New Left Review*, Volume 74, p. 90

(3) Cardoso, F.H. and Faletto, E., 1979, Dependency and Development in Latin America, Berkeley: University of California Press, p. 18

(4) Oyejide, Ademole T., 2000, "Policies for Regional Integration in Africa", Economic Papers, African Development Bank, p. 13

(5) Sarkar, P., 2001, "The North-South Terms of Trade Debate: A Re-examination", *Progress in Development Studies*, Volume 1(4), p. 310

(6) Toye, John, 2002, "The Early Terms of Trade Controversy", from United Nations Intellectual History Project, Volume 2, Trade, Finance, and Development, p. 9, www.cas.umkc.edu.econ/economics/faculty/kregel/5909/Winter2002/Readings/UN3.pdf.

(7) *ibid.*, p. 15

(8) *ibid.*, p. 16

(9) Heintz, J., 2006, "Low-Wage Manufacturing and Global Commodity Chains: A Model in the Unequal Exchange Tradition", *Cambridge Journal of Economics*, Volume 30, p. 510

(10) Toye, John, 2002, "The Early Terms of Trade Controversy", from United Nations Intellectual History Project, Volume 2, Trade, Finance, and Development, p. 19, www.cas.umkc.edu.econ/economics/faculty/kregel/5909/Winter2002/Readings/UN3.pdf.

(11) Lustig, N., 1991, "From Structuralism to Neostructuralism: The Search for a Heterodox Paradigm", in P. Meller editor, The Latin American Development Debate: Neostructuralism, Neomonetarism, and Adjustment Processes, Boulder: Westview Press, p. 30

(12) Evans, P., 1979, Dependent Development: The Alliance of Multinational, State, and Local Capital in Brazil, Princeton: Princeton University Press, p. 26

(13) *ibid.*, p. 26

(14) Farfan, O.H., 2005, "Understanding and Escaping Commodity-Dependence: A Global Value-Chain Perspective", Investment Climate Unit, International Finance Corporation, The World Bank Group, p. 17

(15) Cardoso, F.H. and Faletto, E., 1979, Dependency and Development in Latin America, Berkeley: University of California Press, p. 3

(16) *ibid.*, p. 8
(17) Cardoso, F.H., 1973, "Associated-Dependent Development: Theoretical and Practical Implications", in A. Stephan editor, Authoritarian Brazil, New Haven and London: Yale University Press, p. 156
(18) Cardoso, F.H., 1972, "Dependency and Development in Latin America", *New Left Review*, Volume 74, p. 90
(19) *ibid.*, p. 91
(20) Cardoso, F.H. and Faletto, E., 1979, Dependency and Development in Latin America, Berkeley: University of California Press, p. xvi
(21) *ibid.*, p. xvi
(22) *ibid.*, p. 157
(23) *ibid.*, p. 26
(24) *ibid.*, p. xxiv
(25) Cardoso, F.H., 1973, "Associated-Dependent Development: Theoretical and Practical Implications", in A. Stephan editor, Authoritarian Brazil, New Haven and London: Yale University Press, p. 149
(26) Viotti, E.B., 2002, "National Learning System: A New Approach on Technological Change in Late Industrializing Economies and Evidences from the Cases of Brazil and Korea", *Technological Forecasting & Social Change*, Volume 69, pp. 653-80
(27) Cohen, W.M. and Levinthal, D.A., September 1989, "Innovation and Learning: The Two Faces of R&D", *The Economic Journal*, Volume 99, pp. 569-596
(28) Griffith, R. Redding, S, and Reenen, J.V., December 2000, "R&D and Absorptive Capacity: From Theory to Data", *IFS Working Paper No. W01/03*
(29) Lorentzen, J., Mollgaard, P., and Rojec, M., December 2003, "Host Country Absorption of Technology: Evidence from Automotive Supply Networks in Eastern Europe", *Industry and Innovation*, Volume 10(4), pp. 415-32
(30) Marin, A. and Bell, M., May 2006, "Technology Spillover from Foreign Direct Investment (FDI): the Active Role of MNC Subsidiaries in Argentina in the 1990s", *Journal of Development Studies*, Volume 42(4), pp. 678-97
(31) Cohen, W.M. and Levinthal, D.A., September 1989, "Innovation and Learning: The Two Faces of R&D", *The Economic Journal*, Volume 99, pp. 569-596
(32) Griffith, R. Redding, S, and Reenen, J.V., December 2000, "R&D and Absorptive Capacity: From Theory to Data", *IFS Working Paper No. W01/03*
(33) Criscuola P., and Narula, R., May 2002, "A Novel Approach to National Technological Accumulation and Absorptive Capacity: Aggregating Cohen and Levinthal", *Druid Summer Conference* on 'Industrial Dynamics of the New and Old Economy - who is embracing whom?", Copenhagen/Elsinore
(34) Sunkel, O., 1993, "From Inward-looking Development to Development From Within" in ed. Osvaldo Sunkel, Development From Within: Toward a Neostructuralist Approach for Latin America, Boulder: Lynne Reinner Publishers, p. 46
(35) Kay, C. and Gwynne, R.N., 2000, "Relevance of Structuralist and Dependency Theories in the Neoliberal Period: A Latin American Perspective", *Journal of Development Studies*, Volume 16(1), p. 62

(36) Lall, S., 2003, "Reinventing Industrial Strategy: The Role of Government Policy in Building International Competitiveness", The Intergovernmental Group on Monetary Affairs and Development (G24), p. 10
(37) Naruala, R., 2002, "Switching from Import Substitution to the 'New Economic Model' in Latin America: A Case of Not Learning from Asia", Latin American/Caribbean and Asia/Pacific Economics and Business Association, Working Paper No. 4, p. 12
(38) *ibid.*, p. 12
(39) *ibid.*, p. 12
(40) *ibid.*, p. 11
(41) *ibid.*, p. 12
(42) Cyhn, Jin W., 2000, "Technology Development of Korea's Electronics Industry: Learning from Multinational Enterprises Through OEM", *The European Journal of Development Research*, Volume 12(1), p. 160
(43) Lee, Keun and Lim, Chaisung, 2001, "Technology Regimes, Catching-up, and Leapfrogging: Finding From the Korean Industries", *Research Policy*, Volume 30, p. 460
(44) Kim, Linsu, 2001, "The Dynamics of Technological Learning in Industrialization", *International Social Science Journal*, Volume 53, p. 298
(45) Kim, Linsu, 2004, "The Multifaceted Evolution of Korean Technological Capabilities and its Implications for Contemporary Policy", *Oxford Development Studies*, Volume 32(3), p. 345
(46) *ibid.*, p. 351
(47) Hobday, M., 2000, "East vs. South East Asian Innovation Systems: Comparing OEM-and-TNC-led Growth in Economics", in eds. L. Kim and R.R. Nelson, Technology, Learning and Innovation: Experiences of Newly Industrializing Economies, Cambridge: Cambridge University Press, p. 140
(48) *ibid.*, p. 140
(49) Cyhn, Jin W., 2000, "Technology Development of Korea's Electronics Industry: Learning from Multinational Enterprises Through OEM", *The European Journal of Development Research*, Volume 12(1), p. 172
(50) *ibid.*, p. 169
(51) *ibid.*, p. 180
(52) Kim, Linsu, 2004, "The Multifaceted Evolution of Korean Technological Capabilities and its Implications for Contemporary Policy", *Oxford Development Studies*, Volume 32(3), p. 345
(53) *ibid.*, p. 360
(54) *ibid.*, p. 356
(55) Kim, L., and Yi, G., 1997, "The Dynamics of R&D in Industrial Development", *Industry and Innovation*, Volume 4(2), p. 172
(56) Kim, Linsu, 2001, "The Dynamics of Technological Learning and Industrialization", UNESCO, p. 303
(57) Kim, L., and Yi, G., 1997, "The Dynamics of R&D in Industrial Development", *Industry and Innovation*, Volume 4(2), p. 172

(58) Kim, Linsu, 2004, "The Multifaceted Evolution of Korean Technological Capabilities and its Implications for Contemporary Policy", *Oxford Development Studies*, Volume 32(3), p. 358
(59) *ibid.*, p. 361
(60) Kim, Linsu, 1999, "National System of Industrial Innovation: Dynamics of Capability Building in Korea", in ed. L. Kim, Learning and Innovation in Economic Development, p. 211
(61) *ibid.,* p. 211
(62) Kim, L., and Yi, G., 1997, "The Dynamics of R&D in Industrial Development", *Industry and Innovation*, Volume 4(2), p. 176
(63) Kim, Linsu, 1999, "National System of Industrial Innovation: Dynamics of Capability Building in Korea", in ed. L. Kim, Learning and Innovation in Economic Development, p. 211
(64) Lee, Keun and Lim, Chaisung, 2001, "Technology Regimes, Catching-up, and Leapfrogging: Finding From the Korean Industries", *Research Policy*, Volume 30, p. 465
(65) *ibid.*, p. 468
(66) *ibid.*, p. 462
(67) *ibid.*, p. 463
(68) Kim, Linsu, 1998, "Crisis Construction and Organizational Learning: Capability Building in Catching-up at Hyundai Motor", *Organizational Science*, Volume 9(4), p. 511
(69) *ibid.*, p. 514
(70) *ibid.*, p. 514
(71) *ibid.*, p. 514
(72) *ibid.*, p. 516
(73) *ibid.*, p. 515
(74) Lee, Keun and Lim, Chaisung, 2001, "Technology Regimes, Catching-up, and Leapfrogging: Finding From the Korean Industries", *Research Policy*, Volume 30, p. 470
(75) Kim, Linsu, 1998, "Crisis Construction and Organizational Learning: Capability Building in Catching-up at Hyundai Motor", *Organizational Science*, Volume 9(4), p. 516
(76) Kim, Linsu, 2004, "The Multifaceted Evolution of Korean Technological Capabilities and its Implications for Contemporary Policy", *Oxford Development Studies*, Volume 32(3), p. 354
(77) Kim, Linsu, 1998, "Crisis Construction and Organizational Learning: Capability Building in Catching-up at Hyundai Motor", *Organizational Science*, Volume 9(4), p. 513
(78) Kim, Linsu, 2004, "The Multifaceted Evolution of Korean Technological Capabilities and its Implications for Contemporary Policy", *Oxford Development Studies*, Volume 32(3), p. 354
(79) Lee, Keun and Lim, Chaisung, 2001, "Technology Regimes, Catching-up, and Leapfrogging: Finding From the Korean Industries", *Research Policy*, Volume 30, p. 481

(80) Kim, Linsu, 2004, "The Multifaceted Evolution of Korean Technological Capabilities and its Implications for Contemporary Policy", *Oxford Development Studies*, Volume 32(3), p. 354
(81) Kim, Linsu, 1998, "Crisis Construction and Organizational Learning: Capability Building in Catching-up at Hyundai Motor", *Organizational Science*, Volume 9(4), p. 519
(82) Quadros, R., Consoni, F., and Quintao, R., 2005, "R&D Outsourcing to Research Institutions: A New Look Into R&D in the Brazilian Automobile Industry", 13th GERPISA International Colloquium, June 16-17, Ministere de la Recherche, Paris, France), p. 3
(83) Carneiro-Dias, A. and Salerno, M.S., 2003, "International Division of Labor in Product Development Activities: Towards a Selective Decentralization", 11th GERPISA International Colloquium, June 11-13, Ministere de la Recherche, Paris, France), p. 2
(84) Consoni, F. and Quadros, R., 2003, "Between Centralization and Decentralization of Product Development Competencies: Recent Trajectory Changes in Brazilian Subsidiaries of Car Assemblers", 11th GERPISA International Colloquium, June 11-13, Ministere de la Recherche, Paris, France), p. 3
(85) *ibid.*, p 4
(86) Carneiro-Dias, A. and Salerno, M.S., 2003, "International Division of Labor in Product Development Activities: Towards a Selective Decentralization", 11th GERPISA International Colloquium, June 11-13, Ministere de la Recherche, Paris, France), p. 6
(87) Consoni, F. and Quadros, R., 2003, "Between Centralization and Decentralization of Product Development Competencies: Recent Trajectory Changes in Brazilian Subsidiaries of Car Assemblers", 11th GERPISA International Colloquium, June 11-13, Ministere de la Recherche, Paris, France), p. 10
(88) *ibid.*, p. 10
(89) Humphrey, J., 2003, "Globalisation and Supply Chain Networks: The Auto Industry in Brazil and India", *Global Networks*, Volume 3(2), p. 128
(90) Consoni, F. and Quadros, R., 2003, "Between Centralization and Decentralization of Product Development Competencies: Recent Trajectory Changes in Brazilian Subsidiaries of Car Assemblers", 11th GERPISA International Colloquium, June 11-13, Ministere de la Recherche, Paris, France), p. 4
(91) *ibid.*, p. 3
(92) *ibid.*, p.3
(93) *ibid.*, p.3
(94) Consoni, F. and Quadros, R., 2006, "From Adaptation to Complete Vehicle Design: A Case Study of Product Development Capabilities in a Carmaker in Brazil", *International Journal of Technology Management*, Volume 36 (1/2/3), p. 95
(95) Consoni, F. and Quadros, R., 2003, "Between Centralization and Decentralization of Product Development Competencies: Recent Trajectory Changes in Brazilian Subsidiaries of Car Assemblers", 11th GERPISA International Colloquium, June 11-13, Ministere de la Recherche, Paris, France), p. 4

