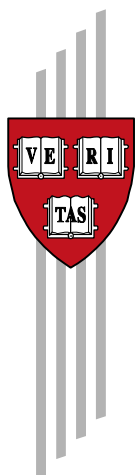


Achieving Export-Led Growth in Colombia

Ricardo Hausmann and Bailey Klinger

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Abstract: The purpose of this paper is to analyze Colombia's experiences with and opportunities for export led growth. We first review Colombia's growth and export performance over the past 30 years and find that the country is indeed facing an export challenge. We then go on to develop new metrics and apply them to Colombia's export challenge. First, we consider the opportunities for upgrading quality within existing exports, and find that Colombia has very little opportunity for growth in this dimension. Second, we consider the level of sophistication of the current export basket, and find that it is low and commensurate with the lack of export dynamism. Although not a significant drag on growth, the current export basket will not be sufficient to fuel future output growth. Finally, we develop the concept distances between products, open forest, and the option value of exports to examine the possibility that Colombia's current structure of production is itself a barrier to future structural transformation. While improvements in the export package have been slow in the past, this evidence suggests that Colombia does now enjoy more options for future structural transformation. As there are attractive options for structural transformation nearby, a parsimonious approach to industrial strategy, rather than a risky strategic bet to move to a new part of the product space, seems appropriate. In order to inform such a strategy, we use the metrics developed in the diagnostic to evaluate new export activities in terms of their proximity to current activities, their sophistication, and their strategic value. We identify the sectors representing the best tradeoffs between these aims for Colombia as a whole, as well as its regions. We also devote separate attention to the topic of Agricultural exports, and to exports of services. Finally, we use these metrics to analyze the list of 'high-potential' sectors in the United States, developed by another firm, as well as the sectors prioritized in Colombia's Agenda Interna. These external lists of high-potential sectors are found to be sensible, but could be further rationalized using these metrics. This identification of nearby, high-potential, and strategically valuable sectors is not meant to be a definitive list for targeted subsidies and 'picking winners'. Rather, it provides a robust data-driven approach to inform the next steps in achieving export-led growth in Colombia: which private sector actors should be consulted first? What sector-specific reforms should be stressed? How should public spending on infrastructure and training, which are also sector-specific, be prioritized? What foreign firms should be targeted by FDI promotion agencies? These decisions can be informed by our analysis and the accompanying data.

Keywords: Colombia, Structural Transformation, Product Space

JEL Codes: O54, F19, O14

Achieving Export-Led Growth in Colombia

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**Center for International Development
Harvard University**

May 2007

EXECUTIVE SUMMARY

The purpose of this paper is to analyze Colombia's experiences with and opportunities for export led growth. We first review Colombia's growth and export performance over the past 30 years and find that the country is indeed facing an export challenge. We then go on to develop new metrics and apply them to Colombia's export challenge.

First, we consider the opportunities for upgrading quality within existing exports, and find that Colombia has very little opportunity for growth in this dimension. Second, we consider the level of sophistication of the current export basket, and find that it is low and commensurate with the lack of export dynamism. Although not a significant drag on growth, the current export basket will not be sufficient to fuel future output growth. Finally, we develop the concept distances between products, open forest, and the option value of exports to examine the possibility that Colombia's current structure of production is itself a barrier to future structural transformation. While improvements in the export package have been slow in the past, this evidence suggests that Colombia does now enjoy more options for future structural transformation.

This diagnostic reveals that Colombia's historically poor export performance and unsophisticated export basket have been a problem, yet the country now seems poised for better performance in exporting and structural transformation. As there are attractive options for structural transformation nearby, a parsimonious approach to industrial strategy, rather than a risky strategic bet to move to a new part of the product space, seems appropriate. In order to inform such a strategy, we use the metrics developed in the diagnostic to evaluate new export activities in terms of their proximity to current activities, their sophistication, and their strategic value. We identify the sectors representing the best tradeoffs between these aims for Colombia as a whole, as well as its regions. We also devote separate attention to the topic of Agricultural exports, and to exports of services. Finally, we use these metrics to analyze the list of 'high-potential' sectors in the United States, developed by another firm, as well as the sectors prioritized in Colombia's *Agenda Interna*. These external lists of high-potential sectors are found to be sensible, but could be further rationalized using these metrics.

This identification of nearby, high-potential, and strategically valuable sectors is not meant to be a definitive list for targeted subsidies and 'picking winners'. Rather, it provides a robust data-driven approach to inform the next steps in achieving export-led growth in Colombia: which private sector actors should be consulted first? What sector-specific reforms should be stressed? How should public spending on infrastructure and training, which are also sector-specific, be prioritized? What foreign firms should be targeted by FDI promotion agencies? These decisions can be informed by our analysis and the accompanying data.

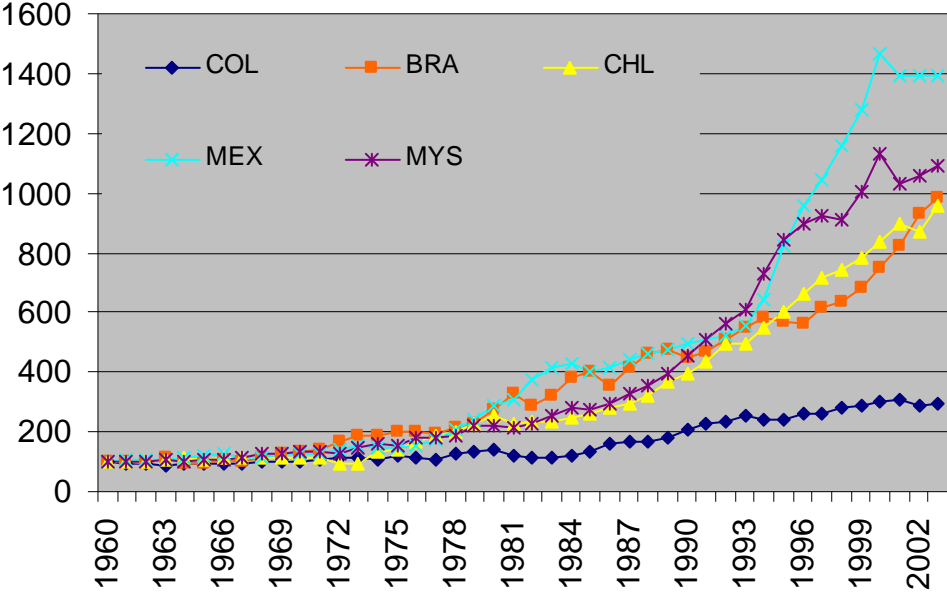
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REVIEW OF OUTPUT AND EXPORT PERFORMANCE IN COLOMBIA

In the past 44 years, exports per capita in Colombia have barely doubled. This performance has been quite poor in comparison to the more successful countries in Latin America. In Brazil and Chile, exports per capita are now 10 times their 1960 levels, and in Mexico they are 14 times their 1960 levels.

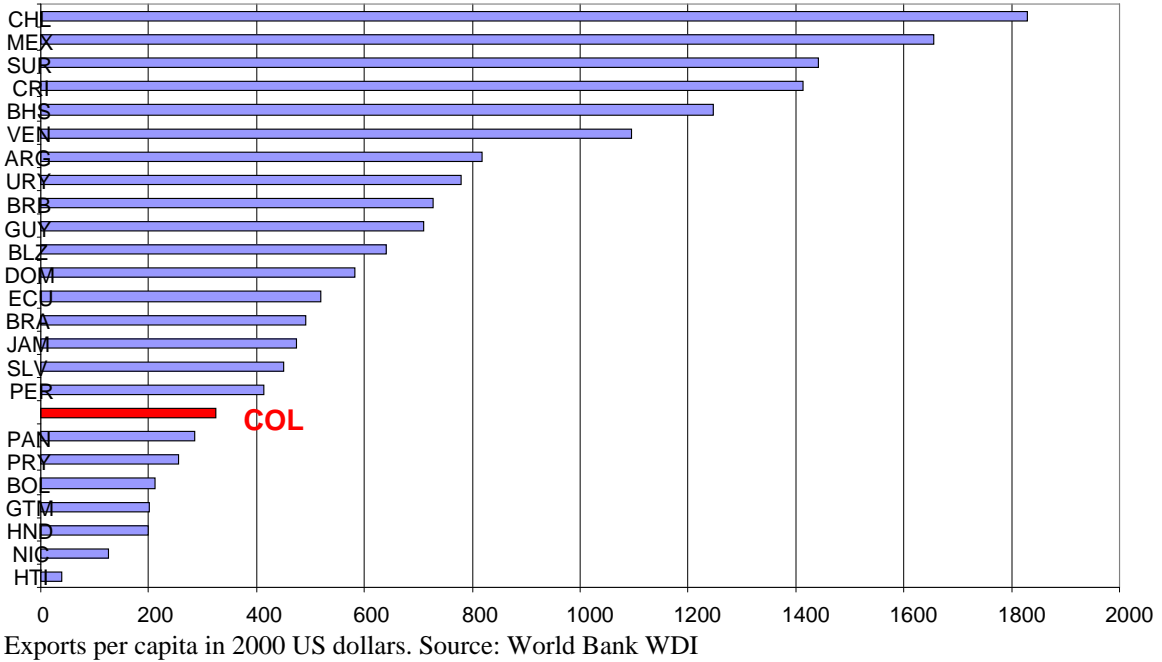
Figure 1
Exports per capita: 1960-2003



Source: World Bank WDI . Exports of goods and services in constant 2000 dollars divided by total population, scaled to 100 in 1960.

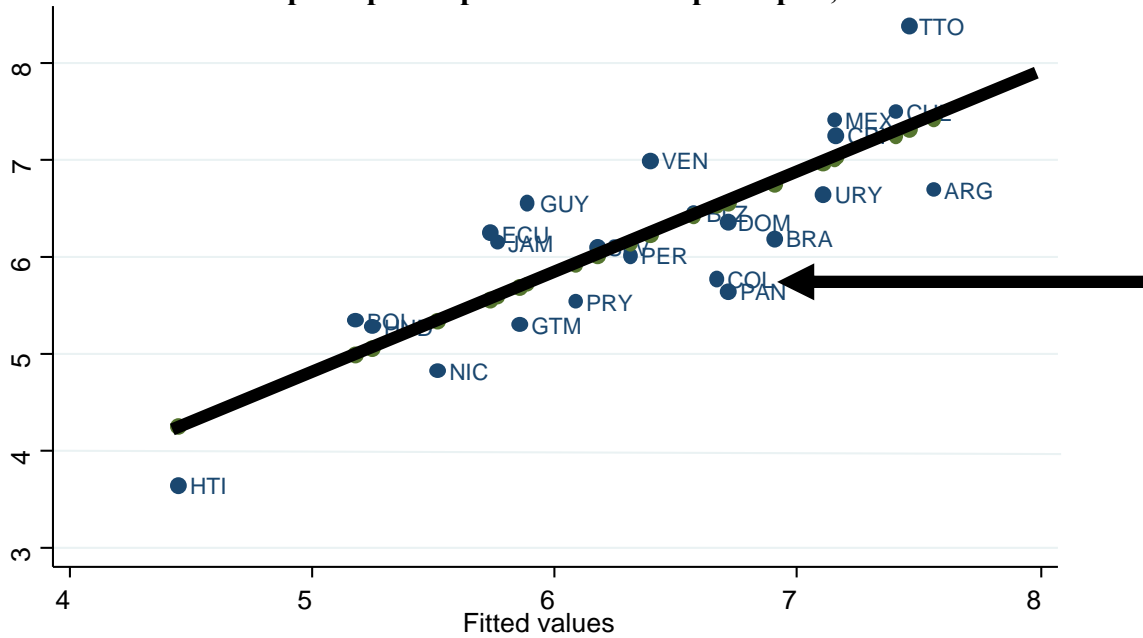
As of 2004, exports per capita in Colombia were among the bottom third in Latin America (see below).

Figure 2
Exports per capita, 2004



This poor export performance is not simply due to a low level of income per capita in Colombia. In fact, the figure below shows that Colombia's exports per capita are surprisingly low given its level of income. The country is an outlier in terms of poor export performance, particularly after controlling for GDP per capita.

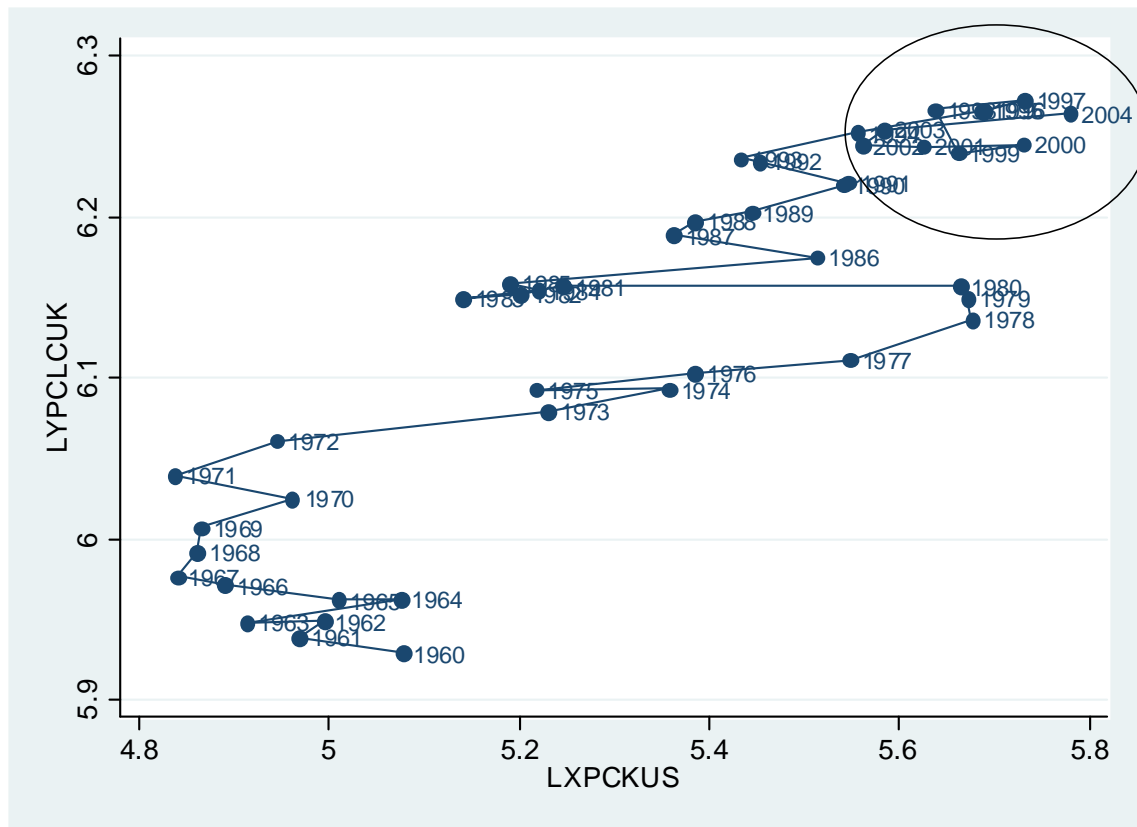
Figure 3
Exports per Capita versus GDP per capita, 2004



Source: Author's Calculations

How have exports and income per capita evolved over time? The figure below shows exports per capita on the x-axis and output per capita on the y-axis. Growth was exported in the 1970s, and was followed by a collapse in the 1980s. There was another expansion in exports per capita from the mid 1980s until the late 1990s. During the seven years from 1997 to 2004, there has been relative stagnation in exports per capita and income per capita, as shown in the circle.

