DEINDUSTRIALIZATION IN COLOMBIA:

QUANTITATIVE ANALYSIS OF DETERMINANTS

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Summary:

This document looks at the deindustrialization process in Colombia during 1965-2012, attempting to distinguish between "secular movements" (normal) from factors that have accelerated its process as a result of the Dutch Disease. This is a case of accelerated deindustrialization, where the Industry Value Added/GDP ratio has fallen from almost 25% during the mid-seventies to 20-22% in the eighties and now reaches a mere 12%.

This deindustrialization has been linked to: i) structural difficulties in the provision of basic services (energy, telecommunications, roads), and ii) the effect springing from the energy-mining boom, accompanied by a costly labor force and a rampant appreciation of the exchange rate, thus giving support to the DD hypothesis.

On the econometric front, the VEC model supports the DD hypothesis for the period 1970-2010, as compared to the alternate hypothesis of "secular" deindustrialization. This is usually explained by the expansion of the services sector (due to relative gains in productivity and "modernization") and the level of development (gains in GDP per capita), which are typically linked to the developed world.

JEL Classification: Industrialization (O14); Industrial History (N66); Latin America (054).

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I. Introduction

During the years 1975-2012, Colombia has experienced a process of deindustrialization by which its ratio Industry Value Added/GDP has decreased to a level of 24% three decades ago, to 15% this past decade, and currently heads towards a level of 9-12% for the period 2012-2020. In terms of job creation, the industry contributed close to 25% of total employment three decades ago, this past decade represented 23%, but currently only contributes with 13%.

Underlining this process one usually finds the so-called "secular forces" which claim that, once the first stage of “simple manufacture industrialization" has been completed, a process of expansion of the services sector follows, in this manner shrinking the share of the agricultural and manufacturing sectors within the GDP.

Nonetheless, in the case of economies with growth led mainly by exporting commodities, enclave-type, the fall in the contribution of these sectors to the economy usually tends to accelerate. This is the result of the effects known as the Dutch Disease, where the abundance of foreign currency resulting from these exporting commodities is accompanied by a persistent real appreciation of the exchange rate, which tends to shrink the value of manufactured exports and agro industrial goods, which in turn are the more labor-intensive.

Furthermore, this exporting commodities boom doesn't have to necessarily end up being a "curse": foreign currency abundance and fewer jobs, with the risk of terrible social misalignments. Consequently, in order to avoid this hardship, structural, timely and profound reforms are needed to enable: i) lowering export/import costs of different commodity goods (thus compensating the appreciation of the exchange rate), ii) labor reforms that allow the labor force to be more competitive

internationally, thus reducing "unitary labor costs" (= change in real wage - change in labor productivity).

During the period 2003-2012, Colombia has experienced a boom of its energy-mining sector entailing many of the risks associated to the DD (previously mentioned). For example, in the past five years, our energy-mining sector has grown on average by 11.8% per year in comparison to a 3.8% annual growth rate for the overall Colombian economy.

Similarly, exports from the energy-mining sector have grown 24% per year (in dollars) against an annual growth rate of 10% from the sector known as "non-traditional exports". This explains the fact that the share of traditional exports to non-traditional exports has changed from representing 50%-50% to close to 70%-30% during the last decade, with a clear bias towards the energy-mining sector.

The energy-mining sector has become the "sole-driver" in attracting Foreign Direct Investment (FDI). For example, during the period 2005-2011, FDI averaged close to US$10.6 billion per year, where close to 65% has reached the energy-mining sector, despite the obvious absence of "green-field" projects to be developed by industrial processes with up-to-date technology, as is the case in Asia and even in some Central American countries (see Anif 2010).

In the short run, the advantages of this type of expansion are undeniable, even under the export-enclave setting. Thanks to this, Colombia has managed to overcome its persistent external deficit, which got in the way of dealing with its "foreign misalignment" and floating the exchange rate. Nonetheless, the trade balance has averaged deficits close to -0.7% of GDP per year during the last decade, compared to surplus figures reaching 3-6% of GDP in countries with similar structures with favorable terms of trade (such as Venezuela, Argentina, Chile, Peru and Brazil).

A paradox exists in which the improvement in the trade account has not resulted in a balance of payments surplus (as a whole) in any single year in the past decade. In fact, this external weakness continues to be of a structural nature, averaging -

2.2% of GDP per year during 2002-2011. In this sense, the concern is twofold: i) the duration of the energy-mining boom is uncertain, given that our oil reserves are estimated to last another 7 years against the almost 300 year duration presented by Venezuela (even though our carbon reserves are of a more lasting nature); ii) the productive distribution between agriculture and manufacture has resulted in premature losses in participation both at the value added level as well as in employment, intensifying the income distribution problem.

The external account weakness of Colombia should set off some alarms in at least two areas: i) a labor reform must be pushed forward that enables labor costs to be more flexible, mainly through the elimination of “non-wage payments” assumed by firms; and ii) we must “harvest” the ongoing boom in the form of adequate infrastructure for transportation (overall), so that we can compensate for the prevalent appreciation of the exchange rate (reaching 15%-20% in real terms when calculated against our main trade partners, during the last decade).

The objective of this document is to analyze the trends related to the deindustrialization process during 1965-2012, hoping to distinguish those “secular movements” (normal) from factors that have accelerated its process because of the Dutch Disease. In order to do this, we will first describe the theories related to Dutch Disease and “secular movements”, and later test these by using econometrics (VEC models).

One of the main messages of this document is that deindustrialization occurs through two channels: i) the secular path resulting from the stages of development, typical of the industrialized world, and ii) as a result of external shocks that improve the volume and prices of commodities, typical in the emerging world, where its final effect will depend on how the DD is addressed.

In the case of Colombia, we will see that an accelerated deindustrialization occurs by means of a fall in the ratio Industry Value Added/GDP, which went from almost 24% during the mid-seventies to 20-22% in the eighties and now reaches a mere 12%. This deindustrialization has been linked to: i) obvious structural difficulties in

the provision of basic services (energy, telecommunications, roads), and ii) the effect springing from the energy-mining boom, accompanied by a costly labor force and a rampant appreciation of the exchange rate, thus giving support to the DD hypothesis.

On the econometric front, the VEC model supports the DD hypothesis for the period 1970-2010, as compared to the alternate hypothesis of "secular" deindustrialization. This is usually explained by the expansion of the services sector (due to relative gains in productivity and "modernization") and the level of development (gains in GDP per capita), which are typically linked to the developed world.

In our view, these results are especially relevant for Colombia in its current juncture. First, forthcoming FTA's will inevitably expose our economy to global competition, in a manner that has not been witnessed to this day. Second, the so-called "third industrial revolution" is underway, without the acknowledgment of some "purist" members of academia and public sector officials.

The premonitions that in this respect The Economist (2012, p.15) has pointed out, speak for themselves:

> "The third industrial revolution is on its way. Manufacturing is going digital (…) this could change not just business, but much else besides (…). A number of remarkable technologies are converging: clever software, novel materials, more dexterous robots, new processes (notably three-dimensional printing) and a whole range of web-based services (…).
>
> (…) The geography of supply chains will change (…) Like all revolutions, this one will be disruptive (…) Most jobs will not be on the factory floor but in the offices nearby, which will be full of designers, engineers, IT specialists, logistics experts, marketing staff and other professionals (…) The revolution will affect not only how things are made, but WHERE (…) Factories used to move to low-wage countries to curb labour costs. But labour costs are growing less and less important, (…) Offshore production is increasingly moving back to rich countries (…) because companies now want to be closer to their customers so that they can respond more quickly to changes in demand".

This implies that to the challenges that Colombia already has to face (overdue FTA's and poorly allocated infrastructure), we must now add a possible reversion of manufacturing labor towards the industrialized world. This on account of advanced technology in developed countries, enabling them to compete with a highly qualified labor force, since this will in fact generate a better share per worker and at a relatively lower cost than that of countries looking to re-industrialize via obsolete XXth Century technologies.

In addition to this introduction, this document is comprised of five additional chapters. The second chapter deals with the theory of development and hypothesis of accelerated deindustrialization. Chapter Three analyzes, in a historical manner, the process that Colombia has experienced and the fourth chapter addresses econometric determinants. Chapter Five presents forecast estimation of future manufacturing participation for the period 2012-2020. Chapter Six summarizes and imparts policy recommendations.

II. Deindustrialization: Theory and Evidence

The so-called Dutch Disease (DD) is a theory that helps explain processes of rapid deindustrialization. Bruno and Sachs (1982) and later Corden and Nearly (1984) explain this as a process by which a rise in volume and prices of exporting commodities, generate an affluence (abundance) of foreign currency, which in turn leads to an evident and persistent appreciation of the real exchange rate. This appreciation negatively affects the likelihood of exporting non-tradable goods, especially those from the agro industrial sector, leading to stagnation of growth in these sectors with respect to those sectors benefited from the export boom of commodities.

In this manner, the typical economy can be categorized as having three sectors: Natural Resources (NR), Tradable Manufacturing goods (M) and Non-tradable Service-based goods (S). In the case of a small and open economy, prices of

natural resources and manufactured goods are given exogenously (global supply and demand). In turn, prices of those service-based non-tradable goods tend to be given by local supply and demand.

A rise in international prices of NR generates free mobility between sectors, also affecting their earnings-expenditure relation. For example, NR producing firms will increase their demand for capital and qualified labor force, in this manner changing the Capital/Labor relation in sector M (causing direct deindustrialization). On the other hand, the mobility of resources from sector S to NR will lead to a fall in production of sector S, whose prices are fixed by the domestic market, leading to an increase in local price, equivalent to an appreciation of the real exchange rate.

The expenditure effect will occur as a result of the monetization of resources produced by sector NR, usually transferred to sector S. If the government is an important receptor of these resources (due to its condition of owner-exporter or because it is heavily-taxed), the magnitude of the DD effect will be a function of the countercyclical role that the State manages to impose in terms of smoothing the windfall gain.

Usually, what happens is that the “sterilization” of this effect is moderate, and therefore the appreciation of the exchange rate causes M-sector goods to lose ground, therefore causing what is known as indirect deindustrialization. The higher share of sector S will push labor demand and increase wages in this sector, leading to a migration of the workforce from sector NR (capital intensive) and M (with lower export-potential) towards sector S.

In this manner, the DD tends to generate 4 effects: i) contraction of the manufacturing sector, due to the direct (NR) and indirect (expansion of S) deindustrialization; ii) persistent exchange rate appreciation; iii) wage increase (another form of revaluation), and iv) expansion of NR and S, as a replacement for M.

Another theoretical model that exposes the effects of DD on the manufacturing sector is discussed by Sachs and Warner (1997; 2001). The authors show that

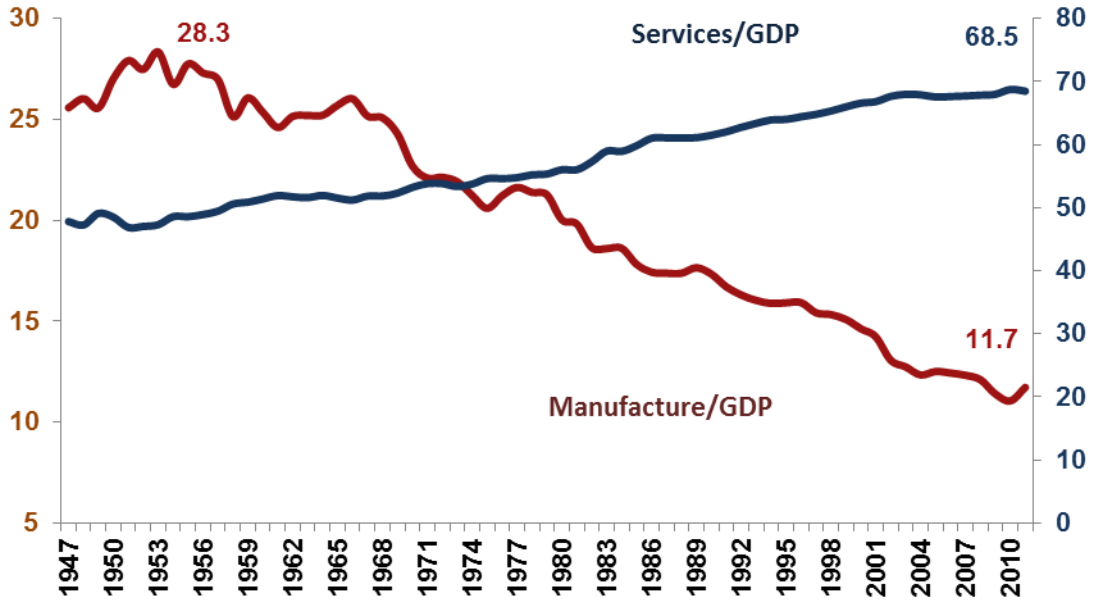
when NR is abundant, production of tradable goods is concentrated in NR instead of M. Therefore, the greatest share of labor and capital that could have been used in the manufacturing production deviate towards the non-tradable sectors of the economy. Hence, when the economy experiences a boom in NR (via better terms of trade or as a result of new findings), the manufacturing sector will tend to constantly lose participation within the economy.