(96) Consoni, F. and Quadros, R., 2006, "From Adaptation to Complete Vehicle Design: A Case Study of Product Development Capabilities in a Carmaker in Brazil", *International Journal of Technology Management*, Volume 36 (1/2/3), p. 95
(97) Quadros, R. and Queiroz, S., 2001, "The Implications of Globalisation, for the Distribution of Design Competencies in the Auto Industry in Mercusor", *Actes du Gerpisa*, No.32, p. 38
(98) Consoni, F. and Quadros, R., 2003, "Between Centralization and Decentralization of Product Development Competencies: Recent Trajectory Changes in Brazilian Subsidiaries of Car Assemblers", 11th GERPISA International Colloquium, June 11-13, Ministere de la Recherche, Paris, France), p. 9
(99) Carneiro-Dias, A. and Salerno, M.S., 2003, "International Division of Labor in Product Development Activities: Towards a Selective Decentralization", 11th GERPISA International Colloquium, June 11-13, Ministere de la Recherche, Paris, France), p. 11
(100) Quadros, R., Consoni, F., and Quintao, R., 2005, "R&D Outsourcing to Research Institutions: A New Look Into R&D in the Brazilian Automobile Industry", 13th GERPISA International Colloquium, June 16-17, Ministere de la Recherche, Paris, France), p. 3
(101) *ibid.*, p. 3
(102) *ibid.*, p.3
(103) Consoni, F. and Quadros, R., 2006, "From Adaptation to Complete Vehicle Design: A Case Study of Product Development Capabilities in a Carmaker in Brazil", *International Journal of Technology Management*, Volume 36 (1/2/3), p. 100
(104) *ibid.*, p. 98
(105) *ibid.*, p.100
(106) *ibid.*, p.101
(107) *ibid.*, p.105

CHAPTER 2:

(1) Moran, T.H., 2002, The Relationship Between Trade, Foreign Direct Investment, and Development: New Evidence, Strategy, and Tactics Under the Doha Development Agenda Negotiations", Asian Development Bank, Manila, www.adb.org/Documents/Events/2002/ADF/theordore_moran.pdf
(2) Palpacur, F., 2000, "Competence-based Strategies and Global Production Networks", *Competition & Change*, Volume 4, p. 354
(3) Lall, S., Albaladejo, M., and Zhang, J., 2004, "Mapping Fragmentation: Electronics and Automobiles in East Asia and Latin America", *Oxford Development Studies*, Volume 32(3), p. 407
(4) Langlois, R.N., 2003, "The Vanishing Hand: The Changing Dynamics of Industrial Capitalism", *Industrial and Corporate Change*, Volume 12(2), p. 373
(5) Altenburg, T., 2005, "Value Chains in Developing Countries: Research Situation and Relevance to Development Policy", Conference on International Agriculture Research for Development, Stuttgart-Hohenheim, October 11-13, 2005, www.tropentag.de/2005/proceedings/node144.html

(6) Parente, R. and Jian, Gu, 2005, "Strategic Modularization and Performance Implications in the Brazilian Automotive Industry", *International Journal of Automotive Technology and Management*, Volume 5(4), p. 432
(7) Blair, J., 2005, "Global Capitalism and Commodity Chains: Looking Back, Going Forward", *Competition & Change*, Volume 9(2), p. 164
(8) Sachwald, F., 2004, "The Integration of China and East European Countries in Global Networks. Are European Multinationals Different?", Tokyo Club Foundation for Global Studies, www.tcf.or.jp/data/20040209-10_Frederique_Sachwald.pdf
(9) Felker, G.B., 2003, "South Asian Industrialization and the Changing Global Production System", *Third World Quarterly*, Volume 24(2), p. 272
(10) Jones, R., Kierzkowski, H., Lurong Chen, 2005, "What Does Evidence Tell Us About Fragmentation and Outsourcing", *International Review of Economics and Finance*, Volume 14, p. 311
(11) *ibid.,* p. 311
(12) Palpacur, F., 2000, "Competence-based Strategies and Global Production Networks", *Competition & Change*, Volume 4, p. 369
(13) Ernst, D., Kim, L., 2002, "Global Production Networks, Knowledge Diffusion, and Local Capability Formation", *Research Policy*, Volume 31, p. 1420
(14) Steinfeld, E.S., 2004, "China's Shallow Integration: Networked Production and the New Challenges for Late Industrialization", *World Development*, Volume 32(11), p. 1984
(15) Lall, S., Albaladejo, M., and Zhang, J., 2004, "Mapping Fragmentation: Electronics and Automobiles in East Asia and Latin America", *Oxford Development Studies*, Volume 32(3), p. 407
(16) *ibid.,* p. 407
(17) Jones, R., Kierzkowski, H., Lurong Chen, 2005, "What Does Evidence Tell Us About Fragmentation and Outsourcing", *International Review of Economics and Finance*, Volume 14, p. 311
(18) *ibid.,* p. 311
(19) Hanson, G.H., Mataloni, R.J., Slaughter, M.J., 2002, "Vertical Specialization in Multinational Firms", p. 2, www.econ.yale.edu/seminars/trade/tdw02/slaughter-020923.pdf
(20) Kei-Mu, Yi, 2001, "Can Vertical Specialization Explain the Growth of World Trade?", p. 2, www.newyorkfed.org/research/staff_reports/sr96.html
(21) *ibid.,* p. 2
(22) Athukorala, Prema-Chandra and Yamashita, N., 2006, "Production Fragmentation and Trade Integration: East Asia in a Global Context", *North America Journal of Economics and Finance*, Volume 17(3), p. 235
(23) *ibid.*, p. 235
(24) Teitel, S., 2006, "On Semi-Industrialized Countries and the Acquisition of Advanced Technological Capabilities", *Economics of Innovation and New Technology*, Volume 15(2), p. 175
(25) Athukorala, P-C., 2006, "Multinational Production Networks and the New Geo-Economic Division of Labor in the Pacific Rim", p. 15, www.econpapers.repec.org/paper/paspapers/2006-09.htm

(26) Steinfeld, E.S., 2004, "China's Shallow Integration: Networked Production and the New Challenges for Late Industrialization", *World Development*, Volume 32(11), p. 1972
(27) Nolan, P. and Zhang, Jin, 2002, "The Challenge of Globalization for Large Chinese Firms", *World Development*, Volume 30(2), p. 2091
(28) Dicken, Peter, 2007, Global Shifts, New York: The Guilford Press, p. 289
(29) Sturgeon, T. and Florida, R., 2004, "Globalization, Deverticalization, and Employment in the Motor Vehicle Industry", in eds. M. Kenney and R. Florida, Locating Global Advantage, Stanford, California: Stanford University Press, p. 66
(30) Humphrey, J. and Memedovic, 2003, "The Global Automotive Industry Value Chain: What Prospects for Upgrading by Developing Countries", UNIDO Sectoral Studies Series, p. 23, www.unido.org/file-storage/download/?file_id=11902
(31) Frigant, V. and Talbot, D., 2005, "Technological Determinism and Modularity: Lessons from a Comparison between Aircraft and Auto Industries in Europe", *Industry & Innovation*, Volume 12(3), p. 352
(32) Kaplinsky, R., 2006, "Revisiting the Revisited Terms of Trade: Will China Make a Difference", *World Development*, Volume 34(6), p. 985
(33) Sadler, D., 1997, "Internationalization and Specialization in the European Automotive Components Sector: Implications for the Hollowing-out Thesis", *Regional Studies*, Volume 32(2), pp. 109-119
(34) *ibid.,* p. 112
(35) *ibid.,* p. 111
(36) *ibid.,* p. 112
(37) Sturgeon, T. and Florida, R., 2004, "Globalization, Deverticalization, and Employment in the Motor Vehicle Industry", in eds. M. Kenney and R. Florida, Locating Global Advantage, Stanford, California: Stanford University Press, p. 74
(38) *ibid.,* p. 75
(39) *ibid.,* p. 75
(40) *ibid.,* p. 70
(41) *ibid.,* p. 78
(42) Doran, D., and Roome, R., 2003, "An Evaluation of Value-Transfer Within a Modular Supply Chain", Proceedings of the I MECH E Part D *Journal of Automobile Engineering*, Volume 217(7), p. 523
(43) *ibid.,* p. 523
(44) Humphrey, John, 2003, "Globalization and Supply Networks: The Auto Industry in Brazil and India", *Global Networks*, Volume 3(2), p. 124
(45) Moran, T.H., 2002, The Relationship Between Trade, Foreign Direct Investment, and Development: New Evidence, Strategy, and Tactics Under the Doha Development Agenda Negotiations", Asian Development Bank, Manila, www.adb.org/Documents/Events/2002/ADF/theordore_moran.pdf
(46) Donor, R.F., Noble, G.W., and Ravenhill, J., 2004, "Production Networks in East Asia's Automobile Parts Industry", in Y.M. Shahid, A. Altaf, and K. Nabeshima Global Production Networking and Technological Change in East Asia, Washington, D.C.: World Bank, p. 169

(47) Dicken, Peter, 2003, "Global Production Networks in Europe and East Asia: The Automobile Components Industries", GPN Working Paper No. 7, p. 47, www.sed.manchester.ac.uk/geography/research/gpn/gpnwp7.pdf
(48) *ibid.,* p. 47
(49) Donor, R.F., Noble, G.W., and Ravenhill, J., 2004, "Production Networks in East Asia's Automobile Parts Industry", in Y.M. Shahid, A. Altaf, and K. Nabeshima Global Production Networking and Technological Change in East Asia, Washington, D.C.: World Bank, p. 169

(50) Dicken, Peter, 2003, "Global Production Networks in Europe and East Asia: The Automobile Components Industries", GPN Working Paper No. 7, p. 51, www.sed.manchester.ac.uk/geography/research/gpn/gpnwp7.pdf
(51) Kaplinsky, R., 2001, "Is Globalization All it is Cracked Up to Be?", *Review of International Political Economy*, Volume 8(1), p. 51
(52) Kaplinsky, R., 2001, "Globalization and Unequalisation: What can be Leant from Value Chain Analysis", *Journal of Development Studies*, Volume 32(7), p. 123
(53) *ibid.,* 122
(54) *ibid.,* 122
(55) Steinfeld, E.S., 2004, "China's Shallow Integration: Networked Production and the New Challenges for Late Industrialization", *World Development*, Volume 32(11), p. 1983
(56) Kaplinsky, R. and Santos-Paulino A., 2005, "Innovation and Competitiveness: Trends in Unit Prices in Global Trade", *Oxford Development Studies*, Volume 33(3&4), p. 333
(57) *ibid.,* p. 334
(58) *ibid.,* p. 335
(59) Kaplinsky, R. and Santos-Paulino A., 2006, "A Disaggregated Analysis of EU Imports: The Implications for the Study of the Patterns of Trade and Technology", *Cambridge Journal of Economics*, Volume 30, p. 597, 598.
(60) *ibid.,* p. 595
(61) Kaplinsky, R. and Santos-Paulino A., 2005, "Innovation and Competitiveness: Trends in Unit Prices in Global Trade", *Oxford Development Studies*, Volume 33(3&4), p. 352
(62) *ibid.,* p. 352
(63) Kaplinsky, R., 2006, "Revisiting the Revisited Terms of Trade: Will China Make a Difference", *World Development*, Volume 34(6), p. 985
(64) Lall, S. and Albaladejo, M., 2004, "China's Competitive Performance: A Threat to East Asian Manufactured Exports?", *World Development*, Volume 32(9), p. 1458
(65) Heintz, J., 2006, "Low-Wage Manufacturing and Global Commodity Chains: A Model in the Unequal Exchange Tradition", *Cambridge Journal of Economics*, Volume 30, p. 509
(66) Kaplinsky, R. and Santos-Paulino A., 2006, "A Disaggregated Analysis of EU Imports: The Implications for the Study of the Patterns of Trade and Technology", *Cambridge Journal of Economics*, Volume 30, p. 601