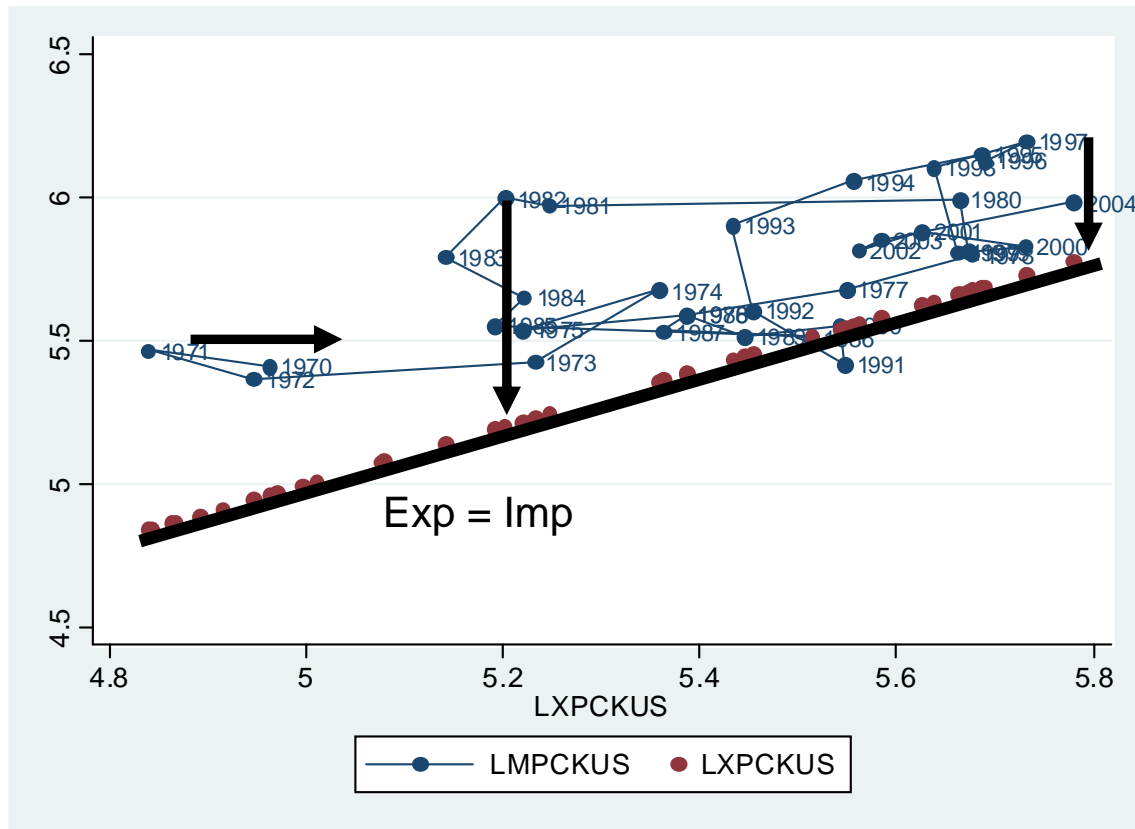
Figure 4
Evolution of Exports and Output per capita, 1960-2004



Source: World Bank WDI. X-axis is the log of exports per capita, y-axis is the log of GDP per capita, both in constant 2000 dollars.

Imports per capita have in turn been constrained. The figure below illustrates that over the long term, there are no imports without exports, and Colombia's imports have been governed by its export performance.

Figure 5
Exports and Imports per Capita



The x-axis shows the log of exports per capita in constant 2000 US dollars. The y-axis shows the equivalent for imports. Source: World Bank WDI.

These results suggest that the low levels of long-term growth in Colombia are not independent of the lack of export dynamism. Exports per capita are low relative to levels of income, and are at similar levels as those during the coffee boom in the 1970s. Accelerating growth in Colombia will depend on addressing this lack of export dynamism. In short, Colombia's growth challenge is an export challenge.

DIAGNOSING COLOMBIA'S EXPORT CHALLENGE

While it is clear that there is a challenge facing Colombia's tradeables sector, we must dig deeper in order to understand the nature of this challenge and how to overcome it. To this end, we will develop five key concepts:

- 1- Distance to the quality frontier: how much room is there to improve quality (and prices) in existing product categories?
- 2- Product sophistication: how rich are countries with comparative advantage in a particular product? How high are salaries in countries that export a product?
- 3- Distance to other products: how different are the capabilities required to produce a new good compared to current capabilities
- 4- Open forest: how attractive is it to move to new products? Depends on distance and sophistication
- 5- Option value of a new product: how much is the open forest improved by successfully producing a new product? How much does it make you closer to other attractive and nearby products?

These five sections will provide tools to better diagnose the export challenge facing Colombia, as well as methods to help better direct public resources to support the process of structural transformation and export growth.

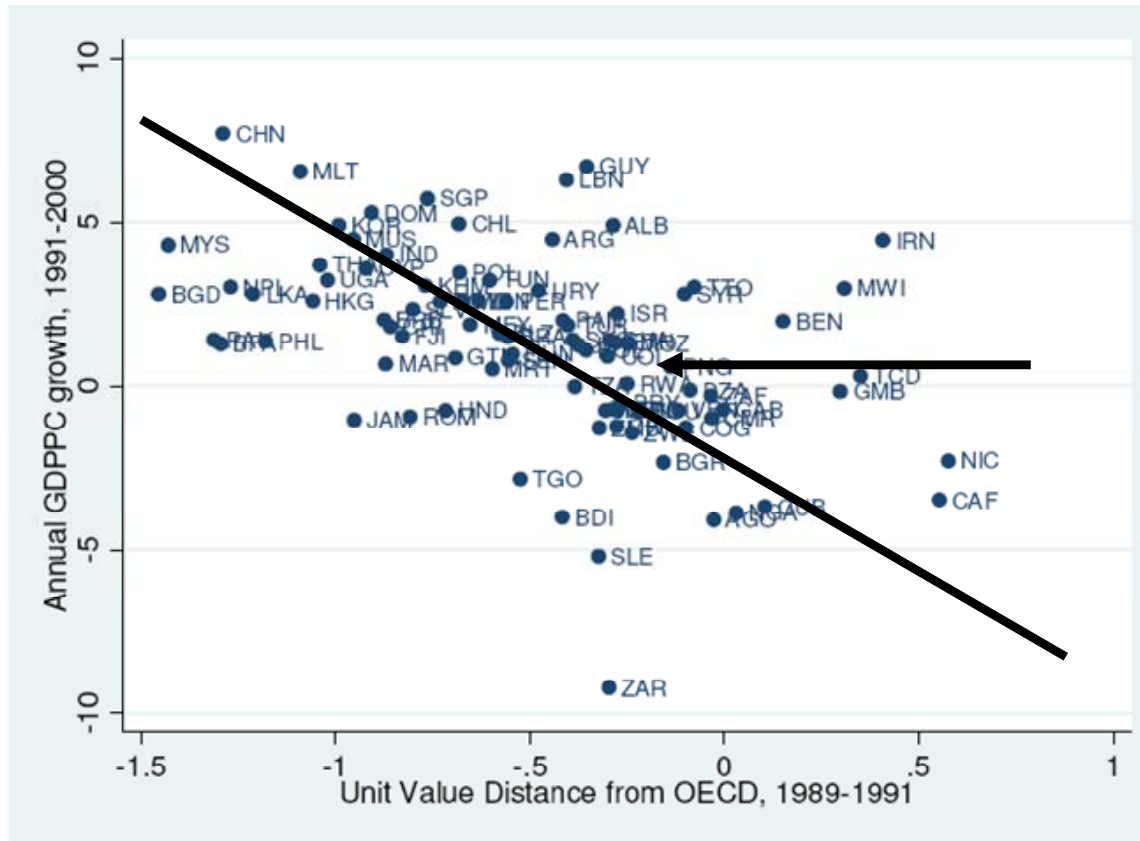
Distance to the frontier within existing products

If the goal is to increase the dollar value of exports per capita of Colombia, one obvious way of doing so is to upgrade the quality of existing exports. That is, to increase the prices fetched for the current export package.

How does this quality upgrading play out internationally? Recent research finds that when a country exports a new product, they tend to enter the market at a lower quality. But this quality, as measured by unit prices, converges to the global frontier at a rate of 5 to 6% per annum *unconditionally* (Hwang 2007). That is, once a country begins to successfully export a particular product, its quality increases to the global frontier unconditionally at a relatively rapid pace.

The implication of this finding is quite important: countries that are currently farther away from the global frontier in products already exported have access to a relatively rapid, and seemingly unconditional, channel of growth. The figure below shows this result, with output growth on the y-axis and the room for quality upgrading within existing products on the x-axis. Countries with room for upgrading in existing products grow faster.

Figure 6
Unit Value Gaps and Growth

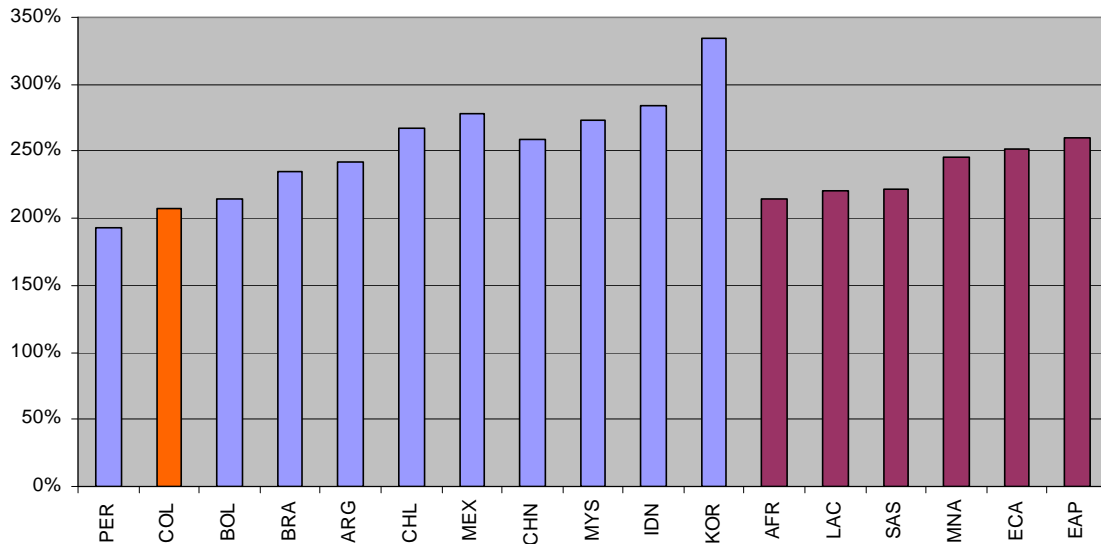


Unit value distance is the log difference between unit values in the highest-priced country's exports and the unit values in Colombia's exports, for each product exported. These gaps are then weighted by the share of each good in total exports. Source: Hwang 2007

We can see that Colombia is to the right of most countries on the x-axis, meaning there was little room for quality upgrading within existing exports in Colombia at the outset of the 1990s, and the subsequent growth rate was correspondingly low.

During the 1990s, the opportunities for within-product upgrading worsened rather than improved. The figure below shows that as of the end of the 1990s, Colombia had one of the lowest export-weighted unit value gaps in its peer group. It is lower than the median value for all regions of the world, including sub-Saharan Africa.

Figure 7
Unit Value Gaps



Source: Author's calculations using Hwang 2006. Values are 1998-2000 averages.

These figures show that within-product upgrading is a relatively attractive channel through which export growth occurs, but in the case of Colombia, this channel is not large enough to lead to substantial growth. There is very limited space to improve quality within the existing export package, and creating room for within-product quality upgrading in the future will require the emergence of new export activities.

Sophistication of the export basket

In addition to exporting better of the same, another channel through which exports per capita could rise is simply by exporting more of the same. Yet recent research shows that the payoff from the existing export basket depends on its composition, specifically the level of export 'sophistication'.

The level of 'sophistication' of exports can be indirectly measured by examining the wages of those countries producing them. This measure, EXPY, is taken from Hausmann, Hwang and Rodrik (2006). In this paper the authors find that is not only how much, but also what you export that matters for growth. Countries that have a more sophisticated export basket enjoy accelerated subsequent growth.

