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Structural change: Brazil, China, and the United States 1995-2018

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To my father,

Edgard Pereira.

My mentor,

my friend

and my inspiration.

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Summary

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Abstract

Is deindustrialization a natural phase in the path of economic development of nations? Is the inverted "U" figure that relates the share of industry value added in a country's gross domestic product to its per capita income levels a valid representation for any country at any time? Are there countries where the "natural" process of deindustrialization occurs early? Is the Brazilian economy a victim of early deindustrialization? This study made the analytical option to treat the phenomenon of deindustrialization within the scope of theories of economic development, particularly the idea of *structural change* as a synthesis of the development process. The pivotal concept of *unbalanced growth* developed by Albert Hirschman is the inspiration for this work. The study is essentially descriptive. Based on the OECD Leontief matrices, the traditional indicator of *backward linkages* was calculated and a new indicator – *leakage* – was defined, representing the degree of leakage of backward linkages by means of imports. This indicator was calculated using the two versions of the OECD Leontief matrices - *total* and *domestic* -, that shows the total value of backward linkages and the value of backward linkages which impacts only the domestic structure. The study performs a comparative analysis of the aggregate and sectoral *linkage* and *leakage* indicators for three countries: Brazil, China, and the United States, from 1995 to 2018.

The study shows that China implemented a successful structural change based on the *substitution of imports with international integration* and reaped as a result a significant increase in its growth potential. It is like China adopted a reinterpreted version of the import substitution industrialization (ISI) model. Comparatively, in Brazil, the international integration did not bring significant gains to the economy's growth potential, when measured by the value of the coefficients of direct and indirect impacts. The United States enters as a counterpoint to demonstrate that advanced economies with a diversified and balanced productive structure tend to be more stable regarding structural changes. The study also verified the existence, in many sectors, of a positive relationship between international integration and gain in growth potential. It was possible identified for which sectors their dynamic impacts increases as the supply of imported inputs grows.

Keywords: Structural change, Development strategy, Unbalanced growth, Leontief matrix, Linkages, Leakages.

Resumo

Mudança estrutural: Brasil, China e Estados Unidos 1995-2018

Será a desindustrialização uma fase natural no caminho do desenvolvimento econômico das nações? Será o formato de "U" invertido que relaciona a percentagem do valor acrescentado da indústria no produto interno bruto de um país com os seus níveis de rendimento per capita uma representação válida para qualquer país em qualquer momento? Existem países onde o processo "natural" de desindustrialização ocorre precocemente? A economia brasileira é vítima da desindustrialização precoce? Neste estudo fez-se a opção analítica de tratar o fenômeno da desindustrialização no âmbito das teorias do desenvolvimento econômico, apoiando-se na ideia de *mudança estrutural* como uma síntese do processo de desenvolvimento. O conceito de *crescimento desequilibrado*, proposto por Albert Hirschman, é a inspiração deste trabalho. O estudo é essencialmente descritivo. Com base nas matrizes Leontief construídas pela OCDE, o indicador tradicional de *encadeamento para trás* foi calculado e um novo indicador – *vazamento* -, identificando o vazamento, por meio de importações, dos encadeamentos a montante, foi definido. Este indicador foi calculado utilizando-se as duas versões das matrizes Leontief da OCDE - *total* e *doméstico* -, que mostram o valor total dos encadeamentos para trás e o valor dos encadeamentos para trás que impactam apenas a estrutura doméstica. O estudo realiza uma análise comparativa do desempenho agregado e setorial dos indicadores de encadeamento e vazamento para três países: Brasil, China e Estados Unidos, de 1995 a 2018.

O estudo mostra que a China implementou uma mudança estrutural bem-sucedida baseada na *substituição de importações com integração internacional* e colheu como resultado um aumento significativo no seu potencial de crescimento. Comparativamente, no Brasil, a integração internacional não trouxe ganhos significativos ao potencial de crescimento do país, quando medido pelo valor dos coeficientes de impactos diretos e indiretos. Os Estados Unidos são o contraponto para demonstrar que economias avançadas com uma estrutura produtiva diversificada e equilibrada tendem a ser mais estáveis no que diz respeito as mudanças estruturais. O estudo verificou também a existência, em muitos setores, de uma relação positiva entre integração internacional e ganho de potencial de crescimento. Foi possível identificar para quais setores seus impactos dinâmicos aumentam à medida que cresce a oferta de insumos importados.

Palavras-chave: Mudança estrutural, Estratégia de desenvolvimento, Crescimento desequilibrado, Matriz de Leontief, Encadeamentos, Vazamentos.
JEL: 014.

1 Introduction

This work is the result of a period of study as a visiting scholar at Columbia University in the years 2022 and 2023, at the invitation of Professor Albert Fishlow, whom I thank for the generous opportunity to benefit from his keen and thought-provoking comments and his vast knowledge of the Brazilian economy and society.[1]

Deindustrialization is a hot topic in Brazil and has received great attention from Brazilian researchers. Countless studies have been conducted using different methodologies and varied databases and the divergence of diagnoses and therapies is remarkable. The matter has moved beyond the academic sphere and is an important item on the political and electoral agenda in Brazil.

As chief economist at the Institute of Studies for Industrial Development (IEDI) in the mid-2000s, I actively participated in this debate, at a time when the discussion on Brazilian deindustrialization was linked to the issue of exchange rate appreciation that plagued the economy, especially the industrial sector.

Studies on exchange rate misalignment were conducted and a series of seminars to deal with the subject were organized.

Years later, as a retired professor at the Institute of Economics at the University of Campinas, I became interested in the subject again and realized that a different methodology from the ones usually employed would be necessary to better understand the phenomenon. I then resorted to the concepts I used in my master's thesis in the distant year of 1985, under the guidance of Professor Maria da Conceição Tavares. In that work, I used the newly constructed first Brazilian input-output matrices (the ones available were for the years 1970 and 1975) to identify "industrial complexes" - an analytical category in vogue at the time - with the aim of understanding the feedback mechanisms of production through the coefficients of direct and indirect impacts.[2]

The availability by the OECD of harmonized input-output matrices and Leontief matrices for several countries in the period from 1995 to 2018 made the option for the new methodology feasible. The vibrant academic environment and exceptional material conditions at Columbia University also made the work possible.

The study presented here is descriptive. It is a first approach. It aims, in fact, to evaluate the possibilities opened up using this methodology and this database. The deepening of the analysis and the eventual formulation of ideas for the interpretation of the phenomenon are tasks that still demand work and the use of more sophisticated methodologies. It is not a task for a solitary researcher.

Based on the OECD Leontief matrices, the traditional indicator of backward linkages was calculated, and a new indicator (leakage) was defined, representing the degree of leakage of linkages to the outside, by means of imports. This new indicator was possible to calculate because the OECD

(1) All the opinions presented here are my responsibility and do not represent the opinion of Professor Fishlow or the Institute of Latin American Studies (ILAS), an institution linked to the School of International and Public Affairs (SIPA), at Columbia University, which kindly hosted me for this period of study.

(2) Currently, input-output matrices have been widely used in the operationalization of computable general equilibrium (CGE) models.

Leontief matrices are constructed in two versions: total and domestic. The difference between the indicators corresponds to the degree of leakage of backward impacts.

A comparative analysis of the indicators for three countries was conducted: Brazil, China, and the United States. The reason for choosing these countries was due to the theoretical approach adopted in the work. The option to treat the phenomenon of deindustrialization within the scope of theories of economic development placed the idea of structural change at the forefront of the analysis, as a synthesis of the development process, in line with the main scholars on the subject, especially Albert Hirschman.

The pivotal Hirschmanian concept of unbalanced growth is the inspiration for this work.

Brazil, China, and the United States are paradigmatic cases for the study of structural changes. While China experienced one of the most fantastic structural changes in recent history, the economic structure of the United States remained stable and that of Brazil involuted.

The analysis was conducted at two levels: aggregate and sectoral. First, we studied the evolution of average aggregate indicators and their respective dispersion coefficients.

Second, at the sectoral level, the linkage and leakage indicators were analyzed for each of the sectors of activity[3]. This analysis sought to verify whether there is any relationship between sectoral linkage and leakage indicators. For this purpose, correlation indices between these indicators were calculated.

Anticipating some of the work's conclusions, the results obtained show that the degree of sectorial leakage (measured by the leakage indicator) is related in distinct ways with the sectoral linkage indicators. The magnitude of backward impact indices varies, sometimes negatively and sometimes positively, depending on the degree of leakage. In principle, contrary to common sense, the indication is that in several sectors of activity, in the three countries, the power to generate productive impacts increases as the supply of imported inputs increases.

At the end of each section presenting the sectoral indicators, a hierarchy is made comparing the relative position of the sectors at the beginning and at the end of the period. For the linkage indicator, the hierarchy shows the effect of structural changes on the magnitude of the indicator, identifying which are the sectors of activity today with the greatest power to generate effects of productive chaining and, in the case of the leakage indicator, those that currently have the highest degree of leakage impacts on the production chain to the outside.

In addition to this brief introduction, this paper has 8 other sections. In the following section, the main theoretical references of the study are pointed out and the indicators and the database are defined. Section 3 shows the evolution of the aggregated linkages and leakages indicators. Sections 4, 5, and 6 present the evolution of sectoral indicators, respectively for Brazil, China, and the USA. Section 7 makes a comparative analysis of the sectoral indicators between countries, and section 8 presents the sectoral correlation coefficients between linkage and leakages. At the end, section 9 presents the conclusions of the work.

(3) For periodization, I considered the Five-Year Plans in China, the alternation between republicans and democrats in the United States, and the transition from the PSDB to the PT in Brazil, along with the brief post-impeachment PMDB period.

2 Deindustrialization and structural change

Is deindustrialization a natural phase in the path of economic development of nations? Is the inverted "U" figure that relates the share of industry value added in a country's gross domestic product to its per capita income levels a valid representation for any country at any time? Are there countries where the "natural" process of deindustrialization occurs early? Is the Brazilian economy a victim of early deindustrialization?

These issues have guided the debate about industry in Brazil for at least 20 years and a consensus on the subject is still far from being reached. Even due to the lack of a minimum consensus on the matter, none of the attempts to put in motion an industrial (and technological) policy that could reverse the phenomenon have been successful so far.

In the absence of a consensus capable of sustaining the implementation of a comprehensive strategy to relaunch industry and the economy itself on a sustainable trajectory of long-term growth, what prevails are sectorial and particular interests, which manage to transform the fulfillment of their specific demands into public policies through their access channels and pressure mechanisms.

Perhaps the difficulty in reaching a mutual understanding and establishing basic principles for a development strategy is that the debate has focused only on industry, losing the perspective that industrial activity is part of a complex productive structure, linked by monetary and productive flows to agricultural, extractive, and service activities.

It is not a question of minimizing the importance of industry for economic development - which occurs, as it is known, especially through the generation of static and dynamic economies and the diffusion of technical progress, among other mechanisms, as sustained in the Kaldorian tradition. But only recognizing an analytical approach that starts from industry and then moves on to the economy as a whole, from the particular to the general, is insufficient, perhaps incorrect, and certainly incapable of understanding the phenomenon of deindustrialization.

Recovering the concept of structure as an analytical category is the first step towards understanding the roots of Brazilian deindustrialization.

As a corollary of this approach, deindustrialization is seen not as something restricted to the industrial sector, but as part of a broader process of structural change.

And structural changes are historically determined processes resulting from the combination of numerous factors, some general and others idiosyncratic to each country.

This study recovers key ideas that emerged in the debate on development, industrialization, and deindustrialization. These will serve as a background for the analysis of the structural changes that occurred in Brazil, China, and the United States in the period from 1995 to 2018. Only works that directly contributed to the design of the approach adopted in the study are referred to here. The other texts consulted are listed separately at the end of the paper.

2.1 Development, industrialization, and deindustrialization

In a study for the World Institute for Development Economics Research (WIDER), Sukti Dasgupta and Ajit Singh[4] use the Kaldorian framework to analyze evidence of deindustrialization in various developing countries, occurring at per capita income levels lower than those observed in the industrialization of advanced economies.

Specifically, they assess the hypothesis that the development of sectors other than industry - in the specific case of India, the services sector - may be the key for countries with lower per capita income to reach the level of development of advanced economies.

In conclusion, the authors state that: "The results indicate that manufacturing continues to be a critical sector in economic development, but services overall, as well as many individual services, including those connected with ICT, also make a positive contribution in a number of developing countries such as India."

This conclusion is valid, however, for services that present "dynamic activities in the Kaldorian sense", as the authors point out in a previous work[5]. More than the nature of the activity in the sector, it is the presence of dynamic activities in the Kaldorian sense that can transform a non-industrial sector into an additional engine of growth and contribute to catching up with advanced economies.

Emphasis on the additional term is important. The authors maintain that the results of the tests conducted in the study show that, in general, industry remains the main mechanism for boosting economic growth in countries with lower per capita income. In this sense, in a paper published by the Center for Business Research at the University of Cambridge, Singh argues that "...The main policy implication of this analysis is that India should take advantage of its strength in ICT and use it extensively in all areas of the economy in order to upgrade manufacturing, agriculture as well as services, to compete effectively in the world economy."[6]

The idea is obviously not to generalize the Indian model, but to retain the concept that, to be successful, an industrial policy must consider the specificities of each country, strategically using the intersectoral interactions of the most dynamic and internationally competitive sector to boost growth and raise the international competitiveness of domestic industry.

This approach to the issue of deindustrialization, which seeks to identify the idiosyncratic elements of each country that drive the process of loss of industry importance, whether in terms of added value or industrial employment, gained impulse with the contribution of José Gabriel Palma. In rigorous statistic work applied to an extensive database, Palma validates the "U" shape as a representation of the relationship between industrial employment and per capita income over time, as proposed by Rowthorn (1994), but problematizes it in time and space, proposing the existence of four

(4) Dasgupta, S. and A. Singh (2006). *Manufacturing, Services and Premature Deindustrialization in Developing Countries – A Kaldorian Analysis*, Research Paper N0 2006/49, United Nations University, World Institute for Development Economics Research (UNU-WIDER).

(5) Dasgupta, S. and Singh, A. (2005). "Will Services Be the New Engine of Indian Economic Growth? *Development and Change* 36(6): 1035-58.

(6) Singh, A. (2008). *The Past, Present and Future of Industrial Policy in India: Adapting to the Changing Domestic and International Environment*, Centre for Business Research, University of Cambridge Working Paper, n. 376.

sources of deindustrialization: (1) an Inverted-U Relationship Between Manufacturing Employment and Income Per Capita; (2) a Declining Relationship Between Income Per Capita and Manufacturing Employment; (3) a Decline in Income Per Capita Corresponding to the Turning Point of the Regression; and (4) Dutch Disease.[7]

Palma argues that the process of deindustrialization is much more complex than most hurried analyzes might indicate at first sight, due to several factors and depending on the group of countries considered. Both the level of per capita income at which the turning point in the relationship takes place and the intensity of the decline vary by country or group of countries. There is no general rule that could be associated with a natural process in any country at any time. For him, a country's deindustrialization is a specific and historically determined phenomenon.

Particularly interesting is the idea that the "Dutch disease" would account for an overshooting in the trajectory of deindustrialization, an additional shift in the curve associated with a sudden surge in primary exports or services. Rather than being the cause of deindustrialization, the Dutch disease is an aggravating factor in the process, in addition to the other factors driving the loss of positive impacts on aggregate employment arising from industrial activity.

Palma also analyzes the recent industrialization (or rather, the reindustrialization) of a group of countries that managed to transform the "curse" of natural resources into a "blessing". In the words of the author: "…, Finland, Sweden, Malaysia, and, to a lesser extent, other Southeast Asian countries rich in natural resources (such as Indonesia, the Philippines, and Thailand) prove that, from the perspective of manufacturing employment, there is no such thing as the so-called curse of natural resources. It seems patently clear that countries rich in natural resources or having a high potential for developing strong export services activities have sufficient degrees of freedom to allow them to pursue trade and industrial policies aimed at continuing to develop a strong manufacturing sector—let alone to implement policies designed to avoid the Dutch disease."[8]

Giovanni Dosi, Frederico Riccio, and Maria Enrica Virgillito[9] are also in line with rescuing the diversity of deindustrialization processes, in an even more radical way. Based on a long-term cross-country analysis and adopting a sectorial characterization based on Pavitt's (1984)[10] taxonomy, the authors categorically reject the idea of a natural tendency towards deindustrialization and the inverted "U"[11] shape as a general representation of the evolution of the relationship between the degree of industrialization and per capita income.

(7) Palma, J. G. (2005). Four Sources of "De-Industrialization" and A New Concept of the "Dutch Disease", in Ocampo, J. A. (2005). *Beyond Reforms - Structural Dynamics and Macroeconomic Vulnerability*, Latin American Development Forum Series, United Nations Economic Commission for Latin America and the Caribbean (ECLAC) and World Bank, Stanford University Press and World Bank.

(8) Palma (2005, p. 108).

(9) Dosi, G., Riccio, F. and Virgillito, M. E. (2021). Varieties of deindustrialization and patterns of diversification: why microchips are not potato chips, Structural Change and Economic Dynamics 57, p. 182-202.

(10) Pavitt, K., (1984). Sectoral patterns of technical change: towards a taxonomy and a theory. Res. Policy 13 (6), p. 343-373.

(11) The authors analyze a panel of data from INDSTAT2/UNIDO, Penn World Table 9.0, and MVA/UNIDO for 173 countries from 1963 to 2015.

The analysis is carried out at two levels: using industry segments according to the ISIC classification and using Pavitt's taxonomy. The authors find a diversity of relationship formats, whether considering segmentation by industry sectors, or by segmentation according to technological standards and learning regimes from a neo-Schumpeterian/evolutionary perspective.

The fundamental reason for the diversity of trajectories when industrial sectors are regrouped according to their patterns of technology generation, absorption, and diffusion is "... in the timing and in the response to globalization."[12] The authors thus join Dani Rodrik, who, in his decisive contribution to the debate on deindustrialization and early deindustrialization, proposes the globalization of the world economy as the driving factor behind the recent deindustrialization of developing countries.

In Rodrik (2016)[13] there is a vigorous study on the trend towards deindustrialization of advanced economies and the early deindustrialization of developing economies. Regarding the latter, Rodrik states that "With some exceptions, confined largely to Asia, developing countries have experienced falling manufacturing shares in both employment and real value added, especially since the 1980s."[14] A first result to be highlighted from the study is that in advanced economies deindustrialization manifests itself only when measured in terms of the share of industrial employment in total employment, but the same does not happen with equal intensity or in a generalized way when measured in terms of participation of industry added value in GDP, a fact generally obscured by the use of value added series in current prices instead of constant prices.

Referring to Robert Z. Lawrence and Lawrence Edwards[15], Rodrik notes that the traditional explanation for the loss of participation of industrial employment in relation to employment in the service sector resides in the difference in the productivity growth rate between these sectors, with the manufacturing sector historically showing higher rates than other sectors of the economy. The adjustment of productivity differentials takes place through changes in relative prices and, if the elasticity of substitution between employment in industry and other sectors of the economy is less than unity, equilibrium in the new vector of relative prices occurs with a fall in demand for industrial employment.

This rationale would be able to explain deindustrialization in advanced economies in a general way, but it would be inadequate to interpret the same phenomenon in developing economies. The reason for this inadequacy lies in the process of domestic price formation in developing economies following their opening up.

Less developed economies, due to their small participation in the global manufacturing market, are international price takers and "import" the deindustrialization of advanced countries through the adjustment of productivity differentials and relative prices promoted in global markets. With economies open to international trade, this adjustment occurs more quickly and intensely, compared to the period when domestic industries were protected from international competition.

(12) Dosi, G., Riccio, F. and Virgillito, M. E. (2021, p. 194).

(13) Rodrik, D. (2016). *Premature deindustrialization*, J Econ Growth 21, p. 1-33.

(14) Rodrik, D. (2016, p. 2).

(15) Lawrence, R. Z.; Edwards, L. (2013). *US Employment deindustrialization: Insights from History and The International Experience*. Peterson Institute for International Economics, Policy Brief No. PB13-27.

This is why Rodrik identified the opening of developing economies to international trade in the context of market globalization as the primary cause of the precocious deindustrialization of these economies.[16]

Specifically in the case of Brazilian deindustrialization, there are a vast number of studies addressing the issue from different angles, using various statistical and econometric methodologies, and obtaining results that are in some cases even contradictory.

It is worth highlighting the work by Regis Bonelli and Samuel Pessoa[17], published as a Text for Discussion by IBRE/FGV, in which the authors make reasoned criticisms of the very construction of the indicator traditionally used to measure the "degree of industrialization" of an economy, that is, the ratio between the added value of the industry and the added value of the economy as a whole, obtained from the national accounts.

Among other limitations of the indicator, the authors point out the one resulting from changes in the system of national accounts of the IBGE in 1989-1990 and 1994-1995 that resulted in discontinuities in the series of participation of the manufacturing industry in the gross domestic product. Another distortion was related to the "servitization" process of originally industrial activities, not adequately captured in the national accounts. The authors also draw attention to the need for methodological corrections for the construction of the indicator for the series of national accounts prior to 1995 and at constant prices.

After making the necessary adjustments, Bonelli and Pessoa conduct a cross-section analysis for a set of 170 countries, estimating the expected shares of industry in GDP considering several variables indicative of the degree of economic and technological development, factor endowment and size of the countries. In the case of Brazil, the authors compare the expected results with those verified and conclude that the development model based on import substitution produced an excessive industrialization of the country from 1970 to 1993, considering the international pattern captured by the cross-section analysis. They maintain that recent deindustrialization (if it occurred) was due to macroeconomic factors – low growth, high interest rates, and the tax burden – and the economic opening that, in the end, would have aligned the participation of Brazilian industry in the GDP to the international standard, correcting the excessive industrialization of the pre-opening period.

(16) Trade liberalization appears as an important explanatory variable for the deindustrialization process of most developing economies in a recent study by Elisangela Araújo, Eliane Araújo, Samuel C. Peres and Lionello F. Punzo. The authors estimate an equation of determinants of industrial added value, with panel data for a selected group of countries in the period 1970 – 2017 and find a significant negative coefficient for the variable economic openness. It is interesting to observe, on the other hand, that this same variable has a significant value and a positive sign for the group of developed countries. See Araujo, E. Araújo, E., Peres, S. C. and Punzo, L. F. (2021) An investigation into shapes and determinants of deindustrialization processes: Theory and evidence for developed and developing countries (1970–2017), Economy 22, p. 129-143, 2021.

(17) Bonelli, R. and Pessoa, S. (2010). *Desindustrialização no Brasil: um Resumo da Evidência*, IBRE – FGV. Texto para Discussão, n. 7.

The work of Edmar Bacha in 2013[18] also looks to macroeconomics for the foundations of deindustrialization in Brazil. Using a simple macroeconomic model with two sectors (tradables and domestic), Bacha demonstrates that the strong inflow of foreign capital and the rise in commodity prices (external bonanza in the author's terms) caused changes in the relative prices between tradable and domestic goods and, consequently, in the demand of these sectors. As a result of the macroeconomic adjustment to the external positive shock, the occupation of labor shifted from the industrial sector to the service sector.

In a distinct perspective from the previous ones, Célio Hiratuka and Fernando Sarti[19] draw attention to the impacts on Brazilian industry of the transformations in the global productive structure resulting from the intensification of global inter-firm competition and the reorganization of large transnational companies. The changes in the productive structures were, in the authors' evaluation, in the direction of "... an intense de-verticalization, with the fragmentation of activities accompanied by an intense international transfer of productive stages, in order to take advantage of the possibilities of cost reduction, accompanied by gains in scale and scope, made possible by the expansion of markets and the coordinated management of geographically dispersed activities." [20]

It is important, in fact, to bring external "microeconomic" conditions to the debate on Brazilian deindustrialization. In the context of economic globalization and the impressive growth of international flows of goods and services, it is imperative that the search for the fundamentals of the loss of importance of Brazilian industry, both in the domestic and international scenario, has the international frame of reference as its starting point.

Finally, André Nassif, Carmem Feijó and Eliane Araújo[21] make an important contribution to the debate by analyzing Brazilian deindustrialization, promoting the encounter between Kaldor/Thirlwall and the neo-Schumpeterians, adding sectoral elements related to patterns of technological change and innovation to the analysis.

From reading the texts referred to here, the following general conclusions emerge, which serve as a reference for the approach adopted in this work:

1. Deindustrialization and early deindustrialization are historical processes robustly proven by empirical studies, whose occurrence cannot be placed in doubt;

2. When measured for industry as a whole, the trajectory of the relationship between the share of industrial employment or industrial value added in aggregate employment or GDP and the country's per capita income presents the shape of an inverted "U" in general;

(18) Bacha, E. (2013). "Bonança externa e desindustrialização. Uma análise do período 2005-2011". In: Bacha, E.; Bolle, M. (Org.). *O Futuro da Indústria no Brasil*: Desindustrialização em Debate. Rio de Janeiro: Civilização Brasileira.

(19) Hiratuka, C.; Sarti, F. (2017). *Transformações na Estrutura Produtiva Global, Desindustrialização e Desenvolvimento Industrial no Brasil*, Revista de Economia Política, v. 37, n. 1 (146), p. 189-207.

(20) Hiratuka, C.; Sarti, F. (2017, p. 198).

(21) Araujo, E.; Feijó, C. e Nassif, A. (2014) *Structural change and economic development: is Brazil catching up or falling behind?* Cambridge Journal of Economics 2015, 39, p. 1307-1332.

3. However, when calculated in a segmented way for sectors or groups of industrial sectors, the generalization of the inverted "U" shape is not verified;

4. Even when calculated for industry as a whole and when there is a recognizable pattern in the trajectory, a detailed analysis of the phenomenon indicates that its probable causes and its form of manifestation differ depending on the country and the historical moment considered;

5. Productivity differentials between domestic and international producers and the intensity of international trade flows are decisive drivers of the early deindustrialization of developing economies;

6. When analyzed by subgroups of developing countries, there is no evidence of widespread deindustrialization. In fact, in most Asian countries, the opposite occurred;

7. There are indications that sectors of activity other than industry can present Kaldorian properties of generation and diffusion of technical progress and innovations;

8. Macroeconomic factors can also play an active role in promoting deindustrialization through relative price adjustments and the generation of sectoral profitability differentials that directly influence the allocation of resources and investment decisions;

9. In the Brazilian case, although there is evidence of deindustrialization, understanding the causes and intensity of the phenomenon requires further studies and a consensus on the nature and consequences of deindustrialization is still far from being achieved.

2.2 Unbalanced growth, import substitution and structural change

In the mid-1980s, the World Bank published a study[22] conducted by Hollis Chenery, Sherman Robinson, and Moshe Syrquin, with contributions from other researchers, which established essential benchmarks for understanding the debate on industrialization and development. [23]

At the beginning of the report, the authors define the concept of development adopted in the work: "Development is now conceived as the successful transformation of the structure of an economy."[24] The corollary of this statement would be: there is no development without a successful transformation of the economy's production structure. Industrialization is, by definition, structural transformation, and understood by many as the key to the development of countries with lower per capita income[25].

(22) This study is the third in a series whose two previous ones are "A Comparative Study of Sources of Industrial Growth and Structural Change", published in 1975, and "The Sources of Growth and Productivity Change", published in 1980.

(23) Chenery, H., Robinson, S. and Syrquin, M. (1986) Industrialization and Growth – A Comparative Study, Oxford University Press, World Bank.

(24) Chenery et al. (1986, p. ix).

(25) On the debate of the 1950s and 1960s about the benefits of industrialization see Rosenstein-Rodan, P. (1943). "Problems of Industrialization in Eastern and South-eastern Europe." Economic journal 53 (June-September): 202-11. Mandelbaum, K. (1945). The Industrialization of Backward Areas. Oxford: Blackwell. Prebisch, R. (1950). The Economic

The authors make an important methodological division between studies on industrialization, development, and economic growth:

> There are two contrasting views of the way economic growth occurs. In the neoclassical tradition, GNP rises as the result of the long-term effects of capital formation, labor force expansion, and technological change, which are assumed to take place under conditions of competitive equilibrium. Shifts in demand and the movement of resources from one sector to another are considered relatively unimportant because labor and capital produce equal marginal returns in all uses.
>
> In the second, broader view, economic growth is regarded as one aspect of the transformation of the structure of production that is required to meet changing demands and to make more productive use of technology. Given imperfect foresight and limits to factor mobility, structural changes are most likely to occur under conditions of disequilibrium; this is particularly true in factor markets. Thus, a shift of labor and capital from less productive to more productive sectors can accelerate growth. Although this type of structural analysis has not received the same rigorous formulation as general equilibrium theory, it can provide a basis for empirical analysis (Chenery et al., 1986, p. 13).

In fact, the distinction between the two theoretical approaches - on the one hand, models of equilibrium, of neoclassical extraction, and on the other hand, structural changes that generate imbalances – is necessary to smooth the terrain of the theoretical-academic debate on development strategies and, by derivation, from the debate on industrialization and deindustrialization.

In the table below, taken from Chenery et al. (1986), the authors summarize the main distinctions between the two theoretical approaches.[26]

Development of Latin America and Its Main Problems. New York: United Nations Economic Commission for Latin America and Nurkse, R. (1961). "Balanced and Unbalanced Growth." In G. Haberler and R. M. Stern, eds., Equilibrium and Growth in the World Economy. Cambridge, Mass.: Harvard University Press, all cited in Chenery et al. (1986).

(26) Chenery et al. (1986, p. 15). The balanced growth models, regardless of their specific formulation, consider in the analysis and definition of the equilibrium path of the economy in the process of industrialization macroeconomic determinants – fiscal, monetary and balance of payments effects on the productive structure. Currently, the most advanced models in this analytical perspective are the Computable General Equilibrium (CGE) models.

Alternative views of growth

Neoclassical approach	*Structural approach*
Assumptions	
Factor returns equal marginal productivity in all uses	Income-related changes in internal demand
No economies of scale	Constrained external markets and lags in adjustment
Perfect foresight and continuous equilibrium in all markets	Transformation of productive structure producing disequilibria in factor markets
Empirical implications	
Relatively high elasticities of substitution in demand and trade	Low price elasticities and lags in adjustment
Limited need for sector disaggregation	Segmented factor markets
	Lags in adopting new technology
Sources of growth	
Capital accumulation	Neoclassical sources plus:
Increase in labor quantity and quality	Reallocation of resources to higher-productivity sectors
Increase in intermediate inputs	
Total factor productivity growth within sectors	Economies of scale and learning by doing
	Reduction of internal and external bottlenecks

There are obvious implications of the chosen theoretical approach for the profile of proposed policy initiatives within the scope of a development strategy. The very idea of the need/possibility of implementing development strategies and policies depends on the theoretical framework adopted.

The idea of imbalance refers, in this context, to imbalances in the productive structure, arising from the exogenous generation of profitability differentials between sectors of the economy, inducing investments in these sectors. This notion of disequilibrium should not be confused with the, to a certain extent, skewed interpretation that structural disequilibria is equivalent to macroeconomic disequilibria, whose most obvious manifestation is inflation.

It is also true that the creation of profitability differentials between sectors of the economy demands some kind of public policy (tax, commercial, technological, regulatory etc.) but does not necessarily imply direct action via public investment, although there are cases where this may be necessary. From the need for some form of public intervention, however, it does not follow that an unbalanced growth strategy is necessarily inflationary. On the contrary, productivity gains and overcoming bottlenecks in the supply of goods and services resulting from successful transformations in the structure of production should have a permanent and long-term deflationary effect.

The formulator of the strategy of economic development through unbalanced growth was Albert O. Hirschman.

In the preface to the 1961 edition of the classic *The Strategy of Economic Development*[27], Hirschman outlines the basic difference between the idea of unbalanced growth and the traditional

(27) Hirschman, A. O. (1958) *The Strategy of Economic Development*, Yale University Press. In this book, Hirschman presents his theory, combining theoretical elements with extensive empirical experience, and addresses a variety of themes, all related to the debate on economic development. He uses concepts from anthropology, sociology, macro and

vision of balanced growth: "In other words, I do not deny by any means the interrelatedness of various economic activities of which the balanced growth theory has made so much. On the contrary, I propose that we take advantage of it, that we probe into the structure that is holding together these interrelated activities. As in the atom, there is much energy here that can be and is in fact being utilized in building up economic development nuclei. Later, these nuclei look as though they could never have been separated even for a single instant when in fact they might never have been assembled, had not a sequential solution, i.e., an unbalanced growth sequence was found, by accident, instinct, or reasoned design. …"[28].

For Hirschman, development is a chain of imbalances: "... the sequence that 'leads away from equilibrium' is precisely an ideal pattern of development from our point of view: for each move in the sequence is induced by a previous disequilibrium and in turn creates a new disequilibrium that requires a further move."[29]

The disequilibrium Hirschman refers to is not that short-term mismatch between supply and demand that results in a shortage (or excess) of demand and is eventually corrected by price adjustments, but rather the disequilibrium of the supply structure, corrected only through investment.

Hirschman proposes redefining the concept of induced investment, in a way that is more appropriate to the reality of underdeveloped countries. Traditionally, induced investment is defined as that which occurs in response to past increases in demand, induced, in this case, by pressure on installed capacity. The induction to which Hirschman refers comes from the complementarities and externalities generated by current investment. In his words, "[t]his definition makes induced investment look very much like the multiplier: each investment is conceived as inducing a series of subsequent investments…"[30]

The transmission mechanism by which complementarities and externalities generated by investment induce new investments, that is, the investment multiplier, is operationalized by the backward linkages and forward linkages, defined by Hirschman in chapter 6 of The *Strategy of Economic Development*.

In the input-output analyzes initially developed by Wassily Leontief[31], the premise adopted is that, in the short term, the technical coefficients of production are fixed or vary monotonically with production, so that the expansion of the production of a sector requires the expansion of the production of all sectors that supply its inputs (backward linkages). If there is no domestic production capacity to meet the increased demand for inputs, this demand will be met by imports.