(67) Dicken, P., Kelly, P.F., Olds, K., Wai-Chung Yeung, H., 2001, "Chains and Networks, Territories and Scales: Towards and Relational Framework for Analyzing the Global Economy", *Global Networks*, Volume 1(2), p. 99
(68) Fedderke, J. and Yongcheol Shin, 2003, "Trade, Technology and Wage Inequality in the South African Manufacturing Sectors", p. 1, www.tips.org.za/node/726
(69) Heintz, J., 2006, "Low-Wage Manufacturing and Global Commodity Chains: A Model in the Unequal Exchange Tradition", *Cambridge Journal of Economics*, Volume 30, p. 509
(70) *ibid.,* p. 510
(71) *ibid.,* p. 514
(72) *ibid.,* p. 516
(73) Kaplinsky, R., 2001, "Is Globalization All it is Cracked Up to Be?", *Review of International Political Economy*, Volume 8(1), p. 52
(74) Lall, S. and Albaladejo, M., 2004, "China's Competitive Performance: A Threat to East Asian Manufactured Exports?", *World Development*, Volume 32(9), p. 1444
(75) Kaplinsky, R., 2006, "Revisiting the Revisited Terms of Trade: Will China Make a Difference", *World Development*, Volume 34(6), p. 992
(76) Farrell, D., Puron, A., and Remes, J.K., 2005, "Beyond Cheap Labor: Lessons for Developing Economies", *The McKinsey Quarterly*, Number 1, p. 1, www.mckinseyquarterly.com
(77) Lall, S., Albaladejo, M., and Zhang, J., 2004, "Mapping Fragmentation: Electronics and Automobiles in East Asia and Latin America", *Oxford Development Studies*, Volume 32(3), p. 425
(78) Kaplan, D., 2004, "Technology and the Growth of Manufactured Exports: Assessing South Africa's Performance and Policy", DRUID Summer Conference on 'Industrial Dynamics, Innovation and Development', Elsinore, Denmark, June 14-16, 2004, p. 3, www.druid.dk/index.php?id=21
(79) Soubbotina, T.P., 2005, "The Challenge of Technological Learning for Developing Countries", World Bank Science and Technology Program, p. 11, www.siteresources.worldbank.org/.../Challenge_Tech_Learning_Oct05.pdf
(80) *ibid.,* p. 11
(81) Polygreen, L. and French, H.W., 2007, "China's Trade in Africa Carries a Price Tag", August 21, 2007, www.nytimes.com
(82) McAliden, S.P., Feinstein, A., and Smith, B.C., 2000, "Michigan Automotive Partnership Memorandum No. 2", Michigan, UNTRI Report No. 2000-24-2, www.cargroup.org/pdfs/hi_tech2_final.pdf
(83) Garrett, G., 2004, "Globalization's Missing Middle", *Foreign Affairs*, Volume 83(6), p. 84
(84) Baldwin, R., 2006, "Globalization: The Great Unbundlings", from 'Globalization Challenges for Europe and Finland Project', p. 17, http://hei.unige.ch/baldwin/PapersBooks/Unbundling_Baldwin_06-09-20.pdf
(85) Yun, Chunji, 2003, "International Production Networks and the Role of the State: Lessons from East Asian Development Experience", *The European Journal of Development Research*, Volume 15(1), p. 171

(86) Hatch, W. and Yamamura, K., 1996, Asia in Japan's Embrace, New York: Cambridge University Press, p. 27
(87) Baldwin, R., 2006, "Globalization: The Great Unbundlings", from 'Globalization Challenges for Europe and Finland Project', p. 18, http://hei.unige.ch/baldwin/PapersBooks/Unbundling_Baldwin_06-09-20.pdf
(88) Jones, Ronald W., 2000, Globalization and the Theory of Input Trade, Cambridge, MA: MIT Press, cited in Milberg, William, 2004, "The Changing Structure of Trade Linked to Global Production Systems: What are the Policy Implications", *International Labor Review*, Volume 143(No. 1-2), p. 59
(89) Athukorala, P-C, 2006, "Multinational Production Networks and the New Geo-Economic Division of Labor in the Pacific Rim", p. 14, http://rspas.anu.edu.au/economics/publish/papers/wp2006/wp-econ-2006-09.pdf
(90) Lall, S. and Albaladejo, M., 2004, "China's Competitive Performance: A Threat to East Asian Manufactured Exports?", *World Development*, Volume 32(9), p. 1457
(91) Dicken, P., Kelly, P.F., Olds, K., Wai-Chung Yeung, H., 2001, "Chains and Networks, Territories and Scales: Towards and Relational Framework for Analyzing the Global Economy", *Global Networks*, Volume 1(2), p. 94
(92) Smith, A., Rainnie, A., Dunford, M., Hardy, J., Hudson, R., and Sadler, D., 2002, "Networks of Value, Commodities and Regions: Reworking Divisions of Labor in Macro-Regional Economies", *Progress in Human Geography*, Volume 26(1), p. 58
(93) Kitschelt, H., 1991, "Industrial Governance Structures, Innovation Strategies, and the Case of Japan: Sectoral or Cross-National Comparative Analysis", *International Organization*, Volume 45(4), p. 468
(94) *ibid.,* p. 468
(95) *ibid.,* p. 462
(96) Araujo, Luis, 2005, "Modularity, Systems Integration and Supply Chain Leadership", 4th Worldwide Symposium on Purchasing & Supply Chain Management, p. 4, www.ht2.org/conference/pdf/SYM1.pdf
(97) Sako, M., 2003, "The Nature of Co-Evolution of Product Architecture and Organization Architecture in the Global Automotive Industry", in Eds. A. Prencipe, A. Davies, and M. Hobday, The Business of Systems Integration, Oxford and New York: Oxford University Press, p. 231
(98) De Nies, S., Gilbert, J., Mishra, A, and Rasovsky, K., 2006, "Standards-Based Interoperability for the Advanced Telecom Computing Architecture (Advanced TCA*)", *Intel Technological Journal*, Volume 10(1), p. 19
(99) Langlois, R.N. and Robertson, P.L., 1992, "Network and Innovation in a Modular System: Lessons from the Microcomputor and Stereo Component Industries", *Research Policy*, Volume 21, p. 302
(100) Persson, M., 2006, "Editorial", *International Journal of Automotive Technology and Management*, Volume 6(3), p. 258
(101) Borrus, M., 1999, "Exploiting Asia to Beat Japan: Production Networks and the Comeback of U.S. Electronics", in editor D. Encarnation, Japanese Multinationals in Asia, New York: Oxford University Press, p. 229
(102) *ibid.,* p. 229
(103) *ibid.,* p. 231

(104) Kim, Sangbae and Hart, J.A., 2001, "The Global Political Economy of Wintelism: A New Mode of Power and Governance in the Global Computer Industry", in eds. James N. Rosenau and J.P. Singh, Information Technologies and Global Politics, Albany: State University of New York Press, p. 149
(105) Kim, Sangbae and Hart, J.A., 2002, "Explaining the Resurgence of U.S. Competitiveness: The Rise of Wintelism", *The Information Society*, Volume 18, pp. 1-12
(106) Borrus, M. and Zysman, J., 1997, "Globalization with Borders: The Rise of Wintelism as the Future of Industrial Competition", *Industry & Innovation*, Volume 4(2), pp. 141-166
(107) O'Brien, K.J. and Lohr, S., 2007, "Microsoft Ruling May Bode Ill for Other Companies", *nytimes.com*, September 18, 2007
(108) Felker, G.B., 2003, "Southeast Asian Industrialization and the Changing Global Production System", *Third World Quarterly*, Volume 24(2), p. 272
(109) *ibid.,* p. 271
(110) *ibid.,* p. 271
(111) Gereffi, G., Humphrey, J., and Sturgeon, T., 2003, "The Governance of Global Value Chains", p. 14, www.globalvaluechains.com
(112) *ibid.,* p. 14
(113) Dubois, A. and Araujo, L., 2006, "The Relationship Between Technical and Organizational Interfaces in Product Development", *The IMP Journal*, Volume 1(1), p. 35
(114) Kitschelt, H., 1991, "Industrial Governance Structures, Innovation Strategies, and the Case of Japan: Sectoral or Cross-National Comparative Analysis", *International Organization*, Volume 45(4), p. 462
(115) Araujo, Luis, 2005, "Modularity, Systems Integration and Supply Chain Leadership", 4th Worldwide Symposium on Purchasing & Supply Chain Management, p. 4, www.ht2.org/conference/pdf/SYM1.pdf
(116) Herrigel, G., 2004, "Emerging Strategies and Forms of Governance in High-Wage Component Manufacturing Regions", *Industry & Innovation*, Volume 11(1/2), p. 55
(117) Frigant, V. and Talbot, D., 2005, "Technological Determinism and Modularity: Lessons from a Comparison between Aircraft and Auto Industries in Europe", *Industry & Innovation*, Volume 12(3), p. 349

CHAPTER 3:

(1) Dunning, John, 2001, "The Eclectic (OLI) Paradigm of International Production: Past, Present and Future", *International Journal of the Economics of Business*, Volume 8(2), p. 176
(2) Dunning, John, 2000, "Globalization and the Theory of MNE Activity" in eds. Neil Hood and Stephen Young, The Globalization of Multinational Enterprise Activity and Economic Development, New York: St. Martin's Press, p. 26
(3) McCann, P. and Mudambi, R., 2004, "The Location Behavior of the Multinational Enterprise: Some Analytical Issues", *Growth and Change*, Volume 35(4), p. 497

(4) Tolentino, P.E., 2001, "From a Theory to a Paradigm: Examining the Eclectic Paradigm as a Framework in International Economics", *International Journal of the Economics of Business*, Volume 8(2), p. 191
(5) Tsai, Su-Lee, 2002, "The Other Half of the Globalization Story: Reverse Leverage as Witnessed in the Manufacturing Sector of Taiwan IT Industry", *Prospectives on Global Development and Technology*, Volume 1(1), p. 5
(6) Husseini, H., 2005, "An Economic Theory of FDI: A Behavioral Economics and Historical Approach", *The Journal of Socio-Economics*, Volume 34, p. 532
(7) Tolentino, P.E., 2001, "From a Theory to a Paradigm: Examining the Eclectic Paradigm as a Framework in International Economics", *International Journal of the Economics of Business*, Volume 8(2), p. 199
(8) *ibid.*, p. 200
(9) Dunning, John, 2001, "The Eclectic (OLI) Paradigm of International Production: Past, Present and Future", *International Journal of the Economics of Business*, Volume 8(2), p. 175
(10) Manolopoulos, D., Papanastassiou, M., and Pearce, R., 2005, "Technology Sourcing in Multinational Enterprises and the Roles of Subsidiaries: An Empirical Investigation", *International Business Review*, Volume 14, p. 261
(11) Miozzo, M., 2000, "Transnational Corporations, Industrial Policy and the 'War of Incentives': The Case of the Argentine Automobile Industry", *Development and Change*, Volume 31, p. 676
(12) Tolentino, P.E., 2001, "From a Theory to a Paradigm: Examining the Eclectic Paradigm as a Framework in International Economics", *International Journal of the Economics of Business*, Volume 8(2), p. 201
(13) Barnes, J. and Lorentzen, J., 2003, "Learning, Upgrading, and Innovation in the South African Automotive Industry", p. 5
www.hsrc.ac.za/Research_Publication_5646.phtml
(14) Sadowski, B., 2003, "Globalization, European Integration and Supply Chain Networks in Transition: The Automotive Industry in Poland", p. 23,
http://fp.tm.tue.nl/ecis/workshop/abstracts/sadowski.doc
(15) Narula, R and Dunning, J., 2000, "Industrial Development, Globalization, and Multinational Enterprises: New Realities for Developing Countries", Volume 28(2), p. 159
(16) Prystay, C. and Takahashi, Y., "Malaysia's Proton Won't Get Funds From Mitsubishi", *Wall Street Journal Eastern Edition*, January 25, 2006
(17) *The Economist*, "Lost Compass", November 15, 2007
(18) Edwin, J., "VW Ends Plans For Ties With Proton", *Wall Street Journal Eastern Edition*, January 16, 2007
(19) *The Economist*, "Rising in the East", April 26, 2007
(20) Landler, M., "Germans See Imitation in Chinese Cars", *nytimes.com*, September 12, 2007
(21) Pack, H. and Saggi, K., 1997, "Inflows of Foreign Technology and Indigenous Technology Development", *Review of Development Economics*, Volume 1(1), p. 85
(22) *ibid.*, p. 90
(23) Mytelka, L.K., 2004, "Catching Up in New Wave Technologies", *Oxford Development* Studies, Volume 32(3), p. 394