This measure of export sophistication is constructed as follows: the authors develop a measure of the revealed sophistication for each product, which they call PRODY, as the revealed comparative advantage (RCA)-weighted GDP per capita of each country that exports the good:

$$PRODY_{i,t} = \sum_c \frac{(xval_{i,c,t} / X_c)}{\sum_j (xval_{j,c,t} / X_c)} Y_c$$

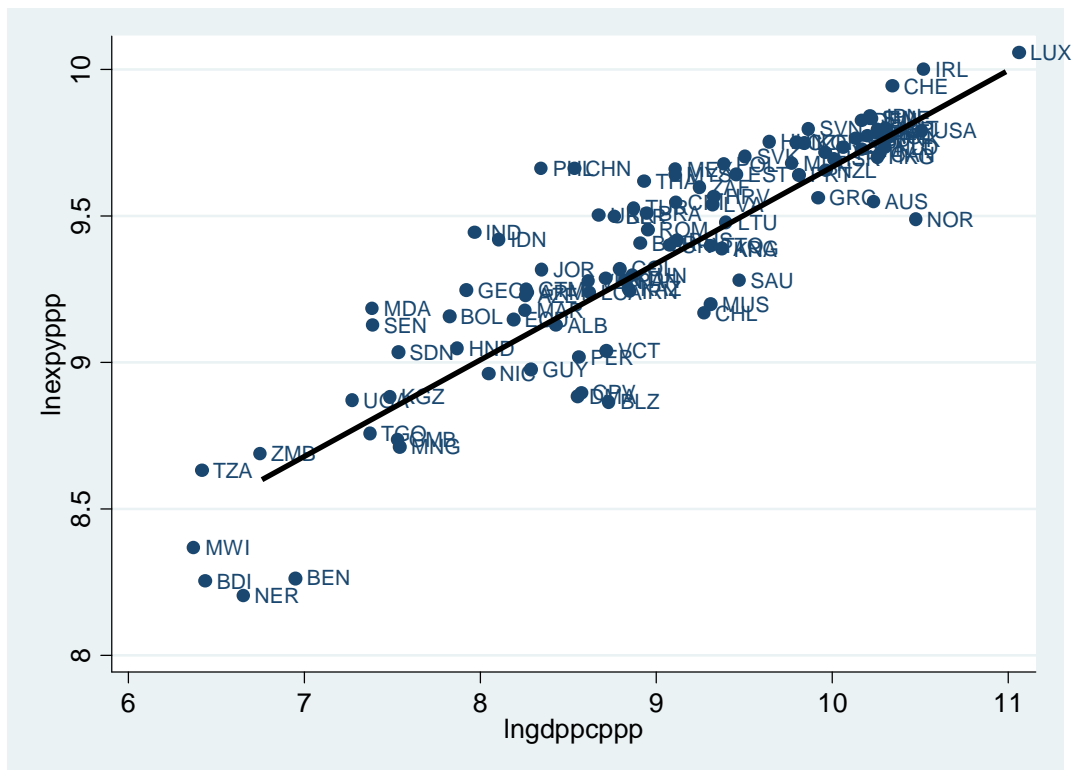
where $xval_{i,c,t}$ equals exports of good i by country c in year t , X_c equals total exports by country c , and Y_c equals GDP per capita of country c . This is a measure of the GDP per capita of the ‘typical’ country that exports product i . Richer-country goods are more ‘sophisticated’, and are associated with higher wages. It is important to keep in mind that this is a measure of sophistication that is inferred from the types of countries exporting a good—it is not measuring sophistication directly.

This product-level measure of sophistication can then be used to measure the sophistication of a country’s entire export basket as a whole. The authors call this measure EXPY. EXPY is simply the PRODY of each good (i) that the country c exports, weighted by that good’s share in the country’s export basket (X_c). It represents the income level associated with a country’s export package.

$$EXPY_{c,t} = \sum_i \left(\frac{xval_{c,i,t}}{X_{c,t}} \right) PRODY_{i,t}$$

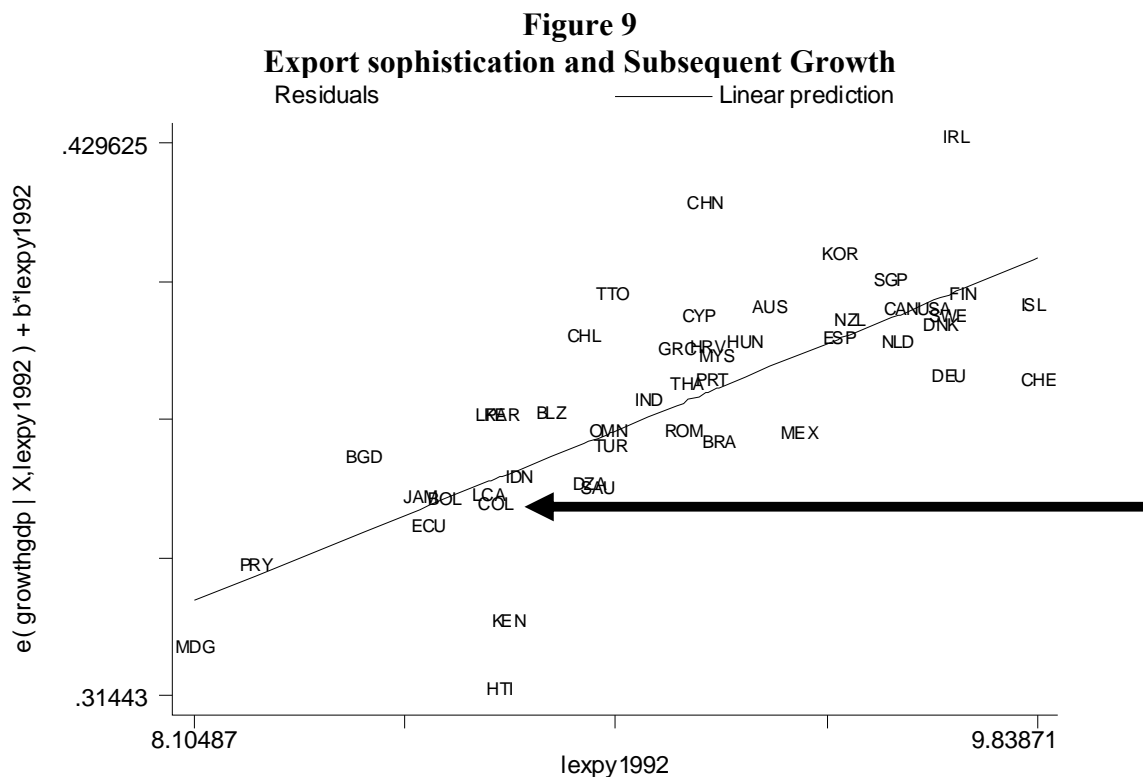
Not surprisingly, the level of income implied by a country’s export basket (EXPY) rises is correlated with actual income. That is, rich countries produce rich country goods, as illustrated below.

Figure 8
Export Sophistication & GDP per capita, 2004



The x-axis is real GDP per capita (PPP) in logs, and the y-axis is EXPY (PPP) in logs. Source: Author’s calculations

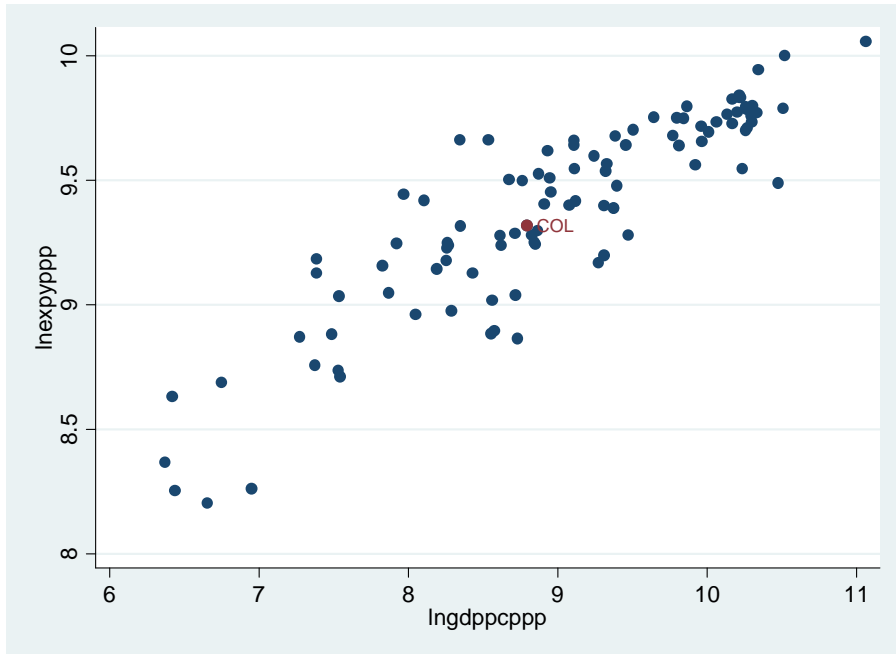
However, there is significant variance in this relationship. Some countries have managed to discover products that are associated with a level of income much higher than their own, such as China, India, Indonesia, the Philippines, Mexico, and Ireland. Moreover, this variance has important consequences: the authors find that countries converge to the income level implied by their export basket. In essence, countries become what they export. This means that if a country has managed to begin exporting a sophisticated export basket relative to its income level, subsequent growth is higher as GDP converges to that level. However, countries specialized in relatively unsophisticated export baskets suffer lagging economic performance. Put another way, the payoff of exporting more of the same depends on export current sophistication. The figure below shows the level of export sophistication (on the x-axis) versus subsequent GDP growth, with a line fitted to the expected level of growth given export sophistication.



The x-axis is the log of initial EXPY, and the y-axis is subsequent GDP growth. The linear prediction is expected growth of GDP per capita given initial EXPY. Source: Hausmann Hwang & Rodrik 2006.

How does Colombia fare in this dimension? Below we show the graph of export sophistication versus GDP per capita with Colombia signaled out. As is clearly shown, the level of sophistication of Colombia's current export basket is moderate. Correspondingly, above we see that Colombia's low growth is exactly what would have been expected given this level of export sophistication.

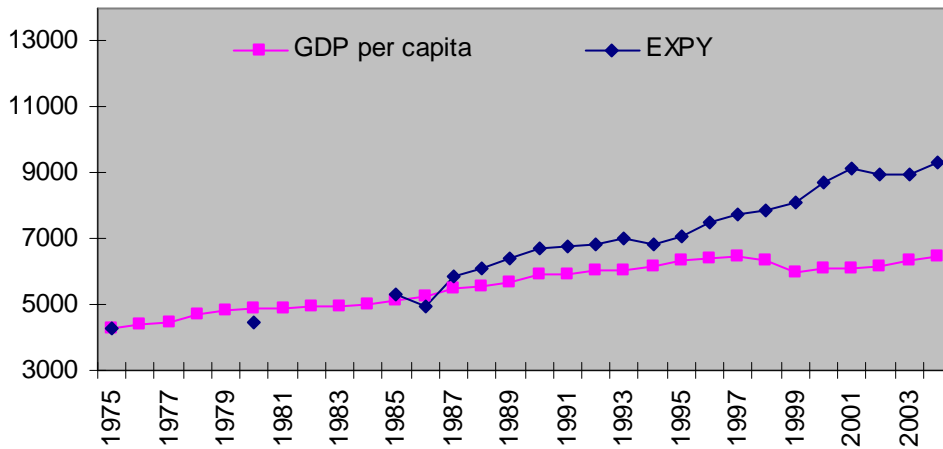
Figure 10
Export Sophistication & GDP per capita, 2004



The x-axis is real GDP per capita (PPP) in logs, and the y-axis is EXPY (PPP) in logs. Source: Author's calculations

The figure below shows the evolution of Colombia's export sophistication over the past thirty years. Over the past 20, there has been a moderate increase in the level of export sophistication.

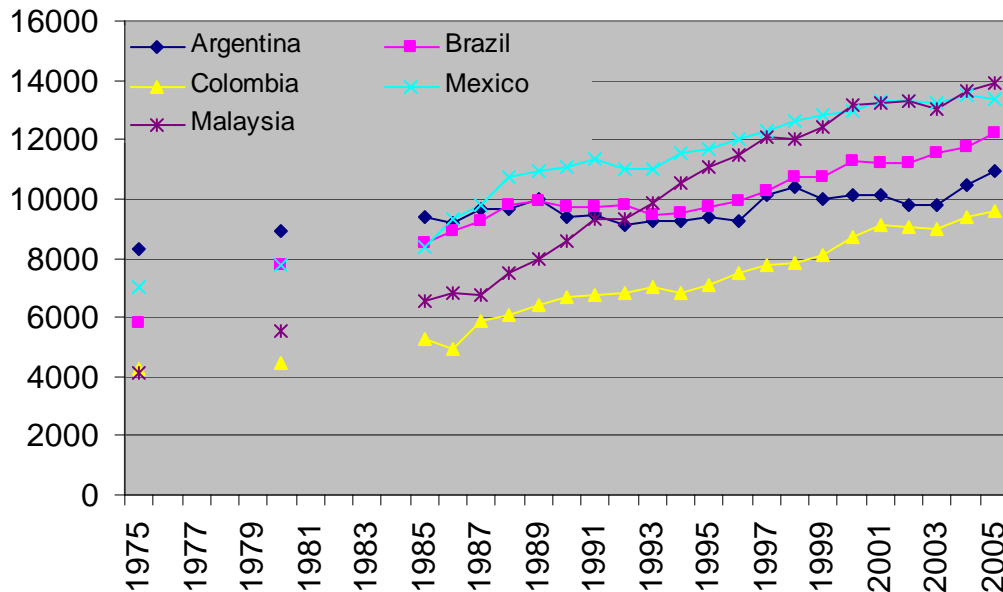
Figure 11
EXPY Over Time
Colombia



Source: Author's Calculations using Feenstra et. al. (2005) for the 1975-2000 period, and UN COMTRADE for the 2000-2004 period, merged using relative changes from 2000 observation which is common to both series.