In the other direction – the destination of sectoral sales, the existence of a domestic supply of a given good should, in practice, stimulate its own demand, provided that the product proves to be competitive with similar imported goods. As long as it is efficient in terms of prices and quality, a

microeconomics, and political economy to outline his analytical framework. Here we refer only to those passages of the book relevant to the foundation of the approach adopted in the present work.

(28) Hirschman, A. O. (1958, p. viii).

(29) Hirschman, A. O. (1958, p. 68-67).

(30) HIrschman (1958, p. 71).

(31) Leontief, W. W. (1941) *The Structure of American Economy 1919-1929 an Empirical Application of Equilibrium Analysis*, Harvard University Press.

theoretical excess of supply capacity will induce an increase in production in the downstream sectors (forward linkages). The increase in intermediate domestic demand, complemented by final demand (exports, public and private consumption – always in competitive terms), will feed back the effects of backward chaining and put the economy in a growth spiral.[32]

Hirshman proposes a simple model of induced investment having as key variables sectoral imports and the minimum economically viable scales of production. Given an aggregate growth rate of the economy and a certain supply structure in which domestic production capacity is lower than the demand in certain sectors, the volume of imports from these sectors tends to grow and, eventually, exceed the minimum viable scales, inducing investments in the creation and/or expansion of the production capacity of goods whose volume of imports has grown.[33]

The effectiveness of the investment will depend on the expectation of maintaining the imbalance over a reasonable time horizon, as well as on solving the financing of capital investment. However, the essential thing is that the basic requirement for conducting the investment – the existence of demand – would be contemplated.

The model, despite its simplicity, also helps to explain the fact that even at a constant rate of economic growth, the trajectory of the rate of gross capital formation is not linear and investment booms occur, especially in the initial stages of the process of industrialization of less developed economies. It also helps to explain why in advanced countries, once an extensive and diversified domestic industrial base is built, the investment rate tends to be more stable and driven especially by technological advances.

In summary, based on the idea of unbalanced growth, at the end of the day Hirshman proposes a development strategy based on inducing private investment to replace imports.

Ten years after the publication of *The Strategy of Economic Development*, in an article published in the Quarterly Journal of Economics[34], Hirschman faced criticism of the "import substitution industrialization" (ISI) model and the disenchantment with this development strategy that emerged after its initial success (disenchantment shared even by its main formulators). In this article, Hirschman re-presents the driving elements of the ISI, the distinct stages of the process and slightly reformulates the scheme of inducing substitutive investment proposed in *The Strategy*.

In this reformulation, one point deserves emphasis: the crucial importance of market size. In the words of the author: "[t]hese considerations make us understand better the tremendous importance of market size (so well illustrated by the exceptional achievements in Latin American of Mexico and Brazil) if the backward linkage process is to be vigorous"[35]. At the end, in defense of the model, he writes: "This paper has no means denied the various difficulties which the ISI process is apt to experience; in fact, they have on occasion been shown to be more deepseated than had been thought.

(32) The intensity, frequency, and specificity of relationships between groups of sectors lead to the configuration of "complexes" or sectoral clusters, in general geographically close.

(33) Hirschman (1958, ch. 6, p. 98-119).

(34) Hirschman, A. O. (1968) The Political Economy of Impost-Substitution Industrialization in Latin America, The Quartely Journal of Economics, v. 82, n. 1, Feb., Oxford University Press.

(35) Hirschman, A. O. (1968, p. 16).

At the same time, our exploration of the characteristics of the process has made it possible to discern avenues toward continued industrial growth that remain open to the late latecomers."[36]

Import substitution was, effectively, the development strategy adopted by most Latin American countries. With the support of the Economic Commission for Latin America and the Caribbean (ECLAC), and under the leadership of Raúl Prebisch, the ISI became state policy, directing economic policy, especially foreign trade, in almost all countries of the region.

The debate about the benefits, rights and wrongs of ISI is huge and remains open. Whether ISI is capable of fully explaining the industrialization of the region or if it responds only to delimited phases of this process is a controversial topic.

It is far beyond the scope of this study to comment on this immense literature. What we will do next is to note the ideas of Albert Fishlow, one of the most distinguished scholars on the subject, which are more related to the study developed here.

Fishlow has been studying the economic development of Latin America and especially Brazil for the last almost 60 years. His work is extensive and, in addition to dealing in depth with the economy in its various dimensions, he also makes advances in the fields of politics and political economy.

In his 2013 essay, Fishlow (2013)[37] identifies three characteristics of Brazilian industrialization: (1) the sequential pattern of import substitution, moving from textiles to intermediate goods and then to consumer durables (capital goods being far from the central focus of the process); (2) the cyclical pattern inherent to import substitution generating imbalances in specific sectors and in the trade balance; and 3) the leading role of state action.

The first of the three features' points to the fact that the sequence of the import substitution process matters. The profile of the sectors subject to import substitution is decisive for the format and continuity of the process. The effects of import substitution by domestic production on the balance of payments, return on invested capital, job creation and domestic income will differ according to the sectoral direction of import substitution. These effects depend on the minimum scale of efficient production, the size of the market and the sectoral productivity level.

The second characteristic has another relevant implication. With the advance of industrialization towards the production of durable consumer goods, the industrial structure becomes even more intensely subject to the cyclical behavior of economic activity, not only due to variations in income and credit, but also to the consumption profile of the population and the lagged effects of the multiplier-accelerator interaction on installed capacity.

The resumption of post-crisis industrialization in the early 1960s would occur with the First National Development Plan (I PND) in 1971, and with the Second National Investment Plan (II PND),

(36) Hirschman, A. O. (1968, p. 32).

(37) Fishlow, A. (2013) Origens e consequências da substituição de importações: 40 anos depois, In Bacha, E. e de Bolle, M. (org.) O Futuro da Indústria no Brasil: Desindustrialização em Debate, Civilização Brasileira, 2013. In this article Fishlow revisits the theses presented in his classic work: Fishlow, A. (1972) *Origins and Consequences of Import Substitution in Brazil* in DI MARCO, L. E. International Economics and Development Essays in Honor of Raúl Prebish, p. 311-365, Academic Press.

now focused on infrastructure, petrochemicals and intensifying the flow of science and technology to the productive sector. However, the option to finance this investment package with external resources proved to be wrong. External factors – rising oil prices and, later, rising international interest rates – led the country to a foreign debt crisis, interrupting ISI's hitherto successful path.

The debt crisis blocked the advance of Brazilian industrialization.

Finally, on the role of the Brazilian state in industrialization, Fishlow records that there is a broad consensus that it was essential. The government activated all possible mechanisms to promote industry: direct investment, public spending, tariff protection, quotas, currency devaluations, multiple exchange rates, economic and labor regulation, public credit etc.

In an article from 1990, Fishlow reaffirms the decisive role of the State in the continuity of the post-industrialization development process, seeking support in the literature of market failures to combat the anti-State wave advocating market liberalization:

> If anything, modern economic theory has reinforced a more skeptical view of laissez-faire. Incomplete markets, imperfect information, strategic interactions, principal-agent problems, transactions costs, and bounded rationality take up a large part of the microeconomic literature.
> …
> Even if there has been implementation failure in Latin America, that is an argument for correcting it, not for pursuing a second-best policy of laissez-faire in the presence of externalities that can be exploited to accelerate economic development. Paradoxically, the very array of powerful private interests celebrated by the rent-seeking and related literature requires a strong state to manage successful reform. In the absence of state capacity, concentrated market and political power and other imperfections may make laissez-faire an nth-best choice[38].

In his most recent work, in partnership with José Eustáquio Ribeiro Vieira Filho[39], he reaffirms the essential role that the state still has in promoting development, but in a different way than the one it played in ISI. The task now would be to implement actions and public policies for innovation and technology that promote a significant increase in the productivity and competitiveness of the Brazilian economy. [40]

The authors study three cases of successful institutional arrangements (Embrapa, Petrobrás and Embraer) and conclude that public-private cooperation initiatives are the most efficient way to promote long-term productivity growth in the current phase of Brazil's economic development: "Overall, the agricultural and industrial revolutions at Embrapa, Petrobrás, and Embraer serve as examples of public policy, effectively designed and implemented, and enabling long-term increases in productivity. Extremes, whether taken up by the state or by private initiatives, are unlike to yield better outcomes."[41]

(38) Fishlow, A. (1990) The Latin American State, Journal of Economic Perspectives, American Economic Association Summer, 1990, v. 4, n. 3, p. 61-74.

(39) Fishlow, A. and Vieira Filho, J. E. R. (2020) Agriculture and Industry in Brazil Innovation and Competitiveness, Columbia University Press.

(40) An extensive study on productivity in Brazil can be seen in De Negri, F. and Cavalcante, L. R. (ed.) (2014) Productivity in Brazil, performance and determinants, ABDI: IPEA, 2014.

(41) Fishlow, A. (2020, p. 211).

2.3 Linkages, leakages, and heterogeneity

Input-output matrices are the best representation of an economy's productive structure. They are built from the tables of uses and resources that record the purchase and sale transactions between producers and consumers in the economy, considering both final and intermediary sales. An additional breakdown of information is necessary to segment final and intermediate consumption by national or imported origin.

As the registered flows are monetary, certain hypotheses are assumed concerning production technology (of the product or of the production sector) to estimate the matrices of technical production coefficients. As a result, the input-output matrices thus generated relate production values (by product and sector) to final demand and make it possible to estimate the impact of variation in the production of a sector on the production of the sectors that produce its inputs, as well as the destination of sales (intermediate and final) of each sector.

The matrix of direct and indirect production coefficients (Leontief matrix) is obtained by transforming the input-output matrix (inversion of the matrix resulting from the subtraction of the identity matrix from the input-output matrix). [42]

In this work, we used the harmonized inverse Leontief matrices for Brazil, China, and the United States, provided by the OECD. [43]

The option to analyze the intersectoral impact coefficients in these three countries is justified because they are paradigmatic countries for the approach adopted in this work.

Our objective was to reposition the debate on deindustrialization in the context of structural changes inherent to the process of the economic development of nations. It should be noted that the input-output matrix is built based on transactions between all sectors of the economy and is not restricted to the industrial sector. This makes it possible to see industry's loss of added value participation in GDP from another perspective, contextualizing it within the framework of structural changes occurring within production chains and under the effect of alterations in the profile of final demand.

The period for which data are available (1995-2018) is the one that witnessed one of the most fantastic structural economic changes in history – Chinese industrialization. Our proposal was to compare this magnificent structural transformation with two other opposing realities: the structural stability of the American economy and the relative involution of Brazil.

In this phase of the work, the analysis of the indicators was only descriptive and only dispersion and correlation indicators were performed. More econometrically elaborate work could be done, but, due to the small number of observations, the analysis would end up being too generic, using aggregated coefficients and a larger set of countries. Thus, the possibility of analyzing specificities would be lost, not only by country, but also by sector in each country, which was exactly the initial objective of the work.

(42) The input-output model was developed by Wassily Leontief and presented in Leontief, W. W. (1941) The Structure of the American Economy 1919-1929, Harvard University Press.

(43) The tables used were obtained from the address: https://stats.oecd.org/Index.aspx?DataSetCode=IOTS_2021.

The indicators analyzed were backward linkages and leakages. The first ones are the sum of the values of the Leontief matrix cells in each column, where each column corresponds to a sector of economic activity. Leakages were defined in this study as the difference (in percentage terms) between the value of total backward linkages and the value of domestic backward linkages. The Leontief matrices available from the OECD are presented in two versions, total and domestic. The difference between them is that, in the domestic version, sectoral imports are deducted from total intermediate purchases, so that the coefficient captures only the impacts on domestic production. Thus, the difference between the total and domestic indicators corresponds to the chaining effects of production that "leak" abroad in the form of imports, hence the name leakage.

The analysis of the linkage indicators makes it possible to rank the sectors of activity according to their potential for generating impacts and to observe changes in this ranking over time. It is an indication of the structural changes the country is going through. The determinants of these changes are related to macro and microeconomic factors. Variables such as interest rates, exchange rates and differentials between domestic and global growth rates are certainly part of these determinants. Likewise, technological changes and differences between the cost structures of local production and imported products are also part of the list of determinants.

However, estimating the contribution of these variables in determining the behavior of the indicators would imply conducting more sophisticated econometric exercises applied to a more extensive database.

The ranking of sectors by magnitude of linkage indicators can also be a kind of "pocket guide" for initiatives to reactivate the economy by stimulating demand in sectors with greater impact indicators. Considering domestic linkages, such a "guide" can help optimize the use of resources to activate the economy in the short term. However, short-term measures should not be confused with long-term policies that, in fact, aim to change impact indicators, which are, by definition, fixed in the short term.

The study of the dispersion coefficients of the linkage indicators also makes it possible to advance considerations on the degree of "homogeneity" of the country's productive structure. The smaller the dispersion, the more "balanced" the productive structure. This "balance" would indicate that the activity sectors have similar relative importance and there would not be a particular dependence on the economy's expansion capacity of specific sectors. A more balanced structure tends to increase the resilience of the economy to supply or demand shocks.

In turn, the leakage indicators show the degree of dependence of the sector's domestic production on imports. If ranked and weighted by the relative size of the sectors, in principle, they help to identify the best investment opportunities for import substitution. The difference between this approach and the traditional ones, which consider only the import volume of a sector, is that imports indirectly related to the variation in production of the sectors of activity are also identified.

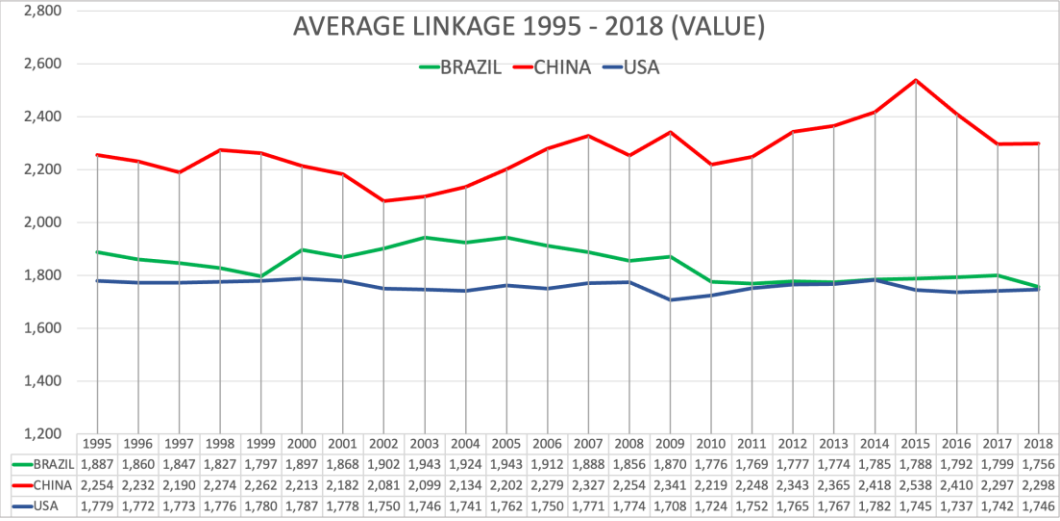
The results of the analysis of sectoral linkages and leakages indicators are presented separately by country in sections 4, 5 and 6 below. Prior to this, section 3 presents the aggregated analysis, year by year, of these aggregated indicators, separately for the three chosen countries. This allows an overview of the profile of structural changes in these countries over the period of analysis and the ability to draw some initial conclusions.

3 Overview 1995-2018: Brazil, China, and the United States

3.1 Linkages

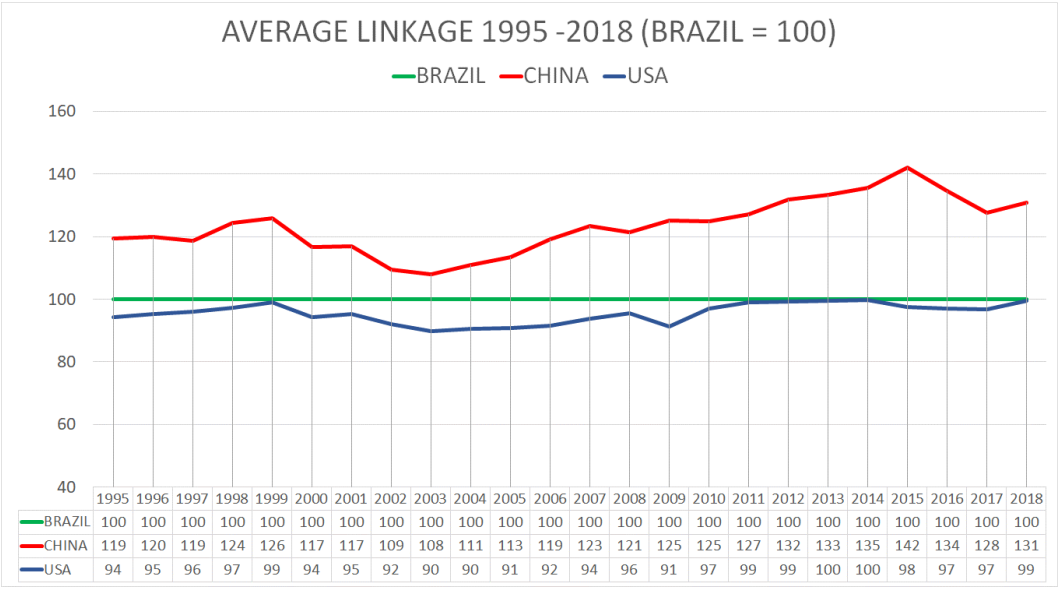
The evolution of the average linkage indices in the three countries shows the obvious difference in the trajectory of the Chinese indicator compared to its Brazilian and American counterparts.

Graph 1A



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
BRAZIL	1,887	1,860	1,847	1,827	1,797	1,897	1,868	1,902	1,943	1,924	1,943	1,912	1,888	1,856	1,870	1,776	1,769	1,777	1,774	1,785	1,788	1,792	1,799	1,756
CHINA	2,254	2,232	2,190	2,274	2,262	2,213	2,182	2,081	2,099	2,134	2,202	2,279	2,327	2,254	2,341	2,219	2,248	2,343	2,365	2,418	2,538	2,410	2,297	2,298
USA	1,779	1,772	1,773	1,776	1,780	1,787	1,778	1,750	1,746	1,741	1,762	1,750	1,771	1,774	1,708	1,724	1,752	1,765	1,767	1,782	1,745	1,737	1,742	1,746

Graph 1B



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
BRAZIL	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
CHINA	119	120	119	124	126	117	117	109	108	111	113	119	123	121	125	125	127	132	133	135	142	134	128	131
USA	94	95	96	97	99	94	95	92	90	90	91	92	94	96	91	97	99	99	100	100	98	97	97	99

The Chinese indicator is superior to the Brazilian and American ones throughout the period and distanced itself even more from these from 2002, when it began to grow practically

uninterruptedly until 2015, reaching a value 22% higher than in 2002 in the latter year (Graph 1A). In 2015, the Chinese linkage indicator was around 40% higher than the Brazilian and American indices (Chart 1B).

Rather than soaring like an eagle, the Brazilian index corresponds to something closer to a "chicken flight" between 1999 and 2010. It grew 8% between 1999 and 2005 and fell 8.5% between 2005 and 2010, returning in the latter year to the value it had in 1999.

The American indicator remained practically constant throughout the period. This behavior is representative of the relative structural stability of mature and developed economies. This is to be expected because in a highly diversified economy with a reasonable balance in the relative weight of each sector of activity in the supply structure, sectoral changes, however impactful they may be for a sector, have their effect[44]diluted in the structure of the economy as a whole[45].

The linkage average is an unweighted average of the linkage coefficients of each industry each year. It is a proxy for the degree of homogeneity/heterogeneity of the country's economic structure in relation to the capacity of each sector of activity to generate productive impacts upstream in the production chain. The higher the dispersion coefficient of the linkage indicator, the greater the structural heterogeneity and vice versa: the lower the coefficient, the more homogeneous the structure.

The trajectories of the dispersion coefficients of the average linkages between 1995 and 2018 of the three countries, shown in Graph 2 below, indicate quite different movements between them regarding the homogenization/heterogenization of the economic structure.

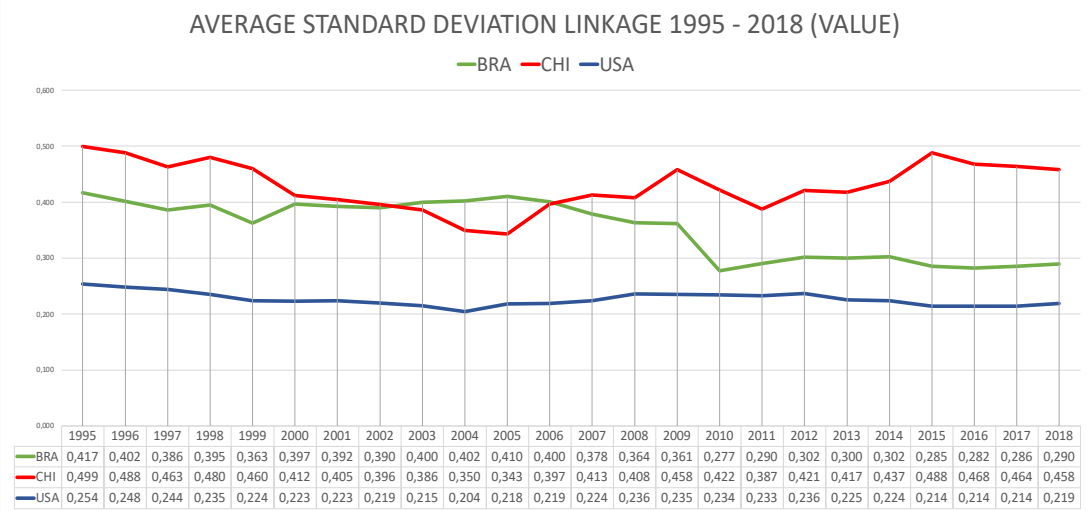
The dispersion coefficient of the linkage indicator for the American economy, after a fall of almost 12% between 1995 and 1999, remained at the same level as that last year until the end of the period, indicating remarkable stability for the economic structure. Note, obviously, that this is not about macroeconomic stability. The latter was precisely the opposite of what in fact occurred in the American and world economy in the period. However, macroeconomic instability did not induce significant changes in the structure of the physical production of goods and the supply of services in the United States. In comparison with the other two countries, the American productive structure was more homogeneous than the Chinese and Brazilian structures for the period[46].

(44) In fact, there was a strong asymmetry in the behavior of US sectoral leakage indicators between 1995 and 2018, as will be seen in section 6.

(45) This is probably the reason why the linkage indicator of chaining impacts varied little throughout the reference period, as previously noted in subsection 3.1.

(46) This hypothesis of structural stability of the US economy in the reference period will be confirmed when analyzing the behavior of the sectoral linkage indicators, which will be carried out in section 6 below.

Graph 2



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
BRA	0,417	0,402	0,386	0,395	0,363	0,397	0,392	0,390	0,400	0,402	0,410	0,400	0,378	0,364	0,361	0,277	0,290	0,302	0,300	0,302	0,285	0,282	0,286	0,290
CHI	0,499	0,488	0,463	0,480	0,460	0,412	0,405	0,396	0,386	0,350	0,343	0,397	0,413	0,408	0,458	0,422	0,387	0,421	0,417	0,437	0,488	0,468	0,464	0,458
USA	0,254	0,248	0,244	0,235	0,224	0,223	0,223	0,219	0,215	0,204	0,218	0,219	0,224	0,236	0,235	0,234	0,233	0,236	0,225	0,224	0,214	0,214	0,214	0,219

The trajectories of the Brazilian and Chinese dispersion coefficients tell a different story.

In the Brazilian case, the sectoral dispersion index was practically stable between 1995 and 2005, fell by more than 32% between 2005 and 2010 and has remained constant since then. The Brazilian economy became structurally more homogeneous, regarding the ability to generate upstream chaining impacts of different activity sectors, from 2005 onwards. This relative homogenization is concomitant with the 8.5% drop between 2005 and 2010 in the magnitude of chaining effects, denoting the weakening of the economy's growth potential, as shown in Graph 1A.[47]

In the case of China, the dispersion coefficient went through two distinct phases: in the downward phase, from 1995 to 2005, the coefficient dropped by 31%, indicating that the Chinese productive structure was becoming more homogeneous. In the ascending phase, from 2005 to 2018, the index increased by more than 33%, reaching a level close to that of 1995 at the beginning of the period.

That is, unlike the Brazilian case, in China the productive structure alternated phases of homogenization and heterogenization and consolidated a significant increase in the capacity to generate impacts upstream of the productive sectors.

In Brazil, there was a "once and for all" shift towards greater homogeneity in the ability to generate linkage effects in the economy, without changing the power to generate sectoral growth impacts.

In both cases, as will be seen in the next section, the behavior of the linkage indicator and its dispersion index have an important relationship with the degree of leakage of the effects of productive chaining to the outside (leakage indicator).

(47) It is likely that the commodity boom experienced from the mid-2000s until the Great Crisis of 2009 was the catalyst for this process.

3.2 Leakages

Compared to Brazil and the United States, China has always been an economy more integrated into international trade than the other two countries.

However, if at the beginning of the period, in 1995, the degree of Chinese productive integration was much higher than that of Brazil and the United States, this picture changed significantly at the end of the period in 2018.

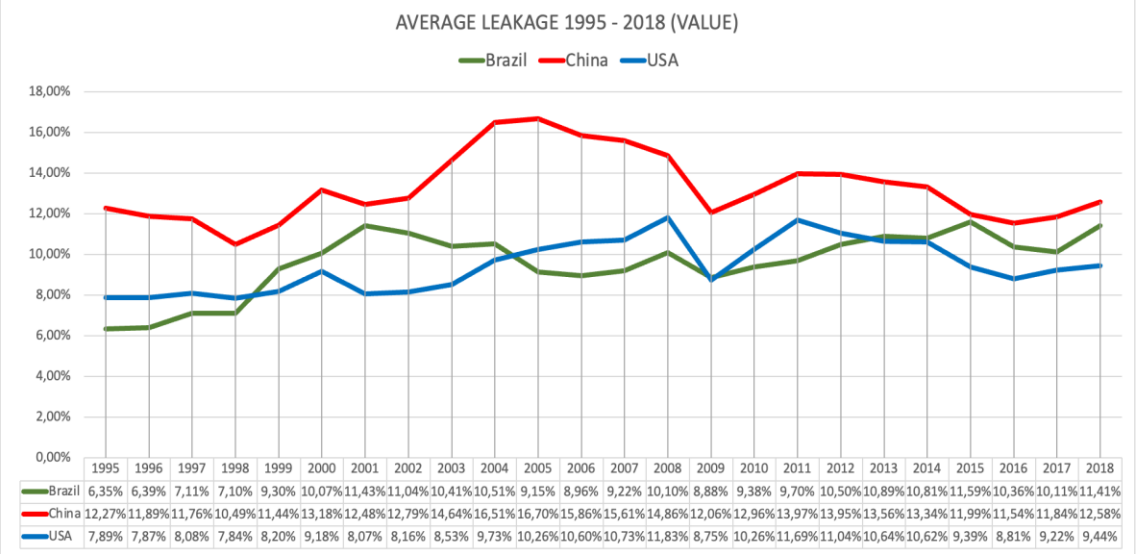
In 1995, the degree of leakage of the impacts of Chinese domestic production abroad was 93% greater than that of Brazil and 70% greater than that of the United States. In 2018, the Chinese index was only 10% higher than the Brazilian index and 27% higher than the American one, as shown in Graphs 3a and 3b below.

Comparing the initial and final years of the series, 1995 and 2018, the Chinese index practically returned in 2018 to the value it had in 1995. The Brazilian index increased by around 80%.

What is essential, however, is to observe the trajectory of convergence of the degree of leakage.

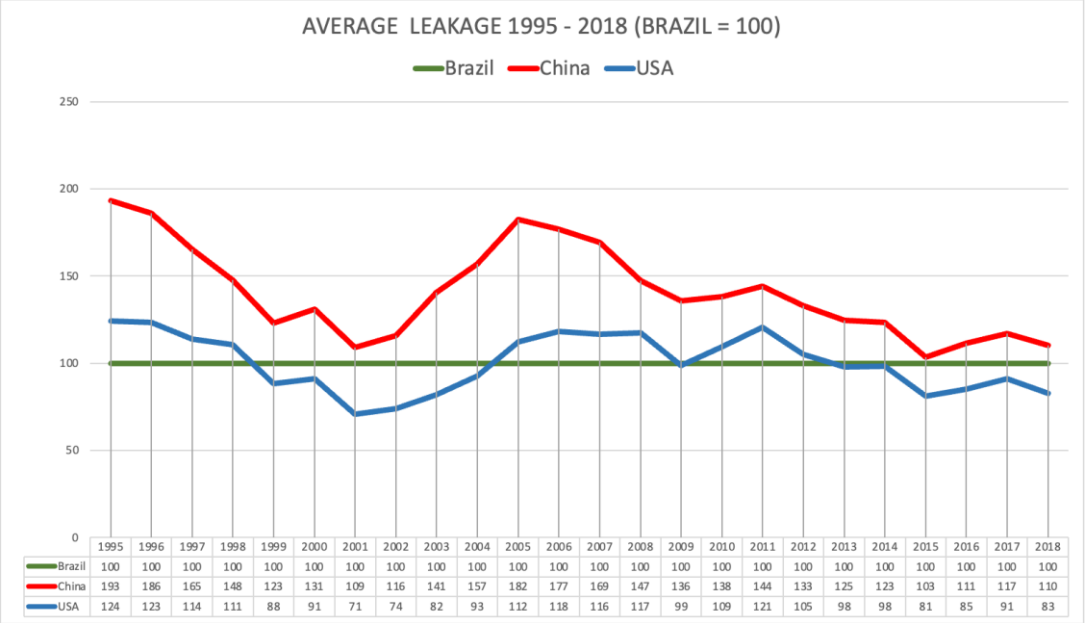
China started from a leakage rate almost double that of Brazilian in 1995 (China: 12.27%, Brazil: 6.35%). In 2005, the index reached the peak of the series (16.7%) and, from then on, it fell back to the level of the beginning of the period (12.58% in 2018).

Graph 3A



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Brazil	6,35%	6,39%	7,11%	7,10%	9,30%	10,07%	11,43%	11,04%	10,41%	10,51%	9,15%	8,96%	9,22%	10,10%	8,88%	9,38%	9,70%	10,50%	10,89%	10,81%	11,59%	10,36%	10,11%	11,41%
China	12,27%	11,89%	11,76%	10,49%	11,44%	13,18%	12,48%	12,79%	14,64%	16,51%	16,70%	15,86%	15,61%	14,86%	12,06%	12,96%	13,97%	13,95%	13,56%	13,34%	11,99%	11,54%	11,84%	12,58%
USA	7,89%	7,87%	8,08%	7,84%	8,20%	9,18%	8,07%	8,16%	8,53%	9,73%	10,26%	10,60%	10,73%	11,83%	8,75%	10,26%	11,69%	11,04%	10,64%	10,62%	9,39%	8,81%	9,22%	9,44%

Graph 3B



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Brazil	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
China	193	186	165	148	123	131	109	116	141	157	182	177	169	147	136	138	144	133	125	123	103	111	117	110
USA	124	123	114	111	88	91	71	74	82	93	112	118	116	117	99	109	121	105	98	98	81	85	91	83

It is an arc-shaped trajectory, illustrated in Graph 4 below, with two phases: expansion followed by reduction. In the first phase, a growing share of the upstream productive impact of Chinese sectoral production leaked abroad through imports. In the second phase, the Chinese economy increasingly internalized the chaining impacts, through the expansion of domestic production of previously imported inputs.

It seems clear that China has implemented a successful strategy of import substitution with international integration over the last twenty years, based on what could be characterized as a critical re-reading of the import substitution industrialization (ISI) model, responsible for the success of Latin-American industrialization, especially in the case of Brazil, as discussed in section 2 of this paper[48].

The basic difference between the Chinese and ISI models is that the former is operationalized through integration into the international market, while the latter relies on the closure of national markets.

Paradoxically to what one might expect, the Chinese strategy of combining import substitution with economic openness led to an increase in the domestic growth impact coefficients, measured by the linkage indicator, rather than a decrease. Integration into the international market was, for China, a driver of development and a growth lever.

In Brazil the story was different.

(48) Confirmation of this analysis hypothesis will come in section 7 below, when an analysis of the Chinese sectoral linkage and leakage indicators will be carried out.

The Brazilian economy was quite closed in 1995 (leakage index: 6.35%) but, from 1998 until 2001, it quickly integrated into international trade and, in that last year (2001), presented a leakage index just 1 pp lower than that of China (Brazil: 11.43%; China: 12.48%). However, unlike China, which continued to expand its connection with international trade, Brazilian integration has stagnated. By 2005, the Chinese index had advanced to 16.70% and the Brazilian had fallen to 9.15%.

As in the Chinese case, in the Brazilian opening phase, the index of chaining impacts grew simultaneously with the growth of the degree of leakage of the economy. With the relative reversal of integration, the impact index stabilized.

Unlike the Chinese case, the opening of the Brazilian economy [49] only resulted in a "shift" in the degree of external dependence of the economy to a higher level than at the beginning of the period.