(24) *ibid.*,, p. 389
(25) Hayter, R. and Edgington, D.W., 2004, "Flying Geese in Asia: The Impacts of Japanese MNCs as a Source of Industrial Learning", *Tijdschrift voor Economische en Geografie*, Royal Dutch Geographical Society, Volume 95(1), p. 5
(26) *ibid.*, p. 9
(27) Humphrey, J., 2000, "Assembler-Supplier Relations in the Auto Industry: Globalization and National Development", *Competition and Change*, Volume 4, p. 266
(28) Humphrey, J. and Memedovic, O., 2003, "The Global Automotive Industry Value Chain: What Prospects for Upgrading by Developing Countries", UNIDO Sectoral Studies Series, p. 24, www.unido.org/en/doc/12769
(29) Humphrey, J., 2000, "Assembler-Supplier Relations in the Auto Industry: Globalization and National Development", *Competition and Change*, Volume 4, p. 252
(30) Barnes, J., 2002, "Up, Up and Away or a Bubble that is Likely to Burst? A Value Chain Analysis of the Key Exporting Subsectors of the South African Automotive Components Industry", Research Report No. 51, Industrial Restructuring Project, School of Development Studies, University of Natal, Durban, p. 44, www.tips.org.za/files/750.pdf
(31) Humphrey, J. and Memedovic, O., 2003, "The Global Automotive Industry Value Chain: What Prospects for Upgrading by Developing Countries", UNIDO Sectoral Studies Series, p. 24
(32) Barnes, J. and Morris, M., 2003, "The German Connection: Shifting Hegemony in the Political Economy of the South African Automotive Industry", *Industrial and Corporate Change*, Volume 13(5), p. 801
(33) Lorentzen, J., Robbins, G., and Barnes, J., 2004, "The Durban Auto Cluster: Global Competition, Collective Efficiency, and Local Development", Working Paper No. 41, p. 12,
www.hsrc.ac.za/research/output.../3401_Lorentzen_Durbanautocluster.pdf
(34) *ibid.*, p. 12
(35) Lorentzen, J., Mollgaard, P., and Rojec, M., 2003, "Host Country Absorption of Technology: Evidence from Automotive Supply Networks in Eastern Europe", *Industry and Innovation*, Volume 10(4), p. 429
(36) *ibid.*, p. 429
(37) *ibid.*, p. 423
(38) Humphrey, J. and Memedovic, O., 2003, "The Global Automotive Industry Value Chain: What Prospects for Upgrading by Developing Countries", UNIDO Sectoral Studies Series, p. 59
(39) Wad, P., 2007, "Offshoring of R&D Activities by TNCs Within the Automobile Industry: The Case of China and India", EADI Symposium, Globalization, TNCs, and Industrial Policies in Developing and Transitioning Countries, p. 9, www.cbs.dk/staff/pw
(40) Fuchs, M., 2005, "Borders and the Internationalization of Knowledge. Two Examples from the Automotive Components Supply Sector in Poland" in editors Gerrit Von Vilsteren and Egbert Wever, Borders and Economic Behavior in Europe: A Geographic Approach, London: Royal Van Gorcum, p. 51

(41) Wad, P., 2007, "Offshoring of R&D Activities by TNCs Within the Automobile Industry: The Case of China and India", EADI Symposium, Globalization, TNCs, and Industrial Policies in Developing and Transitioning Countries, p. 2
(42) Gammeltoft, P., 2005, "Internationalization of R&D: Trends, Drivers, and Managerial Challenges", DRUID Tenth Anniversary Summer Conference 2005, Dynamics of Industry and Innovation: Organization, Networks, and Systems, p. 13, www.druid.dk/conferences/summer2005lsa/Gammeltoft.pdf
(43) Humphrey, J., 2003, "Globalization and Supply Chain Networks: The Auto Industry in Brazil and India", *Global Networks*, Volume 3(2), p. 137
(44) Humphrey, J., 2000, "Assembler-Supplier Relations in the Auto Industry: Globalization and National Development", *Competition and Change*, Volume 4, p. 265
(45) Birkinshaw, J., and Hood, J., 1998, "Multinational Subsidiary Evolution: Capability and Charter Change in Foreign-Owned Subsidiary Companies", *The Academy of Management Review*, Volume 23(4), p. 782
(46) *ibid.*, p. 783
(47) Andersson, U., Forsgren, M., and Holm, U., 2002, "The Strategic Impact of External Networks: Subsidiary Performance and Competence Development in the Multinational Corporation", *Strategic Management Journal*, Volume 23, p. 984
(48) Birkinshaw, J., and Hood, J., 1998, "Multinational Subsidiary Evolution: Capability and Charter Change in Foreign-Owned Subsidiary Companies", *The Academy of Management Review*, Volume 23(4), p. 782
(49) *ibid.*, p. 791
(50) Forbes, N. and Wield, D., 2004, "R&D in Follower Nations", *Science and Public Policy*, Volume 31(4), pp. 267-77
(51) Kuemmerle, W., 1999, "The Drivers of Foreign Direct Investment into Research and Development: An Empirical Investigation", *Journal of International Business Studies*, Volume 30(1), p. 2
(52) Cantwell, J. and Piscitello, 2007, "Attraction and Deterrence in the Location of Foreign-Owned R&D Activities: The Role of Positive and Negative Spillovers", *International Journal of Technological Learning, Innovation, and Development*, Volume 1(1), pp. 83-111
(53) Barnes, J., 2002, "Up, Up and Away or a Bubble that is Likely to Burst? A Value Chain Analysis of the Key Exporting Subsectors of the South African Automotive Components Industry", Research Report No. 51, Industrial Restructuring Project, School of Development Studies, University of Natal, Durban, p. 58, www.tips.org.za/files/750.pdf
(54) *ibid.*, p. 58
(55) *ibid.*, p. 58
(56) Forbes, N. and Wield, D., 2000, "Managing R&D in Technology Followers", *Research Policy*, Volume 29, p. 1098
(57) Fuchs, M., 2003, "New Global Division of Competencies?", Eleventh GERPISA International Colloquium, Paris, p. 3, www.univ-evry.fr/PagesHtml/laboratoires/gerpisa/rencontre/11.rencontre/Programme.pdf
(58) Forbes, N. and Wield, D., 2000, "Managing R&D in Technology Followers", *Research Policy*, Volume 29, p. 1104
(59) *ibid.*, p. 1105

(60) *ibid.*, p. 1108
(61) *ibid.*, p. 1105
(62) Barnes, J., 2002, "Up, Up and Away or a Bubble that is Likely to Burst? A Value Chain Analysis of the Key Exporting Subsectors of the South African Automotive Components Industry", Research Report No. 51, Industrial Restructuring Project, School of Development Studies, University of Natal, Durban, p. 58, www.tips.org.za/files/750.pdf
(63) Criscuolo, P., Narula, R., and Verspagan, B., 2002, "The Relative Importance of Home and Host Innovation Systems in the Internationalization of MNE R&D: A Patent Citation Analysis", Eindhoven Centre for Innovation Studies, Working Paper 02.20, p. 7, http://fp.tm.tue.nl/ecis/Working%20Papers.eciswp73.pdf
(64) John Cantwell, personal communications
(65) Winter, J., 2007, "Spatial Division of Competencies and Local Upgrading in the Automotive Industry: Conceptual Considerations and Empirical Findings from Poland" in editors C. Tamasy and M. Taylor, In Globalizing Worlds: Geographical Perspectives on New Economic Configurations, Aldershot: Ashgate, p. 13
(66) *ibid.*, p. 8
(67) *ibid.*, p.12
(68) *ibid.*, p.11
(69) *ibid.*, p.11
(70) *ibid.*, p.12
(71) Quadros, R. and Queiroz, S., 200?, "The Implications of Globalization for the Distribution of Design Competencies in the Auto Industry in Mercosur", Eighth GERPISA International Colloquium, no. 32., p. 35
(72) Barnes, J. and Morris, M., 2003, "The German Connection: Shifting Hegemony in the Political Economy of the South African Automotive Industry", *Industrial and Corporate Change*, Volume 13(5), p. 806
(73) Cantwell J. and Mudumbi, R., 2005, "MNE Competence-Creating Subsidiary Mandates", *Strategic Management Journal*, Volume 26, pp. 1109-1128
(74) *ibid.*, p. 1117
(75) *ibid.*, p. 1116
(76) *ibid.*, p. 1112
(77) *ibid.*, p. 1122
(78) *ibid.*, p. 1112
(79) *ibid.*, p. 1113
(80) *ibid.*, p. 1115
(81) *ibid.*, p. 1115
(82) Cantwell, J. and Piscitello, L, 2005, "Recent Location of Foreign-Owned Research and Development Activities by Large Multinational Corporations in the European Regions: The Role of Spillovers and Externalities", *Regional Studies*, Volume 39 (1), p. 3
(83) Foss, N.J. and Pedersen, T., 2001, "Building a MNC Knowledge Structure: The roles of Knowledge Sources, Complementarities, and Organizational Context", p. ?, http://ir.lib.cbs.dk/download/ISBN/x656406304.pdf
(84) Mudambi, R. and Pedersen, T., 2007, "Agency Theory and Resource Dependency Theory: Complementary Explanation for Subsidiary Power in

Multinational Corporations", Centre for Strategic Management and Globalization Working Paper 5/2007, p. ?,
www.cbs.dk/content/download/60978/840515/file/SMGWP2007_5.pdf
(85) Lorentzen, J., 2005, "The Absorptive Capacities of South African Automotive Component Suppliers", *World Development*, Volume 33(7), p. 1159
(86) *ibid.*, p. 1167
(87) Barnes, J. and Lorentzen, J., 2003, "Learning, Upgrading, and Innovation in the South African Automotive Industry", p. 15
(88) Carneiro-Dias, A.V. and Salerno, M.S., 2003, "International Division of Labor in Product Development Activities: Towards a Selective Decentralization?", Eleventh GERPISA International Colloquium, Paris, p. 2,
www.gerpisa.univ-enry.fr/recontre.11/rencontre/papers/Carneiro.pdf
(89) Fahy, J., 2002, "A Resource-Based Analysis of Sustainable Competitive Advantage in a Global Environment", *International Business Review*, Volume 11, p. 57
(90) *ibid.*, p. 64
(91) Mudambi, R. and Navarra, P., 2004, "Is Knowledge Power? Knowledge Flows, Subsidiary Power and Rent-Seeking within MNCs", *Journal of International Business Studies*, Volume 35, pgs. 390, 392
(92) Narula, R. and Dunning, J., 2000, "Industrial Development, Globalization and Multinational Enterprises: New Realities for Developing Countries", *Oxford Development Studies*, Volume 28(2), p. 149

Chapter 4:

(1) Cokayne, R., "Vehicle Imports Alarm Car Parts Makers", *Business Report*, January 30, 2007, www.busrep.co.za
(2) *The New York Times*, "Focus on Manufacturing as Exports Continue to Rise", special advertising section, March 21, 2007, www.nytimes.com
(3) Njobeni, S., "Car Exports to Swell 31 Percent – NAAMSA", *Business Day* (Johannesburg), November 26, 2006, http://allafrica.com
(4) Cokayne, R., "Motor Industry Set to Invest Record R5.8bn This Year – NAAMSA", *Business Report*, February 18, 2007, www.busrep.co.za
(5) www.southafrica.info, "South Africa's Automotive Industry", accessed November 15, 2007
(6) Furlonger, D., "The MIDP So Far", *Financial Mail*, July 27, 2007, http://freefinancialmail.co.za
(7) Barnes, J. and Morris, M., 2003, "The German Connection: Shifting Hegemony in the Political Economy of the South African Automotive Industry", *Industrial and Corporate Change*, Volume 13(5), p. 794
(8) Le Roux, M., "Tata Ready to Gear Up, But is it On the Right Road?", *Business Day* (Johannesburg), November 3, 2006, http://allafrica.com
(9) Pouris, A., Steyn, J., and Kaggwa, M., 2006, "South Africa's Support of the Automotive Industry: Prospects of the Productive Asset Allowance", Automotive Industry Development Centre Report, p. 11,
www.gdnet.org/middle.php?oid=237&zone=docs&action=doc&doc=11063