The most well-known cases of DD refer to the gas expansion in the Netherlands occurring between 1950-1960 (therefore its name); the oil boom in Venezuela (Vera, 2009) and gas boom in Bolivia (Cerezo, 2011), discussing their characteristics. They also discuss natural resource findings in Rusia (Oomes and Kalcheva, 2007) and oil and gas wells found in Norway and Great Britain (Hutchison, 1994), even though the effect on the manufacturing industry in these countries was more moderate.

These deindustrialization processes do not necessarily respond to emerging markets benefitting from terms of trade "shocks". These processes may also be the result of "secular trends", like those seen in developed economies.

Let’s take the case of the United States and analyze its long process of industrialization and former deindustrialization. Its industrialization process did in fact begin in the latter half of the XVIIIth century, thanks to strong institutional arrangements and an influx of highly qualified European immigrants (relative to its time). The process finalized during the mid-fifties, when industrial production reached its maximum share, reaching 28% of GDP. From this moment on, production began to fall constantly (see Figure 1).

Figure 1. United States: Services and Manufacturing Share of GDP (1947-2011, % of GDP)



Source: Anif calculations based on U.S. Bureau of Economic Analysis.

This brought on profound structural changes within the US economy. At the same time that manufacturing production went from representing 28% to a mere 12% of GDP during 1953-2012, the provision of services increased more than proportionally, from 48% to 69% of GDP during the same period, as a result of the growth of manufacturing productivity and greater opportunities and innovation towards other sectors.

Within the industry, changes in the type of produced goods occurred. While in the fifties the production of goods belonging to the food and beverages, and machinery and motor vehicles sectors prevailed, during this past decade manufacturing production migrated towards technologically advanced sectors. It was here that the production of computers and other electronic appliances surged. In other words, simple manufacturing took a step towards technological innovation within the industrial sector, but this sector suffered an overall loss of its GDP share.

As can been seen, it wasn't a case of DD, but instead more like a secular process that ends with the expansion of technologically-intensive service sector, occurring

in a rather natural way. Indeed, the expansion of the technologically-intensive services sector could be more severe for the period 2012-2020, when the “third industrial revolution” will be receiving industrial jobs on behalf of sophisticated technological developments. These developments will enable the design, “printing” and the mass production of manufacturing goods, based on highly qualified and well-paid labor force, which is currently unavailable in emerging markets (see The Economist 2012).

Rowthorn y Ramaswamy (1994) have carefully analyzed these cases in which the Industry Value Added/GDP falls as a result of a “secular process”, as is the case of the US, different from the cases of DD. The authors’ highlight the fact that “natural” deindustrialization processes tend to be far much slower than those induced by DD, favoring an orderly transit towards the expansion of the services sector.

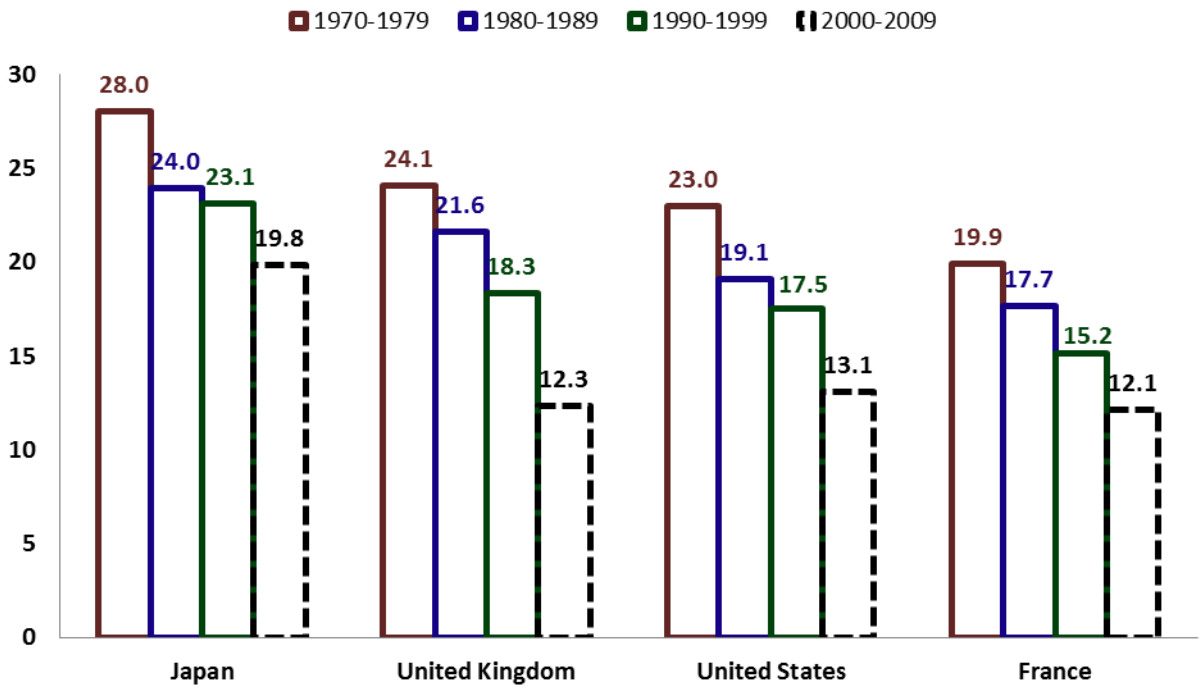
Figure 2 presents the medium term vision of the developed world. As can be observed, during 1970-2009, the United States reduced its manufacturing contribution from 23% to 13%, losing close to 2.5 percentage points of GDP participation, per decade. As was previously noted, an important technological breakthrough occurred during those 40 years, that pushed the tertiary sector forward (with emphasis on financial services), allowing for their own set of cycles and crises, which escalated during 2007-2012.

The case of Great Britain is noteworthy; despite serving as the crib of the industrial revolution of the XIXth Century, during the 70’s only showed an industrial share of 24%, compared to a 23% share of the United States. Nevertheless, since then, the deindustrialization process has been similar to that of the US, shrinking its participation from 24% to 12% in the last four decades, resulting in a 3 points of GDP loss per decade. This case also showed a migration towards the services sector, especially those of financial nature.

France, on the other hand, has had a slower fall in manufacturing participation, amounting to 2 points of GDP per decade, even though its decline has led it towards the 12% level at the end of the last decade. Despite elevated labor costs

and pernicious labor regulation (limiting working hours), France holds important technological advantages in telecommunications, aviation, energy, and others. However, the viability of an elevated State presence in these sectors is still questionable, given its fiscal fragility.

Figure 2. Manufacturing Share of Total GDP



Source: Anif calculations based on OECD and statistics departments for each country.

Finally, we have the case of Japan, which came off to a slow start of its industrial development during 1945-1965. There is a decline from 28% to 20% in its industrial participation, with a loss of 2 points per decade, but still maintaining higher levels of industrialization (when compared to the sample).

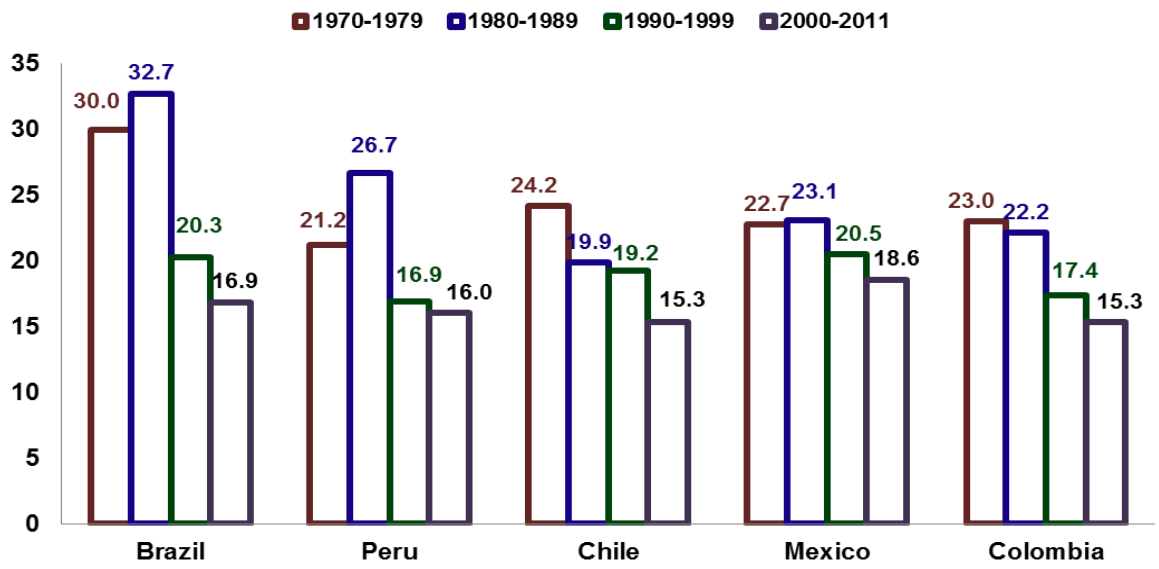
As is commonly known, this theory of secular-type deindustrialization is based on the cycle of sector productivity, beginning with the agricultural sector (transit from feudalism to capitalism), moving on to the manufacturing sector (first and second industrial revolutions) and finishing with the services sector (now pushing towards the third industrial revolution, as previously noted). On the demand side, higher

agricultural productivity and the “wealth of nations” led to a fall in demand of agro goods, in favor of manufactured goods (Engel Law). On the supply side, the displacement of agro labor force led to urbanization, industrialization and the expansion of the services sector (Rowthorn y Ramaswamy, 1994).

The developed countries of the G7 have clearly moved towards the expansion of its tertiary sector. We have discussed how technological advances in the services sector could motivate a third industrial revolution. This would be accompanied by an important recovery of manufacturing employment in developed countries, where high productivity would enable them to compete at an international level, despite maintaining high wages (see Anif (2011a) and The Economist (2012)).

Figure 3 presents the course of deindustrialization in Latin America for the period 1970-2009. It can be observed that industrial production exhibited some stagnation during the second half of the 1970’s, following a rapid expansion two decades prior. This is greatly explained by the first phase of import substitution (light-weight manufactures) coming to an end and the structural difficulties to move towards a more open and competitive export sector.

Figure 3. Latin America: Industrial Production Share of GDP



Source: Anif calculations based on World Bank and statistics departments for each country.

At the end of the 70's, some governments insisted on sector subsidy schemes, with elevated fiscal costs that promoted a "rent-seeking" mindset, instead of encouraging true industrial developments (Brazil being an exception). Only Brazil and Peru managed to increase their industrial GDP share, thanks to commodity producing industries, aiming towards foreign markets (Benavelde et al., 1996).

In Brazil, the industrial participation peaked at 33% of GDP towards the end of the 1980's. However, high levels of protectionism and subsidy schemes could not detain the fall in industrial participation, reaching levels of 17% in 2011, thus averaging a 5.2 percentage point fall per decade. The recent commodities boom seems to be intensifying the deindustrialization process in Brazil.

In Mexico, the fall has been less pronounced. In fact, after reaching an industrial participation peak of 23% of GDP in the 70's-80's, the Mexican industry has maintained a 19% share in the last decade. This suggests a 1.5 percentage point loss, per decade, in manufacturing contribution. In Mexico, despite high competition with China, the arrival of FTAs with the US and Canada has brought on important gains in productivity, especially in durable and semi-durable consumer goods.

Chile, Peru and Colombia have had a similar performance in the past thirty years, even though Peru's fall has been more pronounced. This occurred despite strong State protection and subsidy schemes in the eighties (similar to the Brazilian case). In fact, Peru reached a level of industrialization of close to 27% of GDP in the 80's. However, industrial participation has hovered around 16% in the last decade, reaching 3.6 percentage point loss per decade.

Finally, Chile and Colombia went from industrial participation of close to 23-24% of GDP during the seventies to close to 15% this past decade, amounting to losses of 2.6 percentage points per decade. In the cases of Chile, Peru and Colombia, the recent commodities sector boom, accompanied by favorable terms of trade, has accelerated the deindustrialization process. In relative terms, Colombia is the more

severe case; it boasted having a vast agro-industrial exporting base, of which little is left, and now, close to 70% of its exports are commodities. In fact, the sum of commodity exports and agricultural goods represents almost 80% of total exports, including the US market.

In sum, we have seen that deindustrialization processes occur: i) through secular channels resulting from stages of development, typical of the developed world, and ii) as a result of external shocks that improve volume and prices of commodities, typical of the emerging world, where its final effect will depend on the manner in which the so-called DD is faced. Following is a discussion on the pattern that Colombia has followed.

