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Disassembled structures: the political economy of Mexico's leading auto export sector

Estruturas desmontadas: a economia política do principal setor de exportação de automóveis do México

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RESUMO: A atual economia exportadora do México surgiu da adoção de um modelo de mercado baseado em condições de desarticulação tecnológica que separam as empresas transnacionais dominantes da base industrial nacional. Isso determinou que, ao contrário da análise de Verdoorn, o setor manufatureiro crucial funcionaria não como uma força motriz indutora de um processo de desenvolvimento nacional autônomo, acelerando o crescimento da produtividade e promovendo inovações de produtos e processos, mas aprofundaria um processo de produção fragmentado, centrado no processamento de componentes importados em condições de declínio da produtividade total dos fatores. Apesar do profundo reordenamento de sua geografia econômica nos últimos 30 anos, esse processo não conseguiu produzir marcadores legítimos de "atualização".
PALAVRAS-CHAVE: Desarticulação; atualização; indústria automobilistica; arbitragem trabalhista; transferências de tecnologia.

ABSTRACT: Mexico's current export-led economy arose from the adoption of a market-driven model based in conditions of technological disarticulation separating dominant transnational firms from the national industrial base. This determined that, in contrast to Verdoorn's analysis, the crucial manufacturing sector would function not as a motor-force inducing a process of autonomous national development by accelerating productivity growth and promoting product and process innovations, but rather would deepen a fragmented process of production, centered on processing imported components under conditions of declining total factor productivity. Despite the profound reordering of its economic geography over the past 30 years, this process has failed to produce legitimate markers of "upgrading".
KEYWORDS: Disarticulation; upgrading; auto industry; labor arbitrage; technology transfers.
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INTRODUCTION

The fragmentation and internationalization of production processes over the last three decades has resulted in the transfer of substantial parts of manufacturing to the Global South where higher profits are to be obtained – principally through cheap-labor assembly operations, frequently resulting in the consolidation of a disarticulated, bifurcated, internationalized, economic structure. This process has been particularly notable in Mexico – above all for decades in the auto sector. As one of the world's largest producers of autos and auto parts, Mexico's auto industry has systematically reproduced its special position as a low-wage assembler of autos and most especially its niche in the most labor-intensive, most unremunerated, spectrum of auto parts production that dominate this leading sector. However, bereft of enabling industrial policies promoting endogenous development (Bresser-Pereira 2019), structural stasis persists: In this instance (unlike the analyses advanced by Latin American Structuralists) Mexico's 'leading' sector fails to mobilize the dynamic (1) complementarity, (2) synergy, (3) multiplier, (4) accelerator (5) linkage effects and (6) spillover effects generally associated with the usage of the term "leading sector".

From 2010-2017 the growth in auto assembly and in auto parts production surged at an annual rate of 12.3% – four times greater than the manufacturing sector and total output (GDP).[1] From 2007-2017 auto manufacturing accounted for more than 27% of all foreign direct investment (FDI) which occurred in the manufacturing sector. In 2017-2018, 22% of all manufacturing employment and 26% of all national export arose from auto and auto parts production.

The effects of the recent global transformation of production systems have varied: One path, taken by economies articulating with the new global system through global value chains (GVCs) has relied on national industrial policies. This active articulation has generated endogenous production systems marked by genuine processes of upgrading in terms of national content -and value-added output. The most widely studied cases of nations following this path include Korea, Taiwan and most recently China. It is not the objective of this paper to present a detailed analysis of the industrialization process of these nations. Nevertheless, with the objective of demonstrating the limitations of the neoliberal export-led model pursued in Mexico since 1987/88, it is fundamental to note that Korea (see, e.g., Quintana et al. 2013: 86; Thurborn & Weiss 2021), Taiwan and more recently China have all combined steps toward increasing manufacturing exports with national industry promotion policies, often of a co-evolutionary design emphasizing the national industrial base the internal market and expanding exports which could be termed an authentic industrialization process (Blanco et. al. 2010: 4-5). Mexico's approach

[1] More broadly, the entire industrial sector (including mining, petroleum and construction) grew at an annual rate of 0.8% during this period: INEGI. 2021. Indicador Mensual de la Actividad Industrial (11 de enero): https://www.inegi.org.mx/temas/imai/.

has left the nation with a bifurcated industrial base, a degree of overall deindustrialization, disinvestment in science and technology and widespread poverty as the surplus labor force descends into the informal sector resulting in rising socioeconomic precarization.

A POINT OF CONTRAST: CHINA--PURSUING INDUSTRIAL POLICIES

From 1981 through 2000 the acquisition of technology in China was promoted through channeling FDI toward strategic economic areas via joint ventures (JVs) promoting endogenous industrial capabilities (Zhou, Jiang & Kong 2020). By 2020 acquisitions of "know-how", – consolidated advances toward a national innovation system (NIS) – engendering a rapid increase in autonomous national industrial potentialities (Agarwala & Chandhaury 2019). Transnational corporations (TNCs) involved in earlier JVs have beendiminished including in the auto sector.

Developmentalist policies – drawn from Paul Rosenstein-Rodan, Arthur Lewis and A. O. Hirschman (see Cypher 2021: 193-228) – have now facilitated widespread diminishment of export industries based in low-wage GVC assembling and low-wage production. In 2009-2010 average wages in the manufacturing sectors in China and Mexico were essentially equivalent. But, by 2018 Chinese workers' wages were 158.5% above those in Mexico. In 2018 unit labor costs in China were 75.5% of those in the U.S., while those in Mexico remained at 20%--the competitive advantage of China no longer rests in low wages, but rather in higher technological content, product uniqueness, quality and reliability (Morrison 2019: 13-14).[2] China has attained autonomous technological capacity and endogenous industrialization (De Paula & Jabbour 2020).

MEXICO'S PASSIVE, SUBORDINATE, PATH

The Mexican economy which has configured a new heterogeneous national structure of production: industrial enclaves permanently propelled by FDI have generally shouldered national firms to the margin. Pipkin and Fuentes' large-scale survey confirmed that in nations with low state and private sector institutional capacity – as in Mexico since 1987-88 – "treadmilling" or "decay" results through GVC integration (2017: 537).