(10) Motor Industry News Digest of Southern Africa, "What's the Future for the Local Motor Industry?", Jan-Mar 2006, www.cartoday.com/content/mind/reports/2006/jan-mar/local.asp
(11) Black, A., 2002, "The Export 'Success' of the Motor Industry Development Programme and the Implications for Trade and Industry Policy", p. 3, www.tips.org.za/node/1125
(12) Flatters, F., 2002, "From Import Substitution to Export Promotion: Driving the South African Motor Industry", p. 3, www.tips.org.za/node/1172
(13) Barnes, J. and Morris, M., 2003, "The German Connection: Shifting Hegemony in the Political Economy of the South African Automotive Industry", *Industrial and Corporate Change*, Volume 13(5), p. 796
(14) Flatters, F., 2002, "From Import Substitution to Export Promotion: Driving the South African Motor Industry", p. 3, www.tips.org.za/node/1172
(15) Le Roux, M., "Tata Considers Boosting Car Output for 2010", *Business Day* (Johannesburg), October 30, 2006, http://allafrica.com
(16) Kahn, M., 2006, "The South African National System of Innovation: From Constructed Crisis to Constructed Advantage", *Science and Public Policy*, Volume 33(2), p. 128
(17) Blankley, W. and Kahn M., 2005, "The History of Research and Experimental Development Measurement in South Africa and Some Current Perspectives", *South African Journal of Science*, Volume 101, p. 153
(18) Barnes, J. and Black, A., 2004, "A Strategic Assessment of the South African Motor Vehicle, Parts and Accessories Sector", p. 6, www.tips.org.za/node/388
(19) Black, A., 2002, "The Export 'Success' of the Motor Industry Development Programme and the Implications for Trade and Industry Policy", p. 11, www.tips.org.za/node/1125
(20) Barnes, J., Kaplinsky, R., and Morris, M., 2004, "Industrial Policy in Developing Economies: Developing Dynamic Comparative Advantage in the South African Automobile Sector", *Competition & Change*, Volume 8(2), p. 167
(21) Black, A. and Bhanisi, S., 2006, "Globalization, Imports and Local Content in the South African Automotive Industry", TIPS/DPRU Conference, Accelerated and Shared Growth in South Africa: Determinants, Constraints and Opportunities, p. 25, www.tips.org.za/files/forum/2006/papers/Globalisation_Imports_and_Local_Content_Black.pdf
(22) Flatter, F., 2005, "The Economics of the MIDP and the South African Motor Industry", Support for Economic Growth and Analysis, p. 9, www.sega.2.org.za/studies.php
(23) *ibid.*, p. 7
(24) *ibid.*, p.9
(25) *ibid.*, p.8
(26) Barnes, J., Kaplinsky, R., and Morris, M., 2004, "Industrial Policy in Developing Economies: Developing Dynamic Comparative Advantage in the South African Automobile Sector", *Competition & Change*, Volume 8(2), p. 169
(27) Barnes, J. and Morris, M., 2003, "The German Connection: Shifting Hegemony in the Political Economy of the South African Automotive Industry", *Industrial and Corporate Change*, Volume 13(5), p. 803

(28) *ibid.*, p. 797
(29) Black, A. and Bhanisi, S., 2006, "Globalization, Imports and Local Content in the South African Automotive Industry", TIPS/DPRU Conference, Accelerated and Shared Growth in South Africa: Determinants, Constraints and Opportunities, p. 20, www.tips.org.za/files/forum/2006/papers/Globalisation_Imports_and_Local_Content_Black.pdf
(30) Barnes, J. and Morris, M., 2003, "The German Connection: Shifting Hegemony in the Political Economy of the South African Automotive Industry", *Industrial and Corporate Change*, Volume 13(5), p. 805
(31) Kaplan, D., 2003, "Manufacturing Performance and Policy Review in South African – A Review", TIPS/DPRU Forum 2003, The Challenge of Growth and Poverty: The South African Economy Since Democracy, p. 22, www.tips.org.za/tipsdpruforum/2003
(32) Barnes, J. and Morris, M., 2003, "The German Connection: Shifting Hegemony in the Political Economy of the South African Automotive Industry", *Industrial and Corporate Change*, Volume 13(5), p. 808
(33) Barnes, J. and Lorentzen, J., 2003, "Learning, Upgrading, and Innovation in the South African Automotive Industry", p. 8 www.hsrc.ac.za/Research_Publication_5646.phtml
(34) Lorentzen, J., 2005, "The Absorptive Capacities of South African Automotive Component Suppliers", *World Development*, Volume 33(7), p. 1158
(35) aidc.co.za, "The Automotive Industry in South Africa", Extract from AIDC Business Strategy 2005-2006, p. 2
(36) Milazi, Abdul, "Revenue Lifts as South Africa's Car-Part Exports Fire Up", *Business Day* (Johannesburg), March 28, 2007, http://allafrica.com
(37) Barnes, J. and Morris, M., 2003, "The German Connection: Shifting Hegemony in the Political Economy of the South African Automotive Industry", *Industrial and Corporate Change*, Volume 13(5), p. 805
(38) Barnes, J., 2002, "Up, Up and Away or a Bubble that is Likely to Burst? A Value Chain Analysis of the Key Exporting Subsectors of the South African Automotive Components Industry", Research Report No. 51, Industrial Restructuring Project, School of Development Studies, University of Natal, Durban, p. 42, www.tips.org.za/files/750.pdf
(39) *ibid.*, p. 36
(40) *ibid.*, p. 33
(41) *ibid.*, p. 36
(42) Flatters, F., 2002, "From Import Substitution to Export Promotion: Driving the South African Motor Industry", p. 4, www.tips.org.za/node/1172
(43) Barnes, J. and Morris, M., 2003, "The German Connection: Shifting Hegemony in the Political Economy of the South African Automotive Industry", *Industrial and Corporate Change*, Volume 13(5), p. 807
(44) Kaplan, D., 2003, "Manufacturing Performance and Policy Review in South African – A Review", TIPS/DPRU Forum 2003, The Challenge of Growth and Poverty: The South African Economy Since Democracy, p. 24, www.tips.org.za/tipsdpruforum/2003

(45) Flatter, F., 2005, "The Economics of the MIDP and the South African Motor Industry", Support for Economic Growth and Analysis, p. 7, www.sega.2.org.za/studies.php
(46) Black, A. and Bhanisi, S., 2006, "Globalization, Imports and Local Content in the South African Automotive Industry", TIPS/DPRU Conference, Accelerated and Shared Growth in South Africa: Determinants, Constraints and Opportunities, p. 11, www.tips.org.za/files/forum/2006/papers/Globalisation_Imports_and_Local_Content_Black.pdf
(47) *ibid.*, p. 12
(48) Barnes, J., 2002, "Up, Up and Away or a Bubble that is Likely to Burst? A Value Chain Analysis of the Key Exporting Subsectors of the South African Automotive Components Industry", Research Report No. 51, Industrial Restructuring Project, School of Development Studies, University of Natal, Durban, p. 38, www.tips.org.za/files/750.pdf
(49) Milazi, Abdul, "Revenue Lifts as South Africa's Car-Part Exports Fire Up", *Business Day* (Johannesburg), March 28, 2007, http://allafrica.com
(50) Black, A. and Bhanisi, S., 2006, "Globalization, Imports and Local Content in the South African Automotive Industry", TIPS/DPRU Conference, Accelerated and Shared Growth in South Africa: Determinants, Constraints and Opportunities, p. 11, www.tips.org.za/files/forum/2006/papers/Globalisation_Imports_and_Local_Content_Black.pdf
(51) Black, A., 2002, "The Export 'Success' of the Motor Industry Development Programme and the Implications for Trade and Industry Policy", p. 13, www.tips.org.za/node/1125
(52) Black, A. and Bhanisi, S., 2006, "Globalization, Imports and Local Content in the South African Automotive Industry", TIPS/DPRU Conference, Accelerated and Shared Growth in South Africa: Determinants, Constraints and Opportunities, p. 24, www.tips.org.za/files/forum/2006/papers/Globalisation_Imports_and_Local_Content_Black.pdf
(53) Barnes, J. and Morris, M., 2003, "The German Connection: Shifting Hegemony in the Political Economy of the South African Automotive Industry", *Industrial and Corporate Change*, Volume 13(5), p. 798
(54) *ibid.*, p. 798
(55) *ibid.*, p. 798
(56) Black, A., 2002, "The Export 'Success' of the Motor Industry Development Programme and the Implications for Trade and Industry Policy", p. 8, www.tips.org.za/node/1125
(57) Pouris, A., Steyn, J., and Kaggwa, M., 2006, "South Africa's Support of the Automotive Industry: Prospects of the Productive Asset Allowance", Automotive Industry Development Centre Report, p. 11, www.gdnet.org/middle.php?oid=237&zone=docs&action=doc&doc=11063
(58) Kaplan, D., 2004, "Technology and the Growth of Manufactured Exports: Assessing South Africa's Performance and Policy", Druid Summer Conference, Industrial Dynamics, Innovation and Development, p. 16, www.druid.dk/uploads/tx_picturedb/ds2004-1427.pdf
(59) www.nrf.ac.za/thrip/AnnualReport/grants/html

(60) Kraak, A., 2005, "The Challenge of the 'Second Economy' in South Africa: The Contribution of Skills Development", *Journal of Vocational Education and Training*, Volume 57(4), pp. 429-452
(61) Fernandes, Paulo, 2005, "The Role of the AIDC in Skills Development in the Automotive Industry", p. 4, www.aidc.co.za
(62) *ibid.*, p. 4
(63) www.aidc.co.za, "Developing the Human Capital that the Industry Needs", accessed June 28, 2006
(64) Fernandes, Paulo, 2005, "The Role of the AIDC in Skills Development in the Automotive Industry", p. 13, www.aidc.co.za
(65) www.aidc.co.za, "Budget Cuts Put Programme at Risk", accessed June 28, 2006
(66) Black, A., 2002, "The Export 'Success' of the Motor Industry Development Programme and the Implications for Trade and Industry Policy", p. 13, www.tips.org.za/node/1125
(67) Cokayne, R., "Vehicle Imports Alarm Car Parts Makers", *Business Report*, January 30, 2007, www.busrep.co.za
(68) *ibid*
(69) Robbins, T., "China a Threat to South Africa's Automotive Success", Creamer Media's Engineering News Online, October 25, 2007, www.engineeringnews.co.za/article.php?a_id=58923
(70) Cokayne, R., "Motor Sector to Spend R1bn on Skills", *Business Report*, October 30, 2006, www.busrep.co.za
(71) Cokayne, R., "Ford Engine Plant Revs Up to Generate Forex of R1.5bn", *Business Report*, July 19, 2002, www.busrep.co.za

BIBLIOGRAPHY:

(1) www.aidc.co.za, "Developing the Human Capital that the Industry Needs", accessed June 28, 2006
(2) aidc.co.za, "The Automotive Industry in South Africa", Extract from AIDC Business Strategy 2005-2006, p. 2
(3) Altenburg, T., 2005, "Value Chains in Developing Countries: Research Situation and Relevance to Development Policy", Conference on International Agriculture Research for Development, Stuttgart-Hohenheim, October 11-13, 2005, www.tropentag.de/2005/proceedings/node144.html
(4) Amann, I. and Anger, N., 2006, "Crossing the Border: The Structure of Transnational Corporate Activities", Hamburg Institute of International Economics (www.hwwa.de/), p. 29
(5) Andersson, U., Forsgren, M., and Holm, U., 2002, "The Strategic Impact of External Networks: Subsidiary Performance and Competence Development in the Multinational Corporation", *Strategic Management Journal*, Volume 23, p. 984
(6) Araujo, Luis, 2005, "Modularity, Systems Integration and Supply Chain Leadership", 4th Worldwide Symposium on Purchasing & Supply Chain Management, p. 4, www.ht2.org/conference/pdf/SYM1.pdf
(7) Archibugi, D. and Pietrobelli, C., 2003, "The Globalization of Technology and its Implications for Developing Countries Windows of Opportunity or Further Burden?", *Technological Forecasting & Social Change*, Volume 70, pp. 861-83
(8) Athukorala, P-C., 2006, "Multinational Production Networks and the New Geo-Economic Division of Labor in the Pacific Rim", p. 15, www.econpapers.repec.org/paper/paspapers/2006-09.htm
(9) Athukorala, Prema-Chandra and Yamashita, N., 2006, "Production Fragmentation and Trade Integration: East Asia in a Global Context", *North America Journal of Economics and Finance*, Volume 17(3), p. 235
(10) Baldwin, R., 2006, "Globalization: The Great Unbundlings", from 'Globalization Challenges for Europe and Finland Project', p. 17
(11) Barnes, J., 2002, "Up, Up and Away or a Bubble that is Likely to Burst? A Value Chain Analysis of the Key Exporting Subsectors of the South African Automotive Components Industry", Research Report No. 51, Industrial Restructuring Project, School of Development Studies, University of Natal, Durban, p. 44, www.tips.org.za/files/750.pdf
(12) Barnes, J. and Black, A., 2004, "A Strategic Assessment of the South African Motor Vehicle, Parts and Accessories Sector", p. 6, www.tips.org.za/node/388
(13) Barnes, J., Kaplinsky, R., and Morris, M., 2004, "Industrial Policy in Developing Economies: Developing Dynamic Comparative Advantage in the South African Automobile Sector", *Competition & Change*, Volume 8(2), p. 167
(14) Barnes, J. and Lorentzen, J., 2003, "Learning, Upgrading, and Innovation in the South African Automotive Industry", p. 5 www.hsrc.ac.za/Research_Publication_5646.phtml
(15) Barnes, J. and Morris, M., 2004, "The German Connection: Shifting Hegemony in the Political Economy of the South African Automotive Industry", *Industrial and Corporate Change*, Volume 13(5), p. 797