Yet this moderate increase has not been enough to converge the major Latin American economies, or other comparators. The figure below shows that while Colombia has caught up to Argentina in terms of export sophistication, it has not closed the gap with either Mexico or Brazil. Malaysia, which started 1975 with the same level of export sophistication, has since opened a gap of over 50%.

Figure 12
EXPY Over Time, Comparative



Source: Author's Calculations using Feenstra et. al. (2005) for the 1975-2000 period, and UN COMTRADE for the 2000-2004 period, merged using relative changes from 2000 observation which is common to both series.

The products contributing most to Colombia's current level of export sophistication are listed below.

Table 1
Top 10 Contributors to Colombia's EXPY, 2005

Product	Product Name	PRODY (ppp)	Contribution to EXPY	Exports, US M (2005)
8703	Motor cars and other motor vehicles	\$ 20,489	417	431
3004	Medicaments of mixed or unmixed pro	\$ 23,349	252	228
3902	Polymers of propylene or of other o	\$ 17,917	163	193
3920	Other plates..., of plastics, not r	\$ 22,338	118	112
4901	Printed books, brochures, leaflets	\$ 18,054	106	124
4011	New pneumatic tyres, of rubber	\$ 20,419	94	98
3921	Other plates, sheets, film, foil an	\$ 20,355	73	76
7210	Flat-rolled products of iron/non-al	\$ 18,312	70	81
8708	Parts and accessories of the motor	\$ 18,686	64	72
3903	Polymers of styrene, in primary for	\$ 17,729	59	71

Source: Author's Calculations using UN COMTRADE. Product codes are HS 1988/1992 4-digit. Products with $PRODY \geq 1.5 * EXPY$ in 2005, sorted by contribution to EXPY.

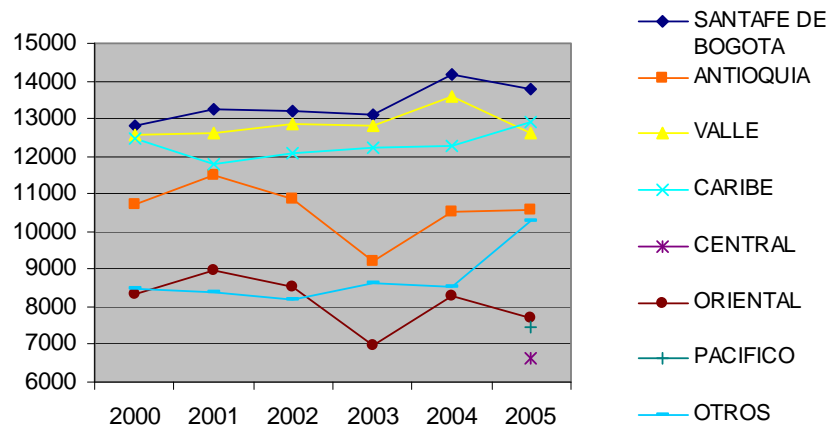
We can extend this analysis to the regional level, using the following groupings by department (taken from regional export data).

Región	Departamentos
Santafé de Bogotá D.C. Y Cundinamarca	Santafé de Bogotá y Cundinamarca
Antioquia	Antioquia
Valle del Cauca	Valle del Cauca
Caribe	Atántico, Bolivar, Cesar, Córdoba, La Guajira, Magdalena, San Andrés y Providencia y Sucre
Central	Caldas, Quindío, Risaralda, Huia, Tolima y Caquetá.
Oriental	Boyacá, Meta, Norte de Santander y Santander
Pacífico	Cauca, Chocó, Nariño
Orinoquía y Amazonía	Arauca, Casanare, Putumayo, Amazonas, Guainía, Guaviare, Vaupés y Vichada

Source: Exportaciones Regionales, DNP

Using data on exports by region, we can repeat the analysis of export sophistication over time. The figure below shows EXPY from 2000-2005 by region.

Figure 13
EXPY by Region



Source: Author's calculations using PRODY calculated internationally, with regional export data provided by the DNP. Orinoquia was dropped as there is only one export good from that region.

Prior to 2005, Coffee exports were not disaggregated by region. As the export baskets of Central and Pacifico are dominated by coffee, this makes the EXPY values pre-2005 unreliable. For this reason, they are omitted. This figure shows that, using this measure of export sophistication, Bogota has the most sophisticated export basket, followed by Caribe, Valle, and Antioquia. It is important to keep in mind that here we are not measuring the sophistication of exports directly. Rather, we are inferring it using the GDP per capita of other countries exporting similar goods. Bogota has more of a 'rich country' export basket than the other regions.

The figure below shows EXPY from 2000-2005 by region, followed by the major contributors to EXPY by region.

Table 2
Top 10 Contributors to Regional EXPY, 2005

SANTAFE DE BOGOTA

Product	Product Name	PRODY (ppp)	Contribution to EXPY	Exports, US M (2005)
8703	Motor cars and other motor vehicles	20489	1616	279
3004	Medicaments of mixed or unmixed pro	23349	696	105
4901	Printed books, brochures, leaflets	18054	460	90
8704	Motor vehicles for the transport of	15094	295	69
3920	Other plates..., of plastics, not r	22338	295	47
6002	Other knitted or crocheted fabrics	15059	255	60
3921	Other plates, sheets, film, foil an	20355	234	41
3302	Mixtures of odoriferous substances	29383	212	26
8708	Parts and accessories of the motor	18686	207	39
9403	Other furniture and parts thereof	13808	181	46

ANTIOQUIA

Product	Product Name	PRODY (ppp)	Contribution to EXPY	Exports, US M (2005)
8703	Motor cars and other motor vehicles	20489	1026	152
2716	Electrical energy	16264	845	157
8704	Motor vehicles for the transport of	15094	261	52
4811	Paper, paperboard, etc, coated...	34673	256	22
4818	Toilet paper..., bed sheets, etc, a	14540	223	46
7112	Waste, scrap of precious metal or of	13369	205	47
1905	Bread, pastry, cakes, etc; communi	13803	166	36
3907	Polyethers and epoxide resins; poly	19615	141	22
5902	Tyre cord fabric of high tenacity y	46002	137	9
7210	Flat-rolled products of iron/non-al	18312	127	21

VALLE

Product	Product Name	PRODY (ppp)	Contribution to EXPY	Exports, US M (2005)
3004	Medicaments of mixed or unmixed pro	23349	1294	90
4011	New pneumatic tyres, of rubber	20419	1212	96
4802	Uncoated paper..., for writing... i	20683	725	57
2106	Food preparations not elsewhere spe	17001	478	46
2918	Carboxylic acids with oxygen functi	25142	325	21
8507	Electric accumulatlors including sp	17187	265	25
7604	Aluminium bars, rods and profiles	15554	259	27
4901	Printed books, brochures, leaflets	18054	198	18
4810	Paper..., coated with kaolin (china	23936	174	12
7013	Glass articles used for indoor deco	14064	162	19

CARIBE

Product	Product Name	PRODY (ppp)	Contribution to EXPY	Exports, US M (2005)
2701	Coal; briquettes, ovoids and simila	14922	6571	2356
3902	Polymers of propylene or of other o	17917	641	191
3904	Polymers of vinyl chloride and halo	15470	618	214
3903	Polymers of styrene, in primary for	17729	233	70
3920	Other plates..., of plastics, not r	22338	225	54
7210	Flat-rolled products of iron/non-al	18312	162	47
3004	Medicaments of mixed or unmixed pro	23349	132	30
2933	Heterocyclic compounds with nitroge	29147	119	22
3921	Other plates, sheets, film, foil an	20355	81	21
2803	Carbon (carbon blacks and other for	14764	69	25

CENTRAL

Product	Product Name	PRODY (ppp)	Contribution to EXPY	Exports, US M (2005)
8418	Refrigerators,freezers electric or	16120	937	74
2101	Extracts and preparations of coffee	9059	632	89
4803	Toilet... similar paper, in rolls o	26149	268	13
8711	Motocycles,motor fitted cycles,with	16697	242	19
6204	Women's or girls' suits, ensembles,	7970	223	36
1704	Sugar confectionery (incl. white ch	10513	220	27
6115	Panty hose, tights, etc, and footwe	12435	179	18
8506	Primary cells and primary batteries	18841	177	12
8708	Parts and accessories of the motor	18686	173	12
8201	Hand tools and other tools of a kin	11110	148	17

ORIENTAL

Product	Product Name	PRODY (ppp)	Contribution to EXPY	Exports, US M (2005)
2701	Coal; briquettes, ovoids and simila	14922	1295	49
2704	Coke and semi-coke of coal, of lign	11519	557	27
8708	Parts and accessories of the motor	18686	388	12
6907	Unglazed ceramic flags,paving,heart	16431	222	8
4901	Printed books, brochures, leaflets	18054	200	6
2902	Cyclic hydrocarbons	17660	197	6
6908	Glazed ceramic flags and paving,hea	14001	185	7
6403	Footwear, with rubber, plastics, le	11342	177	9
6204	Women's or girls' suits, ensembles,	7970	159	11
201	Meat of bovine animals, fresh or ch	12560	149	7

PACIFICO

Product	Product Name	PRODY (ppp)	Contribution to EXPY	Exports, US M (2005)
4803	Toilet... similar paper, in rolls o	26149	691	7
4818	Toilet paper..., bed sheets, etc, a	14540	605	11
5603	Nonwovens	33496	463	4
4901	Printed books, brochures, leaflets	18054	429	6
7310	Tanks,casks,drums,cans,boxes and an	14651	424	8
8475	Machines for assembling bulbs,lamps	20202	307	4
8418	Refrigerators,freezers electric or	16120	273	4.4
7308	Sructures and parts of structures(b	16681	194	3.0
303	Fish, frozen, (excl. those of 03.04	12212	132	2.8
1704	Sugar confectionery (incl. white ch	10513	100	2.5

ORINOQUIA

Product	Product Name	PRODY (ppp)	Contribution to EXPY	Exports, US M (2005)
102	Live bovine animals	6524	5680	11

OTROS

Product	Product Name	PRODY (ppp)	Contribution to EXPY	Exports, US M (2005)
2709	Petroleum oils and oils obtained fr	10437	7604	4032
2710	Petroleum oils, etc, (excl. crude);	9751	2618	1486
2711	Petroleum gases and other gaseous h	14482	42	16

Source: Author's Calculations using UN COMTRADE. Product codes are HS 1988/1992 4-digit. Products with PRODY >= EXPY in 2005, sorted by contribution to EXPY, except for Orinoquia and Otros, which have so few export goods that all significant exports were reported, regardless of PRODY.

A relatively sophisticated export basket can fuel subsequent economic growth, as production can be shifted towards these higher-wage activities, which have achieved sufficient coordination and access to sufficient sector-specific public goods to exist as profitable export opportunities. In the case of Colombia, the current level of export sophistication is not high enough to drive future growth. These data suggest that more of the same will not be a fruitful strategy: movement to new export goods is necessary.

Export Distance

In standard trade theory, moving to new export products (structural transformation) is a passive consequence of changing comparative advantage based on factor accumulation. However, there are many reasons why structural transformation may be more complicated than this picture suggests. Several factors may create market failures such as industry-specific learning by doing (Arrow 1962, Bardhan 1970) or industry externalities (Jaffe 1986). There may also be technological spillovers between industries (Jaffe, Trajtemberg and Henderson 1993). Alternatively, the process of finding out which of the

many potential products best express a country's changing comparative advantage may create information externalities (Hausmann and Rodrik 2003, Klinger 2007) as those that identify the goods provide valuable information to other potential entrepreneurs but are not compensated for their efforts.

Hausmann & Klinger (2006) investigate the determinants of the evolution of the level of sophistication of a country's exports, and find that these barriers are less binding when moving to 'nearby' products. This is based on the idea that every product involves highly specific inputs such as knowledge, physical assets, intermediate inputs, labor training requirements, infrastructure needs, property rights, regulatory requirements or other public goods. Established industries somehow have sorted out the many potential failures involved in assuring the presence of all of these inputs, which are then available to subsequent entrants in the industry. But firms that venture into new products will find it much harder to secure the requisite inputs. For example, they will not find workers with experience in the product in question or suppliers who regularly furnish that industry. Specific infrastructure needs such as cold storage transportation systems may be non-existent, regulatory services such as product approval and phyto-sanitary permits may be underprovided, research and development capabilities related to that industry may not be there, and so on.

We find evidence supporting the view that the assets and capabilities needed to produce one good are imperfect substitutes for those needed to produce another good, but this degree of asset specificity will vary. Correspondingly, the probability that a country will develop the capability to be good at producing one good is related to its installed capability in the production of other similar, or nearby goods for which the currently existing productive capabilities can be easily adapted. The barriers preventing the emergence of new export activities are less binding for nearby products which only require slight adaptations of existing capacity.

This is found by first developing a measure of distance between products. We measure the distance between each pair of products based on the probability that countries in the world export both. If two goods need the same capabilities, this should show up in a higher probability of a country having comparative advantage in both. Formally, the inverse measure of distance between goods i and j in year t , which we will call proximity, equals

$$\varphi_{i,j,t} = \min\{P(x_{i,t} | x_{j,t}), P(x_{j,t} | x_{i,t})\}$$

where for any country c

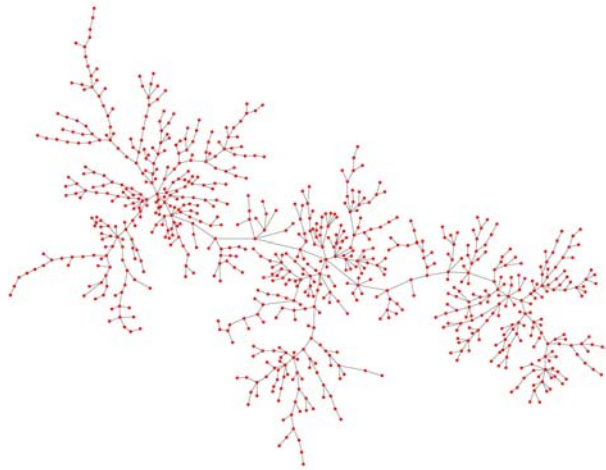
$$x_{i,c,t} = \begin{cases} 1 & \text{if } RCA_{i,c,t} > 1 \\ 0 & \text{otherwise} \end{cases}$$

and where the conditional probability is calculated using all countries in year t . This is calculated using disaggregated export data across a large sample of countries from the World Trade Flows data from Feenstra et. al. (2005) and UN COMTRADE.