While strong endogenous industrialization was experienced in the state-led era, 1940-1982 (Moreno-Brid & Ros 2009: 93-123; Rey Romay 1984; Sosa Barajas 2005), the rupture occasioned through the implementation of neoliberal policies

[2] According to the World Bank's Gini Index, China's distribution of income remains unequal – the Gini Index was 38.5 in 2016 – but much less so than Mexico's 45.1 in 2018: https://data.worldbank.org/indicator/SI.POV.GINI?locations=CN.

from 1987 put Mexico on a new path: an externally-driven disarticulated accumulation process commenced as the national industrial base lagged far behind the enclaves formed by, and for, foreign capital.[3] During the entire period spanning the rapid progress of the national economy, 1940-1982, and the subsequent neoliberal eraMexico remained generally distant from the waves of research and development (R&D) that had dynamized industrial (and a few developing) nations.[4] As has been demonstrated by Fugii and García (2015: 14-15), México is an anomalous manufactures-exporting nation given that the level of nationally-produced value incorporated in these exports is extremely low. Thy demonstrated that Mexico's export surge has been built without engendering spillover externalities, leaving the country essentially as a mere processor/assembler, re-exporting imported components/inputs as "low quality exports".

Indeed, across the entire "high technology" portion of the manufacturing sector – accounting for an average of 75% of all manufacturing exports (1993-2018) – annual total factor productivity growth (1990 – 2018) has been negative (Landa Díaz, Cerezo García & Perrotini Hernández 2020: 7). This has been the case in the vast auto sector, as well as all others (excepting positive, near zero, growth in computer equipment production). Negative total factor productivity (TFP) growth means that no portion of growth can be attributed to technological factors or to education and training. It means that the combined rates of growth of inputs (generally labor and capital) are greater than the growth rate of output – with technology's contribution measured as a negative residual. In the "high technology" areas of manufacturing, where TPF growth has been overwhelmingly negative, we find the highest incidence of lead-firm FDI involving GVC participation. In brief, TFP growth is a measure of efficiency: thus, Mexico's often-booming, GVC-integrated export sector has been built through expanding production processes that have registered declining levels of economic efficiency.

GVCS: HARBINGERS OF SUCCESS OR SURRENDER?

A voluminous and seemingly hegemonic literature which has sought to demonstrate that the growth in FDI in Mexico since 1987-88 has functioned as a lever to

[3] Our understanding of neoliberalism as imposed on Mexico parallel's J. Peck's, 2010, *Constructions of Neoliberal Reason* (Oxford: Oxford U.P.). It "is not so much a triumphal, forward march as a series of prosaic forward failures" (p. 23): failing forward is the process of proceeding to find new market-oriented projects without regard to the failure in meeting stated goals in past projects., Neoliberalism is not a narrowly circumscribed matter, but rather a continually expanding policy process.

[4] Mexico's Petroleum Institute is the research and technology arm of the national oil firm, Pemex. It showed early promise of becoming the leading edge of a rapidly developing sectoral innovation system intended to thrust Pemex into high value-added activities in petrochemicals, oil refining, and the production of plastics and other polymers. It was deemphasized and underfunded at the dawning of the neoliberal era.

raise the level of scientific and technological (S&T) development (see, e.g.: Lourdes, et al. 2014; Carrillo & Martínez 2017; Carrillo, et.al. 2017). Our alternative interpretations consistent with the empirical record: Our analysis stands in contrast to a dominant aspirational school of thought which seeks to show that growing GVC participation holds the promise of national development. We demonstrate that such participation has produced no more than *passive, entropic, articulations* with recently emerged transnational production systems.

Contreras, Carrillo and Alonso (2012) argued that the incorporation of the Mexican auto industry into GVC webs have yielded (or will yield) external learning effects, transfers of knowledge and enhanced technological capacities in consonance with other nations that have participated in such forms of global production while Carrillo 2018: 106) suggested that 20%-30% of the firms that participate in these international value chains also engage in processes of "upgrading". However, the survey generating this conclusion drew only from data provided by TNCs. This survey collected non-quantitative and decontextualized unconfirmed responses and did not show evidence of positive externalities within the Mexican economy.

In contrast Coe and Yeung (2020: 779), find such hopes – as embedded in the original (first generation) theories regarding GVCs – have actually been realized *only* when so-called lead firms (i.e., TNCs) have *not* been free to exercise their inter-firm *power*. Under conditions that exist in Mexico – with passive national policies regarding TNC controls – GVC activities result in "dependent integration of suppliers into their global production networks". Thus, current studies conducted on the economic effects GVCs, in contrast to those widely disseminated in Mexico, have rejected the hypothesis that, merely by hosting TNCs, nations will enter a *linear, deterministic* process of upgrading of the national productive apparatus through induced spillover and learning effects (Coe & Yeung 2020: 780).

The much anticipated *spread* effects arising through spillovers due to FDI have been realized in certain nations – such as China since they arise from "the firm-institutional interface within regional economies" (Coe & Yeung 2020: 780): *if* there exists and array of strong *developmentalist* institutions based in (1) capacity to practice national and international economic statecraft (Weiss & Thurborn 2020), (2) well-considered and embedded strategic industrialization policies, (3) steps taken to build a national, or sectoral, innovation system, etc. – Then returns from incorporating into GVCs can be positive. According to Coe and Yeung, the "first generation" literature regarding GVC-effects left silent the question of *dominance* – something exhibited in the *control* which TNCs exercise over their proprietary technological knowledge. As a consequence, industrialization centered on an export-led structure will not actuate the national economy. This serves to explain why there is an abundance of evidence that small and medium size nationally-owned supplier firms (tier 3 or lower) in Mexico's auto sector, and elsewhere, operate under conditions of stagnant labor productivity (CEPAL 2016: 35).

For those authors who have supported the idea that the TNCs are important founts facilitating the realization of technological diffusion effects, it seems sufficient to assert that labor processes in the auto sector in Mexico have shown some signs

of upgrading. One specific (and isolated) case has been frequently cited – a US TNC (Delphi-APTIV) laboratory in Mexico employing 1,700 engineers and designers. Focusing on the construction of wire harnesses and related low-tech activities, its existence has been taken as an indicator of an important transformation of the productive apparatus in the auto sector (Melgoza Ramos 2017). Yet, even if this plant may have produced some incremental innovations, its very exceptionality tends to argue against the aspirational hypotheses of those who insist that upgrading is being induced by FDI: in the main, the most notable feature of this lab is that its payroll "multiplier" effect is numerically larger than would be the case in a 1,700-worker wire harness plant in the border region (paying only somewhat above the minimum wage per day of roughly $10 USD, plus some benefits). In any case, whatever marginal, incremental, "innovations" may be created at the Delphi-Aptiv lab (such as a gas tank sensor, or a cable connector), such minor productivity-enhancing efforts have not been shown to reach beyond the narrow confines of the Delphi-APTIV corporation and into the Mexican economy at large. Rather – with 54,000 workers, over 90% of which toil in simple, low-wage, assembly – Delphi-APTIV is essentially a labor arbitrage operation anchored in Mexico's meager wages.