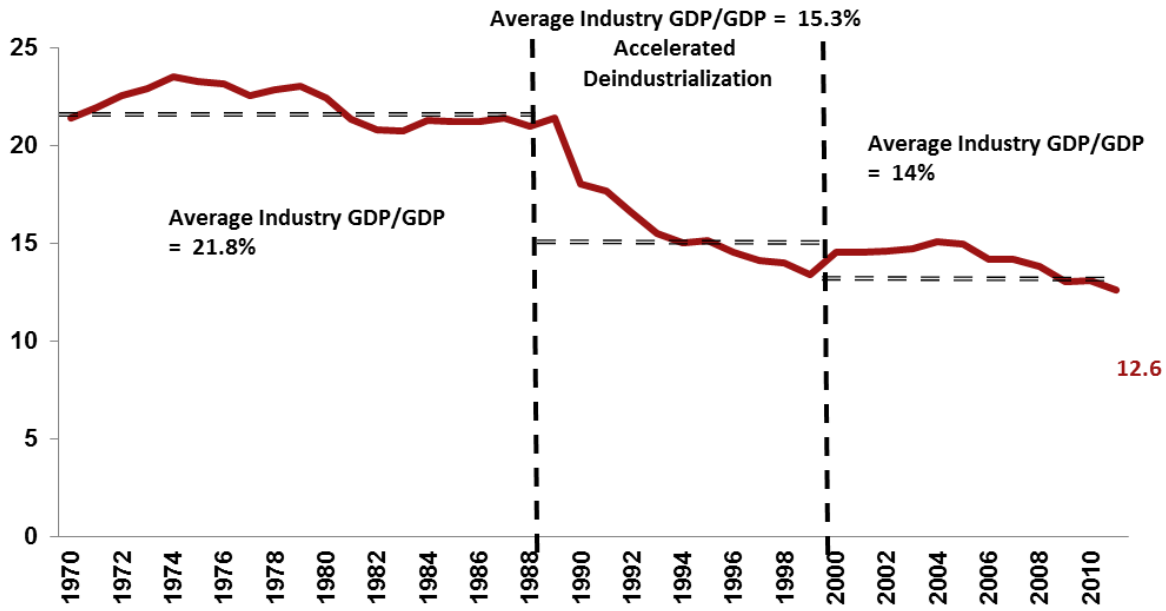
III. Deindustrialization in Colombia

Colombia has faced a relatively rapid deindustrialization process (when compared to the developed world) since the mid-seventies. In fact, its causes and solutions are a matter of debate. For example, Echavarria and Villamizar (2006) conclude that this process has been associated to typical trends in relative productivity within the manufacturing sector, showing little alarm regarding the process. Instead Rodriguez (2010) claims that deindustrialization has showed signs of being “premature” and has been linked to a migration towards activities in the tertiary sector.

Figure 4 shows the course of Industry Value Added/GDP during 1965-2011, where the ratio peaks at around 24.5% with a moderate descent towards the 20%-22% range during the eighties. In fact, the 90’s ended up being the truly “lost decade” in terms of industrial production (and not the eighties, as is commonly claimed), since participation fell from 19% to 14% (a 5 point fall in just one decade!).

Figure 4. Colombia: Manufacturing Contribution to Economic Activity

(% of GDP)



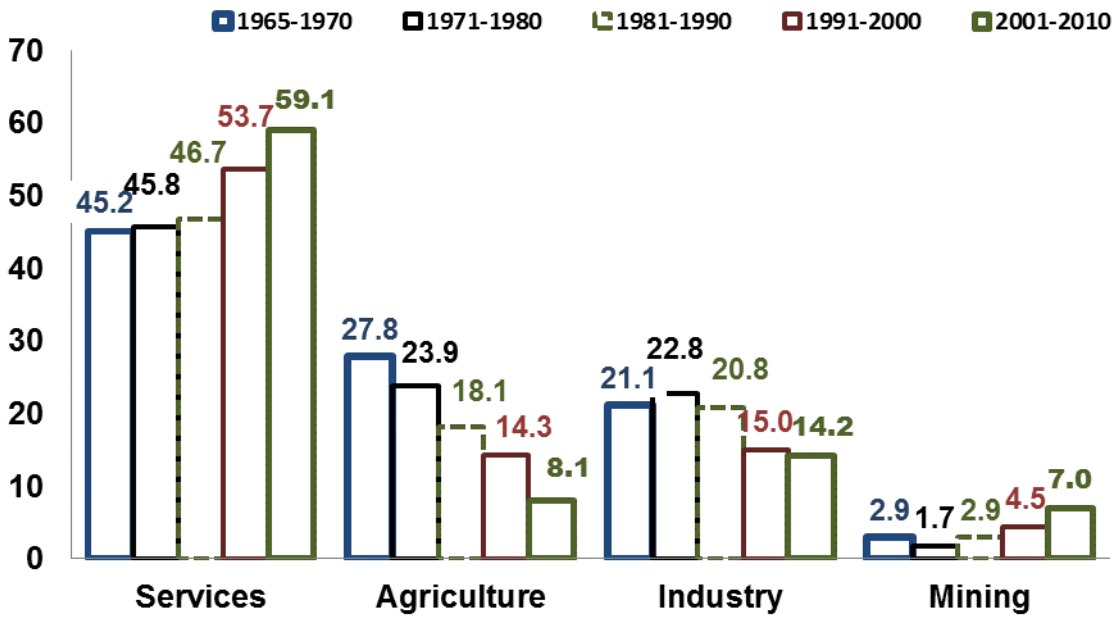
Source: Anif calculations based on Dane.

During the last decade industrial participation has fluctuated around 14-16%, but is actually set towards the 12% level. This loss is greatly linked to different factors, some which are worth mentioning include: i) structural difficulties in the provision of basic services (energy, telecommunications, roads), and ii) the energy-mining boom, accompanied by the elevated cost of labor force and the persistent and rampant appreciation of the real exchange rate, characteristics typical of a DD, as previously discussed.

In historical terms, production of agricultural and manufacturing goods was replaced by production of services and energy-mining goods, in line with “secular” findings (see Figure 5). Nonetheless, rapid changes have been the norm, without it necessarily resulting from a “secular” modernization of agro industrial sectors, like in the case of the developed world. Notice how the agricultural sector showed an important relative loss going from 28% GDP share in 1965-1970 to only 8% in 2001-2010, a participation loss of 4.5 percentage points per decade, where current share reaches just 6% of GDP.

The energy-mining sector has benefitted greatly, increasing its relative share to GDP from 3% in 1965-1970 to 7% in 2001-2010 (currently reaching 8%). The services sector has kept its participation with respect to GDP close to 46% during 1965-1990, but in the 90's gained 7 percentage points, reaching an average of 54% during 1991-2000.

Figure 5. Colombia: GDP Sector Composition



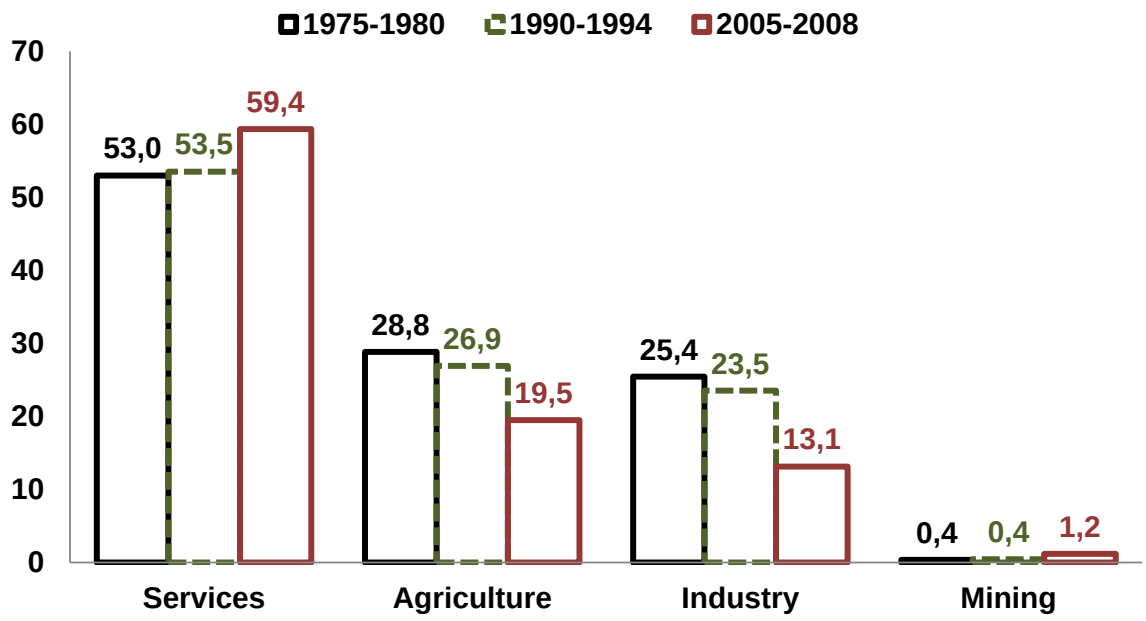
Source: Anif calculations based on Dane.

A historical evolution of sector employment participation shows a similar trend to that of production (see Figure 6). For example, during the period 1975-1980, the participation of agro employment represented 29% of total employment, falling from 19% during 2005-2008, by 3.3 percentage points per decade. The fall in industrial employment was even more severe during 2005-2008, showing a 12.3 percentage point reduction, thus participation went from representing 29% of total employment to just 13.1%.

It's worth noting that employment loss in these two sectors (21.6 percentage points) was not compensated by employment creation in the services and mining

sectors, during those periods; in fact, employment in these sectors increased by only 7.2 percentage points. Notice that mining employment went from contributing 0.4% of total employment to 1.2%, at the same time that production from this sector increased more than proportionally going from 2% to 7% of GDP during the same period, which reinforces the fact that this sector is not labor intensive.

Figure 6. Colombia: Employment Sector Composition (1975-2008)



Source: Anif calculations based on ILO

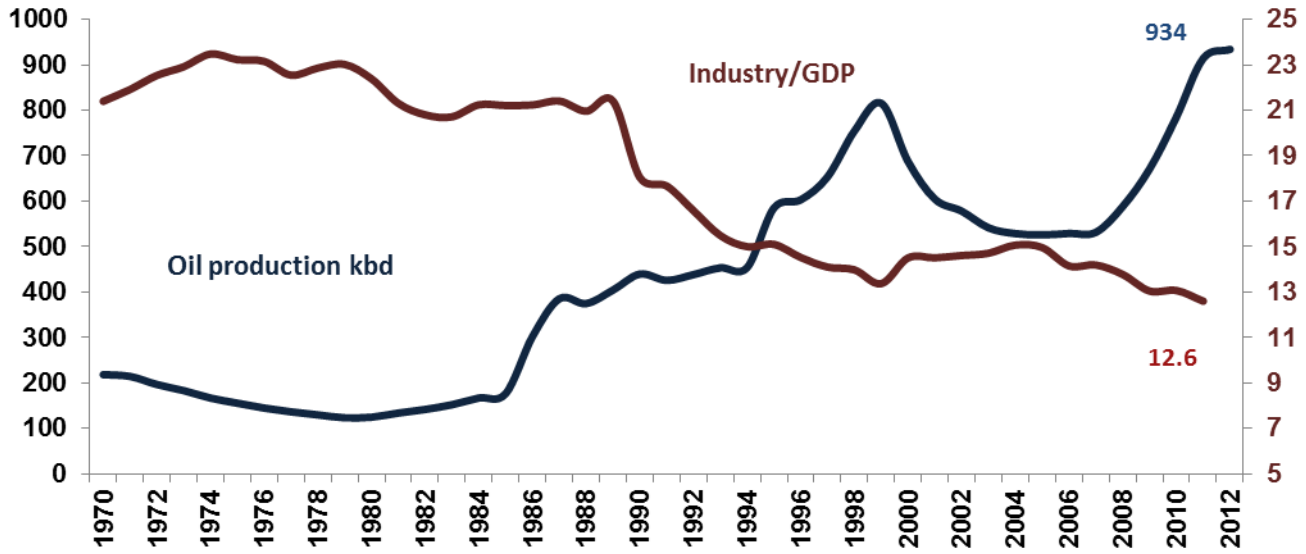
In sum, we have verified Colombia's deindustrialization process for the 1965-2012 period, characterized by an important and rapid loss of relative manufacturing production and employment with respect to GDP. Furthermore, with respect to real GDP, its performance has been weak, growing just 3.7% per year during the last fifty years and just 4.2% during the last decade; these figures are relatively feeble when compared to the dynamism of Asian economies, characterized by an accelerated modernization of its agro industrial sector.

Some questions arise: What explains this process? Is it another case of DD? How is this different from those "secular" processes observed in developed countries?

In what has been discussed so far, there appears to be clear signs that aim in the direction of a typical case of DD: i) energy-mining booms during the last thirty years, resulting in increasing volumes of oil and (mainly) carbon exports along with favorable terms of trade (especially in the last decade), and ii) strong and persistent appreciation of the real exchange rate, amounting to almost 20% in real terms in the last decade.