The heterogeneity of the product space can be shown econometrically, yet it is much more revealing to illustrate these pairwise distances graphically. Using the tools of network analysis, we can construct an image of the product space (all of these graphics were produced with Albert-Lazlo Barabasi and Cesar Hidalgo for forthcoming work).

Considering the linkages as measured in the 1998-2000 period, we first create the maximum spanning tree by taking the one strongest connection for each product that allows it to be connected to the entire product space. This is shown below.

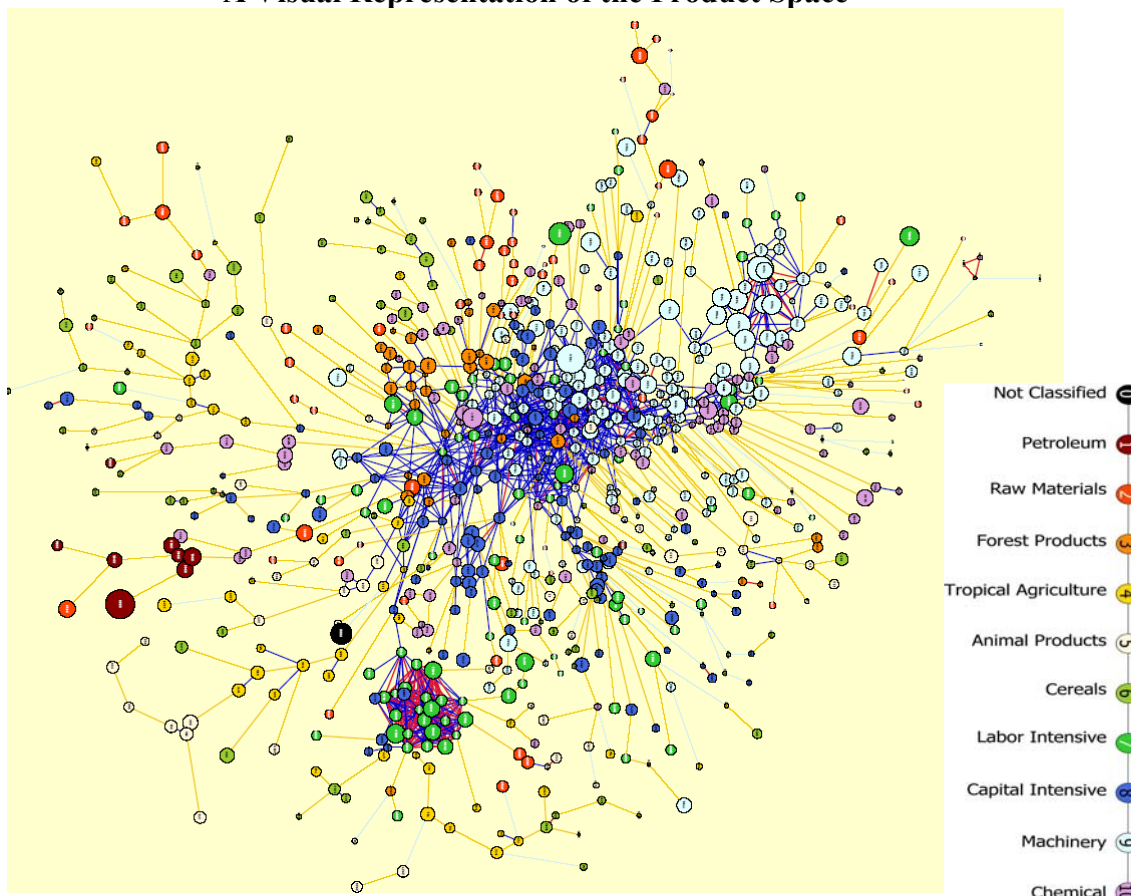
Figure 14
Maximum Spanning Tree



Source: Barabasi et. al., forthcoming

The next step is to overlay this maximum spanning tree with the stronger links, and color-code the linkages between products depending on their proximity. In the Figure below, we show the visual representation of the product space. Each node is a product, its size determined by its share of world trade. In these graphs, physical distances between products are meaningless: proximity is shown by color-coding the linkages between pairs of products. A light-blue link indicates a proximity of under .4, a beige link a proximity between .4 and .55, a dark-blue link a proximity between .55 and .65, and a red link a proximity greater than .65. Links below 0.55 are only shown if they make up the maximum spanning tree, and the products are color-coded based on their Leamer (1984) commodity group.

Figure 15
A Visual Representation of the Product Space



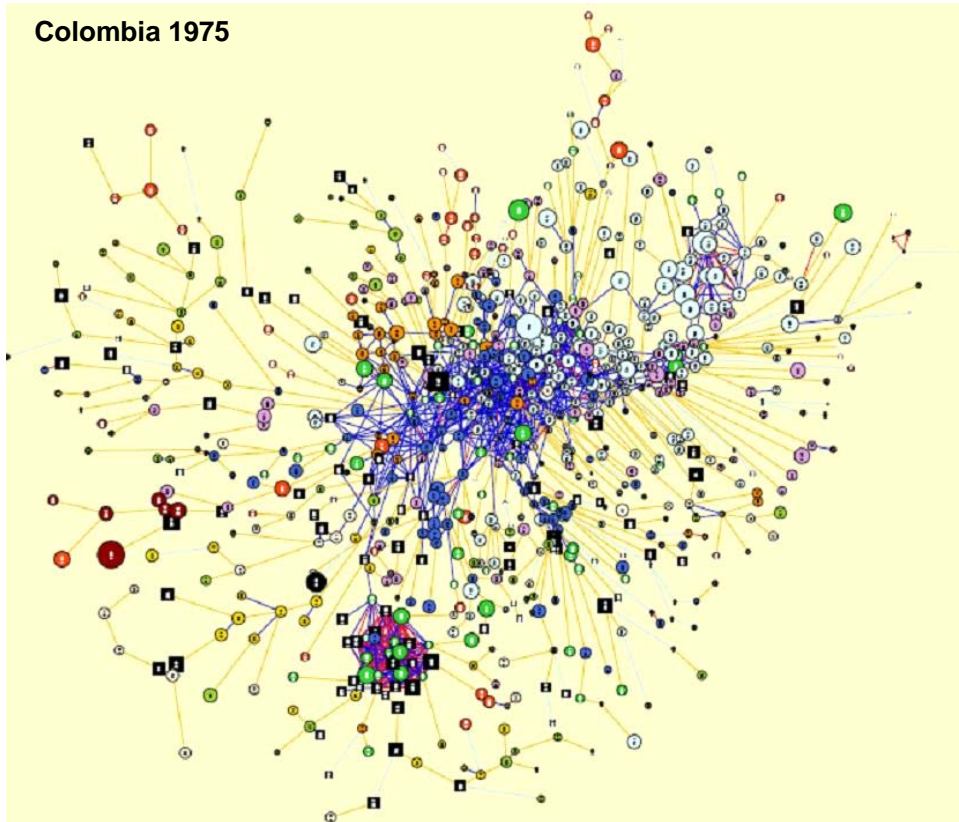
Source: Barabasi et. al. forthcoming

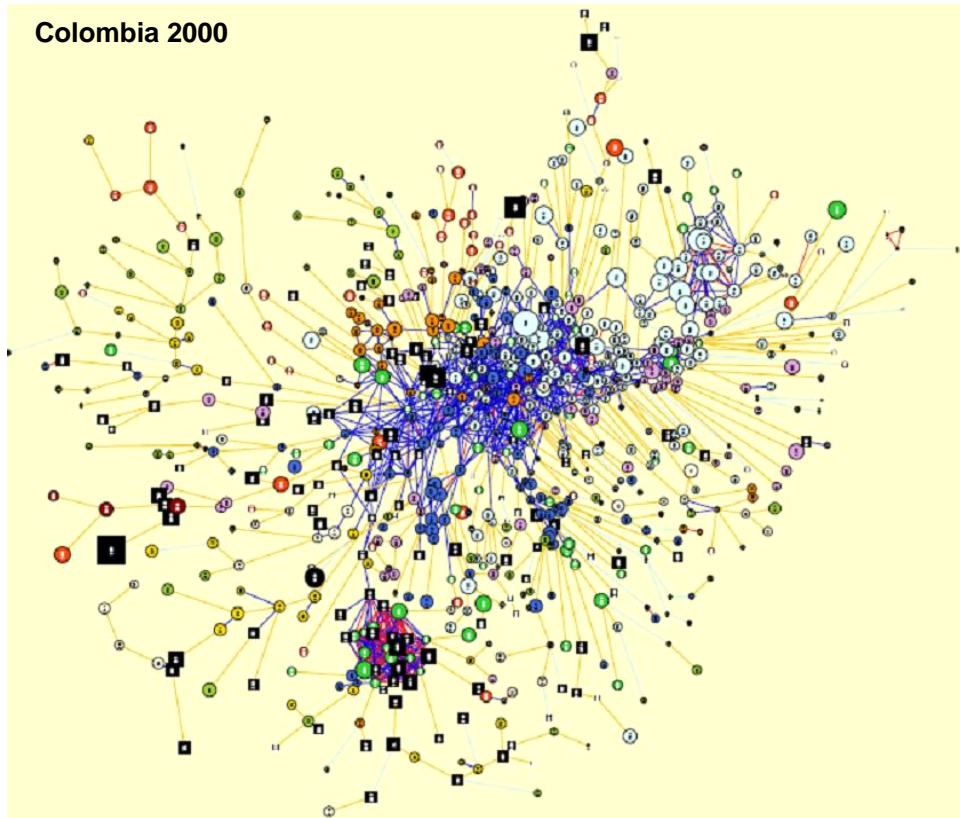
We can immediately see from the figure above that the product space is highly heterogeneous. There are peripheral products that are only weakly connected to other products. There are some groupings among these peripheral goods, such as petroleum products (the large red nodes on the left side of the network), seafood products (below petroleum products), garments (the very dense cluster at the bottom of the network), and raw materials (the upper left to upper periphery). Furthermore, there is a core of closely connected products in the center of the network, mainly of machinery and other capital intensive goods.

This heterogeneous structure of the product space has important implications for structural transformation. If a country is producing goods in a dense part of the product space, then the process of structural transformation is much easier because the set of acquired capabilities can be easily re-deployed to other nearby products. However, if a country is specialized in peripheral products, then this redeployment is more challenging as there is not a set of products requiring similar capabilities. The process of structural transformation can be impeded due to a country's orientation in this space.

The figures below show Colombia's evolution in this product space, where a black square on top of a product indicates that it is exported with comparative advantage.

Figure 16
Colombia's Evolution in the Product Space

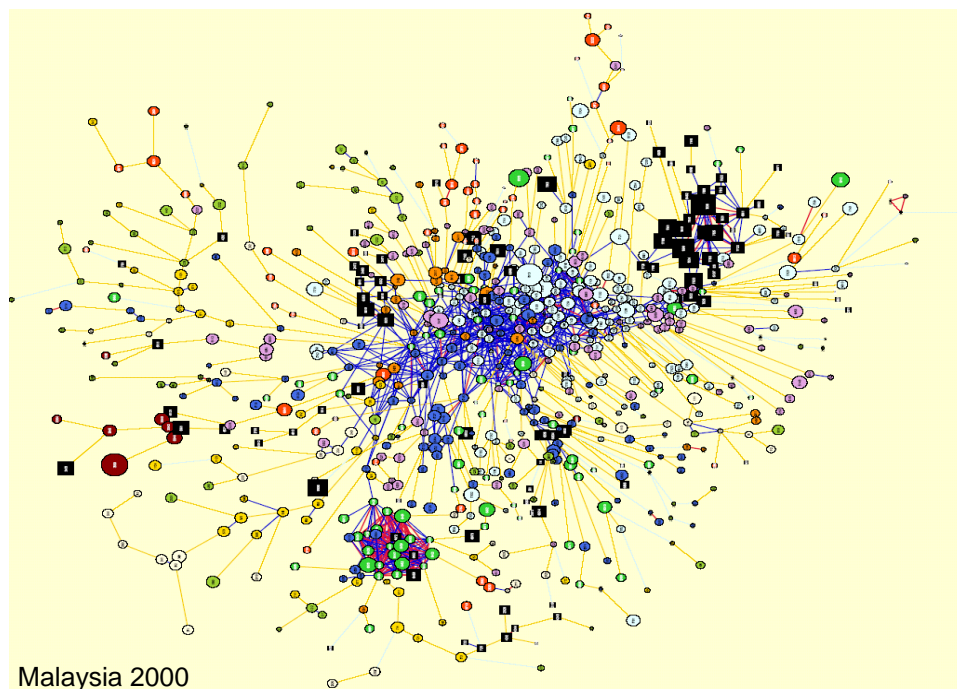
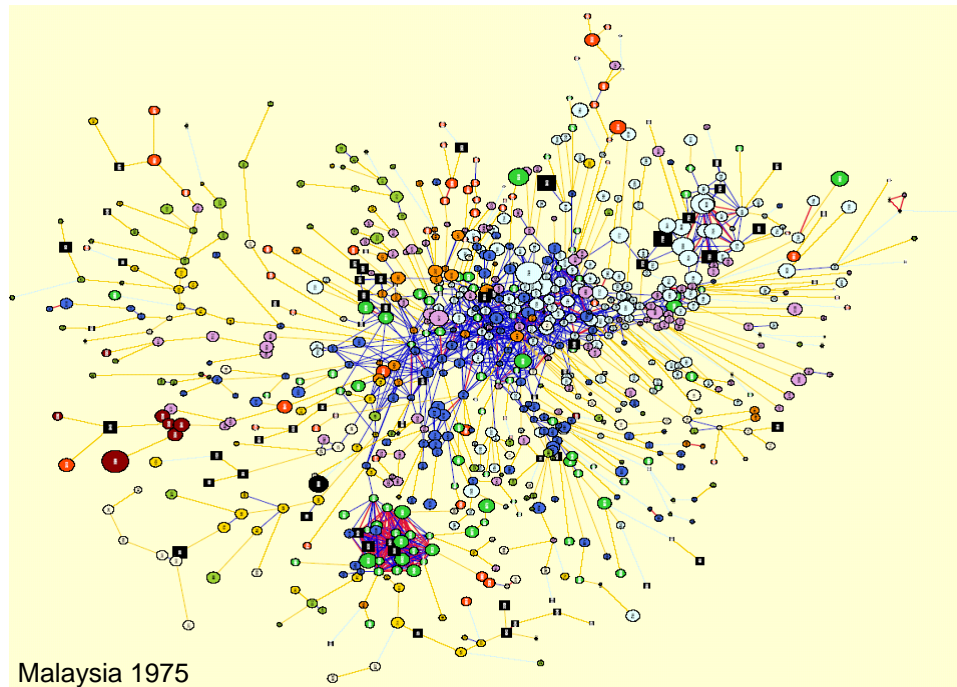




Source: Author's calculations using UN COMTRADE

We can contrast this picture with the equivalent picture for Malaysia, which started the period with the same overall level of export sophistication.