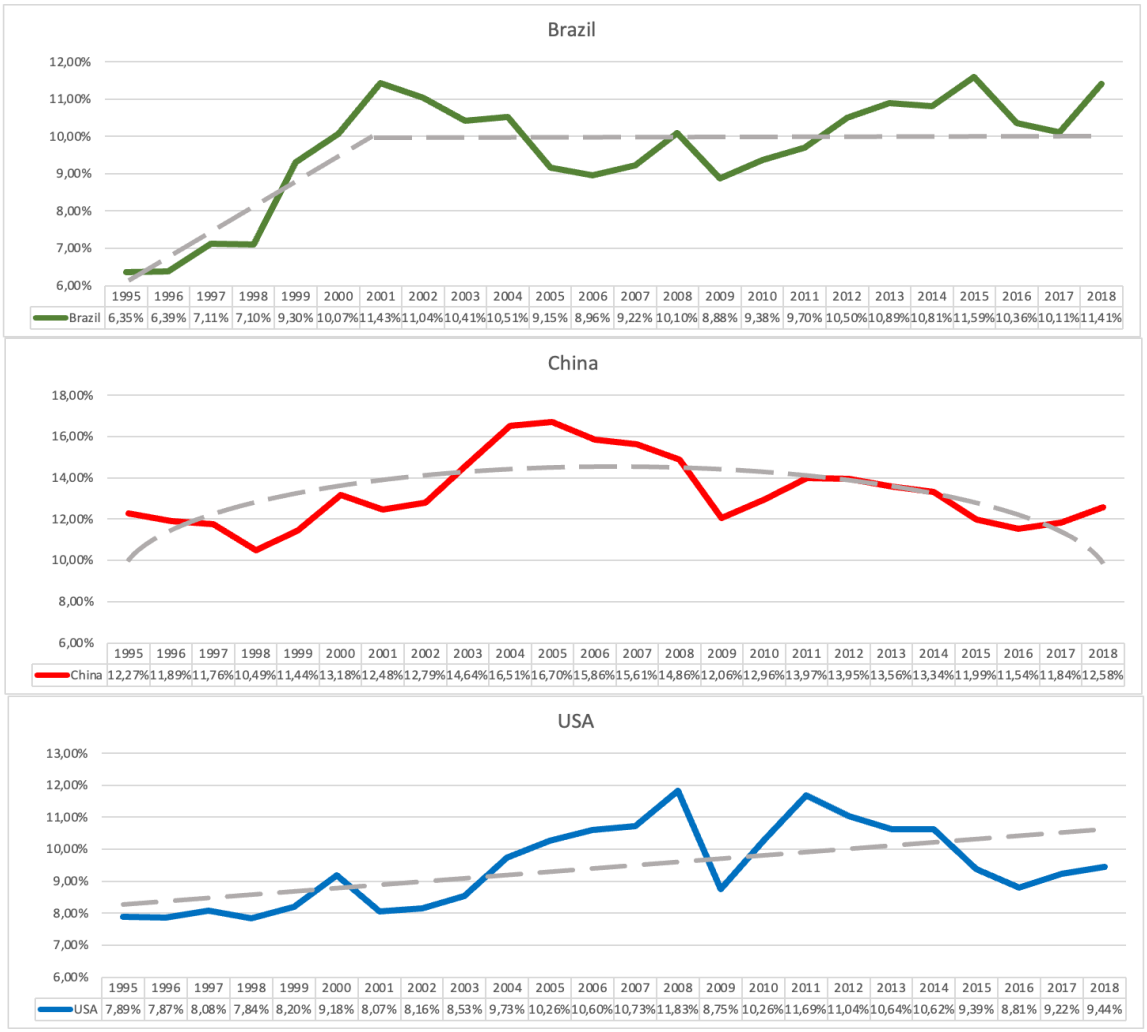
There was no significant substitution of imports. There was no increase in the retention of productive impacts by domestic production.

Finally, in the American case, the trajectory of the leakage indicator can be described as one of moderate expansion. It is also worth mentioning the synchrony of movements of the American and Chinese leakage indicators, clearly visualized in Graph 3b: two sides of the same coin.

To summarize, Graph 4 below illustrates with dashed lines the trajectories of the degree of dependence on the supply of imported inputs for local production in the three countries: displacement in Brazil, an arc in China and moderate expansion in the United States.

(49) The opening of the Brazilian economy to the outside world began in the early 1990s, with the Collor Plan, with the elimination of non-customs barriers in 1990, followed by the application of a schedule of tariff reductions, previously announced, which took place in February 1991, January 1992, October 1992 and July 1993. See in this respect Kume, H. (1996) The import policy in the Real Plan and the structure of effective protection. Text for Discussion, n. 118, IPEA.

Graph 4



It seems clear that distinct strategies were underway for integration into international trade in Brazil, China, and the United States.

4 Brazil Sectoral 1995-2018

As defined earlier, the linkage indicator measures the power to generate productive impacts upstream of the production chain of each sector of activity. This indicator is always higher than the unit and the excess over the unit corresponds to the number of purchases of inputs resulting indirectly from the sector's production.

Domestic linkage captures the net effect of linkage impacts, discounting imports directly and indirectly related to the production of each sector.

The leakage indicator, on the other hand, measures the degree of leakage of upstream chaining impacts to the outside in the form of imports.

4.1 Linkage

Table 1 below shows the evolution of the domestic linkage of each sector of activity in Brazil between 1995 and 2018.[50]

There is no uniformity in the rates of change. Macroeconomic evolution, technological changes and the profile of international trade affected different sectors in diverse ways, without identifying a single pattern of evolution of the indicator.

In 18 of the 44 surveyed sectors, the indicator grew between the first cycle (1995-1998) and the last (2107-2018), and in only 10 of them did this growth exceed 5%. In the other 26 sectors the indicator fell and in 17 of them the fall was greater than 5%.

Of the 10 sectors that showed the greatest positive changes, 8 are service activities. The highest growth rates were observed in D64Q66: Financial and insurance activities (20.76%) and D45T47: Wholesale and retail trade; repair of motor vehicles (18.03%). The two non-service sectors among the 10 highest increases in the indicator are D01Q02: Agriculture, hunting, forestry (8.88%) and D41T43: Construction (8.84%).

On the negative side, the extractive industry and almost the entirety of manufacturing, as well as the services and utilities sectors, experienced a drop in their power to generate domestic impacts

The biggest drops were seen in sectors D07T08: Mining and quarrying, non-energy producing products (25.22%); D05T06: Mining and quarrying, energy producing products (23.74%); D09: Mining support service activities (22.94%) and D24: Basic metals (20.58%). It is noteworthy that these were exactly the sectors most positively affected by the commodity boom resulting from the extraordinary expansion of the Chinese economy that followed China's accession to the WTO. However, the dynamism of the sector did not translate into expansion of the capacity to generate domestic production impacts. The fruits of the growth of these sectors were reaped much more in the macroeconomic sphere, especially by contributing to the generation of a trade balance surplus and its indirect effects on inflation through exchange rate appreciation.

(50) The sectors are presented in descending order of the rate of change between the average of the indicator between 2017 and 2018 and the average between 1995 and 1998.

Table 1
Brazilian domestic linkage (1995-1998 = 100)

SECTOR	1999-2002	2003-2006	2007-2010	2011-2014	2015-2016	2017-2018
D64T66: Financial and insurance activities	111,91	114,41	120,66	126,75	121,21	120,76
D45T47: Wholesale and retail trade; repair of motor vehicles	116,99	118,47	114,05	118,28	119,66	118,03
D53: Postal and courier activities	113,69	130,88	112,72	105,16	105,75	111,60
D55T56: Accommodation and food service activities	118,40	140,83	132,17	110,29	111,25	110,66
D84: Public administration and defence; compulsory social security	106,34	109,06	109,50	114,04	113,38	110,26
D01T02: Agriculture, hunting, forestry	101,19	110,04	107,43	107,74	109,62	108,88
D41T43: Construction	103,95	118,33	112,52	107,36	107,37	108,84
D49: Land transport and transport via pipelines	106,13	114,65	110,25	107,06	107,39	108,39
D85: Education	106,96	113,06	111,92	114,10	110,38	107,92
D52: Warehousing and support activities for transportation	110,41	120,54	111,78	104,95	105,04	105,56
D29: Motor vehicles, trailers and semi-trailers	106,68	115,41	108,18	99,82	101,48	103,08
D36T39: Water supply; sewerage, waste management and remediation activities	90,30	96,87	109,21	106,26	106,94	102,96
D17T18: Paper products and printing	111,16	122,94	115,77	103,81	102,68	102,78
D35: Electricity, gas, steam and air conditioning supply	95,32	102,51	103,38	109,02	105,84	102,24
D10T12: Food products, beverages and tobacco	107,73	113,52	109,29	102,12	103,12	101,88
D58T60: Publishing, audiovisual and broadcasting activities	98,30	101,81	99,76	100,92	101,39	100,95
D62T63: IT and other information services	95,39	97,14	97,48	102,11	102,38	100,88
D31T33: Manufacturing nec; repair and installation of machinery and equipment	88,38	76,91	83,31	97,56	98,52	100,05
D61: Telecommunications	97,61	98,58	97,91	103,32	101,07	99,82
D16: Wood and products of wood and cork	111,78	120,29	109,16	97,03	99,19	99,29
D51: Air transport	101,12	106,70	103,45	102,44	101,24	99,24
D03: Fishing and aquaculture	100,68	102,20	100,62	99,70	101,99	99,08
D25: Fabricated metal products	108,22	115,36	104,41	95,14	94,12	98,27
D21: Pharmaceuticals, medicinal chemical and botanical products	114,39	122,80	112,05	99,26	101,73	98,13
D86T88: Human health and social work activities	99,36	103,41	99,49	97,17	97,05	96,98
D68: Real estate activities	99,77	98,72	99,64	98,76	97,54	96,19
D23: Other non-metallic mineral products	105,33	109,63	102,05	91,88	95,31	95,72
D94T96: Other service activities	92,86	94,64	93,72	95,20	93,98	94,37
D69T75: Professional, scientific and technical activities	98,98	100,60	97,78	98,64	97,69	93,89
D26: Computer, electronic and optical equipment	91,25	92,30	90,76	92,74	93,10	93,75
D27: Electrical equipment	94,48	97,29	95,02	93,55	92,42	93,69
D50: Water transport	100,90	107,67	104,29	97,61	92,02	93,65
D13T15: Textiles, textile products, leather and footwear	113,57	123,70	108,94	93,53	93,91	92,73
D28: Machinery and equipment, nec	92,33	89,95	87,92	92,25	91,02	92,64
D20: Chemical and chemical products	102,33	105,85	97,43	93,12	91,03	91,43
D22: Rubber and plastics products	106,28	111,43	98,32	88,37	88,46	88,74
D19: Coke and refined petroleum products	97,66	95,00	91,83	96,87	88,22	87,83
D90T93: Arts, entertainment and recreation	89,28	91,98	86,95	82,98	83,32	84,61
D77T82: Administrative and support services	99,22	102,31	94,10	80,44	80,01	82,44
D30: Other transport equipment	88,04	91,04	91,73	89,87	85,34	80,82
D24: Basic metals	92,85	87,39	83,44	78,19	79,33	79,42
D09: Mining support service activities	87,90	78,93	74,95	70,28	81,42	77,06
D05T06: Mining and quarrying, energy producing products	89,96	80,56	75,86	68,17	80,36	76,26
D07T08: Mining and quarrying, non-energy producing products	89,42	81,75	73,68	59,80	81,61	74,78

Differences in the growth rates of sectoral indicators obviously altered the relative positions of sectors in the ranking of their importance in generating chaining impacts.

Table 2A below presents, in descending order, the hierarchy of sectors based on the average magnitude of domestic linkages indicators for 1995-1999 and 2017-2018.

Table 2A
Brazilian domestic linkage (Value)

SECTOR	1995-1998	SECTOR	2017-201
D24: Basic metals	2,671	D19: Coke and refined petroleum products	2,281
D19: Coke and refined petroleum products	2,597	D10T12: Food products, beverages and tobacco	2,263
D07T08: Mining and quarrying, non-energy producing products	2,439	D29: Motor vehicles, trailers and semi-trailers	2,192
D20: Chemical and chemical products	2,394	D20: Chemical and chemical products	2,189
D22: Rubber and plastics products	2,362	D24: Basic metals	2,122
D09: Mining support service activities	2,283	D22: Rubber and plastics products	2,096
D05T06: Mining and quarrying, energy producing products	2,280	D51: Air transport	2,087
D30: Other transport equipment	2,236	D23: Other non-metallic mineral products	2,071
D10T12: Food products, beverages and tobacco	2,221	D27: Electrical equipment	2,064
D27: Electrical equipment	2,203	D25: Fabricated metal products	2,026
D23: Other non-metallic mineral products	2,164	D17T18: Paper products and printing	2,004
D28: Machinery and equipment, nec	2,136	D28: Machinery and equipment, nec	1,979
D29: Motor vehicles, trailers and semi-trailers	2,127	D16: Wood and products of wood and cork	1,965
D51: Air transport	2,103	D26: Computer, electronic and optical equipment	1,960
D26: Computer, electronic and optical equipment	2,091	D13T15: Textiles, textile products, leather and footwear	1,891
D25: Fabricated metal products	2,062	D35: Electricity, gas, steam and air conditioning supply	1,885
D13T15: Textiles, textile products, leather and footwear	2,039	D41T43: Construction	1,860
D16: Wood and products of wood and cork	1,979	D31T33: Manufacturing nec; repair and installation of machinery and equipment	1,854
D17T18: Paper products and printing	1,950	D49: Land transport and transport via pipelines	1,851
D90T93: Arts, entertainment and recreation	1,927	D07T08: Mining and quarrying, non-energy producing products	1,824
D31T33: Manufacturing nec; repair and installation of machinery and equipment	1,853	D58T60: Publishing, audiovisual and broadcasting activities	1,810
D35: Electricity, gas, steam and air conditioning supply	1,844	D30: Other transport equipment	1,807
D50: Water transport	1,843	D61: Telecommunications	1,789
D94T96: Other service activities	1,824	D55T56: Accommodation and food service activities	1,773
D58T60: Publishing, audiovisual and broadcasting activities	1,793	D09: Mining support service activities	1,759
D61: Telecommunications	1,792	D05T06: Mining and quarrying, energy producing products	1,739
D77T82: Administrative and support services	1,767	D21: Pharmaceuticals, medicinal chemical and botanical products	1,733
D21: Pharmaceuticals, medicinal chemical and botanical products	1,766	D50: Water transport	1,726
D41T43: Construction	1,709	D94T96: Other service activities	1,722
D49: Land transport and transport via pipelines	1,708	D01T02: Agriculture, hunting, forestry	1,689
D69T75: Professional, scientific and technical activities	1,621	D52: Warehousing and support activities for transportation	1,638
D55T56: Accommodation and food service activities	1,602	D90T93: Arts, entertainment and recreation	1,631
D86T88: Human health and social work activities	1,574	D53: Postal and courier activities	1,586
D52: Warehousing and support activities for transportation	1,552	D36T39: Water supply; sewerage, waste management and remediation activities	1,529
D01T02: Agriculture, hunting, forestry	1,551	D86T88: Human health and social work activities	1,527
D36T39: Water supply; sewerage, waste management and remediation activities	1,485	D69T75: Professional, scientific and technical activities	1,522
D53: Postal and courier activities	1,421	D45T47: Wholesale and retail trade; repair of motor vehicles	1,513
D62T63: IT and other information services	1,400	D64T66: Financial and insurance activities	1,473
D45T47: Wholesale and retail trade; repair of motor vehicles	1,282	D77T82: Administrative and support services	1,457
D84:A43ublic administration and defence; compulsory social security	1,250	D62T63: IT and other information services	1,412
D64T66: Financial and insurance activities	1,220	D84: Public administration and defence; compulsory social security	1,378
D68: Real estate activities	1,188	D85: Education	1,248
D03: Fishing and aquaculture	1,170	D03: Fishing and aquaculture	1,159
D85: Education	1,156	D68: Real estate activities	1,143
D97T98: Activities of households as employers	1,000	D97T98: Activities of households as employers	1,000
AVG	1,836		1,760

Of the 10 sectors with the greatest power to generate domestic impacts at the beginning of the period, 4 are no longer among the top 10 in 2017-2018: D07T08: Mining and quarrying, non-energy producing products; D09: Mining support service activities; D05T06: Mining and quarrying, energy producing products and D30: Other transport equipment.

The following D29 sectors entered the ranking of the top 10 in 2017-2018: Motor vehicles, trailers and semi-trailers, which rose from 13th in 1995-1998 to 3rd; D51: Air transport, from 14th to 7th; D23: Other non-metallic mineral products, from 11th to 8th and D25: Fabricated metal products, from 16th to 10th.[51]

Table 2B below highlights the 10 sectors with the highest linkage power at the end of the surveyed period.

(51) Detailing the factors that explain the behavior of the indicator for each of the sectors is a task that goes beyond the scope of this preliminary study which, as stated at the beginning, is descriptive. In this phase of the work, the objective was to identify the sectors for which it is worthwhile to deepen the analysis to better understand the determining factors of the gain in chaining power.

Table 2B
Brazilian domestic linkage (Value)

SECTOR	2017-2018
D19: Coke and refined petroleum products	2,281
D10T12: Food products, beverages and tobacco	2,263
D29: Motor vehicles, trailers and semi-trailers	2,192
D20: Chemical and chemical products	2,189
D24: Basic metals	2,122
D22: Rubber and plastics products	2,096
D51: Air transport	2,087
D23: Other non-metallic mineral products	2,071
D27: Electrical equipment	2,064
D25: Fabricated metal products	2,026

These are candidates for key sectors for a rapid expansion of the economy. They are like switches capable of activating the feedback mechanism of the upstream production chain.

The indicator shows the total variation in production as a function of the variation in production in a specific sector, considering the impacts on its supply chain, already discounting the effect of leakage abroad.

The trigger for putting into action the feedback mechanism of a sector's production chain is the increase in its demand. It is important in this sense that the food and beverage industry occupies the second position in the ranking, that is, the improvements in income distribution, with the consequent increase in demand for food and beverages, have increased the positive impact on the economy.

4.2 Leakage

Table 3 below is a portrait of the result of Brazilian-style economic opening. All sectors of activity became more dependent on the supply of imported inputs.

Service sectors stand out again: 8 of the 10 sectors with the highest growth rates are service activities. Sectors D85: Education and D64T66: Financial and insurance activities tripled the value of their indicators, 200.20% and 196.98%, respectively. D01T02: Agriculture, hunting, forestry and D05T06: Mining and quarrying, energy producing products are the non-service sectors among the top 10 with the highest rates of change: 87.06% and 86.61%, respectively.

Table 3
Brazilian Leakage (1995-1998 = 100)

SECTOR	1999-2002	2003-2006	2007-2010	2011-2014	2015-2016	2017-2018
D85: Education	214,09	241,67	221,00	333,88	329,39	300,20
D64T66: Financial and insurance activities	238,47	243,75	225,28	312,31	312,70	296,98
D45T47: Wholesale and retail trade; repair of motor vehicles	222,57	231,53	198,27	244,12	253,27	243,60
D84: Public administration and defence; compulsory social security	190,95	200,06	170,27	213,65	216,47	202,45
D94T96: Other service activities	136,40	129,34	125,56	186,56	183,28	194,45
D62T63: IT and other information services	217,25	206,35	161,78	181,38	206,88	194,22
D55T56: Accommodation and food service activities	181,86	196,28	169,93	182,79	190,71	193,49
D52: Warehousing and support activities for transportation	164,97	176,41	159,81	186,69	203,47	192,66
D01T02: Agriculture, hunting, forestry	159,99	154,19	157,16	188,83	185,24	187,06
D05T06: Mining and quarrying, energy producing products	142,76	116,63	112,28	154,27	201,39	186,61
D30: Other transport equipment	188,67	162,30	147,98	139,88	180,38	180,81
D53: Postal and courier activities	192,88	229,13	166,69	155,32	166,71	174,06
D69T75: Professional, scientific and technical activities	162,53	144,23	129,01	170,38	185,08	174,02
D31T33: Manufacturing nec; repair and installation of machinery and equipment	115,59	69,12	95,53	154,46	173,35	171,24
D86T88: Human health and social work activities	175,70	173,28	150,99	160,34	173,01	170,89
D58T60: Publishing, audiovisual and broadcasting activities	147,21	136,69	127,71	156,62	170,66	169,62
D41T43: Construction	156,82	165,05	162,80	159,47	162,01	164,87
D50: Water transport	152,39	142,55	147,63	180,93	159,00	162,39
D26: Computer, electronic and optical equipment	149,38	129,88	126,90	153,63	161,36	161,62
D61: Telecommunications	159,38	160,00	128,05	151,34	169,57	161,32
D27: Electrical equipment	141,20	128,12	129,92	152,89	156,82	160,97
D17T18: Paper products and printing	168,73	155,52	153,48	168,52	165,65	160,96
D20: Chemical and chemical products	156,53	141,85	144,72	170,87	158,04	160,09
D51: Air transport	149,14	146,80	142,79	182,57	156,37	159,21
D35: Electricity, gas, steam and air conditioning supply	153,86	163,73	150,92	185,43	190,16	158,76
D21: Pharmaceuticals, medicinal chemical and botanical products	185,87	175,64	152,62	158,59	173,95	157,81
D49: Land transport and transport via pipelines	162,40	161,36	156,38	182,43	154,41	155,13
D25: Fabricated metal products	154,74	155,12	156,11	136,89	147,02	153,45
D16: Wood and products of wood and cork	169,67	152,26	138,73	145,08	151,25	152,65
D24: Basic metals	136,50	130,50	130,76	123,39	144,66	152,29
D28: Machinery and equipment, nec	138,84	125,41	131,85	152,42	159,09	150,14
D09: Mining support service activities	131,90	115,56	106,05	131,29	171,72	149,99
D29: Motor vehicles, trailers and semi-trailers	138,87	127,93	127,31	135,20	150,78	146,52
D22: Rubber and plastics products	158,17	138,47	142,59	148,79	142,73	145,32
D19: Coke and refined petroleum products	156,67	146,75	147,33	178,53	146,16	143,51
D10T12: Food products, beverages and tobacco	152,27	134,27	128,02	144,85	146,13	142,60
D36T39: Water supply; sewerage, waste management and remediation activities	119,77	134,27	184,38	152,17	157,51	142,45
D23: Other non-metallic mineral products	162,74	151,45	140,83	136,77	139,77	137,41
D77T82: Administrative and support services	161,19	149,51	124,89	129,65	133,21	135,58
D13T15: Textiles, textile products, leather and footwear	135,52	123,13	124,67	129,11	133,80	130,14
D90T93: Arts, entertainment and recreation	130,27	120,61	121,48	116,31	123,67	123,57
D03: Fishing and aquaculture	158,36	158,18	128,46	133,82	137,74	121,46
D68: Real estate activities	176,67	151,54	141,64	140,10	132,88	120,22
D07T08: Mining and quarrying, non-energy producing products	138,95	124,04	107,92	86,51	129,58	112,50

The different rates of change in the leakage indicator resulted in alterations in the ranking of relative importance of sectors in relation to the degree of leakage of chaining impacts. Table 4A shows, in descending order of importance, the hierarchy of sectors at the beginning and end of the analysis period (average values between the years 1995-1998 and 20157-2018).

The 10 sectors with the highest leakage rates in 2017-2018 are all in manufacturing. Among them, D30: Other transport equipment (27.10%) and D26: Computer, electronic and optical equipment (23.62%) have the highest indicators.

Table 4A
Brazilian Leakage (Value)

SECTOR	1995-1998	SECTOR	2017-2018
D30: Other transport equipment	14,99%	D30: Other transport equipment	27,10%
D26: Computer, electronic and optical equipment	14,61%	D26: Computer, electronic and optical equipment	23,62%
D24: Basic metals	12,10%	D24: Basic metals	18,42%
D19: Coke and refined petroleum products	11,32%	D27: Electrical equipment	17,57%
D22: Rubber and plastics products	10,92%	D20: Chemical and chemical products	16,57%
D27: Electrical equipment	10,91%	D19: Coke and refined petroleum products	16,24%
D29: Motor vehicles, trailers and semi-trailers	10,83%	D22: Rubber and plastics products	15,87%
D28: Machinery and equipment, nec	10,44%	D29: Motor vehicles, trailers and semi-trailers	15,87%
D20: Chemical and chemical products	10,35%	D28: Machinery and equipment, nec	15,68%
D07T08: Mining and quarrying, non-energy producing products	9,99%	D31T33: Manufacturing nec; repair and installation of machinery and equipment	14,93%
D25: Fabricated metal products	9,33%	D05T06: Mining and quarrying, energy producing products	14,69%
D50: Water transport	8,89%	D50: Water transport	14,43%
D13T15: Textiles, textile products, leather and footwear	8,72%	D25: Fabricated metal products	14,32%
D31T33: Manufacturing nec; repair and installation of machinery and equipment	8,72%	D51: Air transport	12,71%
D23: Other non-metallic mineral products	7,99%	D17T18: Paper products and printing	12,45%
D51: Air transport	7,98%	D01T02: Agriculture, hunting, forestry	11,73%
D05T06: Mining and quarrying, energy producing products	7,87%	D13T15: Textiles, textile products, leather and footwear	11,34%
D17T18: Paper products and printing	7,73%	D07T08: Mining and quarrying, non-energy producing products	11,24%
D49: Land transport and transport via pipelines	6,89%	D23: Other non-metallic mineral products	10,99%
D09: Mining support service activities	6,75%	D49: Land transport and transport via pipelines	10,68%
D21: Pharmaceuticals, medicinal chemical and botanical products	6,64%	D21: Pharmaceuticals, medicinal chemical and botanical products	10,48%
D10T12: Food products, beverages and tobacco	6,42%	D09: Mining support service activities	10,12%
D16: Wood and products of wood and cork	6,35%	D41T43: Construction	9,93%
D01T02: Agriculture, hunting, forestry	6,27%	D94T96: Other service activities	9,81%
D41T43: Construction	6,02%	D16: Wood and products of wood and cork	9,69%
D58T60: Publishing, audiovisual and broadcasting activities	5,29%	D10T12: Food products, beverages and tobacco	9,15%
D94T96: Other service activities	5,05%	D58T60: Publishing, audiovisual and broadcasting activities	8,98%
D35: Electricity, gas, steam and air conditioning supply	4,89%	D52: Warehousing and support activities for transportation	8,00%
D36T39: Water supply; sewerage, waste management and remediation activities	4,85%	D55T56: Accommodation and food service activities	7,88%
D90T93: Arts, entertainment and recreation	4,65%	D35: Electricity, gas, steam and air conditioning supply	7,76%
D77T82: Administrative and support services	4,30%	D62T63: IT and other information services	7,50%
D52: Warehousing and support activities for transportation	4,15%	D53: Postal and courier activities	7,12%
D53: Postal and courier activities	4,09%	D69T75: Professional, scientific and technical activities	7,03%
D55T56: Accommodation and food service activities	4,07%	D36T39: Water supply; sewerage, waste management and remediation activities	6,91%
D69T75: Professional, scientific and technical activities	4,04%	D86T88: Human health and social work activities	6,30%
D62T63: IT and other information services	3,86%	D61: Telecommunications	6,12%
D61: Telecommunications	3,79%	D45T47: Wholesale and retail trade; repair of motor vehicles	5,97%
D86T88: Human health and social work activities	3,68%	D77T82: Administrative and support services	5,84%
D45T47: Wholesale and retail trade; repair of motor vehicles	2,45%	D90T93: Arts, entertainment and recreation	5,75%
D03: Fishing and aquaculture	2,01%	D64T66: Financial and insurance activities	4,32%
D84: Public administration and defence; compulsory social security	2,00%	D85: Education	4,22%
D64T66: Financial and insurance activities	1,45%	D84: Public administration and defence; compulsory social security	4,04%
D68: Real estate activities	1,43%	D03: Fishing and aquaculture	2,44%
D85: Education	1,41%	D68: Real estate activities	1,72%
D97T98: Activities of households as employers	0,00%	D97T98: Activities of households as employers	0,00%
AVG	6,74%	AVG	10,76%

Table 4B below highlights the sectors with *leakage indicators* greater than 10%.

Table 4B
Brazilian Leakage (Amount)

SECTOR	2017-2018
D30: Other transport equipment	27,10%
D26: Computer, electronic and optical equipment	23,62%
D24: Basic metals	18,42%
D27: Electrical equipment	17,57%
D20: Chemical and chemical products	16,57%
D19: Coke and refined petroleum products	16,24%
D22: Rubber and plastics products	15,87%
D29: Motor vehicles, trailers and semi-trailers	15,87%
D28: Machinery and equipment, nec	15,68%
D31T33: Manufacturing nec; repair and installation of machinery and equipment	14,93%
D05T06: Mining and quarrying, energy producing products	14,69%
D50: Water transport	14,43%
D25: Fabricated metal products	14,32%
D51: Air transport	12,71%
D17T18: Paper products and printing	12,45%
D01T02: Agriculture, hunting, forestry	11,73%
D13T15: Textiles, textile products, leather and footwear	11,34%
D07T08: Mining and quarrying, non-energy producing products	11,24%
D23: Other non-metallic mineral products	10,99%
D49: Land transport and transport via pipelines	10,68%
D21: Pharmaceuticals, medicinal chemical and botanical products	10,48%
D09: Mining support service activities	10,12%

These are the sectors whose upstream supply chains theoretically represent the greatest opportunities for import substitution. The magnitude of the degree of leakage in these sectors

indicates that there would be minimum scales of production at points in the supply chain that would make investments in expanding supply possible.

The decision to invest obviously depends on countless other factors, but what an approach based on leakage coefficients indicates is that one of the essential factors for the viability of any investment – the existence of firm demand – seems to be present in the input supply chain of the listed sectors[52].

5 China Sector 1995-2018

5.1 Linkage

The growth rates of the Chinese linkage indicators were much more significant than the Brazilian ones and occurred in a larger number of sectors.

In 23 of the 44 sectors, the linkage sectoral indicator increased, while in 12 the fall was less than 10% and around 15% in only 3 sectors[53].

Table 5
Chinese Domestic Linkage (1995-2000 = 100)

SECTOR	2001-2005	2006-2010	2011-2015	2016-2018
D03: Fishing and aquaculture	115,46	133,94	145,01	154,59
D01T02: Agriculture, hunting, forestry	112,26	124,88	141,37	147,19
D07T08: Mining and quarrying, non-energy producing products	92,96	102,43	116,25	130,72
D09: Mining support service activities	93,50	96,01	112,43	127,91
D55T56: Accommodation and food service activities	104,42	117,62	122,23	125,68
D53: Postal and courier activities	94,37	106,38	122,21	124,81
D49: Land transport and transport via pipelines	104,34	109,60	127,36	123,94
D05T06: Mining and quarrying, energy producing products	102,02	101,96	111,31	121,91
D90T93: Arts, entertainment and recreation	102,29	128,41	132,95	117,99
D13T15: Textiles, textile products, leather and footwear	92,53	102,17	106,90	117,57
D30: Other transport equipment	103,31	115,48	117,26	116,40
D10T12: Food products, beverages and tobacco	95,41	104,67	113,04	115,88
D51: Air transport	101,89	105,49	111,56	114,84
D35: Electricity, gas, steam and air conditioning supply	95,83	115,98	118,55	112,12
D26: Computer, electronic and optical equipment	90,33	101,90	105,32	111,79
D94T96: Other service activities	109,09	117,20	113,66	108,84
D17T18: Paper products and printing	96,02	102,41	108,07	107,31
D29: Motor vehicles, trailers and semi-trailers	93,46	101,01	105,13	105,90
D16: Wood and products of wood and cork	96,60	98,54	106,09	105,82
D21: Pharmaceuticals, medicinal chemical and botanical products	87,38	94,13	106,33	105,79
D31T33: Manufacturing nec; repair and installation of machinery and equipment	95,08	104,79	107,07	104,77
D28: Machinery and equipment, nec	96,54	103,52	104,27	104,18
D50: Water transport	91,35	92,31	94,05	100,84
D52: Warehousing and support activities for transportation	87,31	95,14	101,95	99,76
D20: Chemical and chemical products	88,14	97,99	104,69	99,18
D84: Public administration and defence; compulsory social security	104,87	91,86	108,89	98,92
D41T43: Construction	93,57	98,46	103,04	98,74
D23: Other non-metallic mineral products	93,99	98,40	104,16	98,32
D22: Rubber and plastics products	89,09	96,60	101,92	98,30
D27: Electrical equipment	90,69	95,87	97,21	96,77
D36T39: Water supply; sewerage, waste management and remediation activities	98,58	105,23	99,54	95,43
D25: Fabricated metal products	94,39	97,16	100,62	95,17
D77T82: Administrative and support services	91,43	98,76	95,62	93,50
D69T75: Professional, scientific and technical activities	95,53	101,23	99,52	92,51
D19: Coke and refined petroleum products	90,73	91,44	88,52	90,11
D24: Basic metals	93,36	93,11	93,61	89,95
D86T88: Human health and social work activities	96,71	108,54	103,45	89,79
D58T60: Publishing, audiovisual and broadcasting activities	92,52	96,42	102,80	88,41
D85: Education	102,88	98,00	91,06	87,78
D61: Telecommunications	91,96	102,10	105,73	87,59
D64T66: Financial and insurance activities	107,73	97,50	100,07	86,72
D62T63: IT and other information services	92,65	103,58	107,21	84,84
D45T47: Wholesale and retail trade; repair of motor vehicles	88,01	87,80	85,91	84,61
D68: Real estate activities	97,10	97,35	96,23	83,61

(52) The identification of the magnitude of the linkage impact indicator (linkage) of a sector on each of its suppliers separately is possible based on the Leontief matrices used in this study to calculate the sectoral indicator.

(53) The periods used for the periodization of the Chinese data were those corresponding to the Five-Year Plans.

The sectors that stood out were D01T02: Agriculture, hunting, forestry (47.19% growth), D07T08: Mining and quarrying, non-energy producing products (30.72%) and D09: Mining support service activities (29.91%).

It should be noted that the positive variations of the indicators resulted from the high values of the linkage indicator at the beginning of the period, as shown in Table 6.