Although the word "innovation" is common in discussions regarding the auto sector in Mexico, in fact there is very little. Whatever examples might be found (from incremental processes at the bottom to epoch-making ones at the top) Mexico is all-but totally reliant on those introduced by TNCs. These have originated and been refined abroad – save for the most inconsequential. The problem posed by the general absence of spillover effects – despite a vast literature suggesting that such effects are right around the corner – is a significant consideration elided in a widely cited work by Contreras, Carrillo & Alonso (2012: 1014-1019). They attempt to confirm that the mere existence of a few national supplier firms – created as start-ups by engineers who took their training at TNCs to subsequently supply TNCs – indicate an impending future of endogenous innovations, upgrading processes and even an NIS.[5] Three such supplier firms, Kinnematics, AIISA and IRMI were cited.

But, according to data available in 2020, these cited firms *had closed their operations*. IRMA collapsed in 2010 when Ford found it non-competitive (Dossier Político 2010). In these three s cases Mexican supplier firms had proved to be "one-day wonders". Of the 1,200 auto parts supplier firms in Mexico in 2020, according to the National Auto parts Industry (INA) there were only *5* (or a few more) first or second tier Mexican firms "suppling the assembling firms" – the TNCs which fabricated 3.8 million finished automobiles and trucks in 2019 (Guerrero Arellano

[5] The definition used to categorize a firms as an "innovator" is vague and inapplicable: Carrillo and Gomis assume that if a firm has a research center or if a firm engages in some "reverse engineering" (essentially copying) or has some ties to government entities involved in any search that might fall under the heading of "innovation" this is sufficient and there is no need to demonstrate anything tangible (Carrillo & Gomis 2014: 402).

2020: 30). But, no "national champions' have arisen as a result of the surge in auto sector FDI as GVCs proliferated in the globalization era.[6]

NEOLIBERALISM: THE ABSENCE OF ENDOGENOUS INDUSTRIALIZATION

In 1987-88 the neoliberal era was fully inaugurated severing all ties to the state-led era (Salas-Porras 2014) leaving an profoundly fractured national industrial base. With regard to science and technology (S&T), national capacities – irregularly attended-to in the state-led era – have essentially atrophied: In contrast to rapid national development in Asia, couplingexport-led strategies to efforts to consolidate an NIS, or a sectorial innovation system (Amsden 1991; Andreoni & Chang 2017), Mexico's approach remains based in technological exclusion with surging manufactures exports largely entail labor-intensive transformations using imported components, creating minimal value-added.

Before the neoliberal turn Mexico had made a number of largely successful efforts to form and implement policies of national industrialization (Moreno-Brid & Ros 2009: 93-123; Sosa Barajas 2005). In spite of the fact that these efforts had led to the consolidation of a "national identity" there was then a striking absence of what has been termed "technological nationalism". According to Arocena and Sutz, Latin American nations have suffered f a consolidated legacy with a "perspective that fails to value technology, a outlook that basically consists of an incapacity to believe that complex technological activities and strategies can be developed, or co-developed, locally" (Arocena & Sutz, 2001: 43). Accordingly, during the period of "growth driven by the internal market" or import substitution industrialization (ISI), large Latin American nations held the capacity to develop an authentic NIS (or at least a sectorial innovation system) but this did not occur because of their failure to prioritize "the generation of endogenous technologies" (Arocena & Sutz 2001: 43). Of the three required elements need in combination to create an NIS – (1) a developmentalist state that prioritizes its long-term commitments to

[6] With reference to the theme of so-called "national champions", the Mexican business press mentions four firms in the auto sector. All constituted considerably before the neoliberal era. Most cited Rassini's parent firm was formed in 1891. Renamed San Luis Rassini in 1994 it acquired brakes production facilities from ICA – which was formed in 1947. Rassini does operate a R&D facility in Michigan, USA. The second large national auto sector firm mentioned is Newmak, created in 1979, by the conglomerate Alfa, with roots extending back to, at that point in time, the core of Alfa was Hylsa, a 1942. The third firm, Metalsa, originating in Monterrey in 1956. Finally, and ironically, the fourth company is Dina (or Diesel Nacional) formed in 1951 as a majority state-owned firm, then privatized in the neoliberal era. There are a few important national firms operating in the auto sector, none formed as a result of the rise of GVC networks. There are at least two more tier 2 national supplier firms considered of some consequence: one being Macimex – created in 1979. In addition, there is an aftermarket auto parts conglomerate firm, Grupo KUO. This company, which operates R&D centers in Belgium and Michigan, was originally created as DESC in 1973.

finance the creation and expansion of endogenous technological capacities, (2) a participatory faction within the private sector determined to create and pursue innovation-supporting activities, and (3) the existence of a range of institutions that sustain S&T, such as laboratories within large firms, universities capable of promoting applied S&T, etc. – none materialized. From roughly 1985 onward incipient steps taken in this direction were abandoned.

The coordinating role of state agencies designed to promote S&T deserves special mention. Likewise, with regard to the triangular relations mentioned, although they narrowly describe core elements of an NIS, they must be made operational through highly-fluid, interrelations, in a context of complementarity undergirded by mutually-shared "confidence in a broad, semi-autonomous, institutional matrix"(Arocena Sutz 2001: 43).[7] Innovation capacity does not arise from the actions of individual firms, but from the way that they interact with research centers and key state entities. In fact, the number of firms and/or research center, etc., involved in technological advancements is much less important that are their practices and habituations with regard to learning and investment. Innovation capacities are partially tacit – arising from concrete experiences that can be recalled and adapted under ever-changing conditions, rooted in production routines and established relations (with regard to tools, equipment, machinery as well as co-workers in the collective act of production). Learning-by-doing is perhaps more important that is the acquisition of foreign technologies.. The general developmental trajectory of a nation gives form to a NIS with firms integrated within a confluence of social, political and economic elements: yet, in Mexico an exceedingly powerful, autonomous, business elite has never been incorporated into a technologically-imbued accumulation process – rather the emphasis has been, to a large degree, on monopolistic-oligopolistic financial and commercial pursuits giving rise to rentier windfalls, along with controlling resource-intensive extractive activities (Delgado 2009: 9; Ortiz Palacios 2009).