(16) Bergmann, M., Mangaleswaran, R., and Mercer, G.A., 2004, "Global Sourcing in the Auto Industry", *The Mckinsey Quarterly*, Special Edition: China Today
(17) Birkinshaw, J., and Hood, J., 1998, "Multinational Subsidiary Evolution: Capability and Charter Change in Foreign-Owned Subsidiary Companies", *The Academy of Management Review*, Volume 23(4), p. 782
(18) Black, A., 2002, "The Export 'Success' of the Motor Industry Development Programme and the Implications for Trade and Industry Policy", p. 3, www.tips.org.za/node/1125
(19) Black, A. and Bhanisi, S., 2006, "Globalization, Imports and Local Content in the South African Automotive Industry", TIPS/DPRU Conference, Accelerated and Shared Growth in South Africa: Determinants, Constraints and Opportunities, p. 25, www.tips.org.za/files/forum/2006/papers/Globalisation_Imports_and_Local_Content_Black.pdf
(20) Blair, J., 2005, "Global Capitalism and Commodity Chains: Looking Back, Going Forward", *Competition & Change*, Volume 9(2), p. 164
(21) Blankley, W. and Kahn M., 2005, "The History of Research and Experimental Development Measurement in South Africa and Some Current Perspectives", *South African Journal of Science*, Volume 101, p. 153
(22) Borrus, M., 1999, "Exploiting Asia to Beat Japan: Production Networks and the Comeback of U.S. Electronics", in editor D. Encarnation, Japanese Multinationals in Asia, New York: Oxford University Press, p. 229
(23) Borrus, M. and Zysman, J., 1997, "Globalization with Borders: The Rise of Wintelism as the Future of Industrial Competition", *Industry & Innovation*, Volume 4(2), pp. 141-166
(24) Cantwell J. and Mudumbi, R., 2005, "MNE Competence-Creating Subsidiary Mandates", *Strategic Management Journal*, Volume 26, pp. 1109-1128
(25) Cantwell, J. and Piscitello, L, 2005, "Recent Location of Foreign-Owned Research and Development Activities by Large Multinational Corporations in the European Regions: The Role of Spillovers and Externalities", *Regional Studies*, Volume 39 (1), p. 3
(26) Cantwell, J. and Piscitello, 2007, "Attraction and Deterrence in the Location of Foreign-Owned R&D Activities: The Role of Positive and Negative Spillovers", *International Journal of Technological Learning, Innovation, and Development*, Volume 1(1), pp. 83-111
(27) Cardoso, F.H., 1972, "Dependency and Development in Latin America", *New Left Review*, Volume 74, p. 90
(28) Cardoso, F.H., 1973, "Associated-Dependent Development: Theoretical and Practical Implications", in A. Stephan editor, Authoritarian Brazil, New Haven and London: Yale University Press, p. 156
(29) Cardoso, F.H. and Faletto, E., 1979, Dependency and Development in Latin America, Berkeley: University of California Press, p. xxiv
(30) Carneiro-Dias, A. and Salerno, M.S., 2003, "International Division of Labor in Product Development Activities: Towards a Selective Decentralization", 11th GERPISA International Colloquium, June 11-13, Ministere de la Recherche, Paris, France), p. 2

(31) Cimoli, M. and Katz, J., 2003, "Structural Reforms, Technological Gaps and Economic Development: A Latin American Perspective", *Industrial and Corporate Change*, Volume 12(2), pp. 387-411
(32) Ciravegna, L., 2004, "Decentralized Automotive Value Chain Globalization: A Motor for Functional Upgrading?", DRUID Summer Conference 2004 on Industrial Dynamics, Innovation and Development, Elsinore, Denmark, June 14-16, 2004
(33) Coe, N.M., Hess, M., Yeung, H., Dicken, P., and Henderson, J., 2004, "Globalizing Regional Development: A Global Production Network Perspective", *Transactions of the Institute of British Geographers*, Volume 29, pp. 468-484
(34) Cohen, W.M. and Levinthal, D.A., September 1989, "Innovation and Learning: The Two Faces of R&D", *The Economic Journal*, Volume 99, pp. 569-596
(35) Cokayne, R., "Ford Engine Plant Revs Up to Generate Forex of R1.5bn", *Business Report*, July 19, 2002, www.busrep.co.za
(33) Cokayne, R., "Motor Sector to Spend R1bn on Skills", *Business Report*, October 30, 2006, www.busrep.co.za
(36) Cokayne, R., "Vehicle Imports Alarm Car Parts Makers", *Business Report*, January 30, 2007, www.busrep.co.za
(37) Cokayne, R., "Motor Industry Set to Invest Record R5.8bn This Year – NAAMSA", *Business Report*, February 18, 2007, www.busrep.co.za
(38) Consoni, F. and Quadros, R., 2003, "Between Centralization and Decentralization of Product Development Competencies: Recent Trajectory Changes in Brazilian Subsidiaries of Car Assemblers", 11th GERPISA International Colloquium, June 11-13, Ministere de la Recherche, Paris, France), p. 3
(39) Consoni, F. and Quadros, R., 2006, "From Adaptation to Complete Vehicle Design: A Case Study of Product Development Capabilities in a Carmaker in Brazil", *International Journal of Technology Management*, Volume 36 (1/2/3), p. 95
(40) Criscuola P., and Narula, R., May 2002, "A Novel Approach to National Technological Accumulation and Absorptive Capacity: Aggregating Cohen and Levinthal", *Druid Summer Conference* on 'Industrial Dynamics of the New and Old Economy - who is embracing whom?", Copenhagen/Elsinore
(41) Criscuolo, P., Narula, R., and Verspagan, B., 2002, "The Relative Importance of Home and Host Innovation Systems in the Internationalization of MNE R&D: A Patent Citation Analysis", Eindhoven Centre for Innovation Studies, Working Paper 02.20, p. 7, http://fp.tm.tue.nl/ecis/Working%20Papers.eciswp73.pdf
(42) Cyhn, Jin W., 2000, "Technology Development of Korea's Electronics Industry: Learning from Multinational Enterprises Through OEM", *The European Journal of Development Research*, Volume 12(1), p. 160
(43) De Nies, S., Gilbert, J., Mishra, A, and Rasovsky, K., 2006, "Standards-Based Interoperability for the Advanced Telecom Computing Architecture (Advanced TCA*)", *Intel Technological Journal*, Volume 10(1), p. 19
(44) Dicken, Peter, 2003, "Global Production Networks in Europe and East Asia: The Automobile Components Industries", GPN Working Paper No. 7, p. 47, www.sed.manchester.ac.uk/geography/research/gpn/gpnwp7.pdf
(45) Dicken, P., Kelly, P.F., Olds, K., Wai-Chung Yeung, H., 2001, "Chains and Networks, Territories and Scales: Towards and Relational Framework for Analyzing the Global Economy", *Global Networks*, Volume 1(2), p. 99

(46) Donor, R.F., Noble, G.W., and Ravenhill, J., 2004, "Production Networks in East Asia's Automobile Parts Industry", in Y.M. Shahid, A. Altaf, and K. Nabeshima Global Production Networking and Technological Change in East Asia, Washington, D.C.: World Bank, p. 169
(47) Doran, D., and Roome, R., 2003, "An Evaluation of Value-Transfer Within a Modular Supply Chain", Proceedings of the I MECH E Part D *Journal of Automobile Engineering*, Volume 217(7), p. 523
(48) Dubois, A. and Araujo, L., 2006, "The Relationship Between Technical and Organizational Interfaces in Product Development", *The IMP Journal*, Volume 1(1), p. 35
(49) Dunning, John, 2000, "Globalization and the Theory of MNE Activity" in eds. Neil Hood and Stephen Young, The Globalization of Multinational Enterprise Activity and Economic Development, New York: St. Martin's Press, p. 26
(50) Dunning, John, 2001, "The Eclectic (OLI) Paradigm of International Production: Past, Present and Future", *International Journal of the Economics of Business*, Volume 8(2), p. 176
(51) Dutrenit, G., 2004, "Building Technological Capabilities in Latecomer Firms: A Review Essay", *Science, Technology & Science*, Volume 9(2), pp. 209-241
(52) *The Economist*, "Rising in the East", April 26, 2007
(53) *The Economist*, "Lost Compass", November 15, 2007
(54) Edwin, J., "VW Ends Plans For Ties With Proton", *Wall Street Journal Eastern Edition*, January 16, 2007
(55) Ernst, D., Kim, L., 2002, "Global Production Networks, Knowledge Diffusion, and Local Capability Formation", *Research Policy*, Volume 31, p. 1420
(56) Evans, P., 1979, Dependent Development: The Alliance of Multinational, State, and Local Capital in Brazil, Princeton: Princeton University Press, p. 26
(57) Fahy, J., 2002, "A Resource-Based Analysis of Sustainable Competitive Advantage in a Global Environment", *International Business Review*, Volume 11, p. 57
(58) Farfan, O.H., 2005, "Understanding and Escaping Commodity-Dependence: A Global Value-Chain Perspective", Investment Climate Unit, International Finance Corporation, The World Bank Group, p. 17
(59) Farrell, D., Puron, A., and Remes, J.K., 2005, "Beyond Cheap Labor: Lessons for Developing Economies", *The McKinsey Quarterly*, Number 1, p. 1, www.mckinseyquarterly.com
(60) Fedderke, J. and Yongcheol Shin, 2003, "Trade, Technology and Wage Inequality in the South African Manufacturing Sectors", p. 1, www.tips.org.za/node/726
(61) Felker, G.B., 2003, "Southeast Asian Industrialization and the Changing Global Production System", *Third World Quarterly*, Volume 24(2), p. 272
(62) Fernandes, Paulo, 2005, "The Role of the AIDC in Skills Development in the Automotive Industry", p. 13, www.aidc.co.za
(63) Flatters, F., 2002, "From Import Substitution to Export Promotion: Driving the South African Motor Industry", p. 3, www.tips.org.za/node/1172

(64) Flatter, F., 2005, "The Economics of the MIDP and the South African Motor Industry", Support for Economic Growth and Analysis, p. 9, www.sega.2.org.za/studies.php
(65) Forbes, N. and Wield, D., 2000, "Managing R&D in Technology Followers", *Research Policy*, Volume 29, p. 1098
(66) Forbes, N. and Wield, D., 2004, "R&D in Follower Nations", *Science and Public Policy*, Volume 31(4), pp. 267-77
(67) Foss, N.J. and Pedersen, T., 2001, "Building a MNC Knowledge Structure: The roles of Knowledge Sources, Complementarities, and Organizational Context", p. ?, http://ir.lib.cbs.dk/download/ISBN/x656406304.pdf
(68) Frigant, V. and Talbot, D., 2005, "Technological Determinism and Modularity: Lessons from a Comparison between Aircraft and Auto Industries in Europe", *Industry & Innovation*, Volume 12(3), p. 352
(69) Fuchs, M., 2003, "New Global Division of Competencies?", Eleventh GERPISA International Colloquium, Paris, p. 3, www.univ-evry.fr/PagesHtml/laboratoires/gerpisa/rencontre/11.rencontre/Programme.pdf
(70) Fuchs, M., 2005, "Borders and the Internationalization of Knowledge. Two Examples from the Automotive Components Supply Sector in Poland" in editors Gerrit Von Vilsteren and Egbert Wever, Borders and Economic Behavior in Europe: A Geographic Approach, London: Royal Van Gorcum, p. 51
(71) Furlonger, D., "The MIDP So Far", *Financial Mail*, July 27, 2007, http://freefinancialmail.co.za
(72) Gammeltoft, P., 2005, "Internationalization of R&D: Trends, Drivers, and Managerial Challenges", DRUID Tenth Anniversary Summer Conference 2005, Dynamics of Industry and Innovation: Organization, Networks, and Systems, p. 13, www.druid.dk/conferences/summer2005lsa/Gammeltoft.pdf
(73) Garrett, G., 2004, "Globalization's Missing Middle", *Foreign Affairs*, Volume 83(6), p. 84
(74) Gereffi, G. and Sturgeon, T., 2004, "Globalization, Employment, and Economic Development: A Briefing Paper", Sloan Workshop Series in Industry Studies, Rockport Massachusetts, June 14-16, 2004
(75) Gereffi, G., Humphrey, J., and Sturgeon, T., 2003, "The Governance of Global Value Chains", p. 14, www.globalvaluechains.com
(76) Gereffi, G., Humphrey, J., and Sturgeon, T., 2003, "The Governance of Global Value Chains", p. 14, www.globalvaluechains.com
(77) Girma, S., 2005, "Absorptive Capacity and Productivity Spillovers from FDI: A Threshold Regression Analysis", *Oxford Bulletin of Economics and Statistics*, Volume 67(3), p. 281
(78) Griffith, R. Redding, S, and Reenen, J.V., December 2000, "R&D and Absorptive Capacity: From Theory to Data", *IFS Working Paper No. W01/03*
(79) Hanson, G.H., Mataloni, R.J., Slaughter, M.J., 2002, "Vertical Specialization in Multinational Firms", p. 2, www.econ.yale.edu/seminars/trade/tdw02/slaughter-020923.pdf
(80) Hartzenberg, T. and Muradzikwa, S., 2002, "Transfer of Technology for Successful Integration into the Global Economy – A Case Study of the South African Automotive Industry", UNCTAD/UNDP