Table 6
Chinese Domestic Linkage (Value)

SECTOR	*1995-2000*	SECTOR	*2016-201*
D24: Basic metals	2,943	D13T15: Textiles, textile products, leather and footwear	3,209
D27: Electrical equipment	2,927	D22: Rubber and plastics products	2,874
D22: Rubber and plastics products	2,924	D29: Motor vehicles, trailers and semi-trailers	2,854
D25: Fabricated metal products	2,903	D27: Electrical equipment	2,832
D41T43: Construction	2,756	D31T33: Manufacturing nec; repair and installation of machinery and equipment	2,831
D13T15: Textiles, textile products, leather and footwear	2,730	D28: Machinery and equipment, nec	2,814
D31T33: Manufacturing nec; repair and installation of machinery and equipment	2,702	D16: Wood and products of wood and cork	2,806
D28: Machinery and equipment, nec	2,701	D17T18: Paper products and printing	2,804
D29: Motor vehicles, trailers and semi-trailers	2,695	D30: Other transport equipment	2,774
D23: Other non-metallic mineral products	2,662	D25: Fabricated metal products	2,762
D20: Chemical and chemical products	2,660	D41T43: Construction	2,721
D16: Wood and products of wood and cork	2,651	D10T12: Food products, beverages and tobacco	2,705
D17T18: Paper products and printing	2,613	D26: Computer, electronic and optical equipment	2,672
D61: Telecommunications	2,575	D09: Mining support service activities	2,651
D58T60: Publishing, audiovisual and broadcasting activities	2,508	D24: Basic metals	2,648
D36T39: Water supply; sewerage, waste management and remediation activities	2,468	D20: Chemical and chemical products	2,638
D69T75: Professional, scientific and technical activities	2,468	D23: Other non-metallic mineral products	2,617
D21: Pharmaceuticals, medicinal chemical and botanical products	2,425	D21: Pharmaceuticals, medicinal chemical and botanical products	2,566
D26: Computer, electronic and optical equipment	2,390	D07T08: Mining and quarrying, non-energy producing products	2,441
D30: Other transport equipment	2,383	D05T06: Mining and quarrying, energy producing products	2,436
D19: Coke and refined petroleum products	2,354	D35: Electricity, gas, steam and air conditioning supply	2,421
D77T82: Administrative and support services	2,341	D55T56: Accommodation and food service activities	2,371
D10T12: Food products, beverages and tobacco	2,335	D51: Air transport	2,369
D50: Water transport	2,265	D36T39: Water supply; sewerage, waste management and remediation activities	2,355
D52: Warehousing and support activities for transportation	2,178	D50: Water transport	2,284
D35: Electricity, gas, steam and air conditioning supply	2,160	D69T75: Professional, scientific and technical activities	2,283
D09: Mining support service activities	2,073	D61: Telecommunications	2,255
D86T88: Human health and social work activities	2,066	D58T60: Publishing, audiovisual and broadcasting activities	2,217
D51: Air transport	2,063	D01T02: Agriculture, hunting, forestry	2,210
D62T63: IT and other information services	2,055	D77T82: Administrative and support services	2,189
D05T06: Mining and quarrying, energy producing products	1,998	D52: Warehousing and support activities for transportation	2,173
D45T47: Wholesale and retail trade; repair of motor vehicles	1,970	D53: Postal and courier activities	2,168
D55T56: Accommodation and food service activities	1,887	D03: Fishing and aquaculture	2,134
D07T08: Mining and quarrying, non-energy producing products	1,867	D19: Coke and refined petroleum products	2,121
D53: Postal and courier activities	1,737	D49: Land transport and transport via pipelines	2,107
D49: Land transport and transport via pipelines	1,700	D86T88: Human health and social work activities	1,855
D84: Public administration and defence; compulsory social security	1,699	D90T93: Arts, entertainment and recreation	1,753
D85: Education	1,650	D62T63: IT and other information services	1,743
D68: Real estate activities	1,618	D84: Public administration and defence; compulsory social security	1,680
D94T96: Other service activities	1,509	D45T47: Wholesale and retail trade; repair of motor vehicles	1,667
D01T02: Agriculture, hunting, forestry	1,502	D94T96: Other service activities	1,642
D90T93: Arts, entertainment and recreation	1,486	D85: Education	1,448
D64T66: Financial and insurance activities	1,476	D68: Real estate activities	1,352
D03: Fishing and aquaculture	1,380	D64T66: Financial and insurance activities	1,280
D97T98: Activities of households as employers	1,000	D97T98: Activities of households as employers	1,000

The changes in positions between sectors are highlighted, with the relative loss of importance of sectors D24: Basic metals (from 1st to 15th position) and D41T43: Construction (from 5th to 11th position) and the gain in importance of sectors D30: Other transport equipment (from 20th to 9th position) and D10T12: Food products, beverages and tobacco (from 23rd to 12th position).

This movement is certainly due to significant changes in the consumption profile of the Chinese population and the growth in the domestic supply capacity of goods whose domestic demand has grown.

D13T15: Textiles, textile products, leather, and footwear (linkage indicator of 3.209) was the sector with the greatest power to generate domestic chain linkage impacts in China in 2016-2018, with an indicator almost 12% higher than that of the sector holding the second position: D22: Rubber and plastics products (2.8740).

5.2 Leakage

The opening of the Chinese economy was much more balanced than was the case in Brazil.

In exactly half of the 44 sectors, the degree of leakage increased, while it decreased in the other half. There is no discernible pattern in the profile of sectors according to the behavior of the indicator. There are services, manufacturing and extractive industry and utilities sectors in both groups.

Among the 10 sectors with the highest positive variations are representatives of all branches of activity.

Table 7
Chinese Leakage (1995-2000 = 100)

SECTOR	2001-2005	2006-2010	2011-2015	2016-2018
D03: Fishing and aquaculture	211,31	213,57	214,49	232,83
D19: Coke and refined petroleum products	147,09	182,43	208,76	208,69
D01T02: Agriculture, hunting, forestry	147,96	161,13	160,56	154,17
D50: Water transport	134,54	140,09	147,15	145,93
D07T08: Mining and quarrying, non-energy producing products	116,13	135,24	143,91	141,79
D55T56: Accommodation and food service activities	134,24	148,49	141,18	139,60
D49: Land transport and transport via pipelines	139,09	157,35	170,26	136,86
D21: Pharmaceuticals, medicinal chemical and botanical products	145,16	140,16	134,08	133,60
D35: Electricity, gas, steam and air conditioning supply	120,33	116,69	126,87	133,37
D24: Basic metals	126,82	146,96	151,29	128,08
D90T93: Arts, entertainment and recreation	138,58	186,37	167,39	125,31
D52: Warehousing and support activities for transportation	107,56	123,63	122,73	121,81
D09: Mining support service activities	121,01	115,57	115,57	117,24
D29: Motor vehicles, trailers and semi-trailers	119,10	139,47	132,16	116,44
D53: Postal and courier activities	109,10	130,15	131,15	115,25
D51: Air transport	120,73	128,31	131,41	113,72
D20: Chemical and chemical products	126,86	131,99	116,52	113,30
D26: Computer, electronic and optical equipment	138,49	132,28	120,64	112,17
D05T06: Mining and quarrying, energy producing products	121,58	117,81	110,09	112,13
D10T12: Food products, beverages and tobacco	117,29	123,27	118,94	111,98
D27: Electrical equipment	123,95	133,44	126,39	111,55
D94T96: Other service activities	157,53	153,27	128,97	104,46
D28: Machinery and equipment, nec	118,55	119,43	110,26	99,85
D25: Fabricated metal products	121,14	119,80	113,66	98,97
D22: Rubber and plastics products	125,05	125,50	103,36	98,84
D36T39: Water supply; sewerage, waste management and remediation activities	125,19	127,25	112,30	95,53
D23: Other non-metallic mineral products	124,15	110,96	102,55	92,21
D86T88: Human health and social work activities	129,07	127,89	103,98	91,46
D84: Public administration and defence; compulsory social security	119,79	96,39	113,04	90,92
D41T43: Construction	124,78	115,28	103,75	90,34
D16: Wood and products of wood and cork	109,69	96,30	84,08	83,11
D31T33: Manufacturing nec; repair and installation of machinery and equipment	107,68	96,97	91,03	81,69
D61: Telecommunications	146,93	126,46	105,82	80,84
D69T75: Professional, scientific and technical activities	141,23	117,76	98,67	80,30
D58T60: Publishing, audiovisual and broadcasting activities	116,91	104,91	89,54	76,79
D17T18: Paper products and printing	105,68	92,37	80,34	75,08
D77T82: Administrative and support services	135,03	112,70	94,33	73,15
D85: Education	128,41	111,63	87,26	72,62
D45T47: Wholesale and retail trade; repair of motor vehicles	105,71	94,76	76,36	71,73
D30: Other transport equipment	86,42	80,53	74,02	63,52
D13T15: Textiles, textile products, leather and footwear	101,43	73,08	63,10	61,70
D62T63: IT and other information services	123,13	93,89	88,56	54,87
D68: Real estate activities	125,53	133,22	87,17	48,76
D64T66: Financial and insurance activities	154,64	101,63	84,22	45,21

The comparison between the leakage indicators at the beginning and at the end of the period confirms, in principle, the hypothesis that China promoted an import substitution strategy with international integration in the period.[54]

(54) In section 7 below, the hypothesis of the existence of a Chinese import substitution strategy will be evaluated by analyzing the correlation indices between the sectoral linkage and leakage indicators.

Table 8
Chinese Leakage (Value)

SECTOR	1995-2000	SECTOR	2016-2018
D30: Other transport equipment	27,91%	D19: Coke and refined petroleum products	29,83%
D26: Computer, electronic and optical equipment	21,35%	D26: Computer, electronic and optical equipment	23,94%
D62T63: IT and other information services	17,03%	D50: Water transport	17,74%
D17T18: Paper products and printing	16,02%	D30: Other transport equipment	17,73%
D13T15: Textiles, textile products, leather and footwear	15,98%	D24: Basic metals	17,46%
D28: Machinery and equipment, nec	15,48%	D27: Electrical equipment	16,40%
D31T33: Manufacturing nec; repair and installation of machinery and equipment	15,19%	D20: Chemical and chemical products	16,38%
D69T75: Professional, scientific and technical activities	14,92%	D51: Air transport	16,01%
D22: Rubber and plastics products	14,88%	D28: Machinery and equipment, nec	15,46%
D27: Electrical equipment	14,71%	D07T08: Mining and quarrying, non-energy producing products	14,75%
D20: Chemical and chemical products	14,46%	D22: Rubber and plastics products	14,71%
D61: Telecommunications	14,31%	D52: Warehousing and support activities for transportation	14,43%
D19: Coke and refined petroleum products	14,29%	D09: Mining support service activities	14,36%
D51: Air transport	14,08%	D35: Electricity, gas, steam and air conditioning supply	14,04%
D16: Wood and products of wood and cork	13,65%	D25: Fabricated metal products	13,41%
D24: Basic metals	13,63%	D29: Motor vehicles, trailers and semi-trailers	13,00%
D25: Fabricated metal products	13,55%	D31T33: Manufacturing nec; repair and installation of machinery and equipment	12,41%
D77T82: Administrative and support services	13,47%	D05T06: Mining and quarrying, energy producing products	12,17%
D58T60: Publishing, audiovisual and broadcasting activities	12,90%	D17T18: Paper products and printing	12,03%
D23: Other non-metallic mineral products	12,58%	D69T75: Professional, scientific and technical activities	11,98%
D41T43: Construction	12,44%	D23: Other non-metallic mineral products	11,60%
D09: Mining support service activities	12,25%	D61: Telecommunications	11,57%
D50: Water transport	12,16%	D16: Wood and products of wood and cork	11,34%
D52: Warehousing and support activities for transportation	11,85%	D41T43: Construction	11,24%
D29: Motor vehicles, trailers and semi-trailers	11,16%	D49: Land transport and transport via pipelines	10,64%
D36T39: Water supply; sewerage, waste management and remediation activities	10,93%	D53: Postal and courier activities	10,61%
D05T06: Mining and quarrying, energy producing products	10,85%	D36T39: Water supply; sewerage, waste management and remediation activities	10,44%
D35: Electricity, gas, steam and air conditioning supply	10,53%	D21: Pharmaceuticals, medicinal chemical and botanical products	10,01%
D07T08: Mining and quarrying, non-energy producing products	10,41%	D58T60: Publishing, audiovisual and broadcasting activities	9,90%
D45T47: Wholesale and retail trade; repair of motor vehicles	9,79%	D13T15: Textiles, textile products, leather and footwear	9,86%
D53: Postal and courier activities	9,20%	D77T82: Administrative and support services	9,85%
D86T88: Human health and social work activities	8,92%	D01T02: Agriculture, hunting, forestry	9,64%
D84: Public administration and defence; compulsory social security	8,27%	D62T63: IT and other information services	9,35%
D85: Education	8,04%	D10T12: Food products, beverages and tobacco	8,69%
D49: Land transport and transport via pipelines	7,78%	D86T88: Human health and social work activities	8,16%
D10T12: Food products, beverages and tobacco	7,76%	D03: Fishing and aquaculture	7,98%
D21: Pharmaceuticals, medicinal chemical and botanical products	7,49%	D55T56: Accommodation and food service activities	7,67%
D94T96: Other service activities	6,94%	D84: Public administration and defence; compulsory social security	7,52%
D64T66: Financial and insurance activities	6,92%	D94T96: Other service activities	7,25%
D01T02: Agriculture, hunting, forestry	6,25%	D45T47: Wholesale and retail trade; repair of motor vehicles	7,02%
D68: Real estate activities	6,12%	D90T93: Arts, entertainment and recreation	6,87%
D55T56: Accommodation and food service activities	5,49%	D85: Education	5,84%
D90T93: Arts, entertainment and recreation	5,49%	D64T66: Financial and insurance activities	3,13%
D03: Fishing and aquaculture	3,43%	D68: Real estate activities	2,98%

In Table 8 above, it can be seen that there was a significant internalization of upstream activities in the information technology and information services sector (D62T63: IT and other information services), whose leakage rate fell from 17.03% at the beginning of the period to 9.35%, a drop of 45%. The same thing happened with the textile, clothing and footwear sector (D13T15: Textiles, textile products, leather and footwear), a drop of around 40%, from 15.98% to (9.86%).

6 Sectorial United States 1995-2018

6.1 Linkage

The behavior of the American sectoral linkage indicators expresses the maturity and diversification of the American productive structure.

There were 25 sectors with positive or negative variations below 5%, while 14 sectors had positive or negative variations between 5% and 10% and only 5 sectors had positive or negative variations greater than 10%.

It is a portrait of a relatively stable economy from a structural point of view.

Table 9
American Domestic Linkage (1995-1996 = 100)

SECTOR	1997-2000	2001-2008	2009-2016	2017-2018
D52: Warehousing and support activities for transportation	103,03	110,18	126,92	125,53
D53: Postal and courier activities	103,68	108,88	113,76	112,00
D61: Telecommunications	116,05	114,27	110,43	110,24
D35: Electricity, gas, steam and air conditioning supply	111,47	112,83	110,42	107,74
D45T47: Wholesale and retail trade; repair of motor vehicles	97,51	98,88	103,15	106,60
D64T66: Financial and insurance activities	104,11	105,56	106,41	105,86
D77T82: Administrative and support services	103,84	99,94	102,37	104,40
D21: Pharmaceuticals, medicinal chemical and botanical products	101,07	105,41	103,28	104,23
D85: Education	101,29	102,29	102,53	103,69
D50: Water transport	101,67	98,24	97,40	102,99
D68: Real estate activities	100,16	103,54	99,78	102,90
D84: Public administration and defence; compulsory social security	100,72	102,29	102,57	102,18
D86T88: Human health and social work activities	100,44	100,61	100,17	101,65
D69T75: Professional, scientific and technical activities	103,96	101,79	100,06	101,27
D01T02: Agriculture, hunting, forestry	99,24	96,92	100,13	101,14
D03: Fishing and aquaculture	99,25	101,27	99,56	100,11
D49: Land transport and transport via pipelines	98,17	98,25	98,69	100,06
D23: Other non-metallic mineral products	97,47	98,01	99,68	99,92
D62T63: IT and other information services	113,61	104,77	101,88	99,90
D24: Basic metals	98,72	99,13	101,17	99,27
D36T39: Water supply; sewerage, waste management and remediation activities	103,28	102,01	99,87	98,96
D25: Fabricated metal products	99,66	100,51	100,67	98,90
D22: Rubber and plastics products	97,87	100,31	99,91	98,55
D05T06: Mining and quarrying, energy producing products	103,53	91,06	92,82	98,48
D17T18: Paper products and printing	98,50	97,60	98,11	98,34
D94T96: Other service activities	96,31	97,72	96,50	98,24
D29: Motor vehicles, trailers and semi-trailers	98,40	96,41	98,81	97,13
D10T12: Food products, beverages and tobacco	98,33	96,43	98,60	96,95
D19: Coke and refined petroleum products	94,94	86,81	92,70	96,56
D90T93: Arts, entertainment and recreation	97,58	100,45	96,21	96,49
D20: Chemical and chemical products	99,59	100,84	99,34	95,36
D09: Mining support service activities	89,34	95,00	94,44	94,73
D28: Machinery and equipment, nec	99,21	97,70	95,56	94,25
D55T56: Accommodation and food service activities	97,20	94,78	95,05	94,22
D07T08: Mining and quarrying, non-energy producing products	96,09	93,38	92,75	94,00
D16: Wood and products of wood and cork	99,65	97,40	94,48	93,91
D41T43: Construction	97,07	94,04	93,35	92,85
D51: Air transport	101,84	101,55	98,28	92,77
D30: Other transport equipment	98,38	94,98	92,06	92,04
D58T60: Publishing, audiovisual and broadcasting activities	102,27	97,30	90,17	90,79
D27: Electrical equipment	103,54	98,20	93,60	90,27
D31T33: Manufacturing nec; repair and installation of machinery and equipment	95,99	96,06	92,78	90,09
D13T15: Textiles, textile products, leather and footwear	98,85	95,59	91,10	88,97
D26: Computer, electronic and optical equipment	97,78	88,58	74,01	71,53

This relative stability of the productive structure is reflected in the hierarchy of the American activity sectors based on the magnitude of the linkage indicators at the beginning and end of the period.

There is only a marginal shift in the top ten with sector D13T15: Textiles, textile products, leather and footwear falling from 4th to 11th and sector D25: Fabricated metal products rising from 12th to 10th.

Table 10
US Domestic Linkage (Value)

SECTOR	1995-1996	SECTOR	2017-20
D10T12: Food products, beverages and tobacco	2,364	D10T12: Food products, beverages and tobacco	2,292
D16: Wood and products of wood and cork	2,200	D50: Water transport	2,172
D29: Motor vehicles, trailers and semi-trailers	2,128	D29: Motor vehicles, trailers and semi-trailers	2,067
D13T15: Textiles, textile products, leather and footwear	2,113	D16: Wood and products of wood and cork	2,066
D50: Water transport	2,109	D22: Rubber and plastics products	2,043
D22: Rubber and plastics products	2,073	D24: Basic metals	2,043
D20: Chemical and chemical products	2,060	D01T02: Agriculture, hunting, forestry	2,038
D24: Basic metals	2,058	D17T18: Paper products and printing	2,016
D17T18: Paper products and printing	2,050	D20: Chemical and chemical products	1,964
D01T02: Agriculture, hunting, forestry	2,015	D25: Fabricated metal products	1,893
D28: Machinery and equipment, nec	1,929	D13T15: Textiles, textile products, leather and footwear	1,880
D25: Fabricated metal products	1,914	D23: Other non-metallic mineral products	1,879
D31T33: Manufacturing nec; repair and installation of machinery and equipment	1,883	D28: Machinery and equipment, nec	1,818
D07T08: Mining and quarrying, non-energy producing products	1,882	D52: Warehousing and support activities for transportation	1,800
D23: Other non-metallic mineral products	1,881	D49: Land transport and transport via pipelines	1,780
D30: Other transport equipment	1,879	D07T08: Mining and quarrying, non-energy producing products	1,769
D26: Computer, electronic and optical equipment	1,867	D19: Coke and refined petroleum products	1,767
D27: Electrical equipment	1,866	D64T66: Financial and insurance activities	1,760
D41T43: Construction	1,853	D55T56: Accommodation and food service activities	1,744
D55T56: Accommodation and food service activities	1,851	D61: Telecommunications	1,738
D51: Air transport	1,839	D30: Other transport equipment	1,730
D19: Coke and refined petroleum products	1,830	D41T43: Construction	1,720
D49: Land transport and transport via pipelines	1,779	D51: Air transport	1,706
D09: Mining support service activities	1,775	D31T33: Manufacturing nec; repair and installation of machinery and equipment	1,696
D58T60: Publishing, audiovisual and broadcasting activities	1,754	D45T47: Wholesale and retail trade; repair of motor vehicles	1,689
D94T96: Other service activities	1,702	D27: Electrical equipment	1,684
D36T39: Water supply; sewerage, waste management and remediation activities	1,690	D09: Mining support service activities	1,682
D64T66: Financial and insurance activities	1,663	D94T96: Other service activities	1,672
D90T93: Arts, entertainment and recreation	1,651	D36T39: Water supply; sewerage, waste management and remediation activities	1,672
D05T06: Mining and quarrying, energy producing products	1,648	D05T06: Mining and quarrying, energy producing products	1,623
D45T47: Wholesale and retail trade; repair of motor vehicles	1,585	D77T82: Administrative and support services	1,613
D61: Telecommunications	1,577	D53: Postal and courier activities	1,605
D86T88: Human health and social work activities	1,577	D86T88: Human health and social work activities	1,603
D84: Public administration and defence; compulsory social security	1,563	D84: Public administration and defence; compulsory social security	1,597
D77T82: Administrative and support services	1,545	D90T93: Arts, entertainment and recreation	1,593
D69T75: Professional, scientific and technical activities	1,540	D58T60: Publishing, audiovisual and broadcasting activities	1,593
D21: Pharmaceuticals, medicinal chemical and botanical products	1,515	D21: Pharmaceuticals, medicinal chemical and botanical products	1,579
D62T63: IT and other information services	1,493	D35: Electricity, gas, steam and air conditioning supply	1,559
D35: Electricity, gas, steam and air conditioning supply	1,447	D69T75: Professional, scientific and technical activities	1,559
D52: Warehousing and support activities for transportation	1,434	D62T63: IT and other information services	1,492
D53: Postal and courier activities	1,433	D68: Real estate activities	1,474
D68: Real estate activities	1,432	D85: Education	1,390
D03: Fishing and aquaculture	1,340	D03: Fishing and aquaculture	1,342
D85: Education	1,340	D26: Computer, electronic and optical equipment	1,336
D97T98: Activities of households as employers	1,000	D97T98: Activities of households as employers	1,000

6.2 Leakage

The behavior of the leakage indicators shows that the American economy looked to international trade for the supply of inputs to domestic production processes in a generalized way: of the 44 sectors surveyed, in 40 of them the degree of leakage increased.

However, as seen above, this greater integration into the international market did not result in a generalized drop in the linkage impact indicator. On the contrary, in several of them, the opening potentiated the coefficient of domestic production impacts.

This also occurred because, except for some sectors, the expansion in the degree of leakage was generalized but moderate.

Table 11
American Leakage (1995-1996 = 100)

SECTOR	1997-2000	2001-2008	2009-2016	2017-2018
D21: Pharmaceuticals, medicinal chemical and botanical products	110,87	151,18	199,60	237,30
D52: Warehousing and support activities for transportation	107,95	145,56	190,99	176,29
D53: Postal and courier activities	116,33	157,42	188,01	173,50
D61: Telecommunications	124,46	141,56	158,71	163,97
D36T39: Water supply; sewerage, waste management and remediation activities	108,74	156,69	165,96	147,83
D68: Real estate activities	99,73	130,63	137,21	139,63
D05T06: Mining and quarrying, energy producing products	114,58	139,80	135,30	135,46
D77T82: Administrative and support services	107,37	117,88	138,71	134,54
D69T75: Professional, scientific and technical activities	110,19	120,04	134,69	131,05
D85: Education	110,97	140,76	145,80	130,86
D29: Motor vehicles, trailers and semi-trailers	105,15	120,81	133,32	130,33
D84: Public administration and defence; compulsory social security	107,56	130,65	140,79	128,85
D13T15: Textiles, textile products, leather and footwear	110,99	132,63	139,85	128,66
D45T47: Wholesale and retail trade; repair of motor vehicles	98,78	117,18	132,26	128,54
D10T12: Food products, beverages and tobacco	104,95	117,31	129,96	128,12
D64T66: Financial and insurance activities	107,94	129,65	149,90	127,98
D62T63: IT and other information services	131,96	123,06	138,99	127,15
D28: Machinery and equipment, nec	103,60	119,13	128,25	125,50
D22: Rubber and plastics products	102,99	124,87	133,59	124,65
D01T02: Agriculture, hunting, forestry	102,26	114,48	127,65	123,25
D27: Electrical equipment	109,43	119,19	126,28	121,37
D25: Fabricated metal products	99,64	112,93	125,52	121,13
D20: Chemical and chemical products	105,69	135,89	132,97	119,64
D17T18: Paper products and printing	107,56	120,15	124,89	118,93
D55T56: Accommodation and food service activities	100,47	112,98	127,94	118,75
D86T88: Human health and social work activities	106,99	127,99	126,44	118,71
D24: Basic metals	99,65	107,99	120,27	118,06
D41T43: Construction	101,80	113,02	122,23	117,71
D23: Other non-metallic mineral products	102,77	120,17	130,11	116,53
D31T33: Manufacturing nec; repair and installation of machinery and equipment	99,44	114,60	121,23	115,96
D94T96: Other service activities	92,21	111,76	121,30	114,50
D09: Mining support service activities	81,23	108,64	113,87	113,87
D03: Fishing and aquaculture	108,69	137,58	149,78	112,27
D35: Electricity, gas, steam and air conditioning supply	131,40	198,32	140,51	112,24
D90T93: Arts, entertainment and recreation	96,89	109,73	114,75	112,10
D16: Wood and products of wood and cork	105,13	120,27	120,73	110,17
D49: Land transport and transport via pipelines	92,11	124,42	149,45	106,70
D30: Other transport equipment	120,74	114,06	109,03	104,96
D50: Water transport	107,17	141,33	139,71	104,32
D07T08: Mining and quarrying, non-energy producing products	93,96	105,13	107,98	101,53
D58T60: Publishing, audiovisual and broadcasting activities	103,60	104,50	102,40	99,22
D19: Coke and refined petroleum products	106,90	121,08	119,04	98,25
D51: Air transport	97,18	148,31	169,08	94,56
D26: Computer, electronic and optical equipment	104,52	103,47	67,63	53,64

It is worth mentioning the important substitution of imported inputs for domestic production in manufacturing in sector D26: Computer, electronic and optical equipment, which presented a drop of 46% (from 15.25% to 8.18%) in the leakage indicator.

In addition to this more prominent alteration, there were some changes in marginal positions among the 10 sectors with the highest leakage rates, without, however, notable change in the magnitude of the indicators.

Table 12
American Leakage (Value)

SECTOR	1995-1996	SECTOR	2017-2018
D19: Coke and refined petroleum products	23,91%	D19: Coke and refined petroleum products	23,49%
D29: Motor vehicles, trailers and semi-trailers	17,79%	D29: Motor vehicles, trailers and semi-trailers	23,19%
D24: Basic metals	15,53%	D24: Basic metals	18,34%
D26: Computer, electronic and optical equipment	15,25%	D28: Machinery and equipment, nec	17,30%
D30: Other transport equipment	14,76%	D27: Electrical equipment	16,57%
D28: Machinery and equipment, nec	13,79%	D25: Fabricated metal products	15,51%
D27: Electrical equipment	13,65%	D30: Other transport equipment	15,49%
D25: Fabricated metal products	12,81%	D13T15: Textiles, textile products, leather and footwear	12,88%
D16: Wood and products of wood and cork	10,70%	D22: Rubber and plastics products	12,45%
D31T33: Manufacturing nec; repair and installation of machinery and equipment	10,12%	D20: Chemical and chemical products	11,95%
D13T15: Textiles, textile products, leather and footwear	10,01%	D16: Wood and products of wood and cork	11,78%
D20: Chemical and chemical products	9,99%	D31T33: Manufacturing nec; repair and installation of machinery and equipment	11,74%
D22: Rubber and plastics products	9,99%	D21: Pharmaceuticals, medicinal chemical and botanical products	11,69%
D41T43: Construction	9,63%	D05T06: Mining and quarrying, energy producing products	11,44%
D17T18: Paper products and printing	9,30%	D41T43: Construction	11,34%
D07T08: Mining and quarrying, non-energy producing products	9,28%	D17T18: Paper products and printing	11,05%
D05T06: Mining and quarrying, energy producing products	8,44%	D10T12: Food products, beverages and tobacco	9,99%
D23: Other non-metallic mineral products	8,42%	D23: Other non-metallic mineral products	9,81%
D10T12: Food products, beverages and tobacco	7,80%	D07T08: Mining and quarrying, non-energy producing products	9,42%
D01T02: Agriculture, hunting, forestry	7,50%	D01T02: Agriculture, hunting, forestry	9,24%
D09: Mining support service activities	7,29%	D09: Mining support service activities	8,30%
D35: Electricity, gas, steam and air conditioning supply	7,24%	D26: Computer, electronic and optical equipment	8,18%
D03: Fishing and aquaculture	6,63%	D35: Electricity, gas, steam and air conditioning supply	8,13%
D50: Water transport	6,31%	D36T39: Water supply; sewerage, waste management and remediation activities	8,03%
D51: Air transport	6,25%	D03: Fishing and aquaculture	7,44%
D49: Land transport and transport via pipelines	5,87%	D53: Postal and courier activities	7,25%
D84: Public administration and defence; compulsory social security	5,44%	D84: Public administration and defence; compulsory social security	7,02%
D36T39: Water supply; sewerage, waste management and remediation activities	5,43%	D50: Water transport	6,58%
D21: Pharmaceuticals, medicinal chemical and botanical products	4,93%	D49: Land transport and transport via pipelines	6,27%
D55T56: Accommodation and food service activities	4,42%	D52: Warehousing and support activities for transportation	6,23%
D58T60: Publishing, audiovisual and broadcasting activities	4,39%	D61: Telecommunications	6,16%
D53: Postal and courier activities	4,18%	D51: Air transport	5,91%
D86T88: Human health and social work activities	4,08%	D55T56: Accommodation and food service activities	5,24%
D94T96: Other service activities	4,06%	D86T88: Human health and social work activities	4,84%
D61: Telecommunications	3,75%	D45T47: Wholesale and retail trade; repair of motor vehicles	4,76%
D45T47: Wholesale and retail trade; repair of motor vehicles	3,71%	D94T96: Other service activities	4,65%
D52: Warehousing and support activities for transportation	3,53%	D77T82: Administrative and support services	4,59%
D77T82: Administrative and support services	3,41%	D58T60: Publishing, audiovisual and broadcasting activities	4,35%
D90T93: Arts, entertainment and recreation	3,39%	D85: Education	4,20%
D85: Education	3,21%	D69T75: Professional, scientific and technical activities	4,00%
D62T63: IT and other information services	3,11%	D62T63: IT and other information services	3,96%
D69T75: Professional, scientific and technical activities	3,05%	D90T93: Arts, entertainment and recreation	3,80%
D64T66: Financial and insurance activities	2,49%	D64T66: Financial and insurance activities	3,19%
D68: Real estate activities	1,98%	D68: Real estate activities	2,77%

7 Comparative evolution of sectoral indicators: Brazil, China, and United States

7.1 Linkage

The comparison between the linkage indicators of the three countries at the end of the period provides a means to evaluate the result of the Chinese and Brazilian integration strategies. It is not necessary to speak exactly of an American strategy, given that the American economy was already more integrated into international trade.

The success of the Chinese strategy is already evident. In only 3 sectors are the impact indicators lower in China than in Brazil: D94T96: Other service activities, D64T66: Financial and insurance activities and D19: Coke and refined petroleum products. Only the latter is an industrial sector.

On average, the Chinese upstream linkage impacts indicator is higher than the Brazilian one by more than 30%.

Compared with the United States, the Brazilian impact indicators are, in general, higher than the American ones in the industrial and extractive sectors and lower than the American ones in the service sectors.

It is also worth highlighting the importance of the agricultural sector for the US economy: it is the 7th sector in order of importance of sectoral indicators and is more than 20% greater than that of Brazil.