This is quite distinct from nations that have forged-forward due to endogenously accumulated capacities coupled with a constructive vision regarding S&T. Within Mexico's structural confines there is little space for small and medium-sized firms to acquire new capacities since they lack access to an inclusive financial system, forcing them to abandon longer-term strategies due to pervasive uncertainty and economic volatility, all of which engenders extreme risk leading to paralysis. In a similar fashion, the universities – most particularly the public ones – even when they are disposed and capable of developing an "association" with the business entities, are unable to make the necessary expenditures in terms of labs and research facilities leading to cutting-edge innovational efforts. Given such

[7] It is no our purpose to present a reductionist analysis overstating the role of a NIS: National development can be advanced without large strides toward technological advancement over a medium term period of several decades as a result of the educational system, improved shop floor practices state infrastructural investments, and so on.

structural impediments it would fall to the state to be the promotor, financer and coordinator of any systematic efforts to construct a NIS – but this necessary condition has been impossible to attain under neoliberal hegemony. Instead,prevailing neoliberal policies have favored export enclaves supplying the US market and have systematically holding wages down. From 1987 to 2018, average real wages hardly rose (still remaining at 75% of their 1980 level) –while the minimum real wage dropped over 30%.[8]

RESEARCH PERSPECTIVES ON THE PROBLEMATIC OF THE NATIONAL INNOVATION SYSTEM

Cimoli's research has illuminated the general weaknesses prevalent with regard to technological capacities in Mexico. He demonstrated the persistence of stagnate conditions which have, over time, widened the gap between the technological capacities of Mexico and the frontier of technological progress. Small advances have been a product of imported technologies embodied in machinery and equipment (Cimoli 2000: 285-292). In terms of linkage effects stressed by A. O. Hirschman (1989) – who emphasized the catalyzing impacts of forward, backward and horizontal effects that might promote increasing returns and/or leaps in productivity by inducing high-impact strategic investments – Cimoli found that "increasingly such effects have been displaced through a process of international integration" to such a degree that "we can witness a dramatic loss of the articulation of the existing links with national, input-supplying, firms" (Cimoli 2000: 285).

Meanwhile, Capdevielle (2003: 455-56; 459) found that:

- 80% of the manufacturing firms operate "mature" production facilities producing little to no technological advances
- low-tech areas of the manufacturing sector are engaged in mere processes of adaptation to already existing technologies
- on average, small and medium firms spent more on R&D as a percentage of their sales than did large Mexican corporations
- US TNCs spent five times more on R&D – measured in relation to total sales – than did Mexican companies

Dutrénit, Puchet & Teubal contended that the construction of a NIS is a coevolutionary process still remote due to low innovative capacities among researchers, including cadres of engineers and technicians: Mexico lacked a "critical mass" todevelop technological capacities (Dutrénit, Puchet & Teubal, 2011: 60).

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[8] See: Armendares, P. E., J. C. Moreno-Brid, L. A. Monroy-Gómez-Franco, I. Salat & J. Sánchez. 2018. "Salarios en México" (p. 147) en J. P. Arroyo Ortiz, I. Islas Arredondo, A. Díaz Castillo & M. Ángeles Cortés Basurto(Coordinadores) Balance de las Reformas Estructurales, Tomo III, México, D.F. : Senado de la Republica.

Mexico's Special Program for Science and Technology 2001-2006 the follow-on program in 2007-2012 and the Special Science Technology and Innovation Program 2014-2018 all failed (Gutiérrez, Hernández & Cárdenas 2018). None were consolidated, nor did they promote advancements. Scientific momentum is absent, while the nation has been unable to raise its gross public and private S&T expenditures above the trivial level of 0.3-0.5% of GDP in recent decades. Using the standardized Gross Expenditures on Research and Development (GERD) measure of the OECD, Mexico has engaged in systemic S&T disinvestment since 2008 (Rodríguez Gómez 2021). For 2018 this ratio fell to 0.3%, far below Brazil's 1.24% in 2017, or the OECD average of 2.58%.

Dutrénit et. al. (2010: 336-339) emphasized "systemic failures", including insufficient infrastructure, scarcity and misdirection of resources due to politicized priorities, short-term businesses focus, extracting of economic rents, reliance on imported technologies and horizontal government policies that failed to prioritize strategic sectors. In 1995, applying the neoliberal doctrine of horizontality, Mexico eliminated a its 30% tax exemption for companies that built and maintained R&D centers – without regard to the US auto industry which had considered this "the most attractive incentive" to shift some of their knowledge and technology capacities to Mexico (Swiecki & Maranger Menk 2016: 5).

Aboites (2013: 22) documented a rapidly growing deficit in Mexico's "technological balance of payments" (the value of Mexico's exports of intellectual property rights, patents technical assistance and related measures minus the importation of these items). From 1996-2007 "technological" exports declined by 23% (Aboites 2013: 23), but technological imports soared – by 2007 they were 3.9 times greater than in 1996: The deficit exploded from $238 million in 1996 to $1.3 billion in 2007. Pursuit of "the technological modernization of the nation" – a primary stated goal for entering NAFTA in 1994 – had failed using any metric, as the technological frontier receded as manufacturing exports surged (Aboites 2013: 35).

MEXICO'S NEOLIBERAL AGENDA IN THE AUTO/AUTO PARTS SECTOR

In spite of the key role of the auto/auto parts industry has acquired over the past 40 years, there are no indications that it has generated conditions facilitating a sectorial NIS. The Mexican State has neither conditioned FDI nor disciplined foreign companies. Meanwhile, local capital has retained and sharpened its rentier tactics thereby extracting many forms of unearned income (consulting and legal fees, lobbying charges, land rents, "middleman"/"go-between" payments to rapidly traverse Mexico's labyrinth of complex government agencies, etc.) as well as exacting bloated sums through private control of strategic infrastructure).

It is possible to locate the insipient steps toward the sweeping opening of the economy to the Border Industrialization Program (BIP) in 1965. Yet, it was not until the 1980s and especially the early 1990s when export-processing *maquila* firms became sufficiently generalized – to the degree that the term *maquila model*

was applied to Mexico. *Mexico*. In the automobile industry, during the course of the 1980s the *maquila* auto parts industry along the border region expanded spectacularly because BIP policies allowed transplant firms to import inputs and to export assembled products exempt of any tariffs, fees or quotas. Later BIP-firms could locate throughout Mexico epicenter as the US reacted to the adverse effects of Asian auto transplants operating in its southern states from the late 1970s. From 1978 onwards, when Packard Electric-General Motors (renamed Delphi in 1995 and Aptiv in 2017) established its first *maquiladora* plant in Ciudad Juárez, dozens of harness plants (auto cable and wire harness manufacturers) as well as automobile seat producers (such as Adient, a subsidiary of the US TNC Johnson Controls) transferred production to Mexico.