(81) Hatch, W. and Yamamura, K., 1996, Asia in Japan's Embrace, New York: Cambridge University Press, p. 27
(82) Hayter, R. and Edgington, D.W., 2004, "Flying Geese in Asia: The Impacts of Japanese MNCs as a Source of Industrial Learning", *Tijdschrift voor Economische en Geografie*, Royal Dutch Geographical Society, Volume 95(1), p. 5
(83) Heintz, J., 2006, "Low-Wage Manufacturing and Global Commodity Chains: A Model in the Unequal Exchange Tradition", *Cambridge Journal of Economics*, Volume 30, p. 510
(84) Herrigel, G., 2004, "Emerging Strategies and Forms of Governance in High-Wage Component Manufacturing Regions", *Industry & Innovation*, Volume 11(1/2), p. 55
(85) Hobday, M., 2000, "East vs. South East Asian Innovation Systems: Comparing OEM-and-TNC-led Growth in Economics", in eds. L. Kim and R.R. Nelson, Technology, Learning and Innovation: Experiences of Newly Industrializing Economies, Cambridge: Cambridge University Press, p. 140
(86) Hobday, M., 2001, "The Electronics Industries of the Asia-Pacific", *Asia-Pacific Economic Literature*, Volume 15, pp. 13-29
(87) Humphrey, J., 2000, "Assembler-Supplier Relations in the Auto Industry: Globalization and National Development", *Competition and Change*, Volume 4, p. 266
(88) Humphrey, J., 2003, "Globalisation and Supply Chain Networks: The Auto Industry in Brazil and India", *Global Networks*, Volume 3(2), p. 138
(89) Humphrey, J. and Memedovic, O., 2003, "The Global Automotive Industry Value Chain: What Prospects for Upgrading by Developing Countries", UNIDO Sectoral Studies, p. 24, www.unido.org/en/doc/12769
(90) Husseini, H., 2005, "An Economic Theory of FDI: A Behavioral Economics and Historical Approach", *The Journal of Socio-Economics*, Volume 34, p. 532
(91) Jones, Ronald W., 2000, Globalization and the Theory of Input Trade, Cambridge, MA: MIT Press, cited in Milberg, William, 2004, "The Changing Structure of Trade Linked to Global Production Systems: What are the Policy Implications", *International Labor Review*, Volume 143(No. 1-2), p. 59
(92) Jones, R., Kierzkowski, H., Lurong Chen, 2005, "What Does Evidence Tell Us About Fragmentation and Outsourcing", *International Review of Economics and Finance*, Volume 14, p. 311
(93) Kahn, M., 2006, "The South African National System of Innovation: From Constructed Crisis to Constructed Advantage", *Science and Public Policy*, Volume 33(2), p. 128
(94) Kaplan, D., 2003, "Manufacturing Performance and Policy Review in South African – A Review", TIPS/DPRU Forum 2003, The Challenge of Growth and Poverty: The South African Economy Since Democracy, p. 22, www.tips.org.za/tipsdpruforum/2003
(95) Kaplan, D., 2004, "Technology and the Growth of Manufactured Exports: Assessing South Africa's Performance and Policy", DRUID Summer Conference on 'Industrial Dynamics, Innovation and Development', Elsinore, Denmark, June 14-16, 2004, p. 3, www.druid.dk/index.php?id=21
(96) Kaplinsky, R., 2001, "Is Globalization All it is Cracked Up to Be?", *Review of International Political Economy*, Volume 8(1), p. 52

(97) Kaplinsky, R., 2001, "Globalization and Unequalisation: What can be Leant from Value Chain Analysis", *Journal of Development Studies*, Volume 32(7), p. 123
(98) Kaplinsky, R., 2006, "Revisiting the Revisited Terms of Trade: Will China Make a Difference", *World Development*, Volume 34(6), p. 985
(99) Kaplinsky, R. and Santos-Paulino A., 2005, "Innovation and Competitiveness: Trends in Unit Prices in Global Trade", *Oxford Development Studies*, Volume 33(3&4), p. 333
(100) Kaplinsky, R. and Santos-Paulino A., 2006, "A Disaggregated Analysis of EU Imports: The Implications for the Study of the Patterns of Trade and Technology", *Cambridge Journal of Economics*, Volume 30, p. 597, 598.
(101) Katrak, H., 2002, "Does Economic Liberalization Endanger Indigenous Technological Developments? An Analysis of the Indian Experience", *Research Policy*, Volume 31, pp. 19-30
(102) Kay, C. and Gwynne, R.N., 2000, "Relevance of Structuralist and Dependency Theories in the Neoliberal Period: A Latin American Perspective", *Journal of Development Studies*, Volume 16(1), p. 50
(103) Kei-Mu, Yi, 2001, "Can Vertical Specialization Explain the Growth of World Trade?", p. 2, www.newyorkfed.org/research/staff_reports/sr96.html
(104) Kiely, R., 1998, "Globalization, Post-Fordism and the Contemporary Context of Development", *International Sociology*, Volume 13(1), pp. 95-115
(105) Kim, L., and Yi, G., 1997, "The Dynamics of R&D in Industrial Development", *Industry and Innovation*, Volume 4(2), p. 172
(106) Kim, Linsu, 1998, "Crisis Construction and Organizational Learning: Capability Building in Catching-up at Hyundai Motor", *Organizational Science*, Volume 9(4), p. 511
(107) Kim, Linsu, 1999, "National System of Industrial Innovation: Dynamics of Capability Building in Korea", in ed. L. Kim, Learning and Innovation in Economic Development, p. 211
(108) Kim, Linsu, 2001, "The Dynamics of Technological Learning and Industrialization", United Nations Educational, Scientific, and Cultural Organization
(109) Kim, Linsu, 2004, "The Multifaceted Evolution of Korean Technological Capabilities and its Implications for Contemporary Policy", *Oxford Development Studies*, Volume 32(3), p. 345
(110) Kim, Sangbae and Hart, J.A., 2001, "The Global Political Economy of Wintelism: A New Mode of Power and Governance in the Global Computer Industry", in eds. James N. Rosenau and J.P. Singh, Information Technologies and Global Politics, Albany: State University of New York Press, p. 149
(111) Kim, Sangbae and Hart, J.A., 2002, "Explaining the Resurgence of U.S. Competitiveness: The Rise of Wintelism", *The Information Society*, Volume 18, pp. 1-12
Kitschelt, H., 1991, "Industrial Governance Structures, Innovation Strategies, and the Case of Japan: Sectoral or Cross-National Comparative Analysis", *International Organization*, Volume 45(4), p. 468
(112) Kraak, A., 2005, "The Challenge of the 'Second Economy' in South Africa: The Contribution of Skills Development", *Journal of Vocational Education and Training*, Volume 57(4), pp. 429-452

(113) Kuemmerle, W., 1999, "The Drivers of Foreign Direct Investment into Research and Development: An Empirical Investigation", *Journal of International Business Studies*, Volume 30(1), p. 2
(114) Lall, S., 2003, "Reinventing Industrial Strategy: The Role of Government Policy in Building International Competitiveness", The Intergovernmental Group on Monetary Affairs and Development (G24)
(115) Lall, S. and Albaladejo, M., 2004, "China's Competitive Performance: A Threat to East Asian Manufactured Exports?", *World Development*, Volume 32(9), p. 1458
(116) Lall, S., Albaladejo, M., and Zhang, J., 2004, "Mapping Fragmentation: Electronics and Automobiles in East Asia and Latin America", *Oxford Development Studies*, Volume 32(3), p. 407
(117) Landler, Mark, "Reworking the A-list", *New York Times*, January 24, 2007
(118) Landler, M., "Germans See Imitation in Chinese Cars", *nytimes.com*, September 12, 2007
(119) Langlois, R.N., 2003, "The Vanishing Hand: The Changing Dynamics of Industrial Capitalism", *Industrial and Corporate Change*, Volume 12(2), p. 373
(111) Langlois, R.N. and Robertson, P.L., 1992, "Network and Innovation in a Modular System: Lessons from the Microcomputor and Stereo Component Industries", *Research Policy*, Volume 21, p. 302
(120) Lauridsen, L.S., 2004, "Foreign Direct Investment, Linkage Formation and Supplier Development in Thailand During the 1990s: The Role of State Governance", *The European Journal of Development Research*, Volume 16(3), pp. 561-586
(121) Lee, Keun and Lim, Chaisung, 2001, "Technology Regimes, Catching-up, and Leapfrogging: Finding From the Korean Industries", *Research Policy*, Volume 30, p. 460
(122) Le Roux, Mathabo, "UN Calls for Subsidized Job Creation", *Business Day* (Johannesberg), October 24, 2006
(123) Le Roux, M., "Tata Considers Boosting Car Output for 2010", *Business Day* (Johannesburg), October 30, 2006, http://allafrica.com
(124) Le Roux, M., "Tata Ready to Gear Up, But is it On the Right Road?", *Business Day* (Johannesburg), November 3, 2006, http://allafrica.com
(125) Li, X. and Liu, X., 2003, "Foreign Direct Investment and Economic Growth: An Increasingly Endogenous Relationship", *World Development*, Volume 33(3), pp. 393-407
(126) Liu, X., and Wang, C., 2003, "Does Foreign Direct Investment Facilitate Technological Progress? Evidence from Chinese Industries", *Research Policy*, Volume 32, pp. 945-53
(127) Lorentzen, J. and Barnes, J., 2004, "Learning, Upgrading and Innovation in the South African Automotive Industry", *European Journal of Development Research*, Volume 16(3), pp. 472
(128) Lorentzen, J., Mollgaard, P., and Rojec, M., December 2003, "Host Country Absorption of Technology: Evidence from Automotive Supply Networks in Eastern Europe", *Industry and Innovation*, Volume 10(4), pp. 415-32
(129) Lorentzen, J., Robbins, G., and Barnes, J., 2004, "The Durban Auto Cluster: Global Competition, Collective Efficiency, and Local Development", Working Paper