Indeed, Colombia has survived three energy-mining booms in the last thirty years. The first one in Cerrejón (1978) and Caño Limón (1983), which extended into the early nineties. This was followed by Cusiana-Cupiagua (1989-1993), which also doubled oil production to the 800,000 barrel per day level by 1995-1998. Looking at its long-run trend, oil production has increased seven-fold during 1984-1999 (see Figure 7).

Figure 7. Total Oil Production in Colombia (thousand barrels per day)

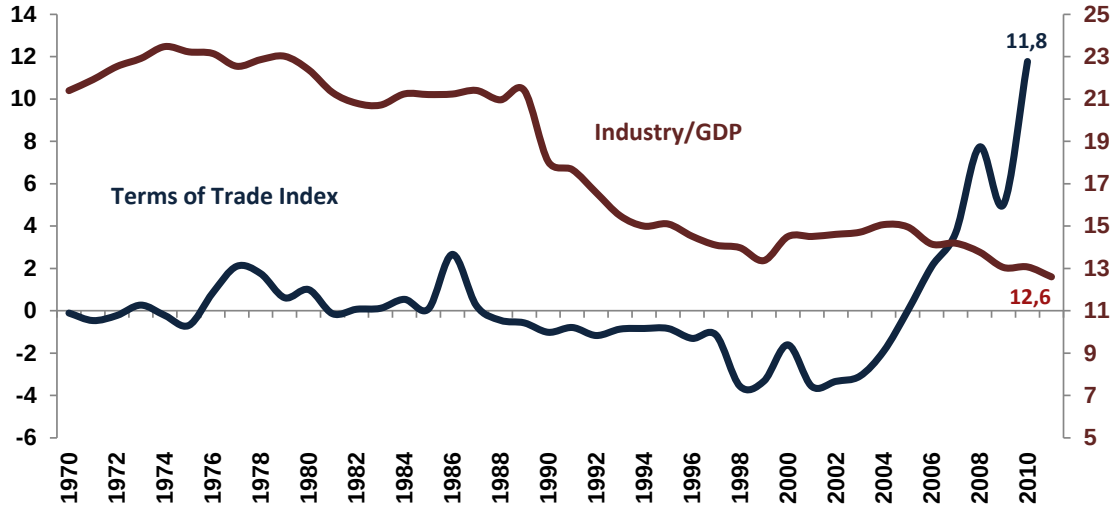


Source: Anif calculations based on ANH and Dane.

More recently (2003-2012), a new boom has emerged, both in oil and carbon production. In the case of oil, this has resulted from the recovery of secondary oil wells, taking advantage of new technologies for extraction and favorable

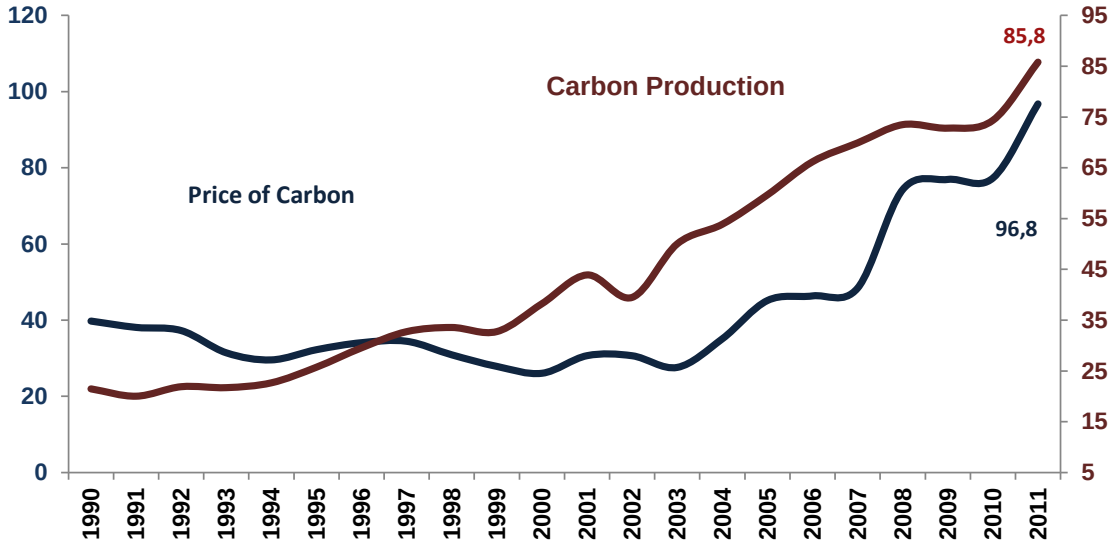
international prices (see Figures 7 and 8). Thus, oil production has doubled, going from 500,000 bpd to close to the 1 million bpd in 2012, reaching annual levels close to 85.8 million tons (se Figure 9).

Figure 8. Terms of Trade in Colombia (1970-2010)



Source: Anif calculations based on World Bank and Dane.

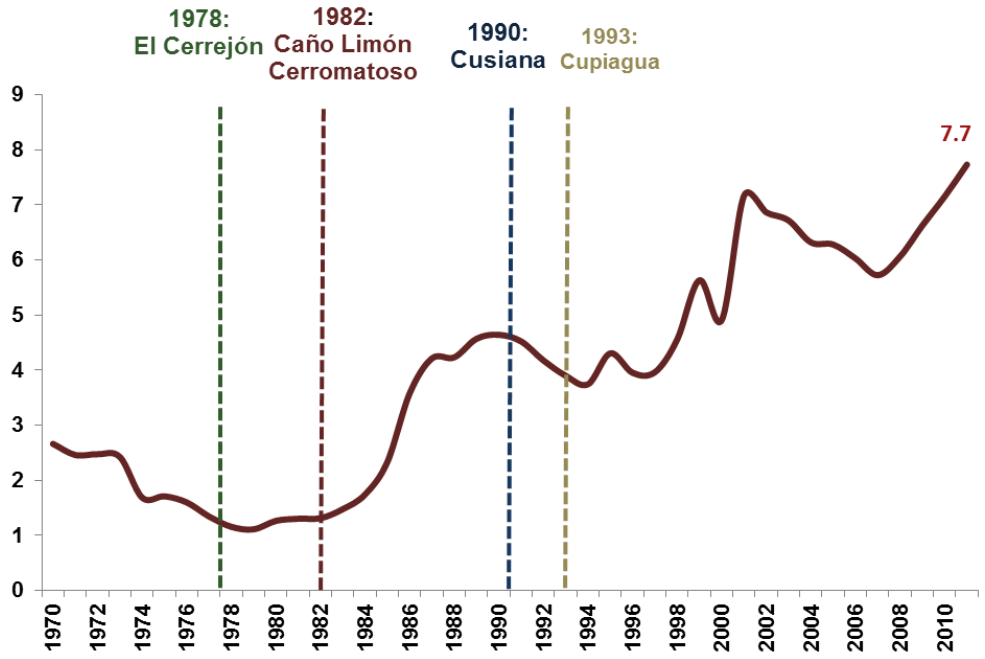
Figure 9. Production and World Prices of Carbon (1990-2011, million tons and US$)



Source: Anif calculations based on Simco.

As was previously noted, the effect of these three expansions has occurred in different arenas. On the one hand, it has enabled an increase in mining-GDP from 2.6% of GDP in 1970 to 7.7% in 2011 (see Figure 10). On the other hand, it resulted in an important expansion of traditional exports (commodities), amounting to US$40 billion, four times the volume from the previous decade (which seems somewhat "miraculous": without FTAs or adequate infrastructure of roads or oil wells), see Anif (2011a).

Figure 10. Mining GDP/Total GDP (%)



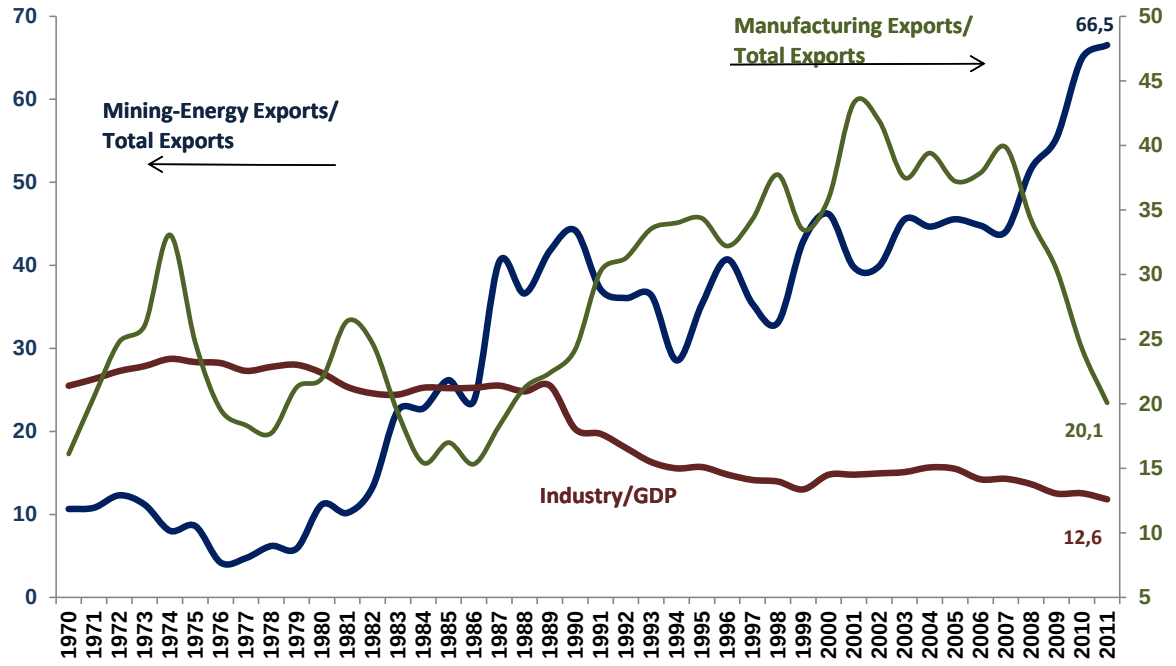
Source: Anif calculations based on Dane.

In fact, Figure 11 shows how the contribution of energy-mining exports has increased from just 10% in 1970 to close to 66% in 2011. Meanwhile, "non-traditional" exports have decreased from 44% contribution in 2000, to just 30% in 2011. Furthermore, manufacturing exports have gone from accounting for 35% per year in 1974 (a year in which industrial contribution peaked) to only 20% in 2011, amounting to US$11.4 billion in the past year. The rebound in manufacturing

exports during 1990-2005 has been linked to the rise in the automobile sector; food and beverage, footwear; and chemicals, in the beginning thanks to the G-3 and later thanks to the expansion of the Venezuelan and Ecuadorian markets, until the collapse of 2008-2012. Notice that this significant fall in manufacturing exports is just another typical phase of the DD, where industrial exports become less competitive and lose their drive in the long run, in this case worsened by difficulties within the CAN market.

Figure 11. Commodities and Manufacturing Exports in Colombia

(% of total exports)



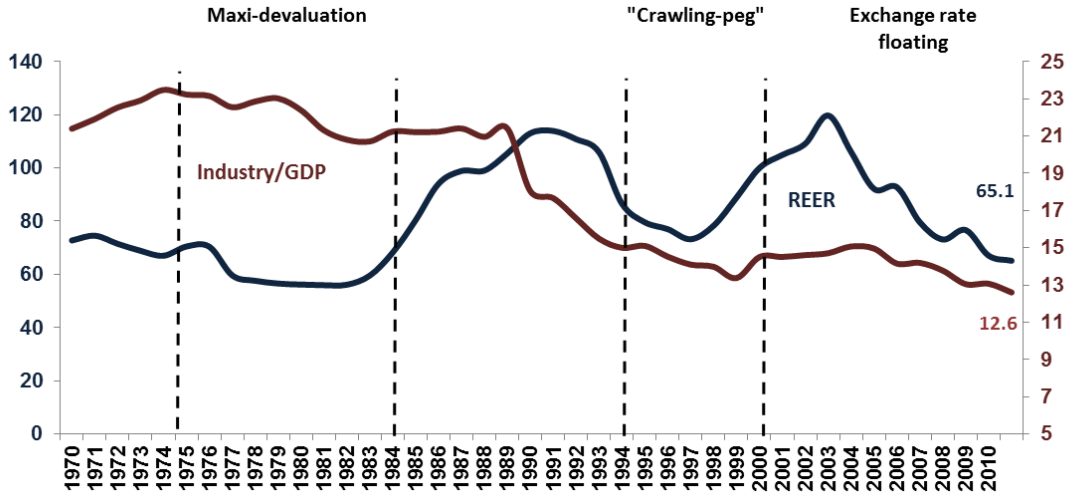
Source: Anif calculations based on Banco de la República.