Figure 16
Malaysia's Evolution in the Product Space



Even though both countries started out with the same value of aggregate export sophistication, we see a much different history. Malaysia moved to the cluster at the top-right of the space (electronics components) and thoroughly occupied it. Colombia, on the other hand, continues to have somewhat peripheral production. However, there has been

successful penetration of a cluster of apparel products, and recently the country has moved towards the central core of the product space with products such as capital goods, machinery, medicaments, and cosmetics.

The distance between products has important implications for export growth. Shown both graphically in the above figures, as well as econometrically in Hausmann & Klinger (2006), movement in this product space occurs towards products nearby those already produced. Therefore, Colombia's opportunities for finding new export opportunities that are themselves sophisticated and allow for within product quality upgrading depend on what products are nearby.

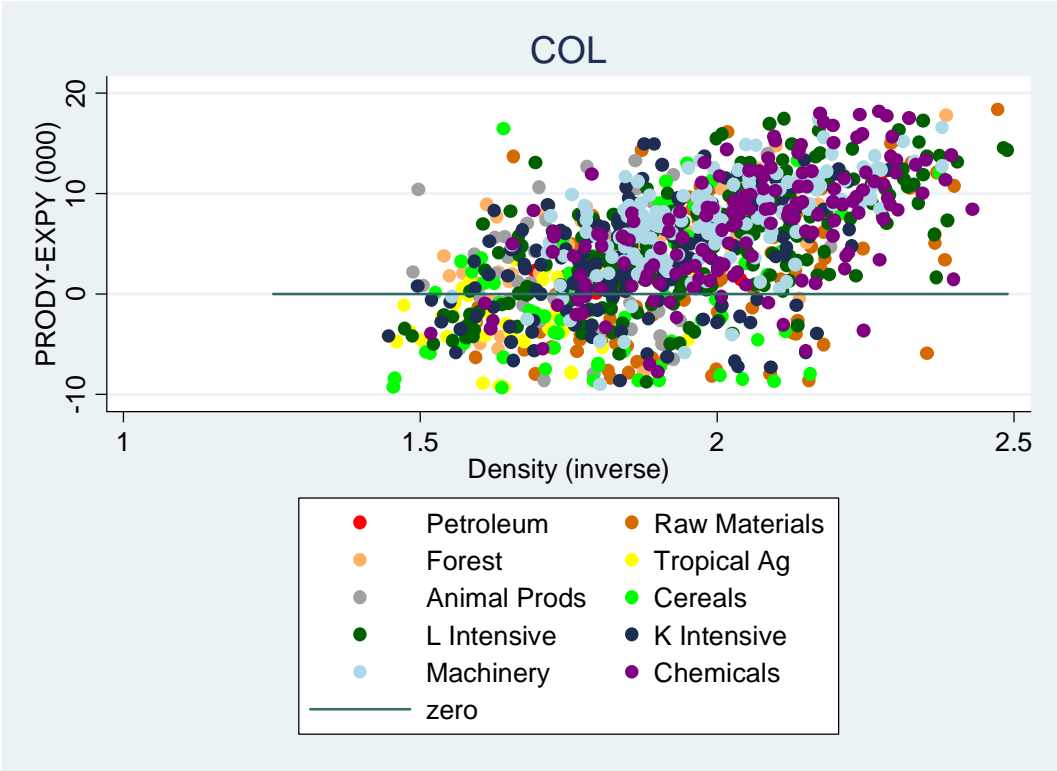
We therefore use the pairwise distance values described above to create a measure of the distance of any particular product from a particular country's export basket as a whole. This measure, taken from Hausmann & Klinger (2006), is called density: the density of current production around any good. This is the distance of good i from country c 's export basket at time t . It is the sum of all paths leading to the product in which the country is present, scaled by the total number of paths leading to that product. As with proximity, we define x based on whether or not the country has revealed comparative advantage in the product (if $RCA \geq 1$). Density varies from 0 to 1, with higher values indicating that the country has achieved comparative advantage in many nearby products, and therefore should be more likely to export that good in the future.

$$density_{i,c,t} = \left(\frac{\sum_k \varphi_{i,k,t} x_{c,k,t}}{\sum_k \varphi_{i,k,t}} \right)$$

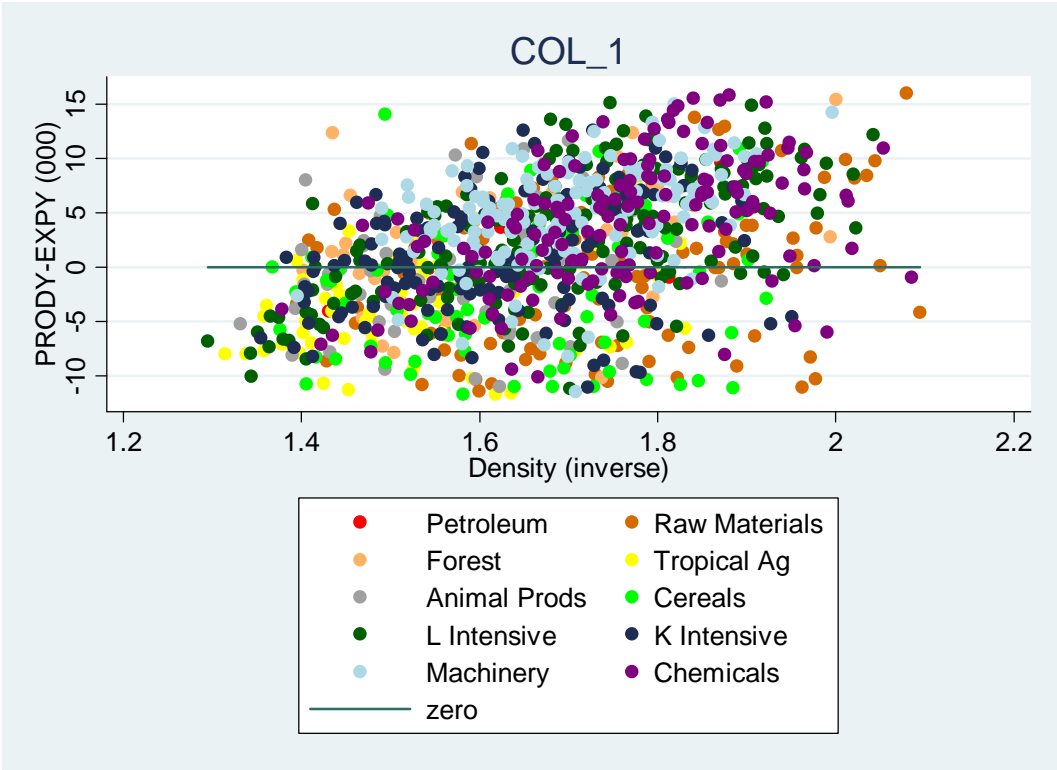
Hausmann & Klinger (2006) show that this measure of density is indeed a highly significant in predicting how a country's productive structure will shift over time: countries are much more likely to move to products that have a higher density, meaning they are *closer* to their current production.

Using calculated densities, we can show graphically how this product space looks from the point of view of Colombia. Each product not currently exported with comparative advantage has a particular distance from the country's current export basket. In addition, each of these products has a level of sophistication, measured by PRODY. We can plot each of these products according to their distance (x-axis: the inverse of log(density), meaning that a smaller value represents a product that is *closer* to the current productive structure) and sophistication (y-axis), and also color-code them corresponding Leamer commodity clusters. This is shown below for Colombia and Colombia's regions. The horizontal line drawn where PRODY of the good equals the EXPY of the country or region. Products below that line are less sophisticated than the country/region's export basket as a whole.

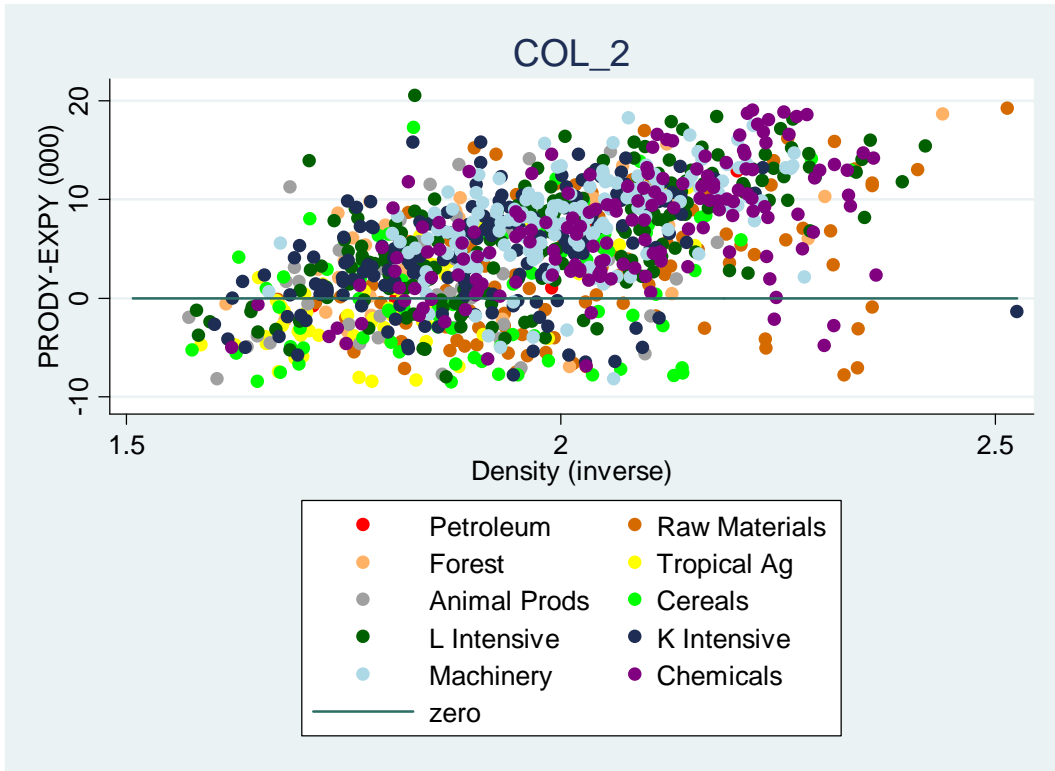
Figure 17
Distance vs. PRODY of Unoccupied Products, 2005
COLOMBIA