The boom in auto parts production in this early period was striking: Employees surged from 120, 000 in 1980 to 446,000 in 1993; then soaring to 1.2 million in 2007, leaping to 2.6 million in 2020.[9] The continuation of the boom in *maquila* production at the close of the 20th century, and beyond, was the result of the imposition of the NAFTA *maquila* model established in 1993. Prior preparative steps were taken including the important "Decree for the Promotion and Modernization of the Automobile Industry (1989) reducing national content requirements to a mere 30% – eliminating the developmentalist 60% requirement mandated in 1962. The 1989 decree was giving impulse to a fundamentally new export-oriented, deregulated auto/auto parts sector. This fit well with the new Foreign Investment Law promulgated in 1993 which allowed TNC ownership of 100% of the capital of any firm, while imposing "horizontal" treatment for foreign firms in relation to national entities. Prior to 1993 TNCs were held to maximum 49% ownership stake, beginning in 1973. Sosa Barajas (2005: 202) determined that the Decree of 1989 signified a complete rupture of the 1962 auto sectorial development policy. Just as NAFTA was a watershed event consolidating an export-led economic structure, the period preceding initiated profound structural change as the Mexican State ceased to promote its national industrial base through active policy measures. NAFTA brought into being a new regional economic bloc dominated by the US It was falsely presented, evermore, as a "free trade" agreement – an obvious act of deception perpetuated by mainstream economists. New "rules of origin" for auto production created an asymmetric regional systems of co-production wherein autos and auto parts could be transshipped over all borders, free of tariffs, or quotas. Instead, regional content in the sector was set at 50%, later raised to 60% for autos and 62% for auto parts. All auto sector imports that failed to reach these regional content requirements were subject to tariffs and quotas at the discretion of the US (Canis et al. 2017: 2). Thus, the double agenda of NAFTA – to form a viable regional bloc in the auto sector and to exclude foreign competitors, particularly those from Asia who had shown that they could

[9] Data from 1990 to 2007 was taken from (Morales 2008: 35). The 2020 figure was taken from INEGI, IMMEX, https://www.inegi.org.mx/sistemas/bie/.

out-compete the Big Three firms in terms of price and productivity, but above all in terms of performance quality and reliability.

FROM NAFTA TO THE USMCA

NAFTA – far from establishing a new era of free trade – was a policy initiative designed to protect the oligopoly structure established by and for the giant US auto sector firms from increasingly effective global competition.

As deepening tensions over international trade between the EU and the US gained momentum – and most particularly between Japan's integrated sphere in East Asia and the now-weakening US industrial system – Mexico became the cheap-labor manufacturing reserve designed to circumvent these adverse circumstances. The possibilities held-forth by the BIP from 1965 onward were now generalized: FDI, while remaining to some extent tied to the border region, began to radiate outward, eventually creating what has been termed the "auto corridor" (also known as Detroit South) which linked non-border states together and spread over 1,000 miles north-to-south from Ciudad Juaréz to Querétaro. As well, important auto and auto parts enclaves emerged in Mexico's geographical center, west of Mexico City and in the north-Pacific region. NAFTA mandated that 60% of production would be spread throughout the bloc. Yet, high-value content (engineering, design, R&D, etc.) remained within the US. But now, the US – with unrestrained access to Mexico's vast labor surplus – could cut direct assembly labor costs by as much as 80% by offshoring certain production stages (Cypher & Crossa 2020).

In 2020 the USMCA replaced NAFTA: US policymakers, facing alarm over processes of deindustrialization, designed a new agreement to raise regional content to 75%. This mitigated the adverse impact on the Big three arising from a steady shift of foreign firms (particularly from Japan and Germany) that had shifted plants to Mexico during the NAFTA years (1994-2020), in addition to containing looming competition coming from electrification and autonomous vehicles. Capital from outside the bloc had frequently linked their Mexico-based assembly plants to their external supply networks and/or maintained their highest value production processes at home.

USMCA rules stipulated that at least 40% of total value would be produced where wages were $16 per hour, or higher. Under these rules, less production will take place in Mexico's cheap-labor, *maquila*-like, assembly and auto parts plants. This will occur because either (1) Mexican plants have lower productivity and therefore will not be able to meet the $16 per hour minimum[10]; or, (2) in those processes

[10] Total factor productivity growth in the Mexican auto sector – a measure of the technological component of productivity – was minus 0.1% per year (1990-2018), but 1.8% in the US (1991-2016). However, in 1991-95, the US rate was -0.6%--a good indicator of the crisis of US producers vis-à-vis Asian and European auto corporations before NAFTA created an exclusive production bloc. Once NAFTA was in place (1995-2016) total factor productivity in US transportation manufacturing rose to 2.2% per year (Baily, Bosworth & Doshi 2020: 35: Landa Díaz, Cerezo García & Perrotini Hernández 2020: 7).

of assembly where Mexican labor productivity is close to that of the US plants (with wages 10%-20% of those in the US), pushing wages up to $16 per hour would eliminate the incentive to transplant production to Mexico because higher direct labor cost coupled with already existing higher costs for transportation and/or energy costs and/or a range of other non-labor costs (such as managerial outlays) can be higher in Mexico. Regions that realize cost-reducing synergistic agglomeration-effects in research, design, engineering, and other technology-intensive activities are to be found in the US, Canada, Asia and Europe. The US-competitor firms, facing the higher regional content, and the mandated higher "Labor Value Content" requirements, now confront intended adverse conditions. More high value activities will remain in the US, further degrading the idea that GVC production in Mexico facilitates technology transfers: According to the Federal Reserve Bank of Dallas' estimate of the impact of the USMCA on Mexico's auto assembly plants (Chiquiar et al. 2020: 4) – there would be nearly a 300,000 decline in vehicles produced, and a reduction in Mexico's GDP of nearly $102 billion (using 2019 GDP as a base number). The available evidence thus points to a relative shift in the Mexican auto sector away from somewhat higher value-added activities such as new auto assembly toward even greater participation for the low-wage/low-technology auto parts sector, leaving Mexico's auto sector even further from the technological frontier.