Table 13
Brazilian, Chinese and American Linkages 1995-2018

SECTOR	BRAZIL 2017-2018	CHINA 2016-2018	USA 2017-2018	CHINA BRAZIL = 100	USA BRAZIL = 100
D01T02: Agriculture, hunting, forestry	1,689	2,210	2,038	130,89	120,67
D03: Fishing and aquaculture	1,159	2,134	1,342	184,10	115,75
D05T06: Mining and quarrying, energy producing products	1,739	2,436	1,623	140,12	93,36
D07T08: Mining and quarrying, non-energy producing products	1,824	2,441	1,769	133,86	97,01
D09: Mining support service activities	1,759	2,651	1,682	150,71	95,59
D10T12: Food products, beverages and tobacco	2,263	2,705	2,292	119,55	101,28
D13T15: Textiles, textile products, leather and footwear	1,891	3,209	1,880	169,70	99,42
D16: Wood and products of wood and cork	1,965	2,806	2,066	142,82	105,17
D17T18: Paper products and printing	2,004	2,804	2,016	139,94	100,57
D19: Coke and refined petroleum products	2,281	2,121	1,767	92,99	77,44
D20: Chemical and chemical products	2,189	2,638	1,964	120,53	89,72
D21: Pharmaceuticals, medicinal chemical and botanical products	1,733	2,566	1,579	148,09	91,11
D22: Rubber and plastics products	2,096	2,874	2,043	137,17	97,49
D23: Other non-metallic mineral products	2,071	2,617	1,879	126,38	90,73
D24: Basic metals	2,122	2,648	2,043	124,80	96,30
D25: Fabricated metal products	2,026	2,762	1,893	136,34	93,41
D26: Computer, electronic and optical equipment	1,960	2,672	1,336	136,33	68,14
D27: Electrical equipment	2,064	2,832	1,684	137,26	81,61
D28: Machinery and equipment, nec	1,979	2,814	1,818	142,18	91,86
D29: Motor vehicles, trailers and semi-trailers	2,192	2,854	2,067	130,20	94,27
D30: Other transport equipment	1,807	2,774	1,730	153,50	95,71
D31T33: Manufacturing nec; repair and installation of machinery and equipment	1,854	2,831	1,696	152,74	91,50
D35: Electricity, gas, steam and air conditioning supply	1,885	2,421	1,559	128,45	82,71
D36T39: Water supply; sewerage, waste management and remediation activities	1,529	2,355	1,672	154,02	109,35
D41T43: Construction	1,860	2,721	1,720	146,27	92,47
D45T47: Wholesale and retail trade; repair of motor vehicles	1,513	1,667	1,689	110,19	111,67
D49: Land transport and transport via pipelines	1,851	2,107	1,780	113,83	96,16
D50: Water transport	1,726	2,284	2,172	132,37	125,85
D51: Air transport	2,087	2,369	1,706	113,50	81,72
D52: Warehousing and support activities for transportation	1,638	2,173	1,800	132,66	109,86
D53: Postal and courier activities	1,586	2,168	1,605	136,72	101,23
D55T56: Accommodation and food service activities	1,773	2,371	1,744	133,78	98,36
D58T60: Publishing, audiovisual and broadcasting activities	1,810	2,217	1,593	122,52	88,01
D61: Telecommunications	1,789	2,255	1,738	126,07	97,15
D62T63: IT and other information services	1,412	1,743	1,492	123,47	105,63
D64T66: Financial and insurance activities	1,473	1,280	1,760	86,92	119,48
D68: Real estate activities	1,143	1,352	1,474	118,31	128,92
D69T75: Professional, scientific and technical activities	1,522	2,283	1,559	150,00	102,43
D77T82: Administrative and support services	1,457	2,189	1,613	150,24	110,67
D84: Public administration and defence; compulsory social security	1,378	1,680	1,597	121,94	115,89
D85: Education	1,248	1,448	1,390	116,07	111,38
D86T88: Human health and social work activities	1,527	1,855	1,603	121,52	104,98
D90T93: Arts, entertainment and recreation	1,631	1,753	1,593	107,53	97,70
D94T96: Other service activities	1,722	1,642	1,672	95,40	97,12
AVG	1,778	2,335	1,744	131,34	98,10

7.2 Leakage

The leakage indicator, by definition, measures the degree of dependence on imported inputs directly and indirectly related to the production of each sector of activity.

At the end of the period under analysis, the Chinese economy was, on average, more open than the Brazilian economy and much more open than the American one, with leakage indicators of 10.76%, 11.99% and 9.33% respectively for Brazil, China, and the United States.

Differences in the degree of leakage between sectors, however, go a long way to explaining differences in each country's integration strategies and outcomes.

China, compared to Brazil, has a lower degree of dependence on imported inputs in the industrial production sectors. That is, it is more vertically integrated in domestic industrial activities than Brazil.

Table 14
Brazilian, Chinese and American Leakage 1995-2018

SECTOR	BRAZIL 2017-2018	CHINA 2016-2018	USA 2017-2018	CHINA BRAZIL = 100	USA BRAZIL = 100
D01T02: Agriculture, hunting, forestry	11,73%	9,64%	9,24%	82,17	78,81
D03: Fishing and aquaculture	2,44%	7,98%	7,44%	326,84	304,87
D05T06: Mining and quarrying, energy producing products	14,69%	12,17%	11,44%	82,88	77,89
D07T08: Mining and quarrying, non-energy producing products	11,24%	14,75%	9,42%	131,25	83,81
D09: Mining support service activities	10,12%	14,36%	8,30%	141,81	81,94
D10T12: Food products, beverages and tobacco	9,15%	8,69%	9,99%	94,94	109,24
D13T15: Textiles, textile products, leather and footwear	11,34%	9,86%	12,88%	86,90	113,52
D16: Wood and products of wood and cork	9,69%	11,34%	11,78%	117,08	121,63
D17T18: Paper products and printing	12,45%	12,03%	11,05%	96,61	88,81
D19: Coke and refined petroleum products	16,24%	29,83%	23,49%	183,67	144,66
D20: Chemical and chemical products	16,57%	16,38%	11,95%	98,89	72,11
D21: Pharmaceuticals, medicinal chemical and botanical products	10,48%	10,01%	11,69%	95,47	111,52
D22: Rubber and plastics products	15,87%	14,71%	12,45%	92,65	78,43
D23: Other non-metallic mineral products	10,99%	11,60%	9,81%	105,59	89,35
D24: Basic metals	18,42%	17,46%	18,34%	94,76	99,55
D25: Fabricated metal products	14,32%	13,41%	15,51%	93,62	108,30
D26: Computer, electronic and optical equipment	23,62%	23,94%	8,18%	101,38	34,64
D27: Electrical equipment	17,57%	16,40%	16,57%	93,37	94,32
D28: Machinery and equipment, nec	15,68%	15,46%	17,30%	98,57	110,36
D29: Motor vehicles, trailers and semi-trailers	15,87%	13,00%	23,19%	81,91	146,14
D30: Other transport equipment	27,10%	17,73%	15,49%	65,44	57,17
D31T33: Manufacturing nec; repair and installation of machinery and equipment	14,93%	12,41%	11,74%	83,14	78,62
D35: Electricity, gas, steam and air conditioning supply	7,76%	14,04%	8,13%	180,94	104,71
D36T39: Water supply; sewerage, waste management and remediation activities	6,91%	10,44%	8,03%	151,04	116,14
D41T43: Construction	9,93%	11,24%	11,34%	113,16	114,18
D45T47: Wholesale and retail trade; repair of motor vehicles	5,97%	7,02%	4,76%	117,55	79,79
D49: Land transport and transport via pipelines	10,68%	10,64%	6,27%	99,64	58,66
D50: Water transport	14,43%	17,74%	6,58%	122,94	45,61
D51: Air transport	12,71%	16,01%	5,91%	125,94	46,46
D52: Warehousing and support activities for transportation	8,00%	14,43%	6,23%	180,35	77,83
D53: Postal and courier activities	7,12%	10,61%	7,25%	148,98	101,84
D55T56: Accommodation and food service activities	7,88%	7,67%	5,24%	97,36	66,58
D58T60: Publishing, audiovisual and broadcasting activities	8,98%	9,90%	4,35%	110,29	48,48
D61: Telecommunications	6,12%	11,57%	6,16%	189,15	100,65
D62T63: IT and other information services	7,50%	9,35%	3,96%	124,56	52,78
D64T66: Financial and insurance activities	4,32%	3,13%	3,19%	72,45	73,91
D68: Real estate activities	1,72%	2,98%	2,77%	173,43	161,12
D69T75: Professional, scientific and technical activities	7,03%	11,98%	4,00%	170,48	56,93
D77T82: Administrative and support services	5,84%	9,85%	4,59%	168,84	78,58
D84: Public administration and defence; compulsory social security	4,04%	7,52%	7,02%	186,14	173,58
D85: Education	4,22%	5,84%	4,20%	138,19	99,58
D86T88: Human health and social work activities	6,30%	8,16%	4,84%	129,62	76,86
D90T93: Arts, entertainment and recreation	5,75%	6,87%	3,80%	119,60	66,20
D94T96: Other service activities	9,81%	7,25%	4,65%	73,88	47,35
AVG	10,76%	11,99%	9,33%	111,38	86,70

The opposite occurs in service activities. In these sectors, China is more dependent on imported inputs than Brazil.

If the behavior of the sectoral leakage degrees is a good indicator to characterize the international integration strategy of the two countries, it can be said that, while China promoted the substitution of imports of goods and industrial inputs, the Brazil opted to internalize the offer of services and their inputs.

8 Sectoral correlation index linkage-leakage: Brazil, China, and United States

The correlation coefficients between linkage and leakage express the degree to which these indicators "go together". They do not prove the existence of a causal relationship. However, as the Leontief matrix coefficients that generate the domestic linkage indicator used in this study are obtained by the difference between the total linkage coefficients and the import coefficients, it is likely that a causal relationship between linkage and leakage, if any, will be from the latter to the former.

The correlation index varies between -1 and +1 according to the strength of the correlation.

The correlation coefficients between linkage and leakage express the degree to which these indicators "go together". They do not prove the existence of a causal relationship. However, as the Leontief matrix coefficients that generate the domestic linkage indicator used in this study are obtained by the difference between the total linkage coefficients and the import coefficients, it is likely that a causal relationship between linkage and leakage, if any, will be from the latter to the former.

The positive correlation between the linkage and leakage indicators reveals that greater integration into the international market likely contributed to an increase in the power to generate domestic chaining impacts upstream of each sector's production chain.

The negative correlation obviously indicates the opposite: greater integration into the international market likely contributed to a decrease in the power to generate domestic impacts linked upstream of each sector's production chain.

8.1 Linkage-leakage sector correlation – Brazil

The correlation index between the linkage and leakage indicator matrices for Brazil in the period 1995-2018 is 0.659.[55]

There is, therefore, a positive relationship between the sector's degree of integration into international trade and the magnitude of the indicator of power to generate upstream chaining impacts.

This relationship, however, varies significantly between sectors.[56]

The correlation index between linkage and leakage is positive in 29 of the 44 sectors and is greater than 0.500 in 14 of them, as shown in Table 15 below.

(55) The linkage indicator matrix has the years 1995 to 2018 in the rows and the indicator values in the columns. The matrix of leakage indicators has an identical configuration.

(56) The vectors of linkage and leakage indicators considered for the calculation of correlation indices by sector have the years from 1995 to 2018 in the lines and the values of the indicators in the column.

Table 15
Brazilian Linkage-Leakage Correlation (I)

SORTED BY CORR			SORTED BY LINKAGE GROWTH (1995-1998 = 100)		
SECTOR	LINKAGE	CORR	SECTOR	LINKAGE	CORR
D45T47: Wholesale and retail; repair	1,513	0,956	D64T66: Financial and insurance activities	120,76	0,889
D53: Postal and courier activities	1,586	0,914	D45T47: Wholesale and retail trade; repair of motor vehicles	118,03	0,956
D64T66: Financial and insurance activities	1,473	0,889	D53: Postal and courier activities	111,60	0,914
D84: Public administration and defence	1,378	0,870	D55T56: Accommodation and food service activities	110,66	0,594
D85: Education	1,248	0,791	D84: Public administration and defence; compulsory social security	110,26	0,870
D31T33: Manufacturing nec; repair and installation	1,854	0,756	D01T02: Agriculture, hunting, forestry	108,88	0,599
D41T43: Construction	1,860	0,679	D41T43: Construction	108,84	0,679
D49: Land transport and transport via pipelines	1,851	0,639	D49: Land transport and transport via pipelines	108,39	0,639
D36T39: Water supply; sewerage, waste	1,529	0,622	D85: Education	107,92	0,791
D01T02: Agriculture, hunting, forestry	1,689	0,599	D52: Warehousing and support activities for transportation	105,56	0,432
D55T56: Accommodation and food service activities	1,773	0,594	D29: Motor vehicles, trailers and semi-trailers	103,08	0,187
D21: Pharmaceuticals, medicinal chemical and botanical products	1,733	0,585	D36T39: Water supply; sewerage, waste management and remedia	102,96	0,622
D35: Electricity, gas, steam and air cond	1,885	0,553	D17T18: Paper products and printing	102,78	0,369
D03: Fishing and aquaculture	1,159	0,508	D35: Electricity, gas, steam and air conditioning supply	102,24	0,553
D16: Wood and products of wood and cork	1,965	0,451	D10T12: Food products, beverages and tobacco	101,88	0,282
D25: Fabricated metal products	2,026	0,446	D58T60: Publishing, audiovisual and broadcasting activities	100,95	0,179
D23: Other non-metallic mineral products	2,071	0,440	D62T63: IT and other information services	100,88	-0,254
D07T08: Mining and quarrying, non-energy producing products	1,824	0,437	D31T33: Manufacturing nec; repair and installation of machinery an	100,05	0,756
D52: Warehousing and support activities	1,638	0,432	D61: Telecommunications	99,82	0,023
D17T18: Paper products and printing	2,004	0,369	D16: Wood and products of wood and cork	99,29	0,451
D10T12: Food products, beverages and tobacco	2,263	0,282	D51: Air transport	99,24	0,263
D51: Air transport	2,087	0,263	D03: Fishing and aquaculture	99,08	0,508
D68: Real estate activities	1,143	0,188	D25: Fabricated metal products	98,27	0,446
D29: Motor vehicles, trailers and semi-trailers	2,192	0,187	D21: Pharmaceuticals, medicinal chemical and botanical products	98,13	0,585
D58T60: Publishing, audiovisual	1,810	0,179	D86T88: Human health and social work activities	96,98	-0,103
D13T15: Textiles, textile products, leather and footwear	1,891	0,173	D68: Real estate activities	96,19	0,188
D77T82: Administrative and support services	1,457	0,131	D23: Other non-metallic mineral products	95,72	0,440
D22: Rubber and plastics products	2,096	0,041	D94T96: Other service activities	94,37	-0,203
D61: Telecommunications	1,789	0,023	D69T75: Professional, scientific and technical activities	93,89	-0,334
D86T88: Human health and social work activities	1,527	-0,103	D26: Computer, electronic and optical equipment	93,75	-0,554
D09: Mining support service activities	1,759	-0,104	D27: Electrical equipment	93,69	-0,618
D94T96: Other service activities	1,722	-0,203	D50: Water transport	93,65	-0,305
D19: Coke and refined petroleum products	2,281	-0,214	D13T15: Textiles, textile products, leather and footwear	92,73	0,173
D62T63: IT and other information services	1,412	-0,254	D28: Machinery and equipment, nec	92,64	-0,474
D90T93: Arts, entertainment and recreation	1,631	-0,256	D20: Chemical and chemical products	91,43	-0,310
D50: Water transport	1,726	-0,305	D22: Rubber and plastics products	88,74	0,041
D20: Chemical and chemical products	2,189	-0,310	D19: Coke and refined petroleum products	87,83	-0,214
D69T75: Professional, scientific technical	1,522	-0,334	D90T93: Arts, entertainment and recreation	84,61	-0,256
D05T06: Mining and quarrying, energy producing products	1,739	-0,394	D77T82: Administrative and support services	82,44	0,131
D28: Machinery and equipment, nec	1,979	-0,474	D30: Other transport equipment	80,82	-0,803
D26: Computer, electronic and optical equipment	1,960	-0,554	D24: Basic metals	79,42	-0,606
D24: Basic metals	2,122	-0,606	D09: Mining support service activities	77,06	-0,104
D27: Electrical equipment	2,064	-0,618	D05T06: Mining and quarrying, energy producing products	76,26	-0,394
D30: Other transport equipment	1,807	-0,803	D07T08: Mining and quarrying, non-energy producing products	74,78	0,437
Average Linkage / Total Correlation	1,778	0,659	Average Linkage / Total Correlation	1,78	0,659

Of the 10 sectors with the highest correlation indices, 7 are service sectors, 1 is a utility and the others are agricultural sectors.

Sector D01Q02: Agriculture, hunting, forestry sector has a correlation index of 0.599, that is, 60% of the behavior of the linkage indicator of agriculture is associated with greater integration into the world economy.

On the other hand, the sectors whose linkage indicators were most negatively impacted by integration into international trade are D30: Other transport equipment (correlation index -0.803); D27: Electrical equipment (-0.618); D24: Basic metals (-0.606) and D26: Computer, electronic and optical equipment (-0.554).

Although there is no pattern in the profile of the sectors impacted to a greater or lesser extent by integration, it is certain that the greatest negative impacts were concentrated in some specific sectors of industry: production of capital goods, computers and other electronic equipment, steel, electrical equipment, and other transport equipment.

If there is a pattern that emerges from the analysis of sectoral correlation indices, it is that, in most cases, greater international integration has boosted the growth of sectoral upstream chaining impact indicators in Brazil.

In Table 13, when the sectors are ranked in descending order of the variation rates between the beginning and the end of the analyzed period, it can be seen that the highest growth rates are associated with the highest correlation coefficients.

It should also be noted that when positive correlation coefficients are associated with sectors in which there was a drop in the linkage indicator, the takeaway is that international integration did not drive the decline in the indicator, as the two indicators moved in the same direction. There was a drop in the impact indicator and a drop in the degree of leakage.

In fact, significant negative effect from greater integration on the generation power of chaining impacts occurred in sectors D26: Computer, electronic and optical equipment, D27: Electrical equipment, D30: Other transport equipment and D24: Basic metals, in which significant declines in the impact indicators are associated with high negative correlation coefficients.

Important results are also obtained by analyzing the impact of international integration on the sectors that present the highest indicators of domestic linkage impacts.

In 7 of the 11 sectors of activity in which the linkage indicator is greater than 2,000, the correlation index is positive. Domestic suppliers of inputs to important activity sectors benefited from the opening of the economy.

Food and beverage, motor vehicle, plastics and rubber, metallurgy and paper activities are industrial sectors in which economic openness has led to increased production by domestic suppliers upstream in the supply chain.

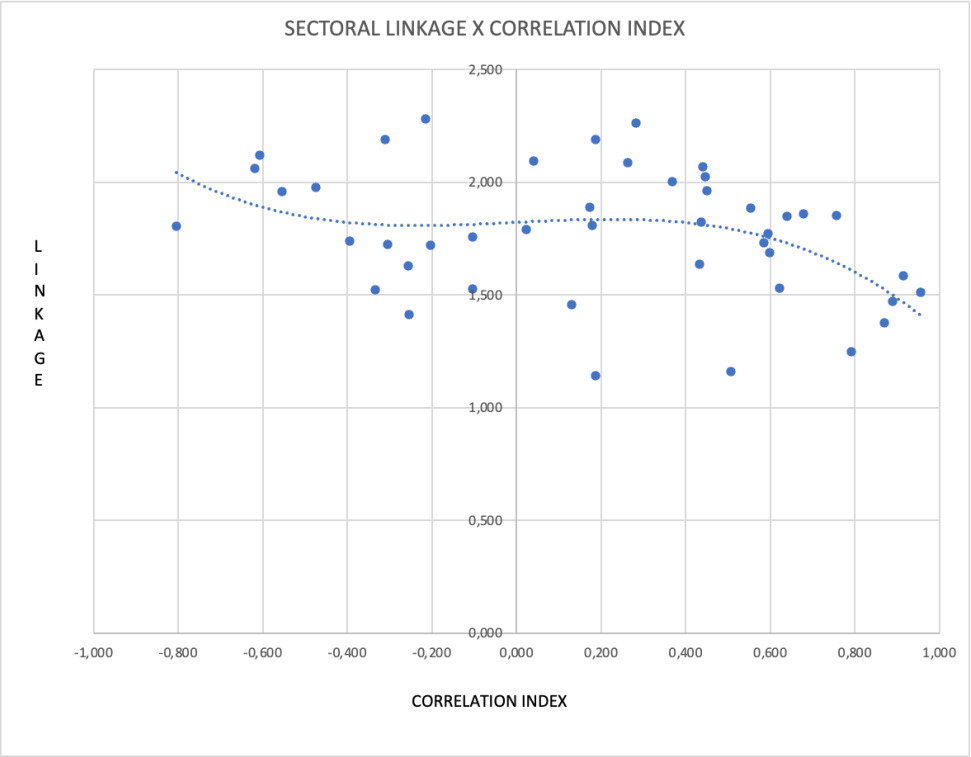
Table 16
Brazilian Linkage-Leakage Correlation (II)

SORTED BY LINKAGE INDICE (VALUE)		
SECTOR	LINKAGE	CORR
D19: Coke and refined petroleum products	2,281	-0,214
D10T12: Food products, beverages and tobacco	2,263	0,282
D29: Motor vehicles, trailers and semi-trailers	2,192	0,187
D20: Chemical and chemical products	2,189	-0,310
D24: Basic metals	2,122	-0,606
D22: Rubber and plastics products	2,096	0,041
D51: Air transport	2,087	0,263
D23: Other non-metallic mineral products	2,071	0,440
D27: Electrical equipment	2,064	-0,618
D25: Fabricated metal products	2,026	0,446
D17T18: Paper products and printing	2,004	0,369
D28: Machinery and equipment, nec	1,979	-0,474
D16: Wood and products of wood and cork	1,965	0,451
D26: Computer, electronic and optical equipment	1,960	-0,554
D13T15: Textiles, textile products, leather and footwear	1,891	0,173
D35: Electricity, gas, steam and air cond	1,885	0,553
D41T43: Construction	1,860	0,679
D31T33: Manufacturing nec; repair and installation	1,854	0,756
D49: Land transport and transport via pipelines	1,851	0,639
D07T08: Mining and quarrying, non-energy producing products	1,824	0,437
D58T60: Publishing, audiovisual	1,810	0,179
D30: Other transport equipment	1,807	-0,803
D61: Telecommunications	1,789	0,023
D55T56: Accommodation and food service activities	1,773	0,594
D09: Mining support service activities	1,759	-0,104
D05T06: Mining and quarrying, energy producing products	1,739	-0,394
D21: Pharmaceuticals, medicinal chemical and botanical products	1,733	0,585
D50: Water transport	1,726	-0,305
D94T96: Other service activities	1,722	-0,203
D01T02: Agriculture, hunting, forestry	1,689	0,599
D52: Warehousing and support activities	1,638	0,432
D90T93: Arts, entertainment and recreation	1,631	-0,256
D53: Postal and courier activities	1,586	0,914
D36T39: Water supply; sewerage, waste	1,529	0,622
D86T88: Human health and social work activities	1,527	-0,103
D69T75: Professional, scientific technical	1,522	-0,334
D45T47: Wholesale and retail; repair	1,513	0,956
D64T66: Financial and insurance activities	1,473	0,889
D77T82: Administrative and support services	1,457	0,131
D62T63: IT and other information services	1,412	-0,254
D84: Public administration and defence	1,378	0,870
D85: Education	1,248	0,791
D03: Fishing and aquaculture	1,159	0,508
D68: Real estate activities	1,143	0,188
Average Linkage / Total Correlation	1,78	0,659

Graph 5 below helps to understand the relationship between the sectorial correlation indices and the magnitude of the respective linkage indicators.[57]

(57) The trendline is a 3rd order polynomial.

Graph 5
Brazilian sector linkage x Correlation index



For values of positive correlation coefficients up to 0.800, the index is mostly associated with sectors with higher indicators of chaining power. In the upper range of positive correlation indices, between 0.800 and 1.000, the association becomes with sectors with lower linkage indicators.

In the case of negative correlation indices, the association with sectors with higher linkage indices occurs in the range -0.600 to -0.200, but the number of sectors in which this association occurs is smaller than the case of positive correlation indices.

A reasonable interpretation of this information is that moderate degrees of international trade integration are preferable to higher degrees. Openness is necessary and efficient to increase a country's growth potential, but it must be planned by sector to obtain the best result for the economy.

In summary, the greater integration of the Brazilian economy into international trade in the period 1995 – 2018, seen from the perspective of a disaggregated sector, seems to have contributed to an increase in the economy's growth potential, but in an asymmetric way: services, utilities and agricultural activities lengthened their domestic supply chains while industrial activities shortened them, letting growing portions of the dynamic effects of the productive chain leak abroad.

8.2 Linkage-leakage sector correlation - China

The correlation coefficient of the Chinese linkage and leakage indicator matrices is 0.479, 27% lower than the coefficient for Brazil.[58]

In 23 of the 44 sectors the correlation coefficient is positive; in 21, therefore, it is negative. [59]In 14 of the 23 sectors where there was growth in the linkage indicator, the correlation coefficient is positive, that is, the opening of the economy likely contributed to increasing the intensity of the upstream linkage impacts. In 9 of the 23 sectors, the correlation coefficient is negative.

Table 17
Chinese Linkage-Leakage Correlation(I)

SORTED BY CORR			SORTED BY LINKAGE GROWTH (1995-2000 =100)		
SECTOR	LINKAGE	CORR	SECTOR	LINKAGE	CORR
D64T66: Financial and insurance activities	1,280	0,923	D03: Fishing and aquaculture	154,59	0,676
D85: Education	1,448	0,862	D01T02: Agriculture, hunting, forestry	147,19	0,703
D90T93: Arts, entertainment and recreation	1,753	0,830	D07T08: Mining and quarrying, non-energy producing products	130,72	0,535
D01T02: Agriculture, hunting, forestry	2,210	0,703	D09: Mining support service activities	127,91	0,040
D84: Public administration and defence; compulsory social security	1,680	0,692	D55T56: Accommodation and food service activities	125,68	0,646
D03: Fishing and aquaculture	2,134	0,676	D53: Postal and courier activities	124,81	0,500
D94T96: Other service activities	1,642	0,668	D49: Land transport and transport via pipelines	123,94	0,598
D55T56: Accommodation and food service activities	2,371	0,646	D05T06: Mining and quarrying, energy producing products	121,91	0,104
D68: Real estate activities	1,352	0,634	D90T93: Arts, entertainment and recreation	117,99	0,830
D49: Land transport and transport via pipelines	2,107	0,598	D13T15: Textiles, textile products, leather and footwear	117,57	-0,746
D45T47: Wholesale and retail trade; repair of motor vehicles	1,667	0,554	D30: Other transport equipment	116,40	-0,815
D07T08: Mining and quarrying, non-energy producing products	2,441	0,535	D10T12: Food products, beverages and tobacco	115,88	0,104
D53: Postal and courier activities	2,168	0,500	D51: Air transport	114,84	0,280
D36T39: Water supply; sewerage, waste management and remediation activities	2,355	0,480	D35: Electricity, gas, steam and air conditioning supply	112,12	0,318
D86T88: Human health and social work activities	1,855	0,378	D26: Computer, electronic and optical equipment	111,79	-0,459
D35: Electricity, gas, steam and air conditioning supply	2,421	0,318	D94T96: Other service activities	108,84	0,668
D51: Air transport	2,369	0,280	D17T18: Paper products and printing	107,31	-0,733
D52: Warehousing and support activities for transportation	2,173	0,159	D29: Motor vehicles, trailers and semi-trailers	105,90	0,078
D05T06: Mining and quarrying, energy producing products	2,436	0,104	D16: Wood and products of wood and cork	105,82	-0,736
D10T12: Food products, beverages and tobacco	2,705	0,104	D21: Pharmaceuticals, medicinal chemical and botanical products	105,79	-0,343
D29: Motor vehicles, trailers and semi-trailers	2,854	0,078	D31T33: Manufacturing nec; repair and installation of machinery and equipment	104,77	-0,615
D62T63: IT and other information services	1,743	0,075	D28: Machinery and equipment, nec	104,18	-0,209
D09: Mining support service activities	2,651	0,040	D50: Water transport	100,84	-0,415
D58T60: Publishing, audiovisual and broadcasting activities	2,217	-0,053	D52: Warehousing and support activities for transportation	99,76	0,159
D69T75: Professional, scientific and technical activities	2,283	-0,065	D20: Chemical and chemical products	99,18	-0,535
D61: Telecommunications	2,255	-0,104	D84: Public administration and defence; compulsory social security	98,92	0,692
D28: Machinery and equipment, nec	2,814	-0,209	D41T43: Construction	98,74	-0,501
D23: Other non-metallic mineral products	2,617	-0,224	D23: Other non-metallic mineral products	98,32	-0,224
D25: Fabricated metal products	2,762	-0,262	D22: Rubber and plastics products	98,30	-0,729
D21: Pharmaceuticals, medicinal chemical and botanical products	2,566	-0,343	D27: Electrical equipment	96,77	-0,563
D77T82: Administrative and support services	2,189	-0,361	D36T39: Water supply; sewerage, waste management and remediation activities	95,43	0,480
D50: Water transport	2,284	-0,415	D25: Fabricated metal products	95,17	-0,262
D26: Computer, electronic and optical equipment	2,672	-0,459	D77T82: Administrative and support services	93,50	-0,361
D41T43: Construction	2,721	-0,501	D69T75: Professional, scientific and technical activities	92,51	-0,065
D20: Chemical and chemical products	2,638	-0,535	D19: Coke and refined petroleum products	90,11	-0,719
D27: Electrical equipment	2,832	-0,563	D24: Basic metals	89,95	-0,640
D31T33: Manufacturing nec; repair and installation of machinery and equipment	2,831	-0,615	D86T88: Human health and social work activities	89,79	0,378
D24: Basic metals	2,648	-0,640	D58T60: Publishing, audiovisual and broadcasting activities	88,41	-0,053
D19: Coke and refined petroleum products	2,121	-0,719	D85: Education	87,78	0,862
D22: Rubber and plastics products	2,874	-0,729	D61: Telecommunications	87,59	-0,104
D17T18: Paper products and printing	2,804	-0,733	D64T66: Financial and insurance activities	86,72	0,923
D16: Wood and products of wood and cork	2,806	-0,736	D62T63: IT and other information services	84,84	0,075
D13T15: Textiles, textile products, leather and footwear	3,209	-0,746	D45T47: Wholesale and retail trade; repair of motor vehicles	84,61	0,554
D30: Other transport equipment	2,774	-0,815	D68: Real estate activities	83,61	0,634
Average Linkage / Total Correlation	2,335	0,479	Average Linkage / Total Correlation	2,335	0,479

The highest growth rates of the linkage indicator are associated with the highest correlation coefficients, but it is possible to identify a bias in this positive association: it occurs especially in primary activities (extractive and agriculture) and services sectors.

In the industrial sectors that recorded the highest growth rates D13Q15: Textiles, textile products, leather, and footwear (17.57%) and D30: Other transport equipment (16.40%) the

(58) The matrices and vectors of Chinese indicators have the same configuration as the Brazilian ones. See footnotes 13 and 14.

(59) Remember that in Brazil the proportion of positive coefficients is higher: 29 out of 44.

correlation coefficients are negative. That is, the growth of the linkage indicator of these sectors is associated with a decrease in the leakage indicator, a process, therefore, of internalization of the production of inputs directly and indirectly linked to these sectors.

Table 18 below shows the hierarchical sectoral correlation coefficients in descending order of magnitude of the sectors' linkage indicators. The initial hypothesis of this study is confirmed, i.e. that China implemented a development strategy between 1995 and 2018 based on import substitution with international integration.

Table 18
Chinese Linkage-Leakage Correlation (II)

SORTED BY LINKAGE INDICE (VALUE)		
SECTOR	LINKAGE	CORR
D13T15: Textiles, textile products, leather and footwear	3,209	-0,746
D22: Rubber and plastics products	2,874	-0,729
D29: Motor vehicles, trailers and semi-trailers	2,854	0,078
D27: Electrical equipment	2,832	-0,563
D31T33: Manufacturing nec; repair and installation of machinery and equipment	2,831	-0,615
D28: Machinery and equipment, nec	2,814	-0,209
D16: Wood and products of wood and cork	2,806	-0,736
D17T18: Paper products and printing	2,804	-0,733
D30: Other transport equipment	2,774	-0,815
D25: Fabricated metal products	2,762	-0,262
D41T43: Construction	2,721	-0,501
D10T12: Food products, beverages and tobacco	2,705	0,104
D26: Computer, electronic and optical equipment	2,672	-0,459
D09: Mining support service activities	2,651	0,040
D24: Basic metals	2,648	-0,640
D20: Chemical and chemical products	2,638	-0,535
D23: Other non-metallic mineral products	2,617	-0,224
D21: Pharmaceuticals, medicinal chemical and botanical products	2,566	-0,343
D07T08: Mining and quarrying, non-energy producing products	2,441	0,535
D05T06: Mining and quarrying, energy producing products	2,436	0,104
D35: Electricity, gas, steam and air conditioning supply	2,421	0,318
D55T56: Accommodation and food service activities	2,371	0,646
D51: Air transport	2,369	0,280
D36T39: Water supply; sewerage, waste management and remediation activities	2,355	0,480
D50: Water transport	2,284	-0,415
D69T75: Professional, scientific and technical activities	2,283	-0,065
D61: Telecommunications	2,255	-0,104
D58T60: Publishing, audiovisual and broadcasting activities	2,217	-0,053
D01T02: Agriculture, hunting, forestry	2,210	0,703
D77T82: Administrative and support services	2,189	-0,361
D52: Warehousing and support activities for transportation	2,173	0,159
D53: Postal and courier activities	2,168	0,500
D03: Fishing and aquaculture	2,134	0,676
D19: Coke and refined petroleum products	2,121	-0,719
D49: Land transport and transport via pipelines	2,107	0,598
D86T88: Human health and social work activities	1,855	0,378
D90T93: Arts, entertainment and recreation	1,753	0,830
D62T63: IT and other information services	1,743	0,075
D84: Public administration and defence; compulsory social security	1,680	0,692
D45T47: Wholesale and retail trade; repair of motor vehicles	1,667	0,554
D94T96: Other service activities	1,642	0,668
D85: Education	1,448	0,862
D68: Real estate activities	1,352	0,634
D64T66: Financial and insurance activities	1,280	0,923
Average Linkage / Total Correlation	2,335	0,479

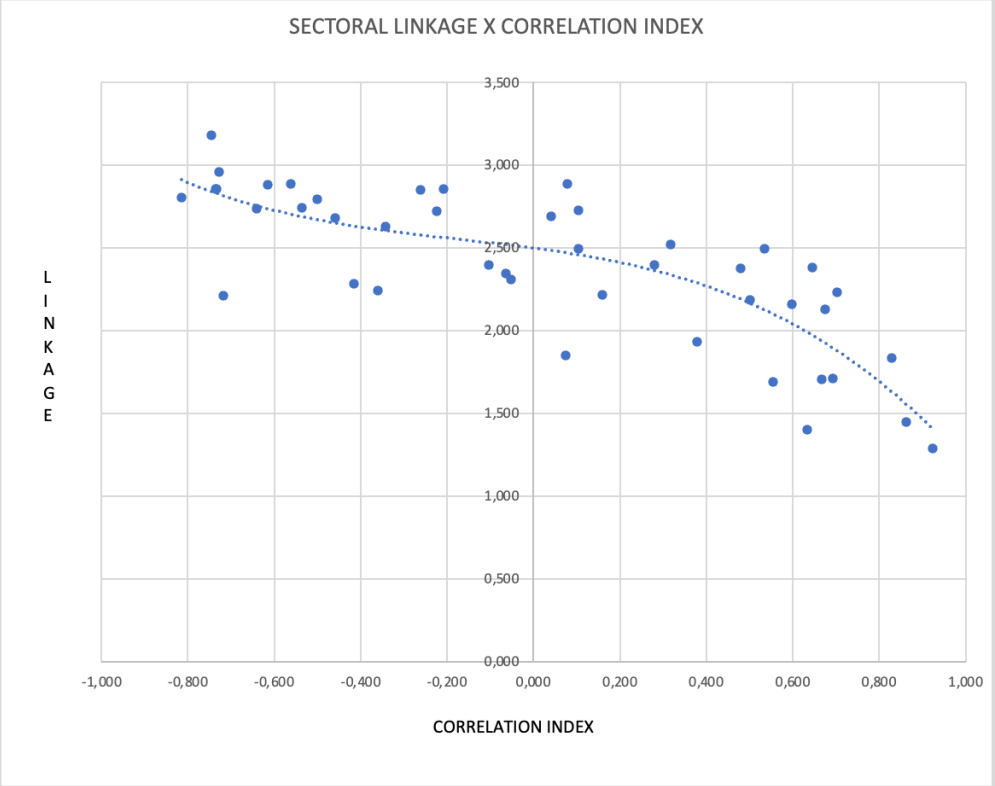
Of the 18 sectors in which the linkage indicator is greater than 2.5000, 15 have negative correlation coefficients. And in the 3 other sectors in which the correlation coefficient is positive, the magnitude of these coefficients is very small, so that it cannot be said that in these 3 sectors the opening of the economy contributed to the growth of these impact indicators.