Figure 12 shows the path of the real exchange rate in Colombia with respect to other trade partners. One can appreciate how the “mini-devaluation” system failed in maintaining stability in the exchange rate during 1970-1982, especially given that the inflation gap outpaced the devaluation rate “decreed” during the crisis (1975 or 1982). The 1984-1992 period was the exception, when exchange rate adjustments were accompanied by drastic fiscal adjustments and improvements in multifactor

productivity (in the end, devaluation is a real sector phenomenon and not so much of a “financial engineer”). But by then, Colombia was already making its transition towards an “extraction” economy and gaining a comparative advantage in commodities, which explains why real devaluation did little to help the recovery of the Industry Value Added / GDP ratio, which continued to descend.

Figure 12. Real Effective Exchange Rate (REER)

(1994=100, global trade)



Source: Anif calculations based on Dane, Banco de la República and World Bank.

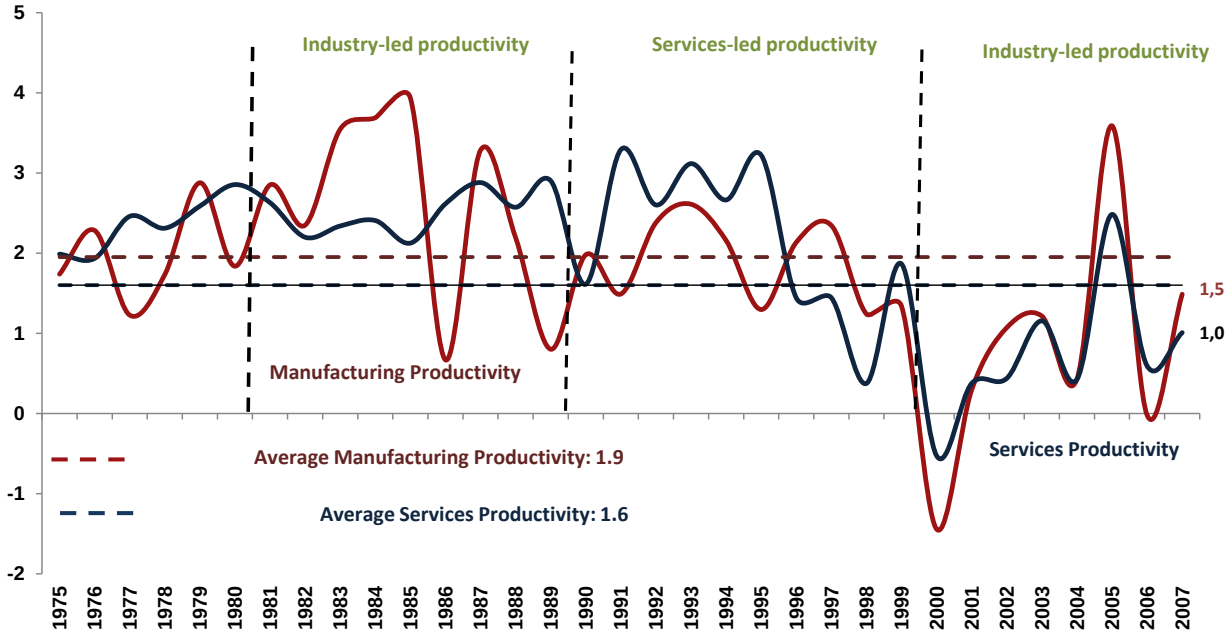
The 1992-1998 period appears as a new cycle of exchange rate appreciation, where the transition towards a “crawling peg” system was unable to contain the appreciation of the exchange rate, worsening the manufacturing situation. With the financial crisis of 1998 (harvested during 1992-1997) came the adoption of the inflation-targeting scheme and the floating of the exchange rate that would enable a real devaluation until a 2002 peak (Villar and Rincón, 2001; Clavijo, 2002).

During 2003-2012 we have witnessed a new cycle of exchange rate appreciation, greatly induced by DD. Currently we are at an appreciation level similar to that of 1980-1982, where different models show a “misalignment” of the exchange rate of between 15%-20% with respect to Purchasing Power Parity (PPP), see Anif (2011b).

The second path to analyzing deindustrialization processes comes from the aforementioned model setup by Rowthorn y Ramaswamy (1994). As we saw, their hypothesis of "secular" transition could be ratified if: i) there is a transfer of the work force from the manufacturing sector to the services sector, in presence of an increase in manufacturing productivity, and ii) an expansion of the tertiary sector occurs, accompanied by a constant rise in GDP per capita, reflecting "modernity" within this sector.

The first part of the hypothesis appears to have some empirical foundation for the 1976-2009 period, when labor productivity in the industry (1.94% annually) exceeded that of the services sector (1.63%), see Figure 13. Nonetheless, this difference of just 0.31 bps in favor of the industry seems somewhat marginal if compared to other differences of close to 2 bps observed in developed countries, when they presented their deindustrialization process.

Figure 13. Manufacturing Productivity Growth in Colombia (1976-2008, %)

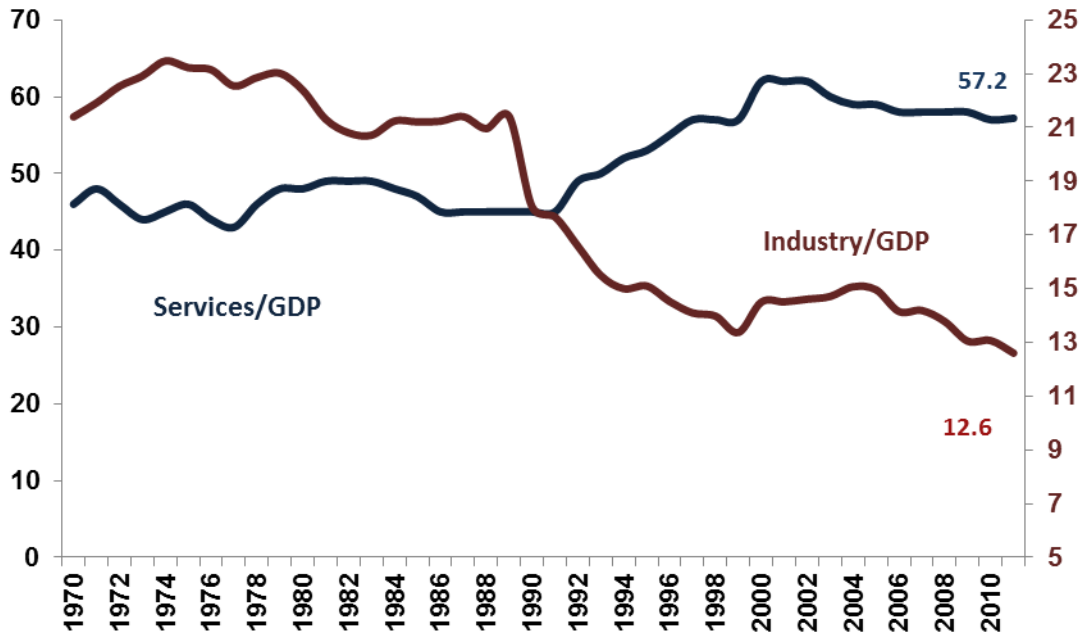


Source: Anif calculations based on Dane, World Bank and ILO.

Even if we give credit to this difference in productivities in favor of the industry, enabling a transit towards the tertiary sector, we find that this sector only showed strength during the 90's, when the manufacturing industry remained stagnant

(growing -0.6% on average against 2.7% for the overall economy). During 1990-2000, value added from the services sector went from 45% to 57%, but instead the industry fell from 18% to 14.5% (see Figure 14). But this hypothesis of tertiary sector expansion on account of gains in industrial productivity lacks support during the 1980's or the last decade.

Figure 14. Manufacturing and Services Share in the Economy (1970-2011, % of GDP)



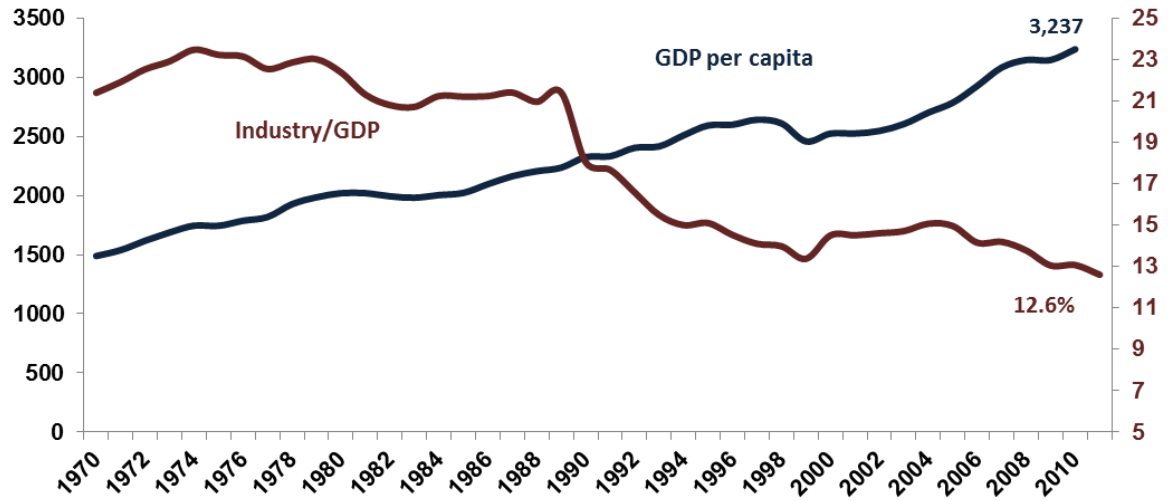
Source: Anif calculations based on Dane and World Bank.

With regards to the second hypothesis, this one claims that the transit from industry-services tends to occur when, "secularly", GDP per capita reaches US$8.000 (constant prices of 2000, according to Rowthorn y Ramaswamy, 1997). This per-capita level was reported by developed countries way back in the 1970s and by the Asian tigers in late eighties.

Figure 15 presents the historical behavior of Colombian GDP per capita (in constant dollars of 2000). Here we observe a moderate annual growth of 2% during 1970-2000, but it is worth highlighting the fact that the deindustrialization of the early eighties coincided with Colombia having a GDP per capita of just over

US$1,700 per year (near the limit of countries with medium-low income). Even for the 1989-1999 period of accelerated deindustrialization, our GDP per capita averaged only US$2,500 per year. This indicator of GDP per capita leaves no doubt with respect to how "premature" Colombia's shift towards the tertiary sector has been, in line with what is argued by Rodríguez (2010).

Figure 15. Colombia's GDP per capita (constant US$ of 2000)



Source: Anif calculations based on Dane.

In sum, the historical analysis of the deindustrialization process in Colombia (1970-2010) does not appear to have been motivated by differences in industrial productivity, nor has it reached developed world growth levels (measured by GDP per capita). Thus, the hypothesis of a "secular" path of deindustrialization holds little ground for the case of Colombia, as might sometimes be argued by the "official" view.

IV. Deindustrialization Determinants in Colombia

This section explores alternatives to the "secular" hypothesis, where the Dutch Disease (DD) appears as the more optioned one, following the discussions from the previous chapters.

First, we will give a detailed analysis of the Vector Error Correction Model (VEC), attempting to define long run relationships between deindustrialization proxy variables and their possible explanatory variables ("secular" vs. DD). Using these results, we will also develop a model that will allow short run determinants and their dynamic effects, which in turn will give an idea of the long run behavior of the deindustrialization process (using OLS and Koyck model).

The Data

These estimations cover the period 1965-2010 in Colombia. The main sources are: World Development Indicators, Penn World Tables (University of Pennsylvania), *UNComTrade, World Bank, International Trade Statistics, NBER-United Nations Trade Data, Banco de la República* and *Dane*. See Appendix 1 for data details and correlation matrices.

Econometric Analysis of Hypothesis

A. Long Run relationship: VEC Model

The Vector Error Correction Model (VEC) allows determining an empirical long run relationship between the variable that characterizes relative deindustrialization in Colombia and the variables that theory defines as possible determinants. Equations (1) and (2) define the relationship to be estimated.

$$\left(\frac{Industry\ GDP}{GDP}\right) = \beta_1 \left(\frac{Energy{-}mining\ Exports}{Total\ Exports}\right) + \beta_2 Ln\ (REER) + \varepsilon \qquad (1)$$

$$\left(\frac{Industry\ GDP}{GDP}\right) = \beta_1 \left(\frac{Services\ GDP}{GDP}\right) + \beta_2 Ln\ (GDP\ per\ capita) + \varepsilon \qquad (2)$$

Equation (1) describes the DD hypothesis, where we relate the deindustrialization proxy variable (Industry Value Added/GDP) with its possible "culprits" that are measured by the energy-mining export boom (energy-mining exports/total exports) and the appreciation of the exchange rate (the REER, previously discussed). If this hypothesis holds, the β_1 coefficient will be negative and (statistically) significant, whereas the β_2 coefficient will appear positive and significant.

Equation (2) describes the “secular” hypothesis of deindustrialization, in the terms previously discussed, where the deindustrialization determinants, in this case, would be growth in the services sector, at the same time that overall development (measured with GDP per capita) will contribute to the process. If this hypothesis holds, both the β_1 and β_2 coefficients will be negative and (statistically) significant.