INNOVATION OR PREDATION? SOME EVIDENCE AFTER 40 YEARS

Within the export-led regime the vehicle transport sector is the most important – accounting in 2018 for approximately $51 billion in vehicle exports, $30 billion in auto parts exports and $27 billion in freight trucks and trailers, or 24.5% of all exports (OEC 2021). In 2018 auto industry exports (including commercial vehicles) were equivalent to 8.9% of GDP: after subtracting imports – necessary in calculating GDP totals – the auto sector was the largest of all manufacturing activities (24% of manufacturing GDP), accounting for 3.3% of GDP in 2018. The vehicle assembly and auto parts production activities, which occupied 120 thousand workers in 1980, subsequently soared to over 980,000 in 2018 – with 10% engaged in assembly operations and 90% in auto parts production.[11] Another 19,000 were employed in truck and trailer production.[12] From the early 1990s through 2016, the auto sector has exploded – its export share soared from 3% to 25%.[13]

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[11] 1980 estimates are from Arteaga García, A. (2003). Integración productiva y relaciones laborales en la industria automotriz en México. México: Plaza y Valdez, p. 105 (2018) estimates from: INEGI, Banco de Información Económica de INEGI (http://www.inegi.org.mx/sistemas/bie/).

[12] Data from ANPACT, the industrial association of the truck industry: (https://www.liderempresarial.com/vehiculos-pesados-la-industria-que-mueve-la-economia/).

[13] Export data from 1983 to 1991 from (Sosa, 2015: 208). All other data from: INEGI, Banco de Información Económica del INEGI (http://www.inegi.org.mx/sistemas/bie/).

The total effect of the auto sector production/exports can be divided into (1) the direct effect (the annual value of production in the sector) and (2) indirect effect – the national linkage effects arising from direct production in the auto sector. The total effect (direct + indirect) is estimated by calculation of a base "multiplier" number. Fujii and Cervantes (2013: 156-157) determined that the average value of the income multiplier effect (= total effect ÷ direct effect) of exports in the *maquila* auto sector was only approximately 1.49 in 2003. This multiplier was small due to the very high relative degree to which indirect employment/production occurred abroad (primarily the US), then imported as components used as inputs in the auto sector, most especially in all *maquila* operations. (Nearly 40% of all workers employed in *maqulia* operations are located in the auto sector.) In comparison, the low multiplier of the auto sector was dwarfed by the income multiplier for exports of refined and processed petroleum products (using national labor and raw materials) of 5.72.

The low level of the multiplier effect in the export auto sector is a reflection of low levels of national backward and forward linkage effects. In a 2012 analysis of the circular flow of production within the Mexican economy, the lowest linkage effects among all 21 productive sectors were 0.81 (for the mining industry) – where any measure < 1 is considered an indicator of a very low level of national sectoral interdependence (García-Remigio et al. 2020: 452). Next, on the bottom of the scale, were auto assembly production (0.88), and then the auto parts industry (0.92). These minimal linkage levels contrasted strongly with all other productive sectors, where all other *manufacturing* activities averaged (2.93). Due to the extremely low linkage effects, the mining and auto sectors were defined as "independent" from the Mexican economy (García-Remigio et al. 2020: 452).

García-Remigio et al. (2020: 453) also estimated the income multiplier effect in 2012 for the auto sector: their Input-Output calculation included (1) the direct effect + (2) the indirect effect and (3) the *induced* effect arising from additional workers' consumption spending occasioned by any increase in production. Adding the induced consumption slightly raised the income multiplier effect – to 1.76 in auto parts and 1.72 in auto assembly production. In contrast, the multiplier for government services was 2.51.

As constructed, however, this "Social Accounting Matrix" model of the Mexican economy does not calibrate the important effects exerted by foreign firms through their ability to create leakages in the circular flow calculations of any national productive system: specifically, there were no adjustments made for the current account measures of the Balance of Payments (BOP) in terms of "factor income receipts and payments": this category is designed to capture outflows from the national economic system due to repatriated profits, and all interest and dividend income paid to foreigners, as well as foreign employee compensation. As such, in an industry which is completely foreign-own (auto assembly production) or one that is overwhelmingly foreign-owned (auto parts production) large leakages from the circular flow will definitely be a factor acting to reduce any estimated income multiplier effects. Furthermore, "non-financial asset" payments for the use of tech-

nology (licenses, patents, intellectual property, etc.) constitute another serious net outflow from the national system (as mentioned earlier) with such items registered in the capital account of the BOP. We therefore conclude that while the estimates of Fujii and Cervantes (2013), as well as García-Remigio et al. 2020), demonstrate the low-level of structural interdependence of the auto sector within the national economy, the inability to model the income outflows in the (BOP) results in a failure to fully capture the auto sector's even higher degree of "independence".

MEXICO: OCCUPYING A PRIVILEGED PLACE AMONG THE GVCS?

Mexico is by far the largest auto sector exporter in Latin America. As such, it is viewed as embodying vast potential by the peak business associations, by government officials and by more than a few influential academics all of whom entertain the idea that Mexico now occupies a privileged location within the worldwide web of GVCs. Thus, the Secretary of the Economy stated that:

> Of all the factors determining Mexico as an optimal environment in which to conduct global business, there is one that in recent years has acquire special relevance. Mexico has learned how to build an important supply chain in strategic economic sectors such as the auto industry (Pro-México, 2016: 8)

This perspective – that Mexico has "consolidated as an industrial node" holds as its basis the perception that significant technological transfers or spillovers have accompanied recurring waves of FDI (Lourdes et al. 2014; Carrillo & Martínez, 2017; Carrillo, Bensusán & Micheli, 2017). This influential perspective has dominated an important part of the analyses conducted in Mexico on the auto sector: it asserts that the national economy has been a beneficiary of the global transference of productive capacity into Mexico and that such investments have served as a pivot to enhance conditions of endogenous advancement that entail the generation of higher value added national industrial processes. For decades, in the absence of clear empirical evidence, such researchers have argued that the auto sector has fostered S&T development, thereby vaulting Mexico up the global competitiveness scale (see, e.g., Villalpando 2004: 324).

For López, Juárez and Carrillo the auto industry in Mexico has passed through at least four stages the last being adoption/diffusion of Toyota´s "Total Production System" management techniques--as expressed by a small subsidiary of Toyota, formed in 2004, with only 330 employees in 2021 (López, Juárez & Carrillo, 2014: 171).[14]

[14] Macimex, a nationally-owned tier 2 auto supplier, was created in 1979, Macimex initiated its own "off-the-shelf" assimilation of Toyota's managerial technique. E. Crespo Ferrer and J. Gasca. (2017). "See

It is claimed that "the dynamic effect of the networks of global production in the auto sector have permitted the development of capacities associated with factors such as technological learning, the transfer of knowledge, the [adaption of] best practices and an entrepreneurial vision, among other factors" (López et al. 2014: 180). Hence, "catching-up" processes had purportedly resulted. According to Carrillo and Gomis (2005: 17):