Of these 18 sectors, 17 are industrial sectors. The remaining sector is civil construction.

The conclusion is that China achieved an extraordinary increase in the growth potential of its economy in the period under review by internalizing the production of virtually all industrial activity.

Graph 6 below illustrates the relationship between the sectoral correlation indices and the magnitude of the respective Chinese linkage indicators.[60]

Graph 6
Chinese sectoral linkage x Correlation index



There is a clear downward trend for linkage indicators as positive correlation coefficients increase; the opposite occurs with negative correlation coefficients: higher negative correlation coefficients are associated with higher linkage indicators.

In short, there are strong indications that the lever of Chinese growth in the period in question was the adoption of a successful strategy of import substitution with international integration.

(60) The trendline is a 3rd order polynomial.

8.3 Linkage-leakage sector correlation – U.S.A.

For the United States, the correlation coefficient of the Chinese linkage and leakage indicator matrices is 0.429, close to the Chinese coefficient of 0.479.[61]

Sectorally speaking, however, there are great differences.

In the first place, it should be noted that the American linkage indicators were those that presented the lowest growth rates among the three countries. At the end of the period, only 3 sectors showed growth in this indicator greater than 10% and in only 2 of them the correlation coefficients were high, 0.922 and 0.837, respectively for sectors D52: Warehousing and support activities for transportation and D53: Postal and courier activities, both service activities.

In 27 of the 44 sectors the correlation coefficients are, in module, less than 0.500.

Table 19
American Linkage-Leakage Correlation (I)

SORTED BY CORR			SORTED BY LINKAGE GROWTH (1995-1996 = 100)		
SECTOR	LINKAGE	CORR	SECTOR	LINKAGE	CORR
D52: Warehousing and support activities for transportation	1,800	0,922	D52: Warehousing and support activities for transportation	125,53	0,922
D84: Public administration and defence; compulsory social security	1,597	0,890	D53: Postal and courier activities	112,00	0,837
D64T66: Financial and insurance activities	1,760	0,854	D61: Telecommunications	110,24	-0,025
D26: Computer, electronic and optical equipment	1,336	0,851	D35: Electricity, gas, steam and air conditioning supply	107,74	0,235
D53: Postal and courier activities	1,605	0,837	D45T47: Wholesale and retail trade; repair of motor vehicles	106,60	0,735
D22: Rubber and plastics products	2,043	0,769	D64T66: Financial and insurance activities	105,86	0,854
D45T47: Wholesale and retail trade; repair of motor vehicles	1,689	0,735	D77T82: Administrative and support services	104,40	0,443
D09: Mining support service activities	1,682	0,687	D21: Pharmaceuticals, medicinal chemical and botanical products	104,23	0,457
D23: Other non-metallic mineral products	1,879	0,621	D85: Education	103,69	0,620
D85: Education	1,390	0,620	D50: Water transport	102,99	-0,485
D20: Chemical and chemical products	1,964	0,601	D68: Real estate activities	102,90	0,393
D25: Fabricated metal products	1,893	0,598	D84: Public administration and defence; compulsory social security	102,18	0,890
D24: Basic metals	2,043	0,573	D86T88: Human health and social work activities	101,65	0,233
D49: Land transport and transport via pipelines	1,780	0,520	D69T75: Professional, scientific and technical activities	101,27	-0,165
D21: Pharmaceuticals, medicinal chemical and botanical products	1,579	0,457	D01T02: Agriculture, hunting, forestry	101,14	0,213
D77T82: Administrative and support services	1,613	0,443	D03: Fishing and aquaculture	100,11	0,402
D62T63: IT and other information services	1,492	0,429	D49: Land transport and transport via pipelines	100,06	0,520
D03: Fishing and aquaculture	1,342	0,402	D23: Other non-metallic mineral products	99,92	0,621
D68: Real estate activities	1,474	0,393	D62T63: IT and other information services	99,90	0,429
D10T12: Food products, beverages and tobacco	2,292	0,365	D24: Basic metals	99,27	0,573
D36T39: Water supply; sewerage, waste management and remediation activities	1,672	0,276	D36T39: Water supply; sewerage, waste management and remediation activities	98,96	0,276
D51: Air transport	1,706	0,270	D25: Fabricated metal products	98,90	0,598
D35: Electricity, gas, steam and air conditioning supply	1,559	0,235	D22: Rubber and plastics products	98,55	0,769
D58T60: Publishing, audiovisual and broadcasting activities	1,593	0,233	D05T06: Mining and quarrying, energy producing products	98,48	-0,286
D86T88: Human health and social work activities	1,603	0,233	D17T18: Paper products and printing	98,34	0,184
D01T02: Agriculture, hunting, forestry	2,038	0,213	D94T96: Other service activities	98,24	-0,179
D17T18: Paper products and printing	2,016	0,184	D29: Motor vehicles, trailers and semi-trailers	97,13	-0,074
D30: Other transport equipment	1,730	0,162	D10T12: Food products, beverages and tobacco	96,95	0,365
D90T93: Arts, entertainment and recreation	1,593	0,082	D19: Coke and refined petroleum products	96,56	-0,679
D61: Telecommunications	1,738	-0,025	D90T93: Arts, entertainment and recreation	96,49	0,082
D29: Motor vehicles, trailers and semi-trailers	2,067	-0,074	D20: Chemical and chemical products	95,36	0,601
D69T75: Professional, scientific and technical activities	1,559	-0,165	D09: Mining support service activities	94,73	0,687
D94T96: Other service activities	1,672	-0,179	D28: Machinery and equipment, nec	94,25	-0,397
D31T33: Manufacturing nec; repair and installation of machinery and equipment	1,696	-0,187	D55T56: Accommodation and food service activities	94,22	-0,253
D07T08: Mining and quarrying, non-energy producing products	1,769	-0,200	D07T08: Mining and quarrying, non-energy producing products	94,00	-0,200
D27: Electrical equipment	1,684	-0,243	D16: Wood and products of wood and cork	93,91	-0,374
D55T56: Accommodation and food service activities	1,744	-0,253	D41T43: Construction	92,85	-0,614
D05T06: Mining and quarrying, energy producing products	1,623	-0,286	D51: Air transport	92,77	0,270
D16: Wood and products of wood and cork	2,066	-0,374	D30: Other transport equipment	92,04	0,162
D28: Machinery and equipment, nec	1,818	-0,397	D58T60: Publishing, audiovisual and broadcasting activities	90,79	0,233
D50: Water transport	2,172	-0,485	D27: Electrical equipment	90,27	-0,243
D13T15: Textiles, textile products, leather and footwear	1,880	-0,578	D31T33: Manufacturing nec; repair and installation of machinery and equipment	90,09	-0,187
D41T43: Construction	1,720	-0,614	D13T15: Textiles, textile products, leather and footwear	88,97	-0,578
D19: Coke and refined petroleum products	1,767	-0,679	D26: Computer, electronic and optical equipment	71,53	0,851
Average Linkage / Total Correlation	1,744	0,429	Average Linkage / Total Correlation	1,744	0,429

It is the stand out Sector D26: Computer, electronic and optical equipment, which had the biggest drop in the linkage indicator in the period (almost 30%) and for which the correlation coefficient is high and positive (0.851). To the extent that the linkage and leakage indicators in this

(61) The matrices and vectors of American indicators have the same configuration as the Brazilian and Chinese ones. See footnotes 13 and 14.

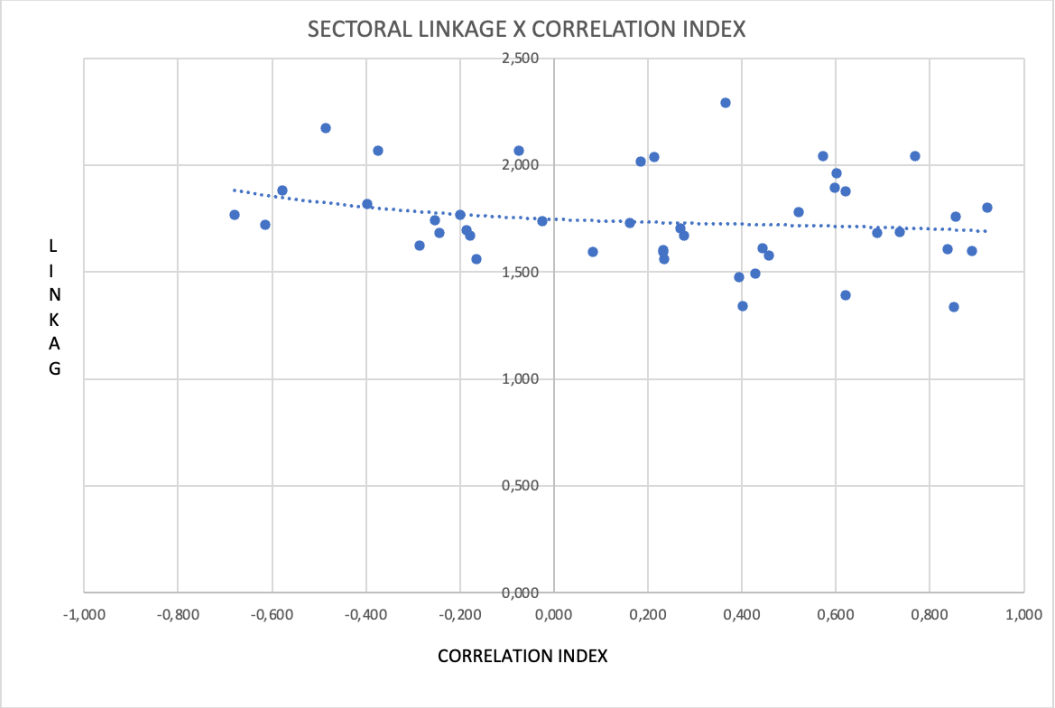
sector moved in the same direction, it can be said that the reduction in the degree of leakage in this sector negatively affected the power to generate upstream chaining impacts in its supply chain. It is also worth noting that this is the sector with the lowest linkage indicator in the entire American production structure (1.336).

Table 20
American Linkage-Leakage Correlation (II)

SORTED BY LINKAGE INDICE (VALUE)		
SECTOR	LINKAGE	CORR
D10T12: Food products, beverages and tobacco	2,292	0,365
D50: Water transport	2,172	-0,485
D29: Motor vehicles, trailers and semi-trailers	2,067	-0,074
D16: Wood and products of wood and cork	2,066	-0,374
D22: Rubber and plastics products	2,043	0,769
D24: Basic metals	2,043	0,573
D01T02: Agriculture, hunting, forestry	2,038	0,213
D17T18: Paper products and printing	2,016	0,184
D20: Chemical and chemical products	1,964	0,601
D25: Fabricated metal products	1,893	0,598
D13T15: Textiles, textile products, leather and footwear	1,880	-0,578
D23: Other non-metallic mineral products	1,879	0,621
D28: Machinery and equipment, nec	1,818	-0,397
D52: Warehousing and support activities for transportation	1,800	0,922
D49: Land transport and transport via pipelines	1,780	0,520
D07T08: Mining and quarrying, non-energy producing products	1,769	-0,200
D19: Coke and refined petroleum products	1,767	-0,679
D64T66: Financial and insurance activities	1,760	0,854
D55T56: Accommodation and food service activities	1,744	-0,253
D61: Telecommunications	1,738	-0,025
D30: Other transport equipment	1,730	0,162
D41T43: Construction	1,720	-0,614
D51: Air transport	1,706	0,270
D31T33: Manufacturing nec; repair and installation of machinery and equipment	1,696	-0,187
D45T47: Wholesale and retail trade; repair of motor vehicles	1,689	0,735
D27: Electrical equipment	1,684	-0,243
D09: Mining support service activities	1,682	0,687
D94T96: Other service activities	1,672	-0,179
D36T39: Water supply; sewerage, waste management and remediation activities	1,672	0,276
D05T06: Mining and quarrying, energy producing products	1,623	-0,286
D77T82: Administrative and support services	1,613	0,443
D53: Postal and courier activities	1,605	0,837
D86T88: Human health and social work activities	1,603	0,233
D84: Public administration and defence; compulsory social security	1,597	0,890
D90T93: Arts, entertainment and recreation	1,593	0,082
D58T60: Publishing, audiovisual and broadcasting activities	1,593	0,233
D21: Pharmaceuticals, medicinal chemical and botanical products	1,579	0,457
D35: Electricity, gas, steam and air conditioning supply	1,559	0,235
D69T75: Professional, scientific and technical activities	1,559	-0,165
D62T63: IT and other information services	1,492	0,429
D68: Real estate activities	1,474	0,393
D85: Education	1,390	0,620
D03: Fishing and aquaculture	1,342	0,402
D26: Computer, electronic and optical equipment	1,336	0,851
Average Linkage / Total Correlation	1,744	0,429

Graph 7 below shows the relationship between the sectorial correlation indices and the magnitude of the respective American linkage indicators.[62]

Graph 7
American sector linkage x Correlation index



As the sectoral dispersion of the American linkage indicators is low (it varied between 0.204 and 0.254 in the period 1995 – 2018), typical, as already mentioned, of a mature economy, the trend of the linkage – leakage relationship in the United States is stability.

9 Conclusion

In this work, we have sought to explore the possibilities of using the Leontief matrices made available by the OECD to approach the issue of deindustrialization from a new angle: that of intersectoral relations.

The first strategy was to search the economic literature for references to frame the phenomenon of deindustrialization in the context of economic development processes in less developed countries. The option was to adopt the idea of an unbalanced growth strategy, proposed by Albert O. Hirschman, as a theoretical reference, as opposed to balanced growth models.

We looked to the works of Albert Fishlow for elements to better understand the characteristics and historical evolution of import substitution industrialization and notes about the current stage of the Brazilian development and its challenges.

(62) The trendline is a 3rd order polynomial.

From the vast literature on deindustrialization in developed economies and on "early" deindustrialization, although many questions remain open, some points shine through: a) it is undeniable that in the case of late industrialization in relation to more advanced countries, the reversal of the process – that is, deindustrialization – occurred at per capita income levels lower than those seen in more developed countries; b) deindustrialization seems to be a phenomenon that occurs at the aggregate level – for the economy as a whole – but it is not confirmed when it advances to more disaggregated levels of analysis; c) there are indications that the causes and profile of the phenomenon are historically determined and vary from country to country; d) although industry was, and continues to be, the sector that most contributed to the increase in productivity and economic growth in countries, other sectors can also present typically Kaldorian properties and contribute to the expansion of aggregate productivity and drive economic growth.

Reframed in the context of economic development, industrialization comes to be seen as structural changes that, following the words of Chenery, Robinson and Syrquim, when successful, are the very expression of development.

In this work, we try to show that China implemented a successful structural change in the period analyzed, based on the substitution of imports with international integration, and reaped a significant increase in its growth potential as a result.

By comparison, in Brazil, in the same period, greater international integration did not bring significant gains to the economy's growth potential, when measured by the value of the coefficients of direct and indirect impacts.

The United States enters as a counterpoint to demonstrate that advanced economies with a diversified and balanced productive structure tend to be more stable regarding structural changes. If structural change and development are synonyms, developed countries, by definition, experience changes more slowly, primarily associated with innovations and radical technological changes.

The study also verified the existence of a relationship between international integration and gain in growth potential via productive linkages. It is not a general relationship, applicable to all sectors, but it is verifiable that, in most activity sectors, endogenous potential growth increases as the supply of imported inputs increases.

The Chinese experience shows that economic integration can be used to raise the economic productivity and, in a subsequent phase, replace imports and gain space in international trade. The key is for a country to make the right choices and tapping into its own sources of competitive advantage.

These conclusions are based on the analysis of the behavior of the linkage and leakage indicators calculated from the OECD harmonized Leontief matrices.

The coefficients of this matrix have a great advantage over the various other indicators by which an economy can be analyzed because they are a synthesis of macro and microeconomic elements and manage to simultaneously capture supply and demand movements. They make it possible to identify disaggregated adjustments, by sector of activity, something that the aggregated indicators do not allow.

The project we propose to develop aimed to better understand this database. In conclusion, it can be assured that conducting more technically sophisticated studies using this database will undoubtedly help to improve the understanding of the phenomenon of deindustrialization and the structural changes that promote the economic development of developing countries.

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Appendices
Appendix I: Brazil Linkage 1995-2018

BRAZIL SECTORAL LINKAGES 1995 - 2018																								
SECTOR	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*
D01T02: Agriculture, hunting, forestry	1,567	1,547	1,555	1,534	1,534	1,572	1,602	1,569	1,618	1,696	1,775	1,737	1,708	1,675	1,633	1,648	1,662	1,695	1,648	1,678	1,724	1,676	1,693	1,684
D03: Fishing and aquaculture	1,169	1,166	1,174	1,170	1,167	1,187	1,178	1,179	1,190	1,176	1,211	1,205	1,176	1,190	1,183	1,159	1,159	1,171	1,167	1,168	1,168	1,218	1,172	1,146
D05T06: Mining and quarrying, energy producing products	2,377	2,240	2,251	2,251	2,145	2,099	1,992	1,967	1,968	1,912	1,755	1,711	1,746	1,687	1,894	1,591	1,584	1,541	1,537	1,554	1,712	1,952	1,845	1,632
D07T08: Mining and quarrying, non-energy producing products	2,525	2,427	2,398	2,404	2,260	2,274	2,146	2,042	2,110	2,062	1,951	1,851	1,915	1,722	1,913	1,637	1,432	1,388	1,430	1,583	1,883	2,097	1,975	1,672
D09: Mining support service activities	2,327	2,251	2,271	2,281	2,159	2,046	1,927	1,893	1,927	1,922	1,734	1,623	1,732	1,492	1,868	1,751	1,629	1,585	1,590	1,613	1,721	1,996	1,911	1,607
D10T12: Food products, beverages and tobacco	2,240	2,227	2,224	2,194	2,182	2,454	2,438	2,498	2,499	2,523	2,548	2,516	2,502	2,483	2,464	2,261	2,254	2,270	2,263	2,286	2,286	2,295	2,264	2,262
D13T15: Textiles, textile products, leather and footwear	2,010	2,033	2,051	2,063	2,050	2,384	2,370	2,460	2,518	2,530	2,563	2,479	2,397	2,331	2,246	1,912	1,898	1,908	1,912	1,911	1,909	1,921	1,901	1,881
D16: Wood and products of wood and cork	1,969	1,978	1,982	1,985	1,977	2,311	2,255	2,303	2,352	2,341	2,415	2,412	2,325	2,238	2,182	1,894	1,901	1,929	1,917	1,932	1,960	1,965	1,953	1,976
D17T18: Paper products and printing	1,951	1,950	1,948	1,950	1,931	2,226	2,185	2,327	2,346	2,382	2,438	2,422	2,349	2,327	2,326	2,027	1,989	2,050	2,021	2,036	2,005	1,999	2,014	1,994
D19: Coke and refined petroleum products	2,637	2,583	2,565	2,603	2,480	2,615	2,541	2,509	2,470	2,437	2,482	2,480	2,421	2,402	2,402	2,314	2,493	2,586	2,513	2,471	2,327	2,255	2,295	2,267
D20: Chemical and chemical products	2,449	2,405	2,367	2,356	2,305	2,476	2,493	2,526	2,528	2,531	2,567	2,511	2,462	2,321	2,353	2,195	2,220	2,258	2,219	2,221	2,198	2,161	2,181	2,197
D21: Pharmaceuticals, medicinal chemical and botanical products	1,763	1,768	1,764	1,767	1,766	2,090	2,073	2,149	2,170	2,166	2,180	2,156	2,117	2,055	2,018	1,723	1,748	1,750	1,758	1,754	1,816	1,776	1,730	1,735
D22: Rubber and plastics products	2,376	2,373	2,352	2,345	2,284	2,550	2,578	2,627	2,606	2,634	2,655	2,631	2,567	2,365	2,299	2,056	2,072	2,098	2,088	2,089	2,100	2,078	2,091	2,100
D23: Other non-metallic mineral products	2,184	2,171	2,154	2,145	2,116	2,353	2,297	2,349	2,337	2,381	2,436	2,333	2,327	2,274	2,250	1,980	1,958	1,975	1,992	2,026	2,060	2,064	2,095	2,047
D24: Basic metals	2,871	2,712	2,566	2,536	2,446	2,567	2,483	2,425	2,434	2,299	2,303	2,302	2,245	2,124	2,372	2,175	2,091	2,083	2,107	2,074	2,114	2,124	2,152	2,091
D25: Fabricated metal products	2,125	2,084	2,021	2,017	1,990	2,324	2,280	2,331	2,400	2,405	2,348	2,361	2,260	2,175	2,189	1,987	1,942	1,951	1,980	1,973	1,943	1,938	2,033	2,019
D26: Computer, electronic and optical equipment	2,120	2,115	2,074	2,054	1,964	1,870	1,897	1,900	1,928	1,916	1,953	1,922	1,904	1,833	1,921	1,932	1,907	1,929	1,936	1,984	1,968	1,925	1,950	1,970
D27: Electrical equipment	2,234	2,218	2,185	2,173	2,120	2,011	2,114	2,079	2,208	2,146	2,133	2,084	2,178	2,055	2,050	2,088	2,060	2,062	2,055	2,065	2,063	2,008	2,107	2,020
D28: Machinery and equipment, nec	2,136	2,150	2,136	2,123	2,077	1,948	1,934	1,931	1,940	1,906	1,944	1,896	1,833	1,795	1,890	1,995	1,965	1,959	1,983	1,976	1,934	1,955	1,973	1,985
D29: Motor vehicles, trailers and semi-trailers	2,143	2,141	2,123	2,099	2,067	2,296	2,371	2,340	2,421	2,450	2,499	2,447	2,400	2,330	2,384	2,088	2,098	2,109	2,125	2,159	2,120	2,196	2,210	2,174
D30: Other transport equipment	2,332	2,277	2,199	2,135	1,962	2,028	1,873	2,010	2,140	1,921	2,070	2,011	1,988	1,958	2,228	2,029	2,024	1,991	1,982	2,040	1,931	1,885	1,899	1,715
D31T33: Manufacturing nec; repair and installation of machinery and equipment	1,853	1,858	1,853	1,846	1,826	1,595	1,568	1,560	1,480	1,376	1,389	1,454	1,458	1,440	1,455	1,820	1,802	1,809	1,807	1,811	1,826	1,824	1,862	1,845
D35: Electricity, gas, steam and air conditioning supply	1,994	1,852	1,840	1,689	1,691	1,821	1,716	1,802	1,896	1,871	1,898	1,895	1,904	2,013	1,927	1,780	1,805	1,935	2,076	2,224	2,016	1,887	1,937	1,833
D36T39: Water supply; sewerage, waste management and remediation activities	1,627	1,535	1,515	1,263	1,220	1,387	1,360	1,397	1,402	1,425	1,456	1,471	1,596	1,654	1,578	1,659	1,629	1,561	1,550	1,572	1,595	1,581	1,596	1,462
D41T43: Construction	1,690	1,688	1,718	1,740	1,691	1,779	1,834	1,802	2,025	1,993	2,040	2,031	1,969	1,977	1,901	1,845	1,838	1,834	1,829	1,838	1,828	1,842	1,886	1,834
D45T47: Wholesale and retail trade; repair of motor vehicles	1,307	1,281	1,280	1,258	1,262	1,584	1,549	1,602	1,542	1,536	1,510	1,485	1,458	1,449	1,431	1,508	1,512	1,516	1,515	1,520	1,529	1,538	1,545	1,480
D49: Land transport and transport via pipelines	1,752	1,716	1,689	1,674	1,666	1,858	1,879	1,847	1,979	1,911	1,980	1,962	1,890	1,917	1,900	1,824	1,824	1,833	1,830	1,826	1,843	1,825	1,842	1,860
D50: Water transport	1,832	1,879	1,843	1,816	1,772	1,904	1,844	1,916	1,989	1,964	2,005	1,977	1,911	2,013	1,918	1,844	1,844	1,837	1,775	1,738	1,712	1,679	1,745	1,706
D51: Air transport	2,133	2,119	2,087	2,073	2,044	2,177	2,135	2,150	2,265	2,208	2,264	2,239	2,178	2,235	2,208	2,081	2,155	2,183	2,142	2,137	2,192	2,066	2,074	2,100
D52: Warehousing and support activities for transportation	1,564	1,557	1,551	1,535	1,529	1,736	1,780	1,808	1,891	1,838	1,892	1,861	1,763	1,736	1,755	1,684	1,618	1,619	1,636	1,641	1,628	1,632	1,639	1,637
D53: Postal and courier activities	1,460	1,421	1,410	1,392	1,390	1,646	1,700	1,725	1,854	1,818	1,903	1,863	1,716	1,631	1,614	1,445	1,422	1,520	1,519	1,515	1,506	1,499	1,605	1,566
D55T56: Accommodation and food service activities	1,625	1,596	1,601	1,585	1,587	2,017	1,910	2,072	2,212	2,271	2,330	2,210	2,136	2,335	2,233	1,764	1,782	1,782	1,751	1,751	1,777	1,787	1,792	1,753
D58T60: Publishing, audiovisual and broadcasting activities	1,810	1,792	1,791	1,777	1,768	1,766	1,701	1,813	1,852	1,803	1,829	1,816	1,795	1,781	1,762	1,815	1,791	1,808	1,810	1,827	1,801	1,834	1,827	1,792
D61: Telecommunications	1,811	1,796	1,790	1,772	1,780	1,746	1,694	1,778	1,804	1,742	1,763	1,758	1,739	1,750	1,736	1,794	1,862	1,835	1,856	1,854	1,819	1,804	1,804	1,774
D62T63: IT and other information services	1,419	1,401	1,398	1,381	1,389	1,302	1,293	1,357	1,393	1,330	1,357	1,359	1,335	1,341	1,349	1,433	1,423	1,438	1,425	1,431	1,431	1,435	1,428	1,396
D64T66: Financial and insurance activities	1,223	1,205	1,235	1,216	1,288	1,418	1,382	1,372	1,376	1,412	1,397	1,397	1,406	1,467	1,476	1,538	1,564	1,550	1,555	1,515	1,498	1,459	1,464	1,482
D68: Real estate activities	1,206	1,175	1,187	1,185	1,178	1,188	1,185	1,191	1,176	1,173	1,173	1,170	1,198	1,167	1,195	1,176	1,177	1,174	1,173	1,170	1,171	1,147	1,144	1,142
D69T75: Professional, scientific and technical activities	1,626	1,624	1,624	1,610	1,600	1,625	1,559	1,634	1,634	1,629	1,645	1,615	1,591	1,576	1,564	1,609	1,596	1,608	1,601	1,591	1,585	1,582	1,581	1,463
D77T82: Administrative and support services	1,770	1,771	1,772	1,756	1,748	1,759	1,713	1,794	1,814	1,810	1,828	1,780	1,767	1,754	1,698	1,433	1,436	1,435	1,414	1,401	1,408	1,420	1,433	1,481
D84: Public administration and defence; compulsory social security	1,285	1,250	1,240	1,224	1,250	1,373	1,321	1,372	1,372	1,359	1,374	1,347	1,360	1,358	1,334	1,422	1,426	1,432	1,414	1,429	1,413	1,421	1,396	1,360
D85: Education	1,173	1,149	1,152	1,150	1,148	1,270	1,246	1,282	1,293	1,303	1,333	1,299	1,284	1,281	1,272	1,338	1,326	1,333	1,319	1,298	1,276	1,276	1,271	1,224
D86T88: Human health and social work activities	1,544	1,583	1,587	1,582	1,582	1,562	1,537	1,575	1,604	1,623	1,659	1,625	1,576	1,559	1,548	1,581	1,566	1,523	1,507	1,522	1,523	1,532	1,549	1,504
D90T93: Arts, entertainment and recreation	1,958	1,940	1,911	1,899	1,875	1,642	1,625	1,740	1,775	1,788	1,790	1,737	1,771	1,710	1,686	1,535	1,585	1,609	1,599	1,603	1,607	1,604	1,621	1,640
D94T96: Other service activities	1,858	1,818	1,821	1,800	1,797	1,638	1,640	1,701	1,746	1,731	1,733	1,696	1,709	1,679	1,673	1,778	1,761	1,747	1,723	1,716	1,725	1,704	1,688	1,755
D97T98: Activities of households as employers	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
AVG	1,887	1,860	1,847	1,827	1,797	1,897	1,868	1,902	1,943	1,924	1,943	1,912	1,888	1,856	1,870	1,776	1,769	1,777	1,774	1,785	1,788	1,792	1,799	1,756
STD	0,417	0,402	0,386	0,395	0,363	0,397	0,392	0,390	0,400	0,402	0,410	0,400	0,378	0,364	0,361	0,277	0,290	0,302	0,300	0,302	0,285	0,282	0,286	0,290