Appendix 3 discusses the unitary root conditions of these variables, resulting in none of them being stationary. Furthermore, all these variables in first differences appear to be stationary, which allows us to establish long run relationship between them. Appendix 4 presents tests that were performed to establish cointegration between variables. In particular, we find that the deindustrialization process is associated to the energy-mining boom and to the long-run behavior of the REER, which validates DD’s model 1. Correspondingly, we instead find that variables in model 2 which refer to the “secular” hypothesis are not statistically significant.

Based on these results, we move on to estimate the VEC model, with results described in Table 1. Here we find a stable long-term relationship between relative deindustrialization and energy-mining exports and the real exchange rate. In particular, we find that a 1 percentage point increase in the share of mining exports would imply a 0.4 percentage point drop in the Industry Value Added / GDP ratio in the long run. Regarding the exchange rate, we determine that a 1% appreciation of the REER would result in a 0.12 percentage point fall in Industry Value Added/GDP.

Table 1. VEC Model used to test the Dutch Disease Hypothesis

Cointegration Vector Estimation			
First obs = 1972			
Last obs = 2010			
Number of obs = 39			
Cointegrating Eq:	**Coef**	**Std. Err**	**P>|z|**
Industry/GDP	1		
MiningExp/TotalExp	**-0,3981905**	.0394406	0.000
Ln(REER)	**-0,3981905**	2,69732	0.000
Cons	28,33194		
Det(Sigma_ml) = .0278599			
Jarque-Bera	0.68254		
Log likelihood	226.293		

Source: Anif calculations based on Dane.

In sum, these econometric results for Colombia during 1970-2010, suggest that variables of the DD hypothesis (energy-mining boom and exchange rate appreciation) determine the path and speed of relative deindustrialization in the country. Likewise, we find that the "secular" hypothesis of deindustrialization represented by the expansion of the services sector (gains in relative productivity and "modernization") and the level of development (gains in GDP per capita) does not hold econometric grounds for the case of Colombia. These results suggest that the DD theory (Corden and Nearly, 1984), discussed in Chapter 2, is more appropriate in explaining the "premature" deindustrialization that Colombia has witnessed in the last forty years.

B. Short and long run relationship: OLS and Koyck model

In order to dig further into these econometric findings, in this section we perform Ordinary Least Squares (OLS) estimations and to establish dynamic or long run effects we use a Koyck type modeling.

Model Specification

Equation (3) defines Industry Value Added/GDP as the dependent variable and as explanatory variables those related to the DD and also the "secular" view.

$$\left(\frac{Industry\ GDP}{GDP}\right) = \beta_0 + \beta_1\left(\frac{Energy-mining\ Exports}{Total\ Exports}\right) + \beta_2\ REER + \beta_3 GDP\ per\ capita + \beta_4\left(\frac{Services\ GDP}{GDP}\right) + \mathrm{X}\gamma + \varepsilon \quad (3)$$

As was previously argued, we would expect coefficients $\beta_{1,3,4}$ to be negative and β_2 to be positive and all (statistically) significant in explaining the DD and "secular" hypothesis. Matrix X represents control variables including: i) changes in the terms of trade; ii) trade openness (X+M/GDP); and iii) a binary variable (signaling periods of energy-mining boom, as described in Chapter 3).

Equation (4) describes the dynamic effects, following a Koyck type model with distributed lags, where determining the non-existence of error correlation is key.

$$\left(\frac{Industry\ GDP}{GDP}\right) = \beta_0(1-\lambda) + \beta_1\left(\frac{Energy-mining\ Exports}{Total\ Exports}\right) + \beta_2\ REER + \beta_3 GDP\ per\ capita + \beta_4\left(\frac{Services\ GDP}{GDP}\right) + \lambda\left(\frac{Industry\ GDP}{GDP}\right)_{-1} \mathrm{X}\gamma + \upsilon \quad (4)$$

Dynamic or long run effects are obtained with the *Long Run Multiplier (LRM)*, as follows:

$$LRM = \sum_{k=0}^{\infty}\beta_k = \beta_n\left(\frac{1}{1-\lambda}\right) \quad (5)$$

Results

Table 2 summarizes the results. The first estimation gives a 70% adjustment rate, for which specification, normality and serial correlation tests were conducted and give significance at the 95% level.

These results show that, except for the economic development proxy (GDP per capita), all relevant variables show some level of significance with the expected signs. According to this first estimation, Mining Exports/Total Exports is negative

and statistically significant at all confidence levels. The estimated coefficient for this variable (-0.11) is, in absolute terms, greater than other explanatory variables in the model. Thus, a 1 percentage point rise in the ratio of mining exports to total exports, will produce in the short run, a 0.11 percentage point fall in Industry Value Added/GDP.

Following these results, an appreciation of the REER will accelerate the deindustrialization process, but its impact in the short run is not statistically different from zero in absolute terms. This implies that, when analyzed by cycles, an appreciation of the exchange rate doesn't appear to have a negative effect on the industry, but instead in the long run the effect is clearly negative.

The variable GDP per capita appears non-zero at all significance levels, in line with the statistical weakness of the "secular" hypothesis. Nonetheless, the services-GDP variable is significant at all confidence levels, which may give support to the "secular" hypothesis but also to the DD hypothesis (via expenditure effect).

Table 2. OLS Model and Koyck Model Estimations

	(1)	(2)	(3) Koyck
VARIABLES	**GDP_industry/GDP**	**GDP_industry/GDP**	**GDP_industry/GDP**
Mining_Export/Total_Export	-.1135391***	-.1111989***	-.0893574***
	(.0125991)	(.0133828)	(.0131114)
REER	4.08e-06*	4.52e-06*	4.63e-06**
	(2.08e-06)	(2.60e-06)	(2.14e-06)
GDP_percapita	5.09e-10	5.84e-10	5.69e-10
	(5.12e-10)	(6.23e-10)	(4.18e-10)
GDP_services/GDP	-.0015368***	-.0014824***	-.0012778***
	(.0004656)	.0005104	.0004972
Boom	-.0054452 ***	-.005101**	-.0039801***
	(.0019771)	(.0024912)	(.0014131)
Openness	.1786598***	.1814914***	.1190168***
	(.0286076)	(.032167)	(.0271301)
Change in Terms of Trade	.0001211	.000135	.0002578*
	(.0001031)	(.0001614)	(.0000946)
L.GDP_IND/GDP			.4877945***
			(.1353066)
t		-.0000909	
		(.0001849)	
LRM_Mining_Export			-.1831866
LRM_REER			2.26e-5
LRM_Services			-.0024947
Constant	.1115586***	.1122731***	.0700077 ***
	(.0083168)	(.0094054)	(.0144489)
Observations	43	40	40
R-square	0.7044	0.8701	0.9000
Ramsey-RESET	0.0839	0.0863	0.2314
Jarque-Bera	0.4693	0.4690	0.4697
Durbin h	0.1513	0.1545	0.1641

Robust standard errors in parenthesis

significance at 99%***, significance at 95%**, significance at 90%*
Source: Anif calculations based on Dane and multilateral organizations

Furthermore, the magnitude of the estimator is somewhat small, indicating that the "transmission" effect to the tertiary sector is moderate. For example, a 1

percentage point rise in the Services Value Added/GDP leads to a relative reduction of the manufacturing sector in the short run of just 0.0015 percentage points.

With regards to other control variables in the model, we observe that booming period negatively affect industrial GDP, reinforcing the effect of mining exports. The variable that captures the level of economic openness is positive and statistically significant at all confidence levels. In this case, a 1 percentage point rise in the level of openness increases the level of industrialization by 0.17 percentage points. This is good news for our country, because it gives the idea that FTAs (by means of lowering the cost of machinery inputs) may lead to a recovery of the industry; they may even compensate (in quantitative terms) the effect of the rise in mining exports.

Finally, and much to our surprise, terms of trade show no statistical significance. It may be the case that this effect is already being captured by the variable of real export value (= volume + price). By removing possible trend effects and spurious relations, changes are non-significant on the coefficients: in fact, the adjustment of the model improves from 70% to 87%.

In sum, in the short run, the deindustrialization phenomenon obeys more to the energy-mining boom than to changes in the exchange rate or terms of trade. A novel result is the potential favorable effect that economic openness may have in lowering the cost of machinery inputs.

Dynamic Effects

By using a distributed lags system, we find that model adjustment rises to 90%. Again, this supports us finding a negative current effect on the mining-exports/total exports variable on industrial contribution. Thus, a 1 percentage point rise of this variable produces a contemporaneous effect of deindustrialization of -0.08

percentage points. In this case, it is worth mentioning that an exchange rate appreciation produces more deindustrialization, as is claimed by DD.

As in the previous cases, GDP per capita is non-significant, and instead the ratio services to total GDP is negative and significant, but its effect on deindustrialization falls (-0.0013 percentage points).

The dynamic effect (LRM) of the mining-exports/total exports variable shows that a 1 percentage point permanent rise in this ratio leads to a -0.18 percentage point drop in the Industrial GDP/Total GDP. Therefore, this turns out to be the greatest effect, in absolute terms, of long-run multipliers In sum, these Koyck estimations give support to a DD hypothesis, which suggests that the Colombian deindustrialization process has been the result of: i) a rise in the mining-exports/total exports ratio, ii) an appreciation of the real exchange rate. Furthermore, these estimations suggest that the size of the tertiary sector in the economy helped explain, although to a lesser degree, the deindustrialization process, probably as a result of the expenditure effect.

(Appendix 2 presents several in-sample forecasting exercises, giving support to the statistical adjustment of the models).

V. Where is the Colombian Manufacturing Sector Headed?

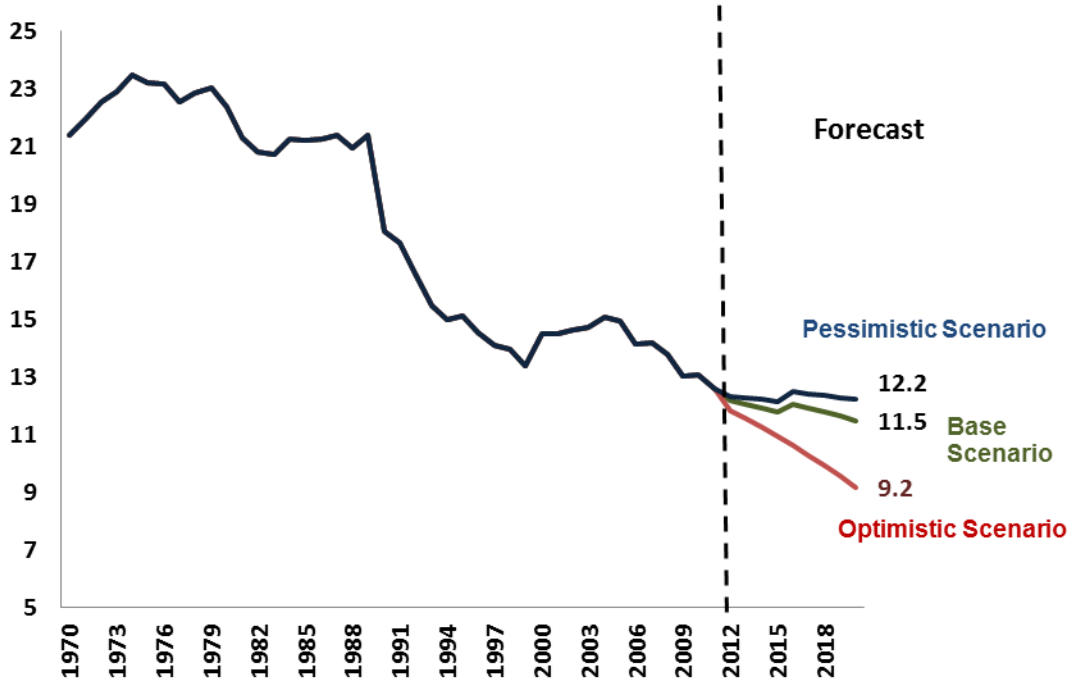
Considering these results, we now move on to forecast the Colombian manufacturing sector into the 2020 horizon, using the Koyck model previously discussed.

We will look at various scenarios. The base scenario assumes an economic growth (status quo) similar to that of this past decade, under the assumption that the energy-mining boom continues until 2015. The second scenario is “optimistic” because it assumes: a) the mining-exports/total exports ratio rises from 64% to 85%, and b) the energy-mining boom prolongs until 2020. Finally, the third “pessimistic” scenario assumes that the growth rate of the mining-exports/total

exports ratio is only half of that observed in the previous decade, meaning that the ratio goes from 64% to 73.4%, and the boom only lasts until 2015.

Figure 16 shows the results of these simulations. We find that in all three scenarios the deindustrialization process continues during the next decade. In the base scenario, the ratio Industry Value Added/GDP falls from 12.6% in 2011 to 11.5% in 2020. The "optimistic" scenario (prolonged boom), forecasts a more rapid fall, from 12.6% to 9.2% of GDP for the 2011-2020 period. Finally, even under the "pessimistic" scenario (short-lived boom) the participation of the industry drops to 12.2% by 2020.