> Firms increasingly […] incorporate process innovations meeting internationally certified standards, engage in product design and engineering activities, obtain premiums for quality control, meeting environmental and safety standards, etc. Mexican nationals increasingly autonomously manage foreign-owned firms. [While] managers, engineers and workers […] sustain learning processes. […] All of this can be summed-up through the term industrial upgrading […]

Such a neoclassical perspective not only is unsupported by the available empirical evidence, it further lacks historical context – particularly in terms of a growing dependence on imported machinery and equipment as well as in terms of the rising trade deficit in technology (Aboites 2013: 22-23; Cypher and Delgado Wise, 2012: 174). As noted above, of the 1,200 auto parts firms operating in Mexico, according to the peak industrial association – INA – less than *10* were able to operate with sufficient technological capacity and logistics/quality control to function as first or second-tier suppliers to the TNC auto assembly firms (Guerrero Arellano 2020: 30). Furthermore, Landa Díaz, Cerezo García and Perrotini Hernández (2020: 7) found that TFP growth in the auto sector had *declined* from 1990 through 2018. There has been no general trend toward the creation of R&D centers; on the contrary, among the few successful national auto sector firms, their R&D facilities operate in the *US and Europe* (see note 6). Unfounded assertions of an endogenous industrial upgrading process in Mexico's leading manufacturing sector, demonstrates the aspirational nature of this "upgrading" perspective; evidence shows endless "treadmilling".

Mexico's auto assembly operations were among the largest in the world by 2018 – ranking above Korea's (Table 1, below). Nonetheless, its level of R&D investment was *sixteen* times less than Korea's and *sixty-two* times less than China's. Another telling comparative metric is the ratio of R&D spending per worker – in 2015 the US figure was $21,000, or *thirty-eight* times greater than in Mexico. (US auto sector employment was 940,000 vs. 980,000 in Mexico.) Mexico's auto sector R&D expenditures were 2% of those in the US

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aplican mexiquenses en lean manufacturing", Vanguardia Industrial (6 de marzo), https://www.vanguardia-industrial.net/tag/tps/.

Table 1: Auto vehicle production (2018) and auto sector R&D expenditures *

	Total vehicle production	Manufacturing Sector R&D **	Auto industry R&D **
China	27,809,196	276,548	27,440
US	11,314,705	236,132	19,078
Japan	9,728,528	105,123	31,144
Germany	5,120,409	59,377	24,552
Mexico	4,100,525	1,707	445
Korea	4,028,834	51,101	7,218

Source: OECD, 2018. Business enterprise R&D expenditure by industry. http://www.oecd.org/innovation/inno/researchanddevelopmentstatisticsrds.htm.

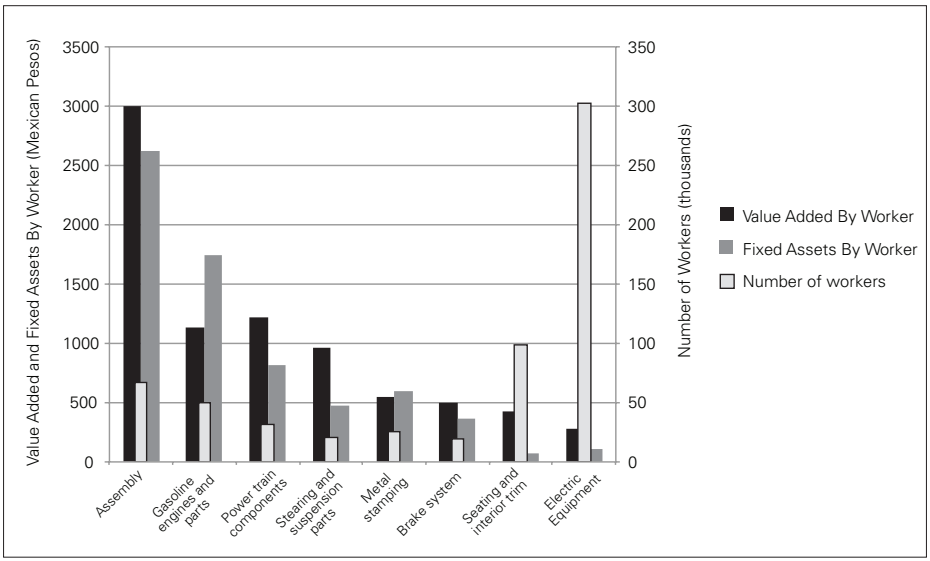
* Auto production data from 2018. R&D data from 2015 (the most recent available). The table excludes India, the world's fourth largest auto producer.

** Millions of US dollars

These aspirational Mexican researchers, asserting industrial upgrading, have essentially amplified a series of anecdotal anomalies while the exogenously-determined process of accumulation, controlled by TNC capital, has continued to consolidate. In spite of the fact that the auto sector has occupied the key position in Mexico's export-led economy, the underlying economic structure has essentially remained that of a labor arbitrage-led assembling operation nearly totally reliant on the importation of parts and components, machinery and equipment and intellectual property (Crossa, 2021). All this is well illustrated in the auto sector where a near majority of the 980,000 employed are located in the two sub-sectors of lowest productivity (Crossa & Ebner, 2020): nearly 45% of all auto sector workers are engaged in low-skill assembling, in labor-intensive wiring and cable harnesses, or auto seat production generating the lowest level of value-added production in the sector.[15]

[15] The category "electric and electronic equipment" essentially refers to the production of cables and harnesses: See the description of industrial code 336320 of the North American Industrial Classification System (NAICS): https://www.colef.mx/emif/metodologia/catalogos/emifnte/2012/Catalogo%20del%20Sistema%20de%20Clasificacion%20Industrial%20de%20America%20del%20Norte%20(SCIAN-2002).pdf.

Figure 1: Mexico, Value-Added, Fixed Capital Assets and Workers, Auto Industry (2016)



Source: INEGI, Banco de Información Estadística, https://www.inegi.org.mx/sistemas/bie/.

INDUSTRIAL PARKS: PARALLEL ENDOGENOUS RENTIER ACCUMULATION

A significant underlying parallel endogenous process has occurred across manufacturing sectors wherein the control of strategically-placed land used to create industrial parks (IPs) facilitating the accumulation of windfall rentier incomes for an ascendant fraction of Mexico's business elite. The opportunity to control the IPs created a vested interest for Mexican business in the status quo of the neoliberal export-led model.