Appendix II: Brazil Leakage 1995-2018

BRAZIL LEAKAGE 1995 - 2018																								
SECTOR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
D01T02: Agriculture, hunting, forestry	5,32%	6,01%	7,00%	6,75%	9,18%	9,45%	11,00%	10,50%	9,15%	10,97%	9,48%	9,06%	9,68%	11,56%	8,72%	9,45%	10,65%	12,09%	12,29%	12,33%	12,71%	10,52%	10,75%	12,70%
D03: Fishing and aquaculture	1,85%	1,93%	2,17%	2,09%	2,67%	3,18%	3,44%	3,44%	3,41%	3,21%	3,12%	2,98%	2,73%	3,09%	2,39%	2,11%	2,36%	2,82%	2,83%	2,75%	2,67%	2,87%	2,41%	2,47%
D05T06: Mining and quarrying, energy producing products	7,58%	7,05%	8,27%	8,57%	11,00%	10,34%	12,21%	11,40%	10,59%	10,44%	8,07%	7,61%	8,20%	7,15%	7,79%	12,20%	12,00%	11,74%	12,27%	12,55%	15,58%	16,12%	14,50%	14,87%
D07T08: Mining and quarrying, non-energy producing products	9,17%	9,61%	10,69%	10,50%	12,74%	13,80%	14,98%	14,02%	13,45%	14,01%	11,32%	10,80%	11,63%	11,47%	10,73%	9,31%	7,79%	7,84%	8,74%	10,21%	12,94%	12,95%	11,75%	10,73%
D09: Mining support service activities	5,83%	6,36%	7,31%	7,50%	9,36%	8,37%	9,02%	8,86%	9,15%	9,00%	6,87%	6,18%	6,83%	5,57%	7,48%	8,75%	8,28%	8,65%	9,14%	9,38%	11,15%	12,03%	10,78%	9,46%
D10T12: Food products, beverages and tobacco	5,80%	6,07%	6,63%	7,15%	8,89%	9,28%	10,56%	10,34%	9,46%	9,21%	7,98%	7,81%	8,12%	9,21%	7,51%	8,01%	8,49%	9,31%	9,77%	9,61%	9,93%	8,82%	8,49%	9,81%
D13T15: Textiles, textile products, leather and footwear	8,59%	8,75%	9,13%	8,39%	10,44%	12,00%	12,51%	12,30%	10,90%	11,91%	9,98%	10,15%	10,79%	12,50%	10,20%	9,98%	10,26%	11,26%	11,77%	11,73%	12,59%	10,73%	10,63%	12,06%
D16: Wood and products of wood and cork	5,34%	6,03%	7,12%	6,89%	9,10%	10,67%	11,88%	11,42%	9,68%	10,48%	9,41%	9,08%	9,32%	9,83%	8,01%	8,06%	8,78%	9,14%	9,49%	9,42%	10,26%	8,94%	8,95%	10,43%
D17T18: Paper products and printing	6,96%	7,36%	8,42%	8,19%	11,01%	12,81%	14,15%	14,23%	12,00%	13,35%	11,51%	11,25%	11,49%	13,17%	11,29%	11,52%	12,15%	13,21%	13,48%	13,29%	13,84%	11,78%	11,67%	13,23%
D19: Coke and refined petroleum products	10,00%	11,02%	12,78%	11,46%	15,59%	17,53%	18,97%	18,83%	17,09%	18,90%	15,46%	14,98%	16,37%	18,02%	15,42%	16,88%	18,72%	20,14%	21,25%	20,73%	18,44%	14,65%	14,62%	17,86%
D20: Chemical and chemical products	9,40%	10,03%	11,05%	10,93%	14,44%	15,32%	17,56%	17,48%	14,74%	16,77%	13,86%	13,35%	14,42%	17,08%	13,68%	14,72%	16,38%	17,98%	18,48%	17,89%	17,52%	15,19%	15,27%	17,87%
D21: Pharmaceuticals, medicinal chemical and botanical products	5,62%	6,31%	7,30%	7,34%	9,94%	11,93%	13,48%	14,04%	11,97%	13,26%	10,95%	10,50%	10,94%	11,46%	9,47%	8,69%	9,52%	10,49%	11,17%	10,96%	12,31%	10,80%	9,90%	11,07%
D22: Rubber and plastics products	9,45%	10,52%	11,94%	11,78%	15,28%	16,50%	18,70%	18,62%	15,14%	17,04%	14,30%	14,02%	15,25%	18,42%	14,76%	13,87%	14,98%	16,35%	17,08%	16,61%	16,80%	14,38%	14,62%	17,13%
D23: Other non-metallic mineral products	7,14%	7,66%	8,81%	8,37%	10,98%	12,59%	14,35%	14,11%	12,67%	13,39%	11,39%	10,99%	11,72%	13,24%	10,61%	9,47%	10,06%	10,88%	11,51%	11,30%	11,82%	10,53%	10,47%	11,50%
D24: Basic metals	11,61%	11,69%	12,57%	12,52%	15,33%	15,78%	17,62%	17,32%	15,89%	17,18%	14,80%	15,27%	15,57%	16,97%	15,77%	14,97%	15,10%	14,74%	14,87%	15,00%	17,58%	17,42%	17,80%	19,05%
D25: Fabricated metal products	8,41%	8,88%	10,02%	10,04%	12,37%	13,99%	15,77%	15,64%	14,53%	15,85%	13,29%	14,24%	14,52%	16,79%	14,46%	12,51%	11,97%	12,82%	13,04%	13,27%	14,78%	12,66%	13,16%	15,49%
D26: Computer, electronic and optical equipment	14,03%	14,02%	14,79%	15,61%	20,49%	21,13%	24,09%	21,62%	20,85%	19,97%	17,63%	17,48%	16,82%	19,61%	16,30%	21,46%	20,87%	22,93%	23,05%	22,95%	24,94%	22,22%	22,83%	24,41%
D27: Electrical equipment	10,39%	10,71%	11,21%	11,34%	14,27%	13,88%	17,36%	16,14%	15,47%	15,04%	12,62%	12,80%	13,98%	14,52%	12,58%	15,64%	15,95%	17,02%	16,94%	16,83%	18,46%	15,77%	16,52%	18,61%
D28: Machinery and equipment, nec	8,64%	9,89%	11,55%	11,69%	14,17%	13,35%	15,55%	14,93%	13,85%	13,91%	12,04%	12,59%	12,76%	14,61%	12,86%	14,85%	14,97%	16,21%	16,68%	15,81%	17,39%	15,84%	14,55%	16,81%
D29: Motor vehicles, trailers and semi-trailers	10,30%	10,46%	11,17%	11,40%	13,22%	14,07%	17,10%	15,77%	14,72%	14,49%	13,17%	13,04%	13,48%	15,33%	13,37%	12,96%	13,59%	14,48%	15,27%	15,23%	17,06%	15,60%	15,07%	16,67%
D30: Other transport equipment	11,33%	13,26%	16,13%	19,22%	28,05%	28,36%	30,73%	25,94%	26,13%	25,43%	23,11%	22,62%	22,10%	26,80%	21,02%	18,78%	18,58%	21,46%	21,88%	21,93%	27,87%	26,19%	22,49%	31,70%
D31T33: Manufacturing nec; repair and installation of machinery and equipment	7,67%	8,29%	9,34%	9,55%	11,79%	8,96%	10,14%	9,41%	6,62%	6,14%	5,45%	5,89%	6,30%	7,99%	6,73%	12,29%	12,61%	13,65%	14,03%	13,56%	15,85%	14,37%	13,68%	16,17%
D35: Electricity, gas, steam and air conditioning supply	5,27%	4,19%	5,35%	4,74%	6,47%	7,14%	7,99%	8,48%	8,85%	8,69%	7,32%	7,15%	7,53%	7,83%	6,95%	7,19%	7,44%	8,29%	10,13%	10,39%	10,28%	8,31%	7,63%	7,89%
D36T39: Water supply; sewerage, waste management and remediation activities	4,96%	5,07%	5,78%	3,59%	4,39%	6,09%	6,21%	6,56%	6,22%	7,11%	6,31%	6,42%	7,85%	11,93%	9,00%	7,01%	7,13%	7,25%	7,63%	7,53%	8,18%	7,11%	6,88%	6,94%
D41T43: Construction	5,22%	5,70%	6,58%	6,60%	8,05%	8,72%	10,62%	10,39%	10,24%	10,71%	9,49%	9,33%	9,64%	11,62%	9,26%	8,71%	9,05%	9,61%	9,99%	9,77%	10,39%	9,13%	9,33%	10,54%
D45T47: Wholesale and retail trade; repair of motor vehicles	2,83%	2,51%	2,29%	2,18%	3,00%	5,71%	6,57%	6,53%	6,15%	6,11%	5,39%	5,05%	4,95%	5,05%	4,28%	5,16%	5,38%	5,96%	6,31%	6,29%	6,54%	5,88%	5,85%	6,09%
D49: Land transport and transport via pipelines	6,66%	6,79%	7,20%	6,90%	9,11%	11,06%	12,77%	11,80%	12,55%	11,49%	10,29%	10,12%	10,51%	12,02%	10,08%	10,46%	11,76%	12,59%	13,27%	12,63%	11,52%	9,74%	10,19%	11,17%
D50: Water transport	10,28%	7,89%	8,40%	8,97%	12,49%	12,42%	15,88%	13,38%	14,12%	12,09%	11,98%	12,48%	13,18%	10,85%	12,54%	15,91%	16,30%	16,61%	16,35%	15,05%	15,12%	13,14%	13,57%	15,29%
D51: Air transport	8,06%	7,83%	8,18%	7,87%	10,35%	11,76%	13,07%	12,46%	13,02%	12,10%	10,97%	10,80%	11,25%	12,04%	10,64%	11,67%	13,59%	14,83%	15,20%	14,69%	13,56%	11,41%	11,63%	13,79%
D52: Warehousing and support activities for transportation	4,40%	3,89%	4,08%	4,24%	5,56%	6,42%	7,82%	7,61%	8,16%	7,31%	7,07%	6,76%	6,32%	6,57%	6,65%	7,01%	6,96%	7,64%	8,14%	8,27%	8,90%	8,00%	7,61%	8,39%
D53: Postal and courier activities	4,95%	3,66%	3,89%	3,87%	5,05%	7,53%	9,57%	9,40%	9,69%	9,73%	9,16%	8,90%	8,38%	7,12%	6,65%	5,12%	5,20%	6,58%	6,81%	6,83%	7,21%	6,43%	6,90%	7,34%
D55T56: Accommodation and food service activities	4,30%	3,68%	4,13%	4,17%	5,48%	7,48%	8,22%	8,44%	8,52%	8,61%	7,65%	7,18%	6,97%	7,60%	6,69%	6,42%	6,85%	7,48%	7,74%	7,70%	8,12%	7,41%	7,39%	8,36%
D58T60: Publishing, audiovisual and broadcasting activities	5,68%	5,13%	5,24%	5,13%	7,05%	7,59%	8,20%	8,34%	7,91%	7,73%	6,83%	6,49%	6,32%	6,85%	6,62%	7,26%	7,39%	8,18%	8,59%	9,01%	9,45%	8,62%	8,42%	9,54%
D61: Telecommunications	4,78%	3,44%	3,45%	3,49%	5,02%	5,77%	6,56%	6,81%	6,91%	6,29%	5,67%	5,38%	5,18%	4,53%	5,03%	4,68%	4,95%	5,61%	6,03%	6,36%	6,77%	6,09%	5,65%	6,58%
D62T63: IT and other information services	3,99%	3,58%	3,92%	3,96%	5,83%	8,57%	9,52%	9,65%	9,95%	7,89%	7,25%	6,79%	6,25%	6,22%	6,12%	6,40%	6,13%	7,05%	7,41%	7,44%	8,45%	7,54%	7,27%	7,73%
D64T66: Financial and insurance activities	1,53%	1,23%	1,52%	1,54%	2,65%	3,60%	3,89%	3,72%	3,84%	3,75%	3,39%	3,19%	3,10%	2,72%	3,34%	3,94%	4,23%	4,62%	4,78%	4,54%	4,95%	4,14%	3,94%	4,69%
D68: Real estate activities	1,31%	1,18%	1,58%	1,66%	2,32%	2,30%	2,71%	2,78%	2,41%	2,33%	2,01%	1,93%	2,20%	2,02%	2,05%	1,84%	1,75%	2,09%	2,17%	2,01%	2,17%	1,63%	1,63%	1,81%
D69T75: Professional, scientific and technical activities	3,73%	3,68%	4,36%	4,39%	6,38%	6,34%	6,76%	6,79%	6,63%	6,16%	5,46%	5,06%	4,79%	4,83%	5,21%	6,02%	6,06%	6,84%	7,13%	7,50%	7,85%	7,11%	6,89%	7,17%
D77T82: Administrative and support services	4,07%	3,85%	4,63%	4,67%	6,77%	6,54%	7,20%	7,24%	7,21%	6,85%	6,06%	5,62%	5,46%	5,39%	5,61%	5,04%	5,21%	5,65%	5,80%	5,66%	6,07%	5,40%	5,29%	6,38%
D84: Public administration and defence; compulsory social security	2,28%	1,96%	1,90%	1,84%	2,87%	3,99%	4,00%	4,39%	4,52%	4,16%	3,78%	3,51%	3,48%	3,21%	3,12%	3,79%	3,97%	4,34%	4,39%	4,35%	4,53%	4,12%	3,79%	4,29%
D85: Education	1,51%	1,29%	1,37%	1,46%	2,05%	3,05%	3,34%	3,61%	3,72%	3,48%	3,41%	2,99%	2,87%	2,73%	2,60%	4,22%	4,33%	4,79%	4,90%	4,77%	4,85%	4,42%	4,22%	4,23%
D86T88: Human health and social work activities	3,44%	3,42%	3,88%	4,00%	5,61%	6,24%	7,02%	7,02%	6,85%	6,78%	6,17%	5,74%	5,46%	5,86%	5,44%	5,50%	5,66%	5,87%	6,05%	6,05%	6,62%	6,13%	5,89%	6,70%
D90T93: Arts, entertainment and recreation	4,72%	4,62%	4,64%	4,62%	5,87%	5,41%	6,39%	6,55%	6,18%	6,24%	5,19%	4,82%	4,94%	7,12%	6,12%	4,42%	4,75%	5,46%	5,61%	5,82%	6,08%	5,42%	5,32%	6,18%
D94T96: Other service activities	5,20%	4,62%	5,25%	5,11%	6,60%	6,24%	7,34%	7,35%	7,13%	7,09%	6,07%	5,83%	5,84%	5,78%	5,43%	8,30%	8,61%	9,53%	9,79%	9,73%	10,02%	8,49%	8,81%	10,82%
D97T98: Activities of households as employers	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
AVG	6,35%	6,39%	7,11%	7,10%	9,30%	10,07%	11,43%	11,04%	10,41%	10,51%	9,15%	8,96%	9,22%	10,10%	8,88%	9,38%	9,70%	10,50%	10,89%	10,81%	11,59%	10,36%	10,11%	11,41%
STD	3,02%	3,33%	3,73%	3,96%	5,20%	5,13%	5,78%	5,13%	4,76%	4,98%	4,28%	4,34%	4,50%	5,43%	4,28%	4,58%	4,72%	5,05%	5,12%	4,98%	5,50%	5,03%	4,83%	5,90%

Appendix III: China Linkage 1995-2018

CHINA SECTORAL LINKAGES 1995 - 2018																								
SECTOR	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*
D01T02: Agriculture, hunting, forestry	1.323	1.348	1.439	1.513	1.628	1.758	1.696	1.655	1.616	1.623	1.838	1.822	1.917	1.855	1.912	1.869	1.963	2.062	2.102	2.185	2.301	2.200	2.182	2.248
D03: Fishing and aquaculture	1.210	1.238	1.329	1.383	1.493	1.628	1.609	1.581	1.526	1.526	1.726	1.855	1.972	1.819	1.826	1.771	1.867	1.978	2.000	2.051	2.111	2.090	2.124	2.187
D05T06: Mining and quarrying, energy producing products	2.013	1.943	1.875	2.077	2.070	2.011	2.059	1.954	2.058	2.102	2.020	1.999	2.144	1.862	2.184	1.998	1.893	2.149	2.086	2.319	2.674	2.546	2.382	2.380
D07T08: Mining and quarrying, non-energy producing products	1.989	2.005	1.948	1.769	1.768	1.725	1.812	1.715	1.718	1.773	1.661	1.904	2.047	1.718	2.042	1.853	1.756	1.996	2.110	2.329	2.663	2.505	2.379	2.439
D09: Mining support service activities	2.067	2.061	2.008	2.127	2.122	2.050	2.008	1.888	1.934	1.972	1.887	1.953	2.104	1.800	2.138	1.954	1.938	2.205	2.241	2.463	2.804	2.728	2.579	2.646
D10T12: Food products, beverages and tobacco	2.291	2.295	2.329	2.333	2.376	2.384	2.254	2.195	2.188	2.211	2.290	2.416	2.505	2.444	2.472	2.382	2.475	2.601	2.642	2.686	2.792	2.732	2.684	2.700
D13T15: Textiles, textile products, leather and footwear	2.705	2.679	2.655	2.769	2.798	2.771	2.557	2.414	2.484	2.525	2.648	2.737	2.885	2.773	2.843	2.706	2.740	2.877	2.916	2.958	3.098	3.136	3.215	3.276
D16: Wood and products of wood and cork	2.663	2.740	2.710	2.647	2.626	2.522	2.700	2.571	2.476	2.518	2.541	2.683	2.644	2.557	2.642	2.537	2.626	2.758	2.808	2.866	3.006	2.837	2.791	2.789
D17T18: Paper products and printing	2.607	2.614	2.593	2.662	2.645	2.559	2.548	2.467	2.416	2.510	2.606	2.684	2.798	2.623	2.701	2.576	2.633	2.765	2.825	2.880	3.018	2.902	2.776	2.735
D19: Coke and refined petroleum products	2.405	2.307	2.200	2.494	2.415	2.302	2.173	2.071	2.156	2.145	2.133	2.212	2.256	2.054	2.227	2.013	1.915	1.987	1.917	2.125	2.474	2.328	2.146	1.889
D20: Chemical and chemical products	2.639	2.609	2.556	2.756	2.737	2.664	2.440	2.300	2.311	2.316	2.356	2.594	2.625	2.564	2.708	2.543	2.572	2.706	2.743	2.850	3.054	2.784	2.616	2.515
D21: Pharmaceuticals, medicinal chemical and botanical products	2.385	2.351	2.317	2.503	2.511	2.485	2.185	2.087	2.067	2.077	2.180	2.281	2.290	2.297	2.324	2.223	2.347	2.452	2.618	2.664	2.813	2.655	2.511	2.531
D22: Rubber and plastics products	2.927	2.901	2.853	2.989	2.974	2.901	2.768	2.632	2.487	2.526	2.613	2.830	2.862	2.766	2.912	2.754	2.779	2.914	2.958	3.036	3.214	2.992	2.817	2.814
D23: Other non-metallic mineral products	2.809	2.767	2.705	2.607	2.584	2.500	2.459	2.350	2.548	2.557	2.596	2.556	2.606	2.619	2.734	2.582	2.531	2.663	2.768	2.869	3.033	2.783	2.572	2.497
D24: Basic metals	3.078	2.974	2.838	3.002	2.960	2.808	2.863	2.760	2.777	2.672	2.667	2.767	2.785	2.694	2.848	2.609	2.553	2.728	2.676	2.812	3.008	2.794	2.570	2.579
D25: Fabricated metal products	3.043	3.030	2.876	2.901	2.865	2.701	2.805	2.724	2.744	2.715	2.711	2.850	2.880	2.759	2.891	2.721	2.737	2.872	2.896	2.981	3.117	2.932	2.688	2.667
D26: Computer, electronic and optical equipment	2.347	2.368	2.301	2.554	2.459	2.312	2.201	2.079	2.139	2.137	2.239	2.321	2.426	2.355	2.629	2.447	2.347	2.486	2.501	2.538	2.715	2.706	2.603	2.707
D27: Electrical equipment	2.905	2.892	2.779	3.065	3.028	2.893	2.708	2.581	2.662	2.637	2.685	2.788	2.794	2.768	2.929	2.752	2.661	2.789	2.829	2.908	3.040	2.894	2.803	2.800
D28: Machinery and equipment, nec	2.889	2.739	2.647	2.705	2.679	2.545	2.639	2.525	2.614	2.589	2.669	2.788	2.798	2.748	2.908	2.736	2.668	2.806	2.781	2.842	2.983	2.834	2.786	2.821
D29: Motor vehicles, trailers and semi-trailers	2.793	2.746	2.677	2.762	2.680	2.512	2.536	2.496	2.450	2.506	2.606	2.708	2.830	2.655	2.801	2.617	2.634	2.751	2.881	2.921	2.979	2.890	2.840	2.832
D30: Other transport equipment	2.537	2.324	2.251	2.334	2.375	2.476	2.604	2.513	2.369	2.376	2.446	2.780	2.768	2.667	2.852	2.691	2.682	2.858	2.742	2.782	2.906	2.813	2.734	2.774
D31T33: Manufacturing nec; repair and installation of machinery and equipment	2.670	2.793	2.746	2.691	2.695	2.618	2.720	2.589	2.469	2.494	2.574	2.812	2.867	2.796	2.912	2.771	2.798	2.918	2.822	2.891	3.037	3.002	2.840	2.651
D35: Electricity, gas, steam and air conditioning supply	2.130	2.056	1.990	2.301	2.273	2.207	1.955	1.868	2.137	2.187	2.200	2.334	2.423	2.587	2.709	2.470	2.414	2.485	2.453	2.640	2.808	2.543	2.391	2.330
D36T39: Water supply; sewerage, waste management and remediation activities	2.568	2.401	2.347	2.530	2.515	2.446	2.494	2.391	2.363	2.413	2.503	2.665	2.753	2.561	2.582	2.424	2.465	2.496	2.443	2.449	2.430	2.374	2.304	2.387
D41T43: Construction	2.817	2.797	2.738	2.764	2.748	2.669	2.669	2.554	2.536	2.545	2.587	2.689	2.769	2.729	2.764	2.615	2.656	2.769	2.854	2.902	3.015	2.839	2.673	2.650
D45T47: Wholesale and retail trade; repair of motor vehicles	2.074	2.081	2.044	1.892	1.867	1.861	1.829	1.717	1.573	1.702	1.847	1.858	1.846	1.724	1.682	1.538	1.607	1.610	1.756	1.728	1.760	1.675	1.608	1.717
D49: Land transport and transport via pipelines	1.750	1.742	1.735	1.692	1.643	1.638	1.789	1.669	1.747	1.792	1.872	1.749	1.800	1.888	1.980	1.899	2.005	2.098	2.183	2.231	2.309	2.178	2.065	2.078
D50: Water transport	2.292	2.278	2.265	2.350	2.298	2.107	2.055	2.028	2.092	2.069	2.101	2.092	2.125	2.070	2.109	2.058	2.065	2.148	2.042	2.121	2.275	2.279	2.271	2.302
D51: Air transport	2.111	2.077	2.071	2.090	2.051	1.976	2.160	2.039	2.084	2.084	2.141	2.148	2.183	2.125	2.261	2.163	2.156	2.251	2.278	2.340	2.481	2.467	2.365	2.274
D52: Warehousing and support activities for transportation	2.178	2.228	2.212	2.227	2.172	2.053	1.958	1.739	1.921	1.922	1.969	2.017	2.094	2.075	2.130	2.046	2.101	2.196	2.213	2.244	2.350	2.229	2.129	2.161
D53: Postal and courier activities	1.753	1.756	1.762	1.763	1.714	1.673	1.558	1.510	1.625	1.700	1.802	1.846	1.910	1.831	1.853	1.798	2.013	2.046	2.170	2.155	2.229	2.147	2.150	2.206
D55T56: Accommodation and food service activities	1.929	1.942	1.900	1.836	1.844	1.870	1.999	1.888	1.883	1.972	2.109	2.186	2.285	2.192	2.231	2.202	2.186	2.263	2.324	2.355	2.403	2.413	2.321	2.380
D58T60: Publishing, audiovisual and broadcasting activities	2.503	2.494	2.465	2.579	2.544	2.461	2.346	2.220	2.255	2.330	2.449	2.407	2.492	2.360	2.446	2.385	2.533	2.605	2.609	2.559	2.583	2.371	2.147	2.133
D61: Telecommunications	2.553	2.548	2.503	2.639	2.621	2.586	2.417	2.317	2.301	2.352	2.453	2.558	2.587	2.607	2.765	2.628	2.615	2.737	2.727	2.708	2.826	2.427	2.192	2.147
D62T63: IT and other information services	1.966	1.998	2.011	2.116	2.144	2.094	2.014	1.878	1.864	1.833	1.930	1.972	2.074	2.117	2.243	2.236	2.214	2.266	2.212	2.150	2.173	1.887	1.669	1.674
D64T66: Financial and insurance activities	1.473	1.460	1.391	1.459	1.517	1.558	1.528	1.458	1.527	1.658	1.781	1.742	1.485	1.453	1.283	1.234	1.541	1.553	1.513	1.462	1.318	1.290	1.274	1.277
D68: Real estate activities	1.638	1.648	1.626	1.595	1.602	1.596	1.644	1.541	1.502	1.564	1.602	1.557	1.470	1.720	1.617	1.509	1.557	1.579	1.548	1.559	1.540	1.404	1.332	1.321
D69T75: Professional, scientific and technical activities	2.463	2.448	2.416	2.531	2.508	2.441	2.420	2.326	2.347	2.301	2.394	2.490	2.506	2.497	2.570	2.428	2.389	2.458	2.448	2.463	2.522	2.380	2.253	2.216
D77T82: Administrative and support services	2.426	2.396	2.336	2.376	2.304	2.209	2.214	2.137	2.162	2.026	2.164	2.301	2.263	2.324	2.414	2.259	2.200	2.208	2.193	2.185	2.407	2.240	2.164	2.163
D84: Public administration and defence; compulsory social security	1.760	1.616	1.563	1.753	1.758	1.742	1.853	1.728	1.690	1.787	1.849	1.597	1.642	1.530	1.480	1.553	1.776	1.835	1.911	1.924	1.802	1.777	1.638	1.626
D85: Education	1.440	1.445	1.408	1.878	1.875	1.852	1.768	1.654	1.604	1.695	1.765	1.788	1.831	1.598	1.445	1.421	1.463	1.490	1.565	1.543	1.450	1.488	1.378	1.478
D86T88: Human health and social work activities	2.066	2.051	2.018	2.072	2.074	2.114	2.013	1.907	1.969	2.011	2.089	2.209	2.333	2.233	2.256	2.180	2.181	2.158	2.111	2.066	2.170	1.935	1.819	1.811
D90T93: Arts, entertainment and recreation	1.490	1.498	1.471	1.478	1.494	1.485	1.381	1.290	1.346	1.748	1.835	1.923	1.999	1.926	1.895	1.798	1.880	1.943	1.981	1.999	2.075	1.858	1.685	1.717
D94T96: Other service activities	1.509	1.502	1.466	1.473	1.495	1.609	1.597	1.566	1.604	1.716	1.748	1.802	1.706	1.814	1.840	1.681	1.770	1.597	1.668	1.643	1.898	1.735	1.585	1.607
D97T98: Activities of households as employers	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
AVG	2.254	2.232	2.190	2.274	2.262	2.213	2.182	2.081	2.099	2.134	2.202	2.279	2.327	2.254	2.341	2.219	2.248	2.343	2.365	2.418	2.538	2.410	2.297	2.298
STD	0.499	0.488	0.463	0.480	0.460	0.412	0.405	0.396	0.386	0.350	0.343	0.397	0.413	0.408	0.458	0.422	0.387	0.421	0.417	0.437	0.488	0.468	0.464	0.458

Appendix IV: China Leakage 1995-2018

CHINA SECTORAL LEAKAGE 1995 - 2018																								
SECTOR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
D01T02: Agriculture, hunting, forestry	5,03%	5,20%	6,07%	5,67%	6,76%	8,77%	7,88%	8,00%	9,06%	9,83%	11,46%	10,73%	10,80%	10,52%	8,74%	9,58%	10,61%	10,85%	10,06%	9,90%	8,76%	8,71%	9,69%	10,51%
D03: Fishing and aquaculture	2,02%	2,37%	3,20%	3,02%	4,11%	5,84%	6,89%	9,24%	7,46%	6,32%	6,30%	8,26%	10,40%	8,27%	5,34%	4,32%	7,39%	9,80%	7,88%	6,77%	4,91%	6,28%	8,37%	9,29%
D05T06: Mining and quarrying, energy producing products	12,06%	10,79%	10,24%	9,50%	10,43%	12,11%	11,52%	11,46%	13,38%	15,11%	14,52%	13,80%	14,75%	12,05%	11,44%	11,90%	11,21%	12,25%	11,95%	12,36%	11,98%	11,66%	11,88%	12,98%
D07T08: Mining and quarrying, non-energy producing products	11,44%	11,44%	10,93%	8,48%	9,33%	10,81%	10,56%	10,16%	12,08%	14,26%	13,35%	15,00%	16,18%	12,92%	12,77%	13,49%	14,01%	15,42%	15,43%	15,62%	14,40%	13,92%	14,94%	15,40%
D09: Mining support service activities	12,60%	12,34%	12,31%	10,67%	11,77%	13,79%	12,70%	12,59%	14,95%	17,32%	16,54%	15,71%	16,11%	13,46%	12,45%	13,04%	13,60%	14,44%	14,30%	14,63%	13,80%	13,67%	14,32%	15,08%
D10T12: Food products, beverages and tobacco	8,03%	7,72%	7,87%	6,68%	7,40%	8,83%	7,92%	8,12%	9,17%	9,83%	10,44%	10,09%	10,18%	10,21%	8,27%	9,05%	9,93%	9,88%	9,24%	9,01%	8,07%	7,98%	8,74%	9,34%
D13T15: Textiles, textile products, leather and footwear	17,81%	17,49%	17,11%	14,51%	14,17%	14,76%	14,45%	15,71%	16,50%	17,65%	16,70%	14,81%	12,28%	11,77%	9,20%	10,31%	10,95%	10,32%	10,11%	10,04%	8,99%	8,92%	9,99%	10,66%
D16: Wood and products of wood and cork	13,51%	13,15%	12,92%	12,21%	13,59%	16,52%	13,77%	13,35%	15,26%	16,40%	16,08%	15,12%	14,16%	13,70%	10,98%	11,76%	12,29%	11,80%	11,64%	11,49%	10,16%	10,34%	11,65%	12,05%
D17T18: Paper products and printing	17,37%	16,38%	15,32%	13,99%	15,22%	17,82%	15,99%	15,46%	16,86%	18,43%	17,90%	16,85%	15,62%	15,52%	12,50%	13,47%	13,76%	13,00%	13,02%	12,89%	11,68%	11,36%	12,04%	12,68%
D19: Coke and refined petroleum products	12,80%	13,53%	13,76%	12,46%	14,96%	18,25%	16,97%	17,23%	21,23%	24,50%	25,21%	25,14%	26,27%	25,85%	25,02%	28,11%	30,44%	33,43%	31,76%	29,14%	24,43%	25,43%	27,79%	36,27%
D20: Chemical and chemical products	15,58%	15,07%	14,60%	12,73%	13,39%	15,40%	15,22%	16,30%	18,74%	20,74%	20,73%	20,48%	20,41%	19,75%	16,68%	18,13%	18,50%	18,25%	17,33%	16,27%	13,90%	14,47%	16,13%	18,56%
D21: Pharmaceuticals, medicinal chemical and botanical products	6,03%	7,37%	7,84%	7,06%	7,75%	8,91%	9,45%	10,81%	11,44%	11,54%	11,13%	11,79%	12,02%	11,24%	8,54%	8,89%	10,35%	10,74%	10,25%	10,15%	8,73%	9,08%	10,29%	10,66%
D22: Rubber and plastics products	16,61%	15,91%	15,39%	13,06%	13,34%	14,95%	15,22%	16,81%	19,25%	20,99%	20,75%	20,53%	20,32%	19,55%	15,81%	17,15%	17,17%	16,26%	15,49%	14,86%	13,11%	13,25%	14,84%	16,03%
D23: Other non-metallic mineral products	13,25%	12,77%	12,63%	10,87%	11,93%	14,03%	12,52%	12,38%	15,63%	18,31%	19,25%	16,50%	14,64%	13,96%	11,86%	12,83%	13,23%	13,37%	13,07%	12,82%	12,01%	11,17%	11,74%	11,89%
D24: Basic metals	14,83%	13,95%	15,06%	11,13%	12,30%	14,52%	13,92%	14,50%	17,65%	19,78%	20,58%	20,94%	21,46%	19,61%	17,78%	20,36%	21,81%	21,77%	21,20%	20,11%	18,22%	17,51%	18,46%	16,40%
D25: Fabricated metal products	14,95%	13,65%	15,34%	10,90%	12,06%	14,39%	13,64%	14,26%	16,72%	18,52%	18,93%	18,08%	17,78%	16,60%	13,70%	15,00%	16,20%	16,27%	15,59%	15,00%	13,94%	13,28%	13,74%	13,21%
D26: Computer, electronic and optical equipment	20,76%	19,35%	19,91%	19,43%	22,40%	26,23%	25,72%	26,17%	30,35%	33,47%	32,11%	31,00%	31,91%	30,59%	22,79%	24,89%	27,16%	26,10%	26,16%	26,07%	23,28%	23,32%	24,57%	23,94%
D27: Electrical equipment	15,08%	14,54%	15,27%	12,78%	14,12%	16,44%	15,64%	16,23%	18,57%	20,26%	20,44%	20,62%	21,67%	20,82%	16,74%	18,27%	19,85%	19,74%	18,73%	17,99%	16,62%	16,09%	16,70%	16,42%
D28: Machinery and equipment, nec	16,45%	15,88%	16,52%	13,11%	14,24%	16,67%	15,96%	16,64%	18,59%	20,24%	20,33%	19,93%	20,47%	19,56%	15,51%	16,97%	18,21%	17,69%	17,28%	16,80%	15,35%	15,00%	15,83%	15,54%
D29: Motor vehicles, trailers and semi-trailers	12,34%	11,68%	11,42%	9,62%	10,01%	11,92%	10,55%	10,70%	12,94%	15,40%	16,90%	16,14%	16,02%	16,80%	13,42%	15,47%	16,09%	15,12%	14,74%	14,44%	13,38%	12,77%	13,18%	13,05%
D30: Other transport equipment	24,79%	29,60%	30,35%	29,51%	28,61%	24,63%	21,85%	20,52%	23,06%	26,94%	28,25%	25,23%	23,30%	23,71%	19,14%	21,02%	21,51%	19,42%	20,31%	21,03%	21,03%	18,75%	17,28%	17,17%
D31T33: Manufacturing nec; repair and installation of machinery and equipment	16,48%	16,15%	16,08%	13,42%	13,73%	15,28%	14,44%	15,09%	16,50%	17,96%	17,79%	16,76%	15,92%	15,32%	12,24%	13,41%	14,70%	14,78%	13,94%	13,52%	12,20%	11,94%	12,75%	12,54%
D35: Electricity, gas, steam and air conditioning supply	10,69%	10,06%	9,75%	9,55%	10,62%	12,49%	10,24%	10,11%	13,17%	14,90%	14,93%	13,65%	12,75%	12,45%	11,01%	11,56%	12,41%	13,86%	14,47%	14,01%	12,03%	12,37%	13,05%	16,70%
D36T39: Water supply; sewerage, waste management and remediation activities	12,35%	11,14%	10,49%	9,42%	10,27%	11,89%	11,50%	11,80%	13,63%	15,51%	15,95%	15,32%	15,21%	14,43%	11,79%	12,77%	13,42%	13,09%	12,34%	11,97%	10,53%	10,14%	10,14%	11,03%
D41T43: Construction	13,08%	12,24%	12,52%	10,75%	11,92%	14,12%	13,20%	13,36%	15,47%	17,42%	18,16%	16,65%	15,71%	14,72%	11,86%	12,78%	13,60%	13,41%	12,99%	12,67%	11,87%	11,00%	11,43%	11,28%
D45T47: Wholesale and retail trade; repair of motor vehicles	9,15%	10,03%	10,90%	8,78%	9,32%	10,53%	9,50%	9,01%	9,13%	11,49%	12,59%	11,44%	10,86%	9,83%	7,33%	6,90%	7,75%	7,36%	7,82%	7,59%	6,83%	6,58%	6,84%	7,64%
D49: Land transport and transport via pipelines	8,85%	8,17%	7,66%	6,62%	6,96%	8,39%	8,82%	8,65%	10,55%	12,54%	13,53%	11,93%	12,32%	13,12%	11,37%	12,45%	13,84%	14,65%	13,58%	12,89%	11,26%	10,33%	10,10%	11,50%
D50: Water transport	13,18%	12,75%	12,07%	10,24%	11,34%	13,36%	13,33%	16,06%	15,78%	18,06%	18,57%	17,41%	18,74%	18,02%	15,06%	15,93%	17,37%	18,79%	17,39%	18,39%	17,51%	17,16%	16,48%	19,59%
D51: Air transport	15,32%	15,16%	14,39%	12,73%	13,31%	13,56%	14,76%	15,78%	16,71%	18,75%	18,99%	19,16%	19,95%	19,17%	15,89%	16,16%	18,27%	19,86%	18,99%	18,69%	16,69%	15,97%	15,48%	16,58%
D52: Warehousing and support activities for transportation	14,55%	12,83%	11,13%	9,84%	10,58%	12,15%	10,47%	9,24%	12,44%	15,07%	16,50%	15,54%	15,67%	15,44%	12,88%	13,71%	14,66%	15,15%	14,39%	14,77%	13,73%	13,64%	13,84%	15,82%
D53: Postal and courier activities	11,02%	9,90%	8,89%	7,79%	8,19%	9,42%	7,92%	7,81%	10,07%	11,87%	12,52%	13,41%	14,27%	12,77%	9,70%	9,74%	12,10%	12,30%	12,61%	12,40%	10,95%	10,32%	10,49%	11,01%
D55T56: Accommodation and food service activities	6,27%	5,91%	5,47%	4,52%	4,90%	5,89%	6,24%	6,44%	7,15%	8,11%	8,94%	8,69%	9,07%	8,78%	6,89%	7,36%	8,19%	8,27%	7,89%	7,65%	6,79%	7,01%	7,60%	8,39%
D58T60: Publishing, audiovisual and broadcasting activities	13,27%	12,64%	11,93%	11,62%	12,79%	15,14%	14,00%	14,12%	15,10%	16,28%	15,90%	15,16%	14,95%	14,15%	11,31%	12,09%	12,50%	11,61%	11,41%	11,58%	10,65%	9,85%	9,79%	10,08%
D61: Telecommunications	14,90%	14,06%	14,19%	12,62%	14,04%	16,04%	17,00%	18,53%	21,49%	24,25%	23,84%	21,70%	20,35%	19,01%	14,37%	15,03%	15,86%	15,11%	15,31%	15,48%	13,95%	12,38%	11,11%	11,21%
D62T63: IT and other information services	17,08%	15,87%	16,07%	15,26%	17,57%	20,35%	19,38%	19,57%	21,75%	22,69%	21,48%	18,95%	17,67%	16,69%	12,86%	13,80%	15,75%	15,73%	15,57%	15,25%	13,11%	10,86%	8,65%	8,52%
D64T66: Financial and insurance activities	6,48%	6,29%	5,76%	6,05%	7,50%	9,42%	8,56%	8,19%	10,18%	13,01%	13,54%	11,48%	8,16%	7,57%	4,18%	3,74%	7,00%	6,50%	6,02%	5,80%	3,80%	3,23%	3,04%	3,11%
D68: Real estate activities	6,61%	6,42%	6,23%	5,23%	5,65%	6,56%	6,54%	6,32%	7,28%	8,86%	9,39%	8,68%	8,18%	9,90%	7,07%	6,91%	6,54%	5,45%	5,09%	5,11%	4,47%	3,31%	2,77%	2,87%
D69T75: Professional, scientific and technical activities	15,04%	14,20%	14,02%	13,38%	15,13%	17,78%	17,43%	18,41%	21,84%	24,11%	23,59%	21,00%	19,40%	18,51%	14,08%	14,90%	15,70%	15,39%	14,82%	14,69%	13,03%	12,18%	11,89%	11,89%
D77T82: Administrative and support services	13,73%	13,06%	12,67%	12,03%	13,48%	15,85%	15,50%	16,56%	18,97%	20,02%	19,91%	18,17%	16,34%	16,10%	12,41%	12,88%	13,69%	13,38%	12,70%	12,35%	11,41%	10,04%	9,61%	9,91%
D84: Public administration and defence; compulsory social security	9,65%	7,97%	7,02%	7,40%	8,10%	9,51%	9,12%	8,62%	9,58%	11,05%	11,19%	8,95%	9,28%	8,22%	6,09%	7,34%	9,16%	9,34%	9,52%	10,14%	8,62%	8,02%	7,20%	7,35%
D85: Education	6,80%	6,41%	5,88%	8,48%	9,51%	11,13%	9,61%	9,12%	9,89%	11,40%	11,57%	11,31%	11,63%	9,41%	6,11%	6,39%	7,17%	7,17%	7,56%	7,44%	5,72%	5,94%	5,23%	6,34%
D86T88: Human health and social work activities	9,86%	9,53%	8,69%	7,46%	8,23%	9,77%	9,28%	8,93%	11,59%	13,51%	14,28%	12,76%	11,60%	11,49%	9,65%	11,56%	10,58%	9,06%	8,93%	9,31%	8,52%	7,73%	8,04%	8,72%
D90T93: Arts, entertainment and recreation	5,34%	5,25%	5,04%	4,83%	5,62%	6,84%	5,48%	4,80%	6,14%	10,59%	11,01%	11,14%	11,20%	10,92%	8,63%	9,24%	9,83%	9,50%	9,21%	9,14%	8,23%	7,24%	6,54%	6,84%
D94T96: Other service activities	6,97%	6,82%	6,39%	6,00%	6,74%	8,74%	8,43%	9,53%	11,09%	13,11%	12,51%	11,93%	10,82%	11,51%	9,36%	9,58%	10,33%	8,32%	8,70%	8,52%	8,88%	7,66%	6,76%	7,32%
D97T98: Activities of households as employers	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
AVG	12,27%	11,89%	11,76%	10,49%	11,44%	13,18%	12,48%	12,79%	14,64%	16,51%	16,70%	15,86%	15,61%	14,86%	12,06%	12,96%	13,97%	13,95%	13,56%	13,34%	11,99%	11,54%	11,84%	12,58%
STD	4,56%	4,72%	4,86%	4,45%	4,51%	4,48%	4,27%	4,48%	5,09%	5,45%	5,24%	4,90%	5,00%	4,90%	4,33%	4,95%	5,05%	5,28%	5,12%	4,91%	4,54%	4,53%	4,86%	5,59%