Figure 16. Manufacturing Share in the Economy Forecast (% of GDP)



Source: Anif calculations based on Dane

Hence, these out-of-sample estimations (2012-2020) speak of persistent deindustrialization at a pace that will leave the industry contributing just 9.2%-12.2% of GDP by 2020. Even though the pace at which participation has been lost

has dropped from 3.5 pps during the nineties to just 1 pp during this past decade, those low levels of participation are worth noting in the light of the DD discussion.

VI. Conclusions

The main finding of this document is that deindustrialization happens by: i) a secular path resulting from different stages of development, typical of the developed world; and ii) as a result of external shocks that improve the volume and prices of commodities, typical processes of the emerging world, where its final effect will depend on the way the so-called Dutch Disease (DD) is faced.

In the case of Colombia, we confirm an accelerated deindustrialization process during 1965-2012, reflected in a rapid descent of the Industry Value Added/GDP ratio, from almost 24% in the mid-70s to 20%-22% in the 80s and now closing in at 12%. This deindustrialization is related to: i) structural difficulties in the provision of basic services (energy, telecommunications and roads); and ii) the energy-mining boom that has been accompanied by a relative rise in labor and a severe appreciation of the real exchange rate, giving grounds to the hypothesis of Dutch Disease.

In our view, these results are especially relevant for Colombia in its current juncture. First, forthcoming FTA's will inevitably expose our economy to global competition, in a way that has not been witnessed to this day. Second, the "third industrial revolution" is underway, without the acknowledgment of some "purist" members of academia and public sector officials.

As is common knowledge, this energy-mining boom requires careful management at the macro level to avoid it turning into a "curse" for the agro-industrial exports. In facing structural pressures of exchange rate appreciation resulting from a Dutch Disease, the best antidote comes from "sowing the seeds" of the expansion. This may be done by modernizing our productive infrastructure, lowering transportation

costs and making the labor market more flexible. Only in this manner will we be competitive in sectors other than exporting commodities.

Clearly, the developed countries of the G-7 have gone through the “secular” phase of deindustrialization and are well aware that economic development will depend on their capacity to develop cutting-edge technologies in the services sector. Recent cyber-developments are good evidence of what they have accomplished thus far, absorbing labor force that was otherwise being displaced by the industrial withering (… until the devastating fiscal-financial crisis of 2007-2011).

Bhagwati (2009) has argued, convincingly, that we must not fall prey to the “fetish” of believing that our industrial sector is capable of absorbing labor force. In fact, recent G-7 figures show that the services sector has actually been the one generating more than two thirds of new jobs. Therefore, the flexibilization of trade services and productivity-enhancing policies should be the “artillery” used to face this stage of tertiary sector development, covering the period 1990-2020.

However, a second view argues that the historical backdrop and the course of emerging economies may prove to be very different from those of the developed world and the G-7. Anif (2001c) has argued that the transition from industry to services may be abrupt and traumatic for many emerging countries if these: a) lack an adequate infrastructure that allows for lowering costs and dealing with exchange rate appreciation resulting from a boom in exporting commodities; and b) leads to a “sudden withering” of the industry, in times when they are incapable of making the “technological leap” that would enable a rapid transition towards the tertiary sector, as has been the case of developed countries.

Unfortunately, Colombia has remained trapped in this scheme of “early withering” of its industry, as a result of the commodities boom and exchange rate appreciation, at the same time unable to make that “technological leap” towards the services sector. Can anyone really claim that the deindustrialization in Colombia “doesn’t seem worrying” because the average wage in China has increased from US$70 to US$100 per month, whereas in Colombia the minimum

legal wage has been stable at a “mere” US$330 per month or US$490 per month when taking into account additional costs.

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Appendix 1. Definition of Variables and Descriptive Statistics

Table A.1.1. Definition of Variables and Descriptive Statistics

Variables	Description	Construction	Source
GDP	Gross domestic product base 1975-2005 (billion)	National Accounts	Dane
GDP_industry	Industry gross domestic product base 1975-2005 (billion)	National Accounts	Dane
GDP_industry/GDP	Industry GDP share in total GDP	Anif	Dane
GDP_percapita	Gross domestic product per capita base 1975-2005, constant prices of 2000	Anif	Dane/World Bank
GDP_services	Services gross domestic product base 1975-2005 (billion)	National Accounts	Dane
GDP_services/GDP	Services GDP share in total GDP	Anif	Dane
Total_Export	Total exports (million US dollars FOB)	Anif	Banrep/UNComTrade/ International Trade Statistics
Mining_Export	Mining exportaciones (million US dollars FOB)	Anif	Banrep-UN Comtrade
Mining_Export/Total_Export	Share of mining exports in total exports	Anif	Banrep-UN Comtrade
REER	Real Effective Exchange Rate	Anif	World Bank-Banrep
Terms of Trade	Terms of Trade	Anif	World Bank-Banrep
Change in Terms of Trade	Change in Terms of Trade	Anif	World Bank-Banrep
Boom	Dummy for mining-energy boom	Anif	Anif
Openness	Share of Exports and Imports over GDP	(Export + Import)/ GDP	Banrep

Source: Anif

Table A.1.2. Descriptive Statistics of Model Variables

Variable	Obs	Mean	Standard Deviation	Min	Max
GDP_industry/GDP	45	18.3	3.81157	13.05	23.47
Mining_Export/Total_Export	48	29.8	16.47702	4.20	64.91
REER	48	82.7	18.93229	55.93	119.68
GDP_percapita	48	2,297	460.1227	1,488	3,237
GDP_services/GDP	50	51.2	6.153127	43.00	62.00
Openness	42	31.7	3.116701	24.74	38.58
Change in Terms of Trade	47	0.78	4.652246	´-2,857246	30.4

Source: Anif calculations

Table A.1.3. Partial Correlations of Model Variables

	GDP_industry/GDP	Mining_Export/ Total_Export	REER	GDP_percapita	GDP_services /GDP	Openness	Change in Terms of Trade
GDP_industry/GDP	1						
Mining_Export/Total_Export	-0.8506	1					
REER	-0.6492	0.617	1				
GDP_percapita	-0.4587	0.8912	0.3652	1			
GDP_services/GDP	-0.8743	0.6868	0.2978	0.7865	1		
Openness	-0.8046	0.7296	0.7785	0.7043	0.4835	1	
Change in Terms of Trade	-0.1066	0.2062	0.2688	0.327	0.1732	0.2822	1

Source: Anif calculations

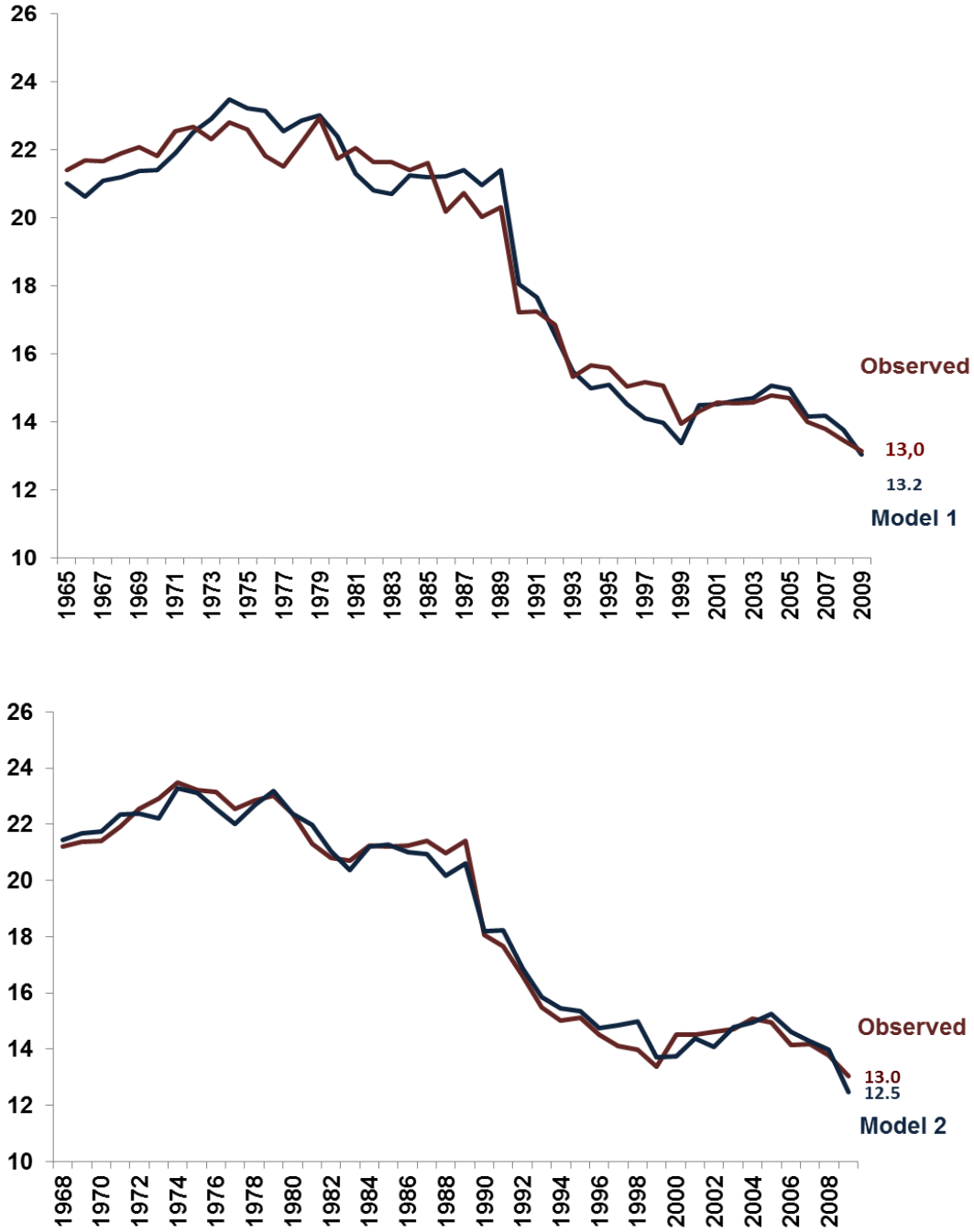
Appendix 2. In-sample Forecast of Short-Run Models

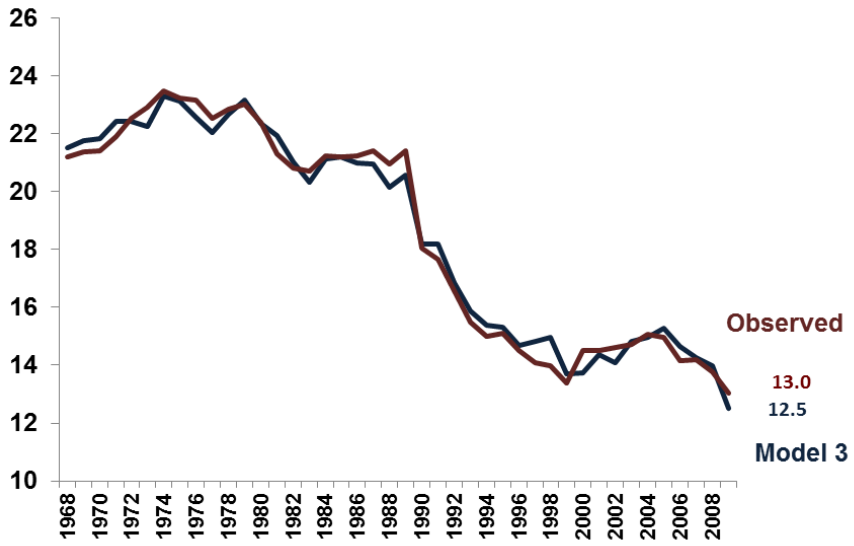
Figure A.2.1 shows the in-sample forecast estimations for each of the models described in Chapter 4 and a comparison of observed data related to the deindustrialization process that occurred in Colombia since the 1970's.

Estimations for models 1 and 2, which include key explanatory and control variables and a contemporaneous variable to avoid any possible spurious results, show good adjustment with the observed trend. In fact, the model reaches levels of adjustment of 70% and 87% accordingly.

However, the greatest level of adjustment is obtained when estimating the Koyck transformation, given in model 3 (see Figure A.2.1). These forecasts have highly coincide with observed data, which is also reflected in an R-squared of 90%.