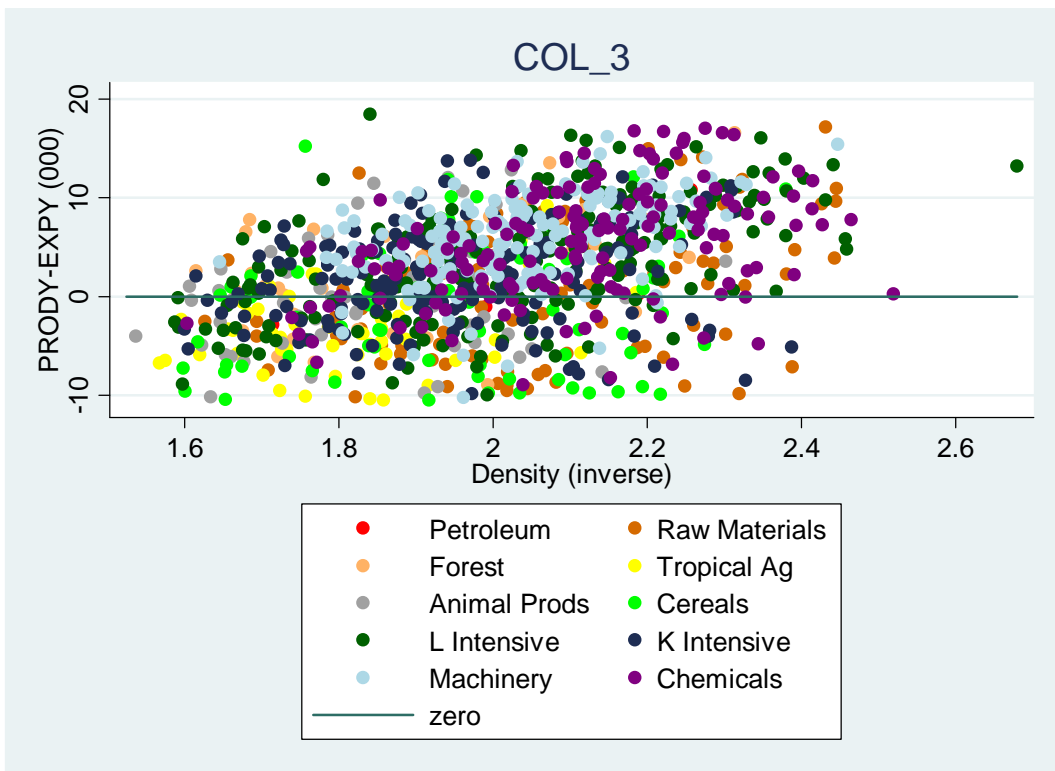
SANTAFE DE BOGOTA



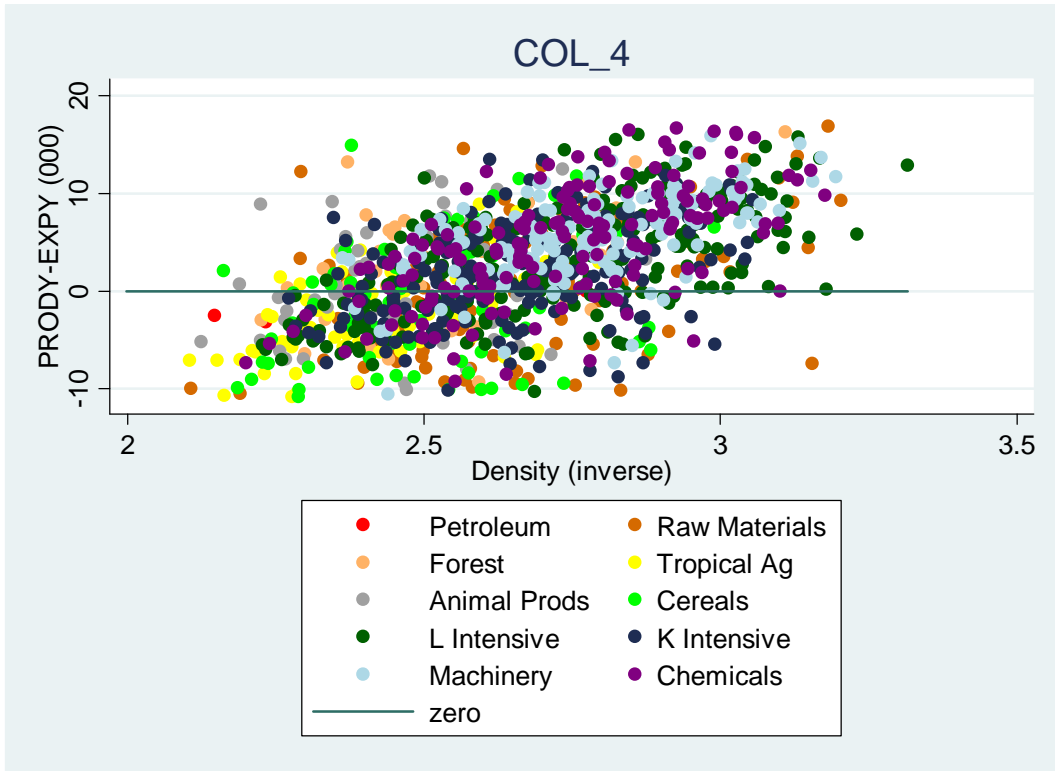
ANTIOQUIA



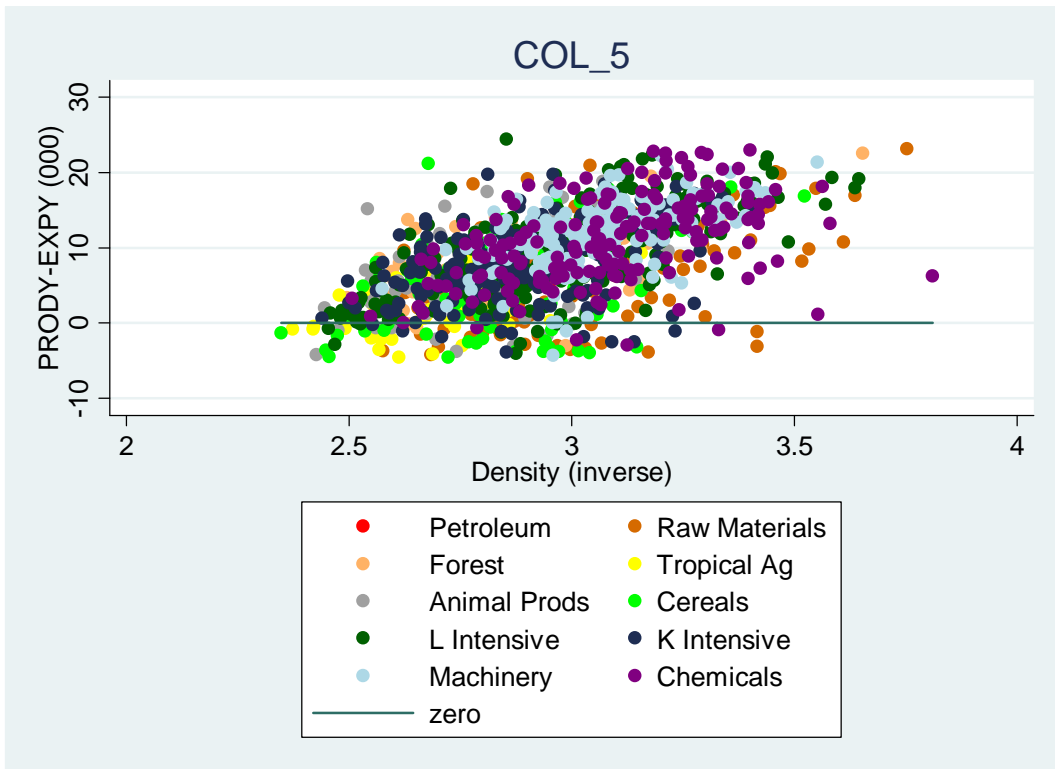
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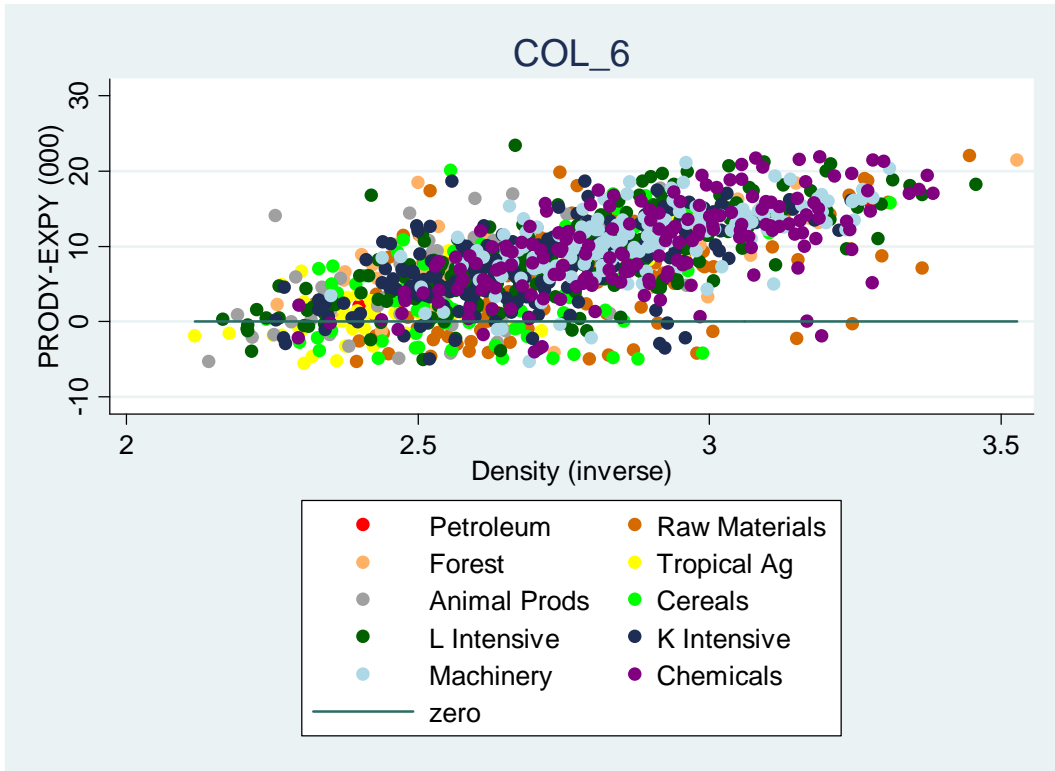
CARIBE



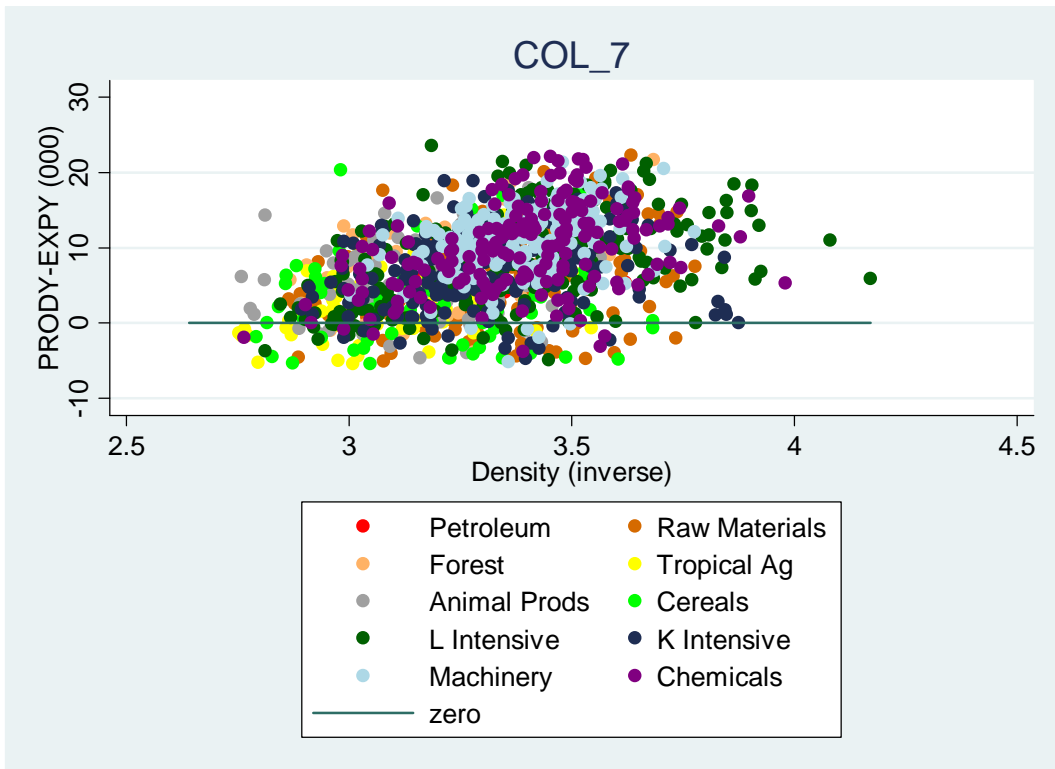
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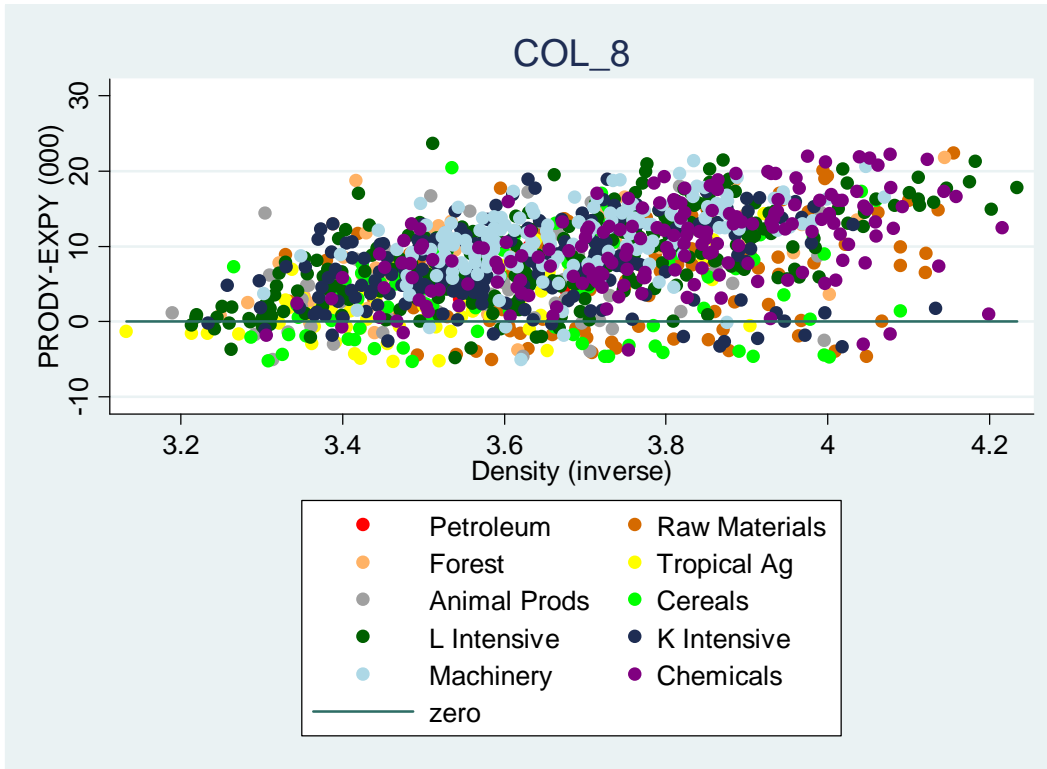
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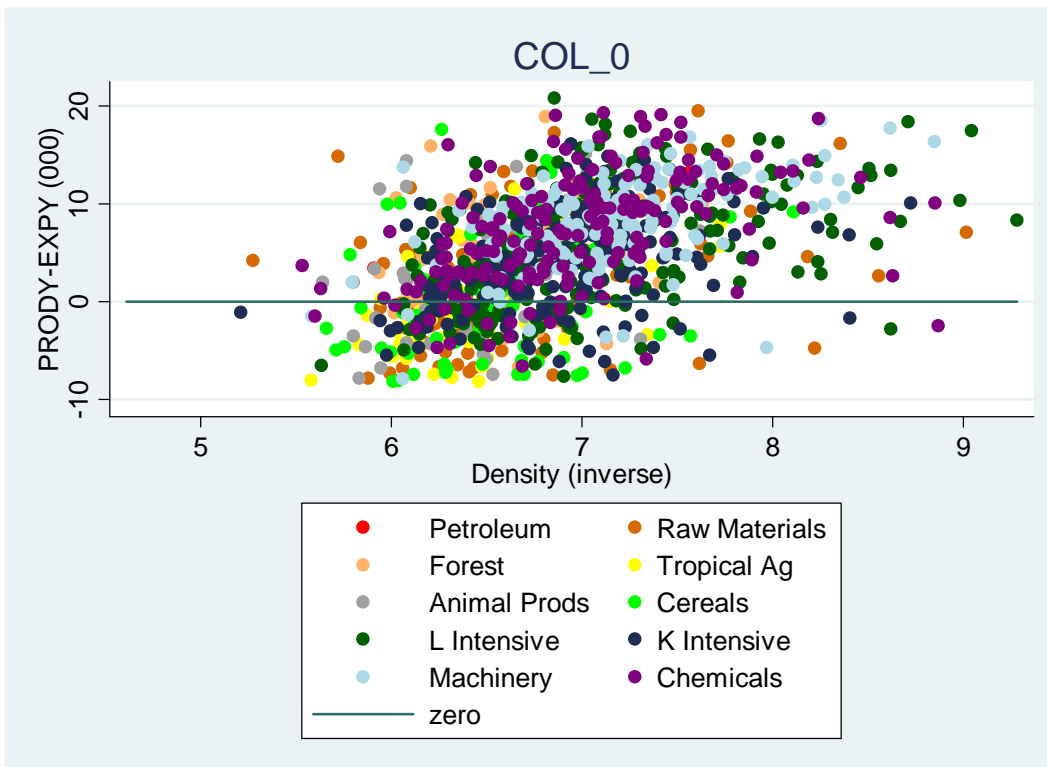
PACIFICO