IPs are spaces designated for the location of industrial activities: They must include a full range of plant-specific infrastructure, including power and communication facilities, water and waste disposal, storage and loading facilities and a direct connection to transportation infrastructure – such as a railhead, a seaport, an airport or a superhighway. IPs originated during the peak developmentalist period (1940-1980). They were first located in the central states such as Puebla, the State of Mexico, Querétaro, Tlaxcala and Morelos as a strategy designed to halt the negative agglomeration tendencies occurring in Mexico City. As Maldonado noted (2009: 65), the IPs were then administered either by the federal government or the states, in pursuit of "regional development through the construction of decentralized parks. [They] cooperated to define and coordinate the investment priorities for state-owned industries and regional infrastructure in order to promote long-term growth in depressed areas."

However, in the 1980s state policy abruptly changed – the focus shifted to

policies to promote Mexico's integration into processes of globalization, with the IPs largely ceasing to function under the control of governmental entities. They became a crucial part of the private real estate sector, designed to attract manufacturing FDI (Maldonado, 2009: 67).

The deepening of *maquila* and other FDI-driven forms of production created an new opportunity. Through the control of strategically-located land, as well as through linked activities relating to construction, legal and financial consulting, the ownership and/or rental of storage and loading facilities and a range of other service-related activities a new national strata of rentiers emerged and prospered. Salas-Porras (1987: 1) found that:

> transnationals [had] to rely upon a social agent in the receptor nation that could perform diverse functions, among them: to deliver or develop the services which the translational would find, in their state of foreignness, difficult to complete on their own account; to defend and promote their interests and well-being among public functionaries – particularly those responsible for the regulation and oversight of their industrial activities […] .To the extent that their fortunes depended on the development of these [maquila] plants these social agents were converted into one of the most effective promotors and key components operating in the service of these transnationals.

The number of IPs rose from 127 in 1968 to 564 in 2018 – covering 52 thousand hectares.[16] Since 1987-88 large real estate developers have "structured the production chains, developed the most efficient suppliers and served as the anchor for the grouping-together of industrial activities. In this manner, the norm in Mexico is that the [IPs] are created by large companies" (López Lira, et al. 2012: 5).

In 2021 there were at least 20 large real estate developers who were designing, building, owning or leasing IP facilities, including Finsa – operating 25 – VYNMSA – operating 23 – Grupo IAMSA – operating 15 – and Grupo Alianza – operating the most extensive (a 10 square-mile behemoth with 6 multi-lane entrance/exit highways).[17] Finsa –"the most important, most recognized industrial [real estate] developer in Mexico" – according to its website – operated 8 IPs in 1998 and 22 in the auto sector alone by 2020.

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[16] The 1968 figure provided by (Maldonado, 2009: 66) with the 2018 data taken from CREA: https://www.creasoluciones.com.mx/panorama-de-los-parques-industriales-en-mexico-2018/.

[17] Data as cited by individual company and industry websites, including: https://www.finsa.net/; https://www.industrialparks.com; and https://www.industrialparks.com.mx/revista-digital.html.

GRUPO BERMÚDEZ: THE PRIME EXAMPLE OF THE DOMINANCE OF THE RENTIER CULTURE

The rentier culture spawned by the rise of the *maquila* industry is perhaps best exemplified by Grupo Bermúdez (GB): launched in the northern border city of Ciudad Juaréz in the 1960s, by A. J. Bermúdez. By 2021 GB owned Mexico's largest IP, where 22,000 workers toiled at 50 TNCs, the largest being the auto-sensor manufacturer TE Connectivity (with nearly 3,000 employees).[18] The foremost magnate in Ciudad Jauréz, Bermúdez was designated Director of the National Border Program, PRONAF (1961-1965). Up to that time, his wealth had been amassed from extensive landholdings in the Valley of Juaréz as well as through ownership of some construction companies. As the program rapidly gained traction, Bermúdez inaugurated the first, and still largest, IP in 1968. By 2018 GB operated 14 IPs where established plants still paid entry-level wages (as late as 2018) that, adjusted for inflation, were at or below their *1968* rate. The political-economic influence of GB has been augmented in many ways, including through AMPIP–the powerful national owner's association that represents IP capital – which Bermúdez created in 1986 (Hernández López, 2016: 269). Bermúdez presided over Cidudad Juaréz as it emerged as a key industrial center where it long held the nodal position within Mexico's auto globalization process.

CONCLUSIONS

Sustained endogenous processes of economic development have arisen in nations that have made concrete steps toward the creation of either a sectoral or NIS. The centrality of technological capacities has been a well-documented component of nations that have orchestrated a catching-up or leapfrogging process, as best exemplified by some East Asian nations.

In Mexico over the past three decades all available evidence – including the negative and growing trade deficit in the technology, the disinvestment in national R&D expenditures and other metrics mentioned above – demonstrates that the national industrial base operates at growing distance from the technological frontier. Although Mexico's increasing involvement in high-technology exports is often celebrated, the evidence presented here shows, using the crucial measure of total factor productivity (TFP) growth, that *all* high-tech sectors were operating in a condition of "decay" from 1990 through 2018 (with one exception where positive TFP growth approached zero). Distinguished in this group exhibiting negative TFP growth was the auto sector. Rather than initiating across-the-board or sectoral upgrading, the rapidly-growing auto sector *downgraded* as a result of asymmetric involvement in GVC-led production systems.

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[18] See: http://www.parqueindustrialbermudez.com/industrial_bermudez.html.

As FDI leaped upward in the auto sector, Hirschman-style forward and backward linkage effects were the lowest across the entire economy (except for mining). Various efforts to gauge the multiplier effects of the auto sector found that it was anemic – far below other sectors, including government and petroleum.

Unlike the growth patterns to be noted in some East Asian nations, booming exports in vehicles and auto parts have not lead to the establishment of any "national champion" firms. The few "national champion" firms in the auto sector were established *before* the onset of globalization, not as a result of this new stage. To the degree that these national firms engage in R&D activities of any consequence, they tend to site their research and design facilities in the US or Europe where some spread and spillover effects might occur.

The result of over three decades of single-minded pursuit of FDI as the elixir of growth has been endogenous technological atrophy coupled with grinding wage stagnation as GVC participation has increased. This new structure has created another cadre of national rentiers specialized in the construction and management of over 500 industrial parks which have – through an array of government policies to provide infrastructure, tax exemptions, etc. – subsidized the expansion of some of the largest corporations in the world.

Our critical account has documented and theoretically demonstrated the futility of the numerous attempts to superimpose on Mexico's export-led neoliberal economy a ficticious "aspirational" industrial-upgrading-through-GVCs perspective that has no empirical basis. As we have confirmed, this is most particularly the case with regard to the leading, low-wage, auto sector. The empirical evidence shows that national economic and social returns derived from Mexico's passive, opportunist, GVC-led approach have been, almost without exception, lacking.

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