Appendix V: USA Linkage 1995-2018

USA SECTORAL LINKAGES 1995 - 2018																									
SECTOR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
D01T02: Agriculture, hunting, forestry	2.075	1.954	1.987	2.015	2.026	1.969	1.988	1.987	1.933	1.861	1.908	1.953	1.971	2.018	2.017	2.003	1.984	2.051	1.962	2.046	2.029	2.045	2.041	2.034
D03: Fishing and aquaculture	1.408	1.272	1.321	1.349	1.377	1.273	1.264	1.279	1.293	1.476	1.418	1.306	1.428	1.392	1.263	1.238	1.393	1.312	1.337	1.425	1.353	1.352	1.382	1.301
D05T06: Mining and quarrying, energy producing products	1.651	1.645	1.675	1.700	1.705	1.745	1.667	1.576	1.580	1.534	1.489	1.415	1.359	1.385	1.344	1.473	1.540	1.536	1.572	1.586	1.608	1.578	1.594	1.652
D07T08: Mining and quarrying, non-energy producing products	1.884	1.880	1.880	1.801	1.738	1.815	1.828	1.791	1.780	1.730	1.766	1.741	1.696	1.727	1.618	1.593	1.653	1.753	1.770	1.836	1.903	1.839	1.770	1.768
D09: Mining support service activities	1.756	1.794	1.611	1.653	1.559	1.520	1.488	1.571	1.637	1.775	1.842	1.759	1.719	1.699	1.626	1.626	1.547	1.687	1.660	1.732	1.837	1.696	1.753	1.610
D10T12: Food products, beverages and tobacco	2.365	2.363	2.364	2.358	2.286	2.290	2.277	2.227	2.249	2.264	2.308	2.248	2.309	2.354	2.232	2.300	2.379	2.404	2.373	2.380	2.297	2.282	2.286	2.298
D13T15: Textiles, textile products, leather and footwear	2.122	2.104	2.123	2.087	2.081	2.064	2.026	2.009	2.068	1.997	2.064	2.041	2.003	1.951	1.925	1.929	1.994	1.946	1.935	1.932	1.872	1.867	1.872	1.888
D16: Wood and products of wood and cork	2.200	2.200	2.186	2.202	2.204	2.177	2.160	2.154	2.123	2.097	2.115	2.169	2.170	2.154	2.090	2.075	2.058	2.081	2.056	2.111	2.091	2.067	2.069	2.063
D17T18: Paper products and printing	2.067	2.032	2.040	2.033	2.003	1.999	2.034	1.997	1.985	1.966	2.001	1.957	2.011	2.051	1.933	1.988	2.041	2.060	2.049	2.043	1.988	1.984	2.018	2.013
D19: Coke and refined petroleum products	1.818	1.841	1.761	1.676	1.746	1.765	1.671	1.678	1.591	1.558	1.565	1.546	1.542	1.555	1.556	1.606	1.644	1.657	1.773	1.766	1.720	1.846	1.768	1.765
D20: Chemical and chemical products	2.065	2.054	2.051	2.033	2.038	2.082	2.041	2.019	2.012	2.025	2.127	2.093	2.159	2.138	1.998	2.033	2.109	2.130	2.111	2.073	1.989	1.924	1.972	1.956
D21: Pharmaceuticals, medicinal chemical and botanical products	1.529	1.500	1.538	1.539	1.497	1.549	1.569	1.551	1.569	1.572	1.656	1.612	1.638	1.605	1.384	1.512	1.570	1.564	1.626	1.679	1.611	1.568	1.579	1.578
D22: Rubber and plastics products	2.092	2.054	2.048	2.016	2.009	2.042	2.025	2.021	2.026	2.031	2.108	2.115	2.143	2.167	1.991	2.055	2.104	2.115	2.122	2.142	2.030	2.010	2.043	2.043
D23: Other non-metallic mineral products	1.859	1.902	1.813	1.821	1.833	1.865	1.837	1.859	1.785	1.761	1.818	1.880	1.924	1.881	1.843	1.882	1.921	1.914	1.901	1.869	1.812	1.854	1.868	1.890
D24: Basic metals	2.061	2.055	2.050	2.032	2.038	2.007	2.049	2.028	2.038	2.000	2.031	2.018	2.070	2.087	2.043	2.123	2.093	2.099	2.111	2.109	2.042	2.036	2.025	2.061
D25: Fabricated metal products	1.929	1.898	1.910	1.915	1.905	1.898	1.918	1.918	1.893	1.881	1.910	1.920	1.954	1.992	1.901	1.954	1.960	1.936	1.940	1.945	1.896	1.879	1.873	1.912
D26: Computer, electronic and optical equipment	1.864	1.870	1.815	1.824	1.863	1.800	1.874	1.733	1.650	1.626	1.590	1.575	1.617	1.566	1.437	1.401	1.427	1.407	1.389	1.350	1.321	1.322	1.333	1.338
D27: Electrical equipment	1.863	1.868	1.877	1.976	1.930	1.943	1.904	1.835	1.781	1.839	1.855	1.775	1.863	1.804	1.697	1.739	1.811	1.796	1.738	1.795	1.679	1.714	1.674	1.694
D28: Machinery and equipment, nec	1.930	1.928	1.950	1.893	1.896	1.916	1.902	1.876	1.886	1.857	1.876	1.872	1.907	1.901	1.824	1.851	1.855	1.878	1.855	1.857	1.817	1.810	1.798	1.838
D29: Motor vehicles, trailers and semi-trailers	2.141	2.114	2.135	2.093	2.101	2.045	2.083	2.026	2.007	2.015	2.048	2.037	2.078	2.115	2.247	2.108	2.102	2.059	2.085	2.093	2.063	2.061	2.047	2.086
D30: Other transport equipment	1.923	1.835	1.904	1.909	1.829	1.752	1.794	1.802	1.803	1.773	1.779	1.745	1.779	1.802	1.726	1.715	1.686	1.773	1.766	1.762	1.717	1.694	1.734	1.725
D31T33: Manufacturing nec; repair and installation of machinery and equipment	1.917	1.848	1.826	1.816	1.777	1.809	1.802	1.785	1.799	1.786	1.821	1.804	1.831	1.838	1.734	1.727	1.754	1.752	1.792	1.760	1.745	1.709	1.690	1.702
D35: Electricity, gas, steam and air conditioning supply	1.423	1.471	1.491	1.573	1.631	1.757	1.857	1.619	1.601	1.523	1.649	1.565	1.600	1.647	1.527	1.586	1.576	1.576	1.626	1.667	1.647	1.577	1.552	1.566
D36T39: Water supply; sewerage, waste management and remediation activities	1.683	1.696	1.700	1.755	1.758	1.767	1.724	1.647	1.643	1.697	1.726	1.807	1.777	1.766	1.681	1.597	1.692	1.710	1.723	1.715	1.674	1.707	1.678	1.666
D41T43: Construction	1.852	1.853	1.824	1.807	1.788	1.774	1.761	1.752	1.749	1.737	1.744	1.733	1.714	1.747	1.716	1.718	1.727	1.726	1.739	1.742	1.730	1.737	1.724	1.716
D45T47: Wholesale and retail trade; repair of motor vehicles	1.598	1.571	1.555	1.517	1.555	1.553	1.523	1.538	1.546	1.573	1.571	1.582	1.604	1.597	1.517	1.596	1.642	1.656	1.668	1.683	1.655	1.658	1.676	1.702
D49: Land transport and transport via pipelines	1.777	1.781	1.776	1.732	1.738	1.740	1.704	1.742	1.719	1.733	1.755	1.750	1.782	1.798	1.712	1.742	1.769	1.761	1.790	1.801	1.733	1.737	1.770	1.790
D50: Water transport	2.102	2.115	2.128	2.137	2.185	2.125	2.072	2.103	2.100	2.096	2.105	2.006	2.036	2.053	1.986	2.050	2.048	2.107	2.002	2.073	2.050	2.113	2.167	2.176
D51: Air transport	1.827	1.850	1.832	1.857	1.867	1.933	1.899	1.868	1.877	1.863	1.861	1.831	1.828	1.909	1.806	1.754	1.888	1.885	1.890	1.858	1.726	1.648	1.682	1.729
D52: Warehousing and support activities for transportation	1.433	1.434	1.465	1.420	1.538	1.485	1.502	1.500	1.542	1.530	1.527	1.596	1.722	1.716	1.694	1.756	1.807	1.840	1.875	1.900	1.855	1.828	1.817	1.782
D53: Postal and courier activities	1.440	1.426	1.416	1.427	1.548	1.552	1.571	1.585	1.579	1.526	1.517	1.534	1.594	1.576	1.538	1.556	1.601	1.677	1.708	1.712	1.622	1.628	1.607	1.603
D55T56: Accommodation and food service activities	1.857	1.844	1.829	1.815	1.773	1.778	1.769	1.737	1.746	1.740	1.762	1.752	1.758	1.767	1.746	1.751	1.769	1.773	1.769	1.781	1.744	1.738	1.741	1.746
D58T60: Publishing, audiovisual and broadcasting activities	1.756	1.752	1.808	1.789	1.694	1.884	1.843	1.720	1.712	1.667	1.700	1.753	1.641	1.617	1.567	1.552	1.577	1.590	1.591	1.624	1.579	1.573	1.569	1.616
D61: Telecommunications	1.558	1.595	1.751	1.797	1.861	1.909	1.944	1.924	1.878	1.793	1.751	1.767	1.689	1.666	1.681	1.702	1.759	1.793	1.722	1.796	1.736	1.738	1.741	1.735
D62T63: IT and other information services	1.481	1.505	1.596	1.619	1.752	1.818	1.688	1.599	1.556	1.494	1.527	1.490	1.591	1.569	1.521	1.523	1.524	1.575	1.539	1.535	1.483	1.468	1.479	1.504
D64T66: Financial and insurance activities	1.651	1.674	1.689	1.696	1.753	1.785	1.685	1.670	1.703	1.752	1.718	1.730	1.818	1.963	1.780	1.761	1.776	1.737	1.820	1.788	1.760	1.730	1.765	1.755
D68: Real estate activities	1.419	1.445	1.408	1.441	1.429	1.459	1.442	1.434	1.459	1.505	1.537	1.543	1.490	1.451	1.407	1.411	1.399	1.409	1.427	1.445	1.459	1.474	1.469	1.478
D69T75: Professional, scientific and technical activities	1.536	1.543	1.585	1.610	1.609	1.598	1.575	1.533	1.554	1.567	1.588	1.582	1.596	1.542	1.533	1.536	1.543	1.540	1.541	1.553	1.535	1.543	1.561	1.557
D77T82: Administrative and support services	1.542	1.547	1.555	1.618	1.619	1.623	1.546	1.506	1.534	1.554	1.564	1.533	1.555	1.556	1.519	1.556	1.580	1.582	1.594	1.626	1.596	1.596	1.603	1.622
D84: Public administration and defence; compulsory social security	1.567	1.559	1.566	1.567	1.577	1.587	1.595	1.593	1.592	1.591	1.599	1.600	1.603	1.617	1.604	1.614	1.615	1.613	1.607	1.600	1.583	1.589	1.595	1.599
D85: Education	1.325	1.355	1.346	1.359	1.355	1.369	1.379	1.363	1.355	1.346	1.364	1.374	1.396	1.389	1.364	1.365	1.375	1.378	1.380	1.383	1.372	1.374	1.388	1.391
D86T88: Human health and social work activities	1.571	1.582	1.574	1.591	1.581	1.588	1.587	1.575	1.582	1.577	1.600	1.587	1.602	1.579	1.552	1.565	1.577	1.590	1.584	1.598	1.581	1.586	1.602	1.603
D90T93: Arts, entertainment and recreation	1.648	1.654	1.617	1.637	1.610	1.580	1.662	1.615	1.627	1.631	1.652	1.681	1.709	1.690	1.647	1.606	1.596	1.571	1.574	1.563	1.588	1.563	1.595	1.591
D94T96: Other service activities	1.697	1.707	1.628	1.642	1.639	1.648	1.722	1.673	1.682	1.665	1.634	1.633	1.630	1.667	1.603	1.620	1.634	1.650	1.649	1.664	1.646	1.674	1.663	1.681
D97T98: Activities of households as employers	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
AVG	1.779	1.772	1.773	1.776	1.780	1.787	1.778	1.750	1.746	1.741	1.762	1.750	1.771	1.774	1.708	1.724	1.752	1.765	1.767	1.782	1.745	1.737	1.742	1.746
STD	0.254	0.248	0.244	0.235	0.224	0.223	0.223	0.219	0.215	0.204	0.218	0.219	0.224	0.236	0.235	0.234	0.233	0.236	0.225	0.224	0.214	0.214	0.214	0.219

Appendix VI: USA Leakage 1995-2018

USA SECTORAL LEAKAGE 1995 - 2018																								
SECTOR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
D01T02: Agriculture, hunting, forestry	7.74%	7.26%	7.84%	7.19%	7.45%	8.21%	7.19%	7.45%	7.47%	7.92%	8.84%	9.29%	9.50%	11.02%	8.57%	9.77%	10.87%	10.36%	9.59%	9.75%	8.93%	8.75%	9.09%	9.40%
D03: Fishing and aquaculture	7.55%	5.71%	6.71%	6.71%	7.58%	7.82%	7.40%	7.59%	7.84%	10.33%	10.08%	9.12%	9.22%	11.39%	8.61%	9.64%	13.37%	11.41%	10.57%	10.55%	7.96%	7.33%	7.68%	7.20%
D05T06: Mining and quarrying, energy producing products	8.48%	8.41%	9.21%	7.91%	9.36%	12.22%	10.18%	9.22%	12.85%	14.06%	13.23%	11.62%	10.12%	13.17%	8.51%	13.66%	14.63%	12.43%	11.54%	12.18%	9.61%	8.84%	10.75%	12.13%
D07T08: Mining and quarrying, non-energy producing products	9.29%	9.27%	9.27%	8.39%	8.28%	8.93%	8.14%	8.11%	8.90%	9.90%	10.36%	10.58%	10.22%	11.84%	8.02%	9.44%	11.56%	11.29%	10.74%	10.70%	9.60%	8.82%	9.28%	9.57%
D09: Mining support service activities	7.24%	7.33%	6.23%	6.29%	5.86%	5.30%	4.80%	5.93%	6.88%	9.02%	9.26%	9.19%	8.66%	9.58%	7.30%	8.45%	8.57%	8.91%	8.34%	8.65%	8.33%	7.83%	8.70%	7.89%
D10T12: Food products, beverages and tobacco	7.83%	7.77%	8.27%	7.93%	8.01%	8.55%	7.81%	8.01%	8.02%	8.86%	9.53%	9.79%	10.09%	11.10%	8.71%	9.91%	11.30%	10.86%	10.35%	10.53%	9.82%	9.62%	9.89%	10.09%
D13T15: Textiles, textile products, leather and footwear	9.93%	10.09%	10.57%	10.70%	11.03%	12.13%	11.49%	11.42%	12.34%	12.91%	13.89%	13.99%	14.55%	15.61%	12.34%	14.15%	15.51%	14.65%	14.57%	14.44%	13.85%	12.47%	12.36%	13.39%
D16: Wood and products of wood and cork	10.68%	10.71%	11.28%	10.56%	11.24%	11.90%	10.96%	11.03%	11.21%	13.06%	13.60%	13.93%	14.20%	14.93%	10.99%	12.85%	14.89%	14.36%	13.36%	13.27%	12.03%	11.55%	11.54%	12.03%
D17T18: Paper products and printing	9.14%	9.45%	10.01%	9.60%	9.82%	10.56%	9.56%	9.35%	9.85%	11.36%	11.81%	11.85%	11.99%	13.57%	9.76%	11.57%	13.11%	12.53%	12.10%	12.17%	11.05%	10.59%	10.87%	11.24%
D19: Coke and refined petroleum products	24.03%	23.80%	24.68%	22.76%	25.16%	29.65%	26.29%	27.36%	28.78%	30.07%	28.96%	29.89%	28.61%	31.68%	28.26%	32.24%	33.12%	31.89%	28.10%	27.53%	23.83%	22.76%	23.53%	23.46%
D20: Chemical and chemical products	9.90%	10.07%	10.40%	9.72%	10.02%	12.08%	10.56%	10.66%	12.29%	13.87%	14.78%	14.71%	14.56%	17.13%	11.90%	13.64%	15.47%	14.29%	13.91%	13.84%	12.19%	11.01%	11.73%	12.17%
D21: Pharmaceuticals, medicinal chemical and botanical products	5.03%	4.82%	5.18%	5.18%	5.37%	6.12%	5.82%	6.40%	6.33%	7.15%	7.80%	7.62%	8.49%	9.98%	7.11%	8.53%	9.93%	10.11%	10.81%	9.54%	11.58%	11.06%	11.34%	12.04%
D22: Rubber and plastics products	9.98%	9.99%	10.33%	9.72%	9.95%	11.14%	9.72%	9.94%	10.79%	12.23%	13.43%	13.78%	13.97%	15.91%	11.27%	13.29%	15.20%	14.27%	14.02%	14.11%	12.73%	11.84%	12.20%	12.69%
D23: Other non-metallic mineral products	8.29%	8.56%	8.30%	7.89%	8.58%	9.86%	8.38%	8.83%	8.51%	9.55%	10.58%	11.32%	11.25%	12.55%	9.35%	11.52%	13.27%	12.28%	11.46%	10.87%	9.67%	9.25%	9.76%	9.87%
D24: Basic metals	15.25%	15.81%	16.26%	15.51%	14.66%	15.49%	12.70%	13.18%	13.39%	16.18%	17.47%	20.05%	20.23%	21.01%	15.72%	18.91%	22.16%	19.36%	19.67%	19.50%	17.96%	16.18%	17.95%	18.73%
D25: Fabricated metal products	12.71%	12.90%	13.22%	13.11%	12.01%	12.70%	10.37%	10.96%	10.71%	14.42%	15.45%	17.38%	17.34%	19.06%	13.39%	16.07%	18.64%	17.02%	16.56%	17.09%	15.58%	14.24%	15.36%	15.66%
D26: Computer, electronic and optical equipment	15.43%	15.08%	14.79%	15.24%	16.53%	17.20%	16.04%	15.46%	14.11%	15.22%	16.45%	16.58%	16.26%	16.12%	11.41%	11.61%	12.08%	10.33%	9.98%	9.40%	9.02%	8.70%	8.32%	8.04%
D27: Electrical equipment	13.43%	13.88%	14.33%	14.97%	14.79%	15.67%	13.34%	13.28%	12.87%	16.03%	17.52%	18.76%	19.11%	19.28%	14.42%	17.03%	20.15%	18.70%	17.63%	18.30%	16.05%	15.65%	16.43%	16.72%
D28: Machinery and equipment, nec	13.69%	13.89%	14.21%	13.88%	14.05%	15.00%	13.23%	13.67%	13.68%	16.50%	17.32%	18.50%	18.57%	19.92%	14.77%	17.00%	19.31%	19.19%	18.35%	18.77%	17.56%	16.51%	17.03%	17.58%
D29: Motor vehicles, trailers and semi-trailers	17.72%	17.87%	18.14%	18.02%	18.82%	19.87%	18.51%	19.51%	19.01%	21.07%	21.98%	22.99%	23.57%	25.34%	21.57%	23.18%	24.69%	24.61%	24.18%	24.82%	23.79%	22.95%	23.10%	23.28%
D30: Other transport equipment	15.06%	14.45%	15.45%	18.87%	17.95%	19.00%	17.37%	17.26%	15.31%	16.56%	16.20%	16.75%	17.45%	17.75%	13.53%	14.21%	15.95%	16.96%	17.28%	18.31%	17.05%	15.43%	15.17%	15.81%
D31T33: Manufacturing nec; repair and installation of machinery and equipment	10.21%	10.03%	10.09%	9.65%	9.84%	10.67%	9.49%	9.53%	9.87%	11.50%	12.33%	12.98%	13.06%	14.03%	10.20%	11.93%	13.89%	12.92%	12.97%	12.87%	12.05%	11.31%	11.61%	11.86%
D35: Electricity, gas, steam and air conditioning supply	6.99%	7.48%	8.86%	7.90%	9.09%	12.19%	10.33%	10.95%	14.16%	15.86%	16.42%	14.95%	14.67%	17.53%	10.91%	12.90%	12.69%	10.76%	10.46%	10.52%	7.11%	6.02%	7.51%	8.74%
D36T39: Water supply; sewerage, waste management and remediation activities	5.40%	5.46%	5.45%	5.14%	5.74%	7.29%	6.00%	6.37%	6.81%	8.37%	8.87%	10.54%	10.25%	10.85%	7.43%	8.06%	10.19%	10.14%	9.88%	10.02%	8.32%	8.03%	8.51%	7.55%
D41T43: Construction	9.57%	9.70%	9.70%	9.42%	9.79%	10.31%	9.32%	9.41%	9.66%	10.88%	11.38%	11.81%	11.79%	12.87%	10.02%	11.81%	13.26%	12.65%	12.26%	12.37%	11.19%	10.65%	11.23%	11.46%
D45T47: Wholesale and retail trade; repair of motor vehicles	3.79%	3.62%	3.54%	3.38%	3.72%	4.02%	3.61%	3.51%	3.92%	4.26%	4.38%	4.70%	4.92%	5.45%	3.87%	5.00%	5.69%	5.37%	5.28%	5.24%	4.50%	4.27%	4.72%	4.81%
D49: Land transport and transport via pipelines	5.83%	5.92%	5.83%	4.84%	4.92%	6.05%	4.64%	5.48%	5.76%	7.03%	8.21%	8.52%	8.90%	9.92%	6.75%	8.65%	10.97%	10.75%	10.37%	9.59%	6.83%	6.31%	6.30%	6.23%
D50: Water transport	6.33%	6.29%	6.38%	6.48%	6.46%	7.73%	6.75%	6.95%	7.00%	8.71%	10.27%	10.04%	10.11%	11.51%	6.54%	7.82%	11.76%	10.98%	10.02%	9.40%	7.24%	6.75%	6.76%	6.41%
D51: Air transport	6.21%	6.28%	6.05%	4.87%	5.32%	8.04%	5.94%	5.61%	6.15%	8.09%	11.04%	11.29%	11.90%	14.09%	8.74%	11.23%	13.71%	12.53%	11.81%	11.48%	8.04%	6.95%	6.19%	5.62%
D52: Warehousing and support activities for transportation	3.50%	3.56%	3.68%	3.14%	4.00%	4.44%	3.84%	4.03%	4.46%	4.79%	4.86%	5.45%	6.46%	7.24%	5.26%	6.50%	7.57%	7.68%	7.59%	7.54%	6.12%	5.72%	6.10%	6.36%
D53: Postal and courier activities	4.19%	4.17%	4.07%	3.84%	5.15%	6.39%	5.42%	5.43%	6.12%	6.61%	6.65%	6.97%	7.33%	8.10%	5.93%	7.38%	9.24%	9.25%	9.20%	8.74%	6.78%	6.33%	6.84%	7.66%
D55T56: Accommodation and food service activities	4.43%	4.41%	4.44%	4.17%	4.32%	4.82%	4.17%	4.03%	4.43%	4.92%	5.17%	5.40%	5.53%	6.26%	4.75%	5.71%	6.55%	6.04%	6.05%	6.11%	5.11%	4.87%	5.23%	5.26%
D58T60: Publishing, audiovisual and broadcasting activities	4.41%	4.37%	4.44%	4.28%	4.19%	5.28%	4.56%	4.18%	4.25%	4.58%	4.60%	4.99%	4.54%	4.99%	3.81%	4.14%	4.83%	4.90%	4.67%	4.92%	4.42%	4.26%	4.33%	4.38%
D61: Telecommunications	3.71%	3.80%	4.26%	4.26%	4.81%	5.35%	4.57%	4.37%	4.62%	5.18%	5.50%	6.01%	6.22%	6.03%	5.08%	6.28%	7.08%	6.22%	5.70%	6.21%	5.75%	5.34%	5.99%	6.32%
D62T63: IT and other information services	3.08%	3.15%	3.39%	3.52%	4.42%	5.11%	4.15%	3.44%	3.35%	3.43%	3.66%	3.68%	4.33%	4.62%	3.55%	4.33%	4.93%	4.95%	4.71%	4.60%	3.89%	3.67%	3.96%	3.96%
D64T66: Financial and insurance activities	2.48%	2.50%	2.48%	2.36%	2.72%	3.20%	2.54%	2.40%	2.74%	3.10%	3.10%	3.35%	3.91%	4.71%	3.94%	4.08%	4.26%	3.66%	3.96%	3.61%	3.30%	3.08%	3.29%	3.09%
D68: Real estate activities	1.94%	2.03%	1.81%	1.84%	1.92%	2.34%	1.97%	1.85%	2.15%	2.59%	2.91%	3.02%	2.99%	3.27%	2.29%	2.62%	2.91%	2.83%	2.93%	2.96%	2.67%	2.58%	2.65%	2.89%
D69T75: Professional, scientific and technical activities	3.09%	3.02%	3.18%	3.19%	3.36%	3.73%	3.08%	2.85%	3.12%	3.51%	3.76%	3.95%	4.43%	4.64%	3.58%	4.24%	4.64%	4.35%	4.29%	4.31%	3.76%	3.74%	4.00%	4.01%
D77T82: Administrative and support services	3.44%	3.37%	3.36%	3.40%	3.69%	4.19%	3.31%	3.21%	3.52%	4.01%	4.17%	4.25%	4.60%	5.06%	3.74%	4.54%	5.28%	5.10%	5.12%	5.24%	4.43%	4.37%	4.58%	4.59%
D84: Public administration and defence; compulsory social security	5.49%	5.40%	5.61%	5.43%	5.79%	6.59%	5.84%	5.74%	6.24%	7.01%	7.36%	7.67%	7.98%	9.06%	6.91%	8.24%	9.12%	8.46%	8.01%	7.83%	6.55%	6.20%	6.83%	7.20%
D85: Education	3.14%	3.28%	3.24%	3.21%	3.49%	4.33%	3.70%	3.61%	3.70%	4.27%	4.75%	4.98%	5.29%	5.89%	4.21%	5.08%	5.89%	5.23%	4.96%	4.75%	3.79%	3.58%	4.01%	4.40%
D86T88: Human health and social work activities	4.09%	4.06%	4.02%	4.04%	4.41%	4.97%	4.63%	4.60%	4.81%	5.11%	5.33%	5.54%	5.60%	6.12%	4.43%	5.27%	5.79%	5.47%	5.38%	5.16%	5.05%	4.69%	4.81%	4.87%
D90T93: Arts, entertainment and recreation	3.40%	3.39%	3.35%	3.14%	3.19%	3.48%	3.20%	2.89%	3.21%	3.61%	3.79%	4.05%	4.26%	4.79%	3.40%	3.95%	4.55%	4.32%	4.14%	4.05%	3.47%	3.28%	3.68%	3.93%
D94T96: Other service activities	4.07%	4.05%	3.67%	3.53%	3.76%	4.02%	3.96%	3.85%	4.10%	4.42%	4.50%	4.78%	4.96%	5.71%	4.13%	4.93%	5.71%	5.34%	5.23%	5.29%	4.52%	4.23%	4.54%	4.76%
D97T98: Activities of households as employers	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
AVG	7.89%	7.87%	8.08%	7.84%	8.20%	9.18%	8.07%	8.16%	8.53%	9.73%	10.26%	10.60%	10.73%	11.83%	8.75%	10.26%	11.69%	11.04%	10.64%	10.62%	9.39%	8.81%	9.22%	9.44%
STD	4.74%	4.75%	4.93%	4.95%	5.01%	5.47%	4.94%	5.10%	5.14%	5.64%	5.69%	5.91%	5.77%	6.18%	5.08%	5.72%	6.13%	5.85%	5.48%	5.57%	5.21%	4.91%	5.03%	5.16%