Figure A.2.1 In-sample Forecast of Short-Run Models

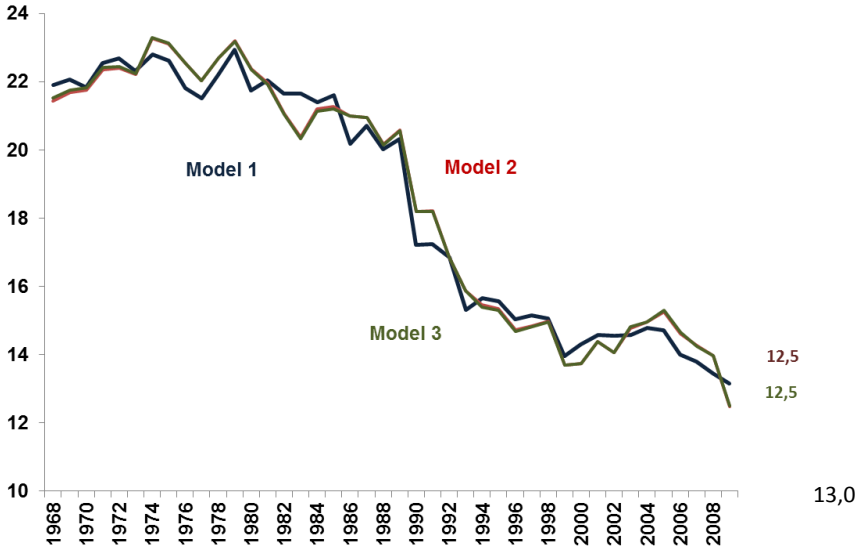




Source: Anif calculations based on Dane

Figure A.2.2 summarizes forecast estimations for all three models. Regardless of the model specification that was used, there is evidence that the process of deindustrialization has been premature for the past forty years.

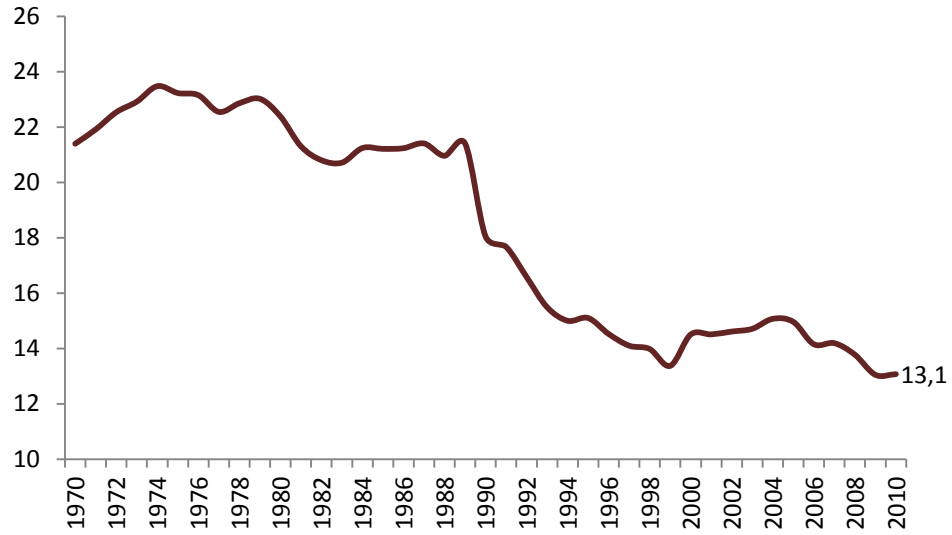
Figure A.2.2 Comparison of Short-Run Model Forecast Estimations



Source: Anif calculations based on Dane

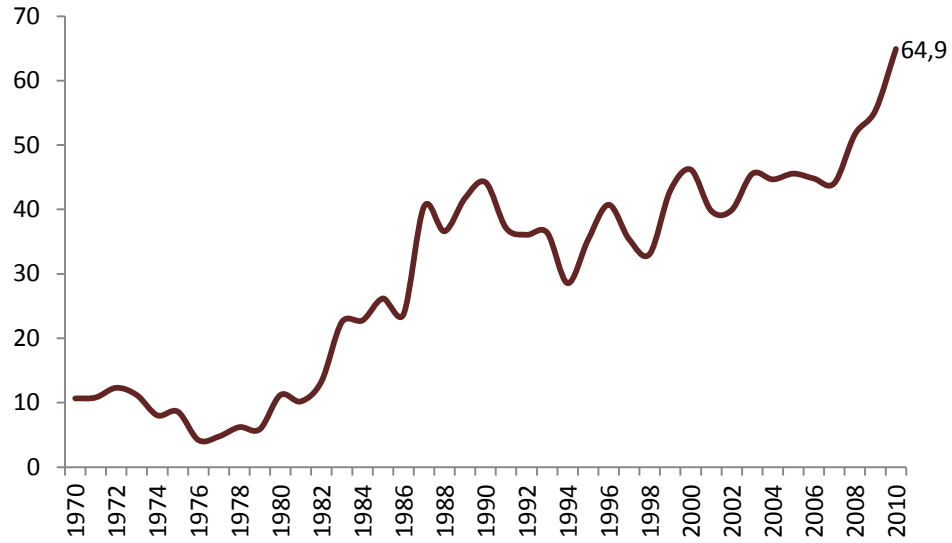
Appendix 3. Testing Stationarity

Figure A.3.1 Industry GDP/ GDP (%)



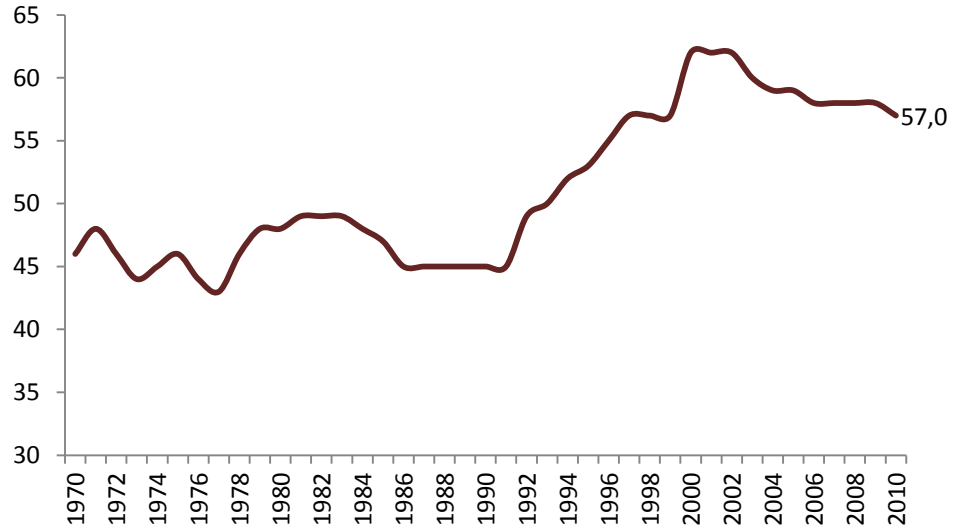
Source: Anif calculations based on Dane.

Figure A.3.2 Mining Exports/ Total Exports (%)



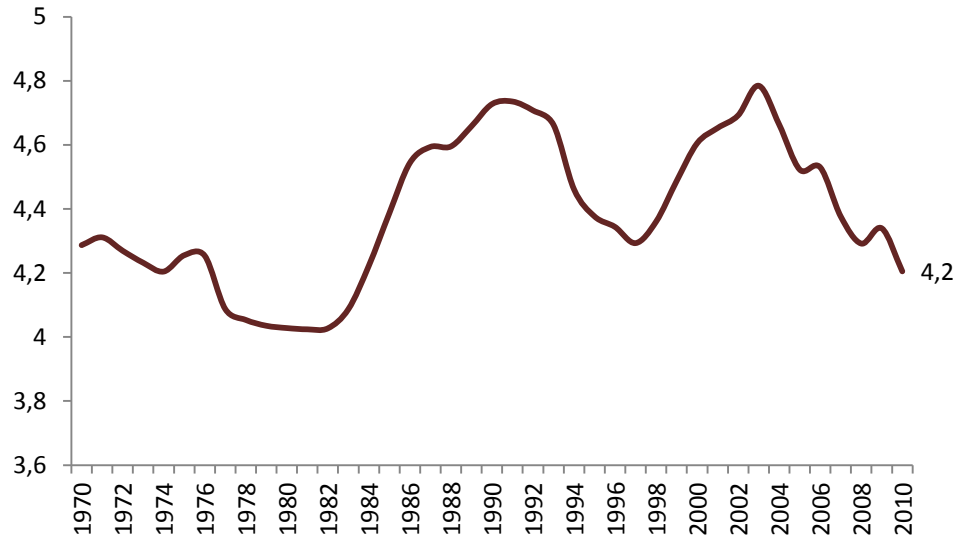
Source: Anif calculations based on Dane y Banco de la República

Figure A.3.3 Services GDP/ Total GDP (%)



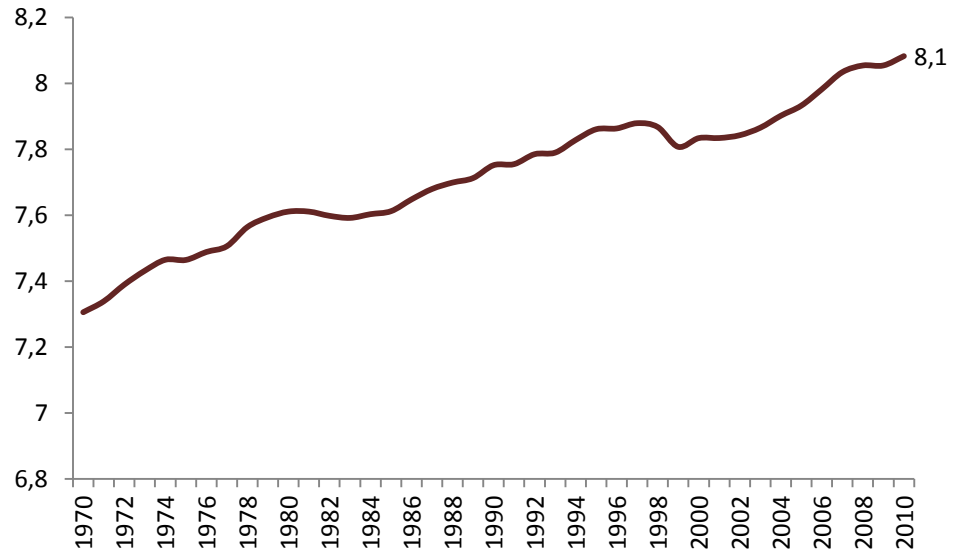
Source: Anif calculations based on Dane

Figure A.3.4 Ln (REER)



Source: Anif calculations based on Banco de la República and World Bank

Figure A.3.5. Ln (GDP per capita)



Source: Anif calculations based on Dane

Table A.3.1. Dickey Fuller Unit Root Test

Variable	ADF unit root test of levels	ADF unit root test of first differences
Industry /GDP	P-value = 0.4172 > 0.05	P-value = 0.0038 < 0.05
Mining_Export/Total_Export	P-value = 0.6359 > 0.06	P-value = 0.0039 < 0.06
ln (REER)	P-value = 0.7105 > 0.05	P-value = 0.0000 < 0.05
Services/GDP	P-value = 0.7121 > 0.05	P-value = 0.0036 < 0.05
ln (GDP_percapita)	P-value = 0.7110 > 0.05	P-value = 0.0000 < 0.05

Source: Anif calculation

Appendix 4. Testing for Cointegration

In order to determine whether or not, one or several, vectors of cointegration exist between the variables in equations (1) and (2), we perform Johansen's test for

cointegration. In the case where trace statistics and the maximum proper value are greater than the critical value we confirm that there is a relationship with some level of cointegration. In the case in which the range is zero, there is no cointegration. For a range of 1, we speak of a unique cointegration relationship, and if the range is 2, there are two vectors of cointegration, and so forth.

Figure A.4.1 shows the results of Johansen's test for cointegration for the Dutch Disease hypothesis. We include three lags in the estimation. We find that the null hypothesis of zero range of cointegration is rejected. However, the hypothesis of range 1 is non-rejected, meaning that at least one long-run cointegration relationship exists between deindustrialization, the REER and the mining exports/total exports variable.

Table A.4.2 reports the test for cointegration of the secular hypothesis of deindustrialization, including 3 lags in the estimation. In this case the zero range hypothesis is non-rejected, meaning that there doesn't appear to be a long-run relationship between the proxy variable used for deindustrialization and the explanatory variables used in the secular hypothesis model.

Table A.4.1 Johansen Test for Cointegration of the Dutch Disease Hypothesis

Johansen tests for cointegration				
Constant trend				
Number of obs = 38				
Period: 1973 - 2010				
Lags= 3				
Max range	Parameters	Eigenvalue	Statistic	Value
0	21	.	384.193	29.68
1	26	0.47623	13.8448*	15.41
2	29	0.29238	0.7023	3.76
3	30	0.01831		

Source: Anif calculations

Table A.4.2. Johansen Test for Cointegration to test the Secular Hypothesis Deindustrialization

Johansen tests for cointegration

Constant trend
Number of obs = 36
Period: 1973 - 2010
Lags = 5

Max range	Parameters	Eigenvalue	Statistic	Value
0	21	.	21.8089*	29.68
1	26	0.33449	63.352	15.41
2	29	0.15269	0.0389	3.76
3	30	0.00102		

Source: Anif calculations