No. 41, p. 12,
www.hsrc.ac.za/research/output.../3401_Lorentzen_Durbanautocluster.pdf
(130) Lustig, N., 1991, "From Structuralism to Neostructuralism: The Search for a Heterodox Paradigm", in P. Meller editor, The Latin American Development Debate: Neostructuralism, Neomonetarism, and Adjustment Processes, Boulder: Westview Press, p. 30
(131) Luthje, B., 2002, "Electronics Contract Manufacturing: Global Production and the International Division of Labor in the Age of the Internet", *Industry and Innovation,* Volume 9(3), pp. 227-247
(132) Malairaja, C. and Zawdie, G., 2004, "The Black Box Syndrome in Technology Transfer and the Challenge of Innovation in Developing Countries", *International Journal of Technology Management and Sustainable Development*, Volume 3(3), 233-251
(133) Manolopoulos, D., Papanastassiou, M., and Pearce, R., 2005, "Technology Sourcing in Multinational Enterprises and the Roles of Subsidiaries: An Empirical Investigation", *International Business Review*, Volume 14, p. 261
(134) Marin, A. and Bell, M., May 2006, "Technology Spillover from Foreign Direct Investment (FDI): the Active Role of MNC Subsidiaries in Argentina in the 1990s", *Journal of Development Studies*, Volume 42(4), pp. 678-97
(135) McAliden, S.P., Feinstein, A., and Smith, B.C., 2000, "Michigan Automotive Partnership Memorandum No. 2", Michigan, UNTRI Report No. 2000-24-2, www.cargroup.org/pdfs/hi_tech2_final.pdf
(136) McCann, P. and Mudambi, R., 2004, "The Location Behavior of the Multinational Enterprise: Some Analytical Issues", *Growth and Change*, Volume 35(4), p. 497
(137) Milazi, Abdul, "Revenue Lifts as South Africa's Car-Part Exports Fire Up", *Business Day* (Johannesburg), March 28, 2007, http://allafrica.com
(138) Miozzo, M., 2000, "Transnational Corporations, Industrial Policy and the 'War of Incentives': The Case of the Argentine Automobile Industry", *Development and Change*, Volume 31, p. 676
(139) Moran, T.H., 2002, The Relationship Between Trade, Foreign Direct Investment, and Development: New Evidence, Strategy, and Tactics Under the Doha Development Agenda Negotiations", Asian Development Bank, Manila, www.adb.org/Documents/Events/2002/ADF/theordore_moran.pdf
(140) Moran, T.H., Graham, E.M., and Blomstrom, M., 2005, Does Foreign Direct Investment Promote Development? Washington D.C.: Institute for International Economics
(141) Mortimore, M., 2006, "The Transnationalization of Developing America: opportunities and challenges",
www.lse.ac.uk/collections/DESTIN/pdf/GlobalisationAmericasConference/Mortimore.pdf
(142) Motor Industry News Digest of Southern Africa, "What's the Future for the Local Motor Industry?", Jan-Mar 2006,
www.cartoday.com/content/mind/reports/2006/jan-mar/local.asp

(143) Mudambi, R. and Navarra, P., 2004, "Is Knowledge Power? Knowledge Flows, Subsidiary Power and Rent-Seeking within MNCs", *Journal of International Business Studies*, Volume 35, pgs. 390, 392
(144) Mudambi, R. and Pedersen, T., 2007, "Agency Theory and Resource Dependency Theory: Complementary Explanation for Subsidiary Power in Multinational Corporations", Centre for Strategic Management and Globalization Working Paper 5/2007, p. ?, www.cbs.dk/content/download/60978/840515/file/SMGWP2007_5.pdf
(145) Mytelka, L.K., 2004, "Catching Up in New Wave Technologies", *Oxford Development* Studies, Volume 32(3), p. 394
(146) Narayanan, S. and Wah, L.Y., 2000, "Technological Maturity and Development Without Research: The Challenge for Malaysian Manufacturing", *Development and Change,* Volume 31, pp. 435-457
(147) Naruala, R., 2002, "Switching from Import Substitution to the 'New Economic Model' in Latin America: A Case of Not Learning from Asia", Latin American/Caribbean and Asia/Pacific Economics and Business Association, Working Paper No. 4, p. 12
(148) Narula, R and Dunning, J., 2000, "Industrial Development, Globalization, and Multinational Enterprises: New Realities for Developing Countries", Volume 28(2), p. 159
(149) *The New York Times*, "Focus on Manufacturing as Exports Continue to Rise", special advertising section, March 21, 2007, www.nytimes.com
(150) Njobeni, S., "Car Exports to Swell 31 Percent – NAAMSA", *Business Day* (Johannesburg), November 26, 2006, http://allafrica.com
(151) Nolan, P. and Zhang, Jin, 2002, "The Challenge of Globalization for Large Chinese Firms", *World Development*, Volume 30(2), p. 2091
(152) O'Brien, K.J. and Lohr, S., 2007, "Microsoft Ruling May Bode Ill for Other Companies", nytimes.com, September 18, 2007
(153) Oyejide, Ademole T., 2000, "Policies for Regional Integration in Africa", Economic Papers, African Development Bank, p. 13
(154) Pack, H. and Saggi, K., 1997, "Inflows of Foreign Technology and Indigenous Technology Development", *Review of Development Economics*, Volume 1(1), p. 85
(155) Palpacuer, F., 2000, "Competence-based Strategies and Global Production Networks", *Competition & Change*, Volume 4, p. 354
(156) Palpacuer, F. and Parisotto, A., 2003, "Global Production and Local Jobs: Can Global Enterprise Networks Be Used As Levers for Local Development", *Global Networks*, Volume 3(2), p.. 97-120
(157) Parente, R. and Jian, Gu, 2005, "Strategic Modularization and Performance Implications in the Brazilian Automotive Industry", *International Journal of Automotive Technology and Management,* Volume 5(4), p. 432
(158) Park, K-H and Lee, K., 2006, "Linking the Technological Regime to the Technological Catch-up: Analyzing Korea and Taiwan Using the US Patent Data", *Industrial and Corporate Change*, Volume 15(4), pp. 715-753
(159) Pavlinek, P., 2002, "Transformation of the Central and East European Passenger Car Industry: Selective Peripheral Integration through Foreign Direct Investment", *Environment and Planning A*, Volume 34, pp. 1685-1709

(160) Pearce, R., 1999, "The Evolution of Technology in Multinational Enterprises: The Role of Creative Subsidiaries", *International Business Review*, Volume 8, pp. 125-148

(161) Persson, M., 2006, "Editorial", *International Journal of Automotive Technology and Management*, Volume 6(3), p. 258

(162) Polygreen, L. and French, H.W., 2007, "China's Trade in Africa Carries a Price Tag", August 21, 2007, www.nytimes.com

(163) Pouris, A., Steyn, J., and Kaggwa, M., 2006, "South Africa's Support of the Automotive Industry: Prospects of the Productive Asset Allowance", Automotive Industry Development Centre Report, p. 11, www.gdnet.org/middle.php?oid=237&zone=docs&action=doc&doc=11063

(164) Prystay, C. and Takahashi, Y., "Malaysia's Proton Won't Get Funds From Mitsubishi", *Wall Street Journal Eastern Edition*, January 25, 2006

(165) Quadros, R., Consoni, F., and Quintao, R., 2005, "R&D Outsourcing to Research Institutions: A New Look Into R&D in the Brazilian Automobile Industry", 13th GERPISA International Colloquium, June 16-17, Ministere de la Recherche, Paris, France), p. 3

(166) Quadros, R. and Queiroz, S., 2001, "The Implications of Globalisation, for the Distribution of Design Competencies in the Auto Industry in Mercusor", *Actes du Gerpisa*, No.32, p. 38

(167) Robbins, T., "China a Threat to South Africa's Automotive Success", Creamer Media's Engineering News Online, October 25, 2007, www.engineeringnews.co.za/article.php?a_id=58923

(168) Sachwald, F., 2004, "The Integration of China and East European Countries in Global Networks. Are European Multinationals Different?", Tokyo Club Foundation for Global Studies, www.tcf.or.jp/data/20040209-10_Frederique_Sachwald.pdf

(169) Sadler, D., 1997, "Internationalization and Specialization in the European Automotive Components Sector: Implications for the Hollowing-out Thesis", *Regional Studies*, Volume 32(2), pp. 109-119

(170) Sadowski, B., 2003, "Globalization, European Integration and Supply Chain Networks in Transition: The Automotive Industry in Poland", p. 23, http://fp.tm.tue.nl/ecis/workshop/abstracts/sadowski.doc

(171) Sarkar, P., 2001, "The North-South Terms of Trade Debate: A Re-examination", *Progress in Development Studies*, Volume 1(4), p. 310

(172) Sako, M., 2003, "The Nature of Co-Evolution of Product Architecture and Organization Architecture in the Global Automotive Industry", in Eds. A. Prencipe, A. Davies, and M. Hobday, The Business of Systems Integration, Oxford and New York: Oxford University Press, p. 231

(173), Scott, J.T., 2003, "Absorptive Capacity and the Efficiency of Research Partnerships", *Technology Analysis & Strategic Management,* Volume 15(2), 247-253

(174) Smith, A., Rainnie, A., Dunford, M., Hardy, J., Hudson, R., and Sadler, D., 2002, "Networks of Value, Commodities and Regions: Reworking Divisions of Labor in Macro-Regional Economies", *Progress in Human Geography*, Volume 26(1), p. 58

(175) Soubbotina, T.P., 2005, "The Challenge of Technological Learning for Developing Countries", World Bank Science and Technology Program, p. 11, www.siteresources.worldbank.org/.../Challenge_Tech_Learning_Oct05.pdf

(176) Soubbotina, T.P., 2006, "Generic Models of Technological Learning by Developing Countries", World Bank Science and Technology Program
(177) www.southafrica.info, "South Africa's Automotive Industry", accessed November 15, 2007
(178) Sumner, Andrew, 2005, "Is Foreign Direct Investment Good For the Poor? A Review and Stocktake", *Development in Practice,* Volume 15(3&4), p. 271
(179) Sunkel, O., 1993, "From Inward-looking Development to Development From Within" in ed. Osvaldo Sunkel, Development From Within: Toward a Neostructuralist Approach for Latin America, Boulder: Lynne Reinner Publishers, p. 46
(180) Steinfeld, E.S., 2004, "China's Shallow Integration: Networked Production and the New Challenges for Late Industrialization", *World Development*, Volume 32(11), p. 1984
(181) Sturgeon, T., 2002, "Modular Production Networks: A New American Model of Industrial Organization", *Industrial and Corporate Change*, Volume 11(3), pp. 451-496
(182) Sturgeon, T. and Florida, R., 2004, "Globalization, Deverticalization, and Employment in the Motor Vehicle Industry", in eds. M. Kenney and R. Florida, Locating Global Advantage, Stanford, California: Stanford University Press, p. 66
(183) Taggart, J. and Hood, N., 1999, "Determinants of Autonomy in Multinational Corporation Subsidiaries", *European Management Journal,* Volume 17(2), 226-236
(184) Teitel, S., 2006, "On Semi-Industrialized Countries and the Acquisition of Advanced Technological Capabilities", *Economics of Innovation and New Technology*, Volume 15(2), p. 175
(185) Tolentino, P.E., 2001, "From a Theory to a Paradigm: Examining the Eclectic Paradigm as a Framework in International Economics", *International Journal of the Economics of Business*, Volume 8(2), p. 191
(186) Toye, John, 2002, "The Early Terms of Trade Controversy", from United Nations Intellectual History Project, Volume 2, Trade, Finance, and Development, p. 9,
www.cas.umkc.edu.econ/economics/faculty/kregel/5909/Winter2002/Readings/UN3.pdf.
(187) Tsai, Su-Lee, 2002, "The Other Half of the Globalization Story: Reverse Leverage as Witnessed in the Manufacturing Sector of Taiwan IT Industry", *Prospectives on Global Development and Technology*, Volume 1(1), p. 5
(188) UNIDO, 2005, "Inserting Local Industries into Global Value Chains and Global Production Networks", www.value-chain.org/en/art/?83
(189) Vallejo, B., 2005, "Firms' Learning Capabilities Under a New Economic Environment: A Case Study of Mexican Auto Parts Firms", www.intech.unu.edu/publications/discussion-papers/2005_5.php
(190) Viotti, E.B., 2002, "National Learning System: A New Approach on Technological Change in Late Industrializing Economies and Evidences from the Cases of Brazil and Korea", *Technological Forecasting & Social Change*, Volume 69, pp. 653-80
(191) Wad, P., 2007, "Offshoring of R&D Activities by TNCs Within the Automobile Industry: The Case of China and India", EADI Symposium, Globalization, TNCs, and

Industrial Policies in Developing and Transitioning Countries, p. 9, www.cbs.dk/staff/pw
(192) Wood, A., Roberts, J. and Wade, R.H., 2003, "Symposium on Infant Industries", *Oxford Development Studies*, Volume 31(1), pp. 3-20
(193) Wong, P-K, 1999, "National Innovation Systems for Rapid Technological Catch-up: An analytical framework and a comparative analysis of Korea, Taiwan and Singapore", DRUID Summer Conference on National Innovation Systems, Industrial Dynamics and Innovation Policy, Rebild, Denmark, June 9-12, 1999
(194) Winter, J., 2007, "Spatial Division of Competencies and Local Upgrading in the Automotive Industry: Conceptual Considerations and Empirical Findings from Poland" in editors C. Tamasy and M. Taylor, In Globalizing Worlds: Geographical Perspectives on New Economic Configurations, Aldershot: Ashgate, p. 13
(195) Young, S. and Tavares, A.T., 2004, "Centralization and Autonomy: Back to the Future", *International Business Review,* Volume 13, pp. 215-237
(196) Yun, Chunji, 2003, "International Production Networks and the Role of the State: Lessons from East Asian Development Experience", *The European Journal of Development Research,* Volume 15(1), p. 171