ORINOQUIA



OTROS



The x-axis is distance ($-1 \cdot \log(\text{density})$), meaning that smaller values indicate the product is closer to the current basket, and the y-axis is prody (PPP) minus EXPY (PPP). The horizontal line indicates the level

where the PRODY of the good equals EXPY of the country, i.e. the good is not more sophisticated than the current export basket. Source: Author’s calculations using UN COMTRADE.

From the point of view of adding valuable new exports to the current basket, the ideal location on this plane is the upper-left quadrant: goods that are close and also highly sophisticated. You can see from the changes in values on the x-axis that the overall proximity of unoccupied export goods differs greatly across regions. Moreover, the sectoral composition of the nearest products differs greatly across regions. We will return to these issues in a later section.

These figures suggest a tradeoff between proximity and export sophistication. The products that are closest to the current export basket are easiest to move towards, yet these nearest products are often not of a high level of sophistication. The more sophisticated products are further away from the current structure of production. However, there is an efficient frontier in this tradeoff. Some products are both further away *and* of lower sophistication than other potential exports. This is an important tradeoff that we will return to when exploring how to measure a particular product’s attractiveness for productive diversification.

Open Forest

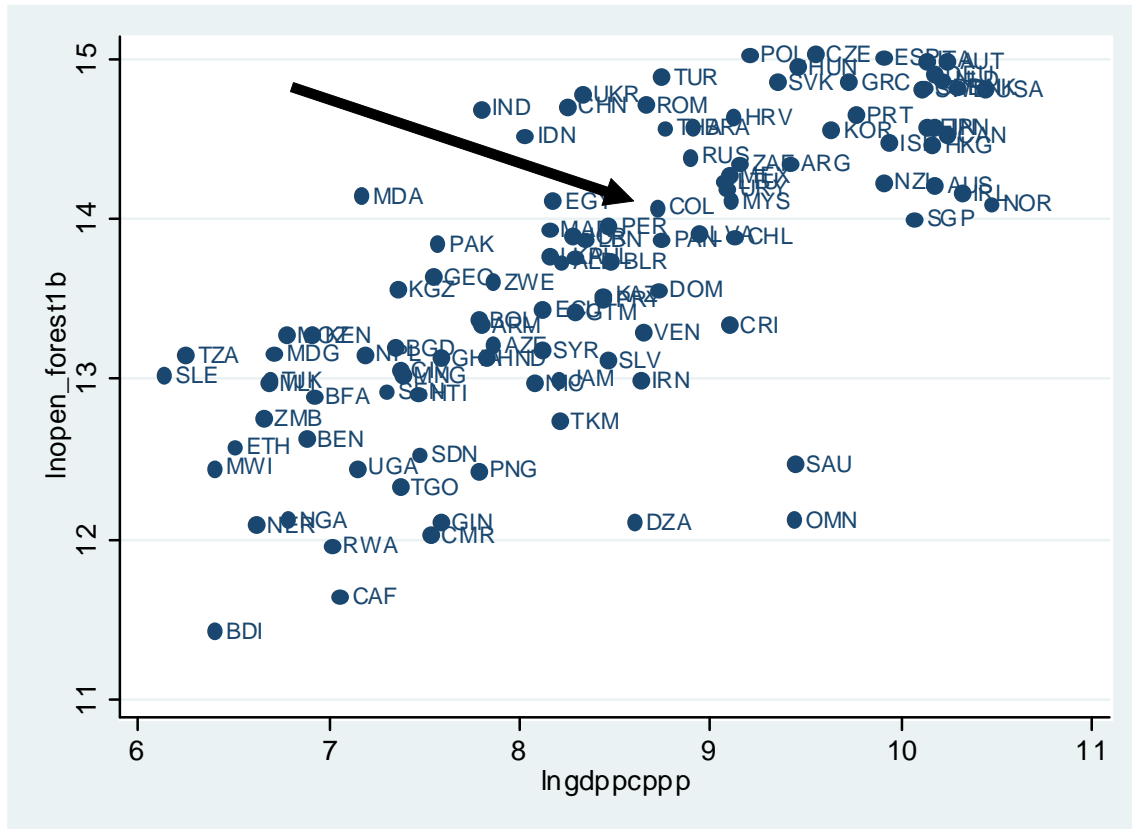
The density measure discussed above is at the country-product level. That is, there is a density for each country around each product. We can aggregate this measure to the country level to assess the degree to which the current export basket is connected with valuable new productive possibilities. This measure, called ‘open forest’, answers the question “how green is your valley”—is the current export basket in a part of the product well-connected to other new and valuable opportunities for structural transformation, or is it in a sparse, unconnected part of the product space. It is calculated as follows:

$$open_forest_{c,t} = \sum_i \sum_j \left[\frac{\varphi_{i,j,t}}{\sum_i \varphi_{i,j,t}} (1 - x_{c,j,t}) x_{c,i,t} PRODY_{j,t} \right]$$

Hausmann & Klinger (2006) show that open forest is highly significant in determining the future growth of export sophistication at the country level. Countries with a high level of open forest enjoy faster subsequent growth in export sophistication and overall economic growth.

As with export sophistication, there is also a positive relationship between income and open forest, with richer countries specialized in more connected parts of the product space. Yet, there is variation in this relationship, and countries that have managed to move into a relatively well-connected part of the product space given their level of development enjoy faster subsequent structural transformation.

**Figure 18
Open Forest vs. GDP per capita, 2000**

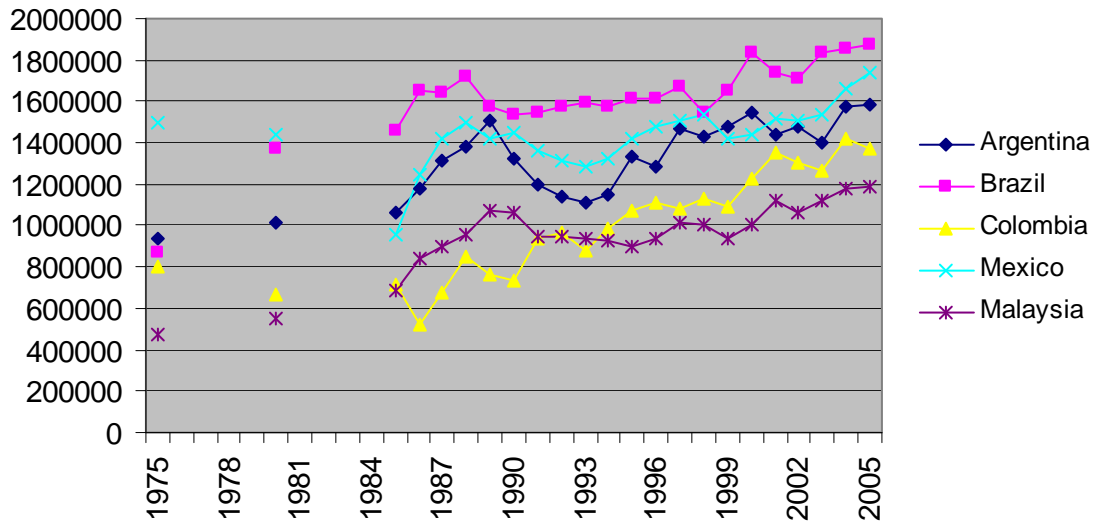


Source: Author’s calculations

We see from the figure above that Colombia is neither in a relatively dense nor a relatively sparse part of the product space. Below we show the evolution of open forest over time, along with comparator countries.

Figure 19

Open Forest, Comparative



Source: Author's Calculations using Feenstra et. al. (2005) for the 1975-2000 period, and UN COMTRADE for the 2000-2004 period, merged using relative changes from 2000 observation which is common to both series.

While we saw in the previous section that while Colombia has not been able to close the gap in export sophistication with its comparator countries, the picture of open forest is somewhat better. Since 1985, Colombia has caught up with Argentina, closed the gap with Brazil, and kept pace with Mexico. The emerging picture is one that while the direct value of the export basket has not increased significantly, its position in the product space has, indicating new opportunities for future structural transformation.

What are the products contributing to the current level of open forest? These are listed below.

Table 3
Largest Contributors to Colombia's Open Forest, 2005
Exports,

Product	Product Name	PRODY (ppp)	US M (2005)	Contribution
3920	Other plates..., of plastics, not r	22338	112	19021
3921	Other plates, sheets, film, foil an	20355	76	18953
5906	Rubberized textile fabrics	19817	3	18753
9402	Medical,surgical chairs,having rota	19366	5	18748
2918	Carboxylic acids with oxygen functi	25142	24	18106
8203	Files,rasps,pliers,pincers,tweezers	17856	4	17993
3005	Wadding, gauze, etc with pharmaceut	18201	14	17796
2904	Sulphonated, nitrated or nitrosated	8134	8	17736
2928	Organic derivatives of hydrazine or	23187	6	17650
8546	Electrical insulators of any materi	16943	11	17643
7007	Safety glass,consisting of toughene	31065	24	17546
7503	Nickel waste and scrap	16756	14	17281
4822	Bobbins, spools, cops and similar s	32079	1	17166
3904	Polymers of vinyl chloride and halo	15470	216	16970
4902	Newspapers, journals and periodical	20574	24	16815

Sorted by contribution to open forest.

The Strategic Value of Exports

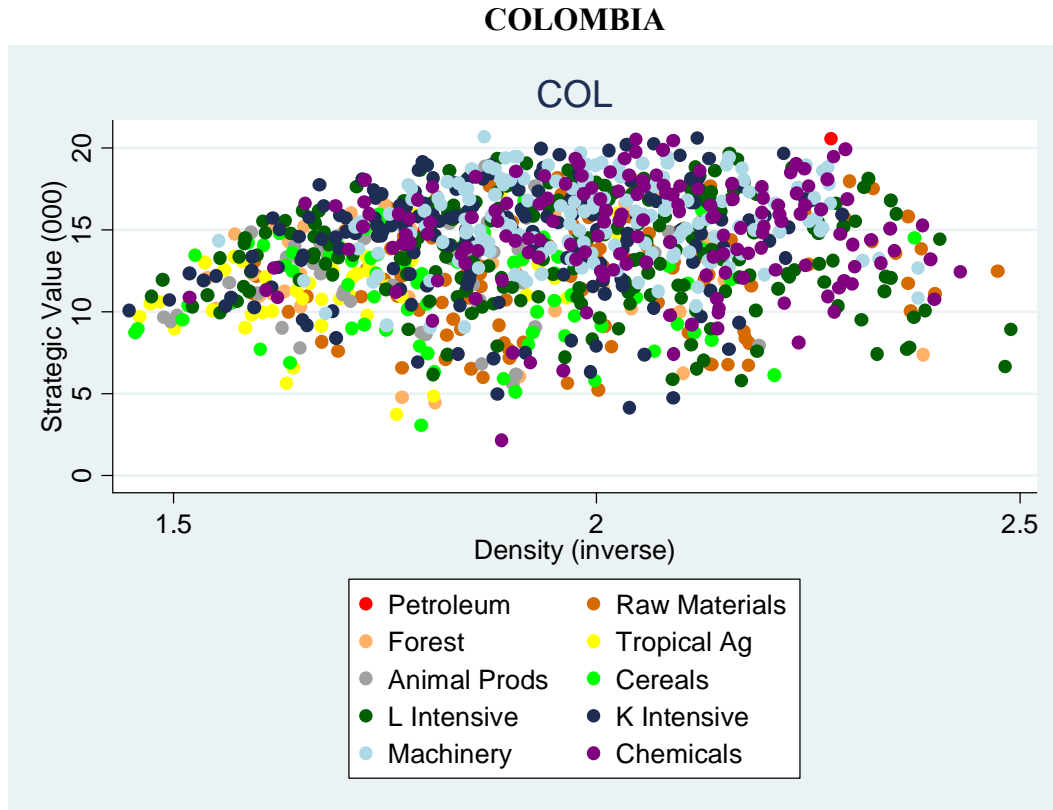
As can be clearly seen above in the figures of the product space, not all goods were created equal in terms of their strategic value. Some products are in a dense part of the product space, meaning that they are intensive in capabilities that are easily deployed to a wide range of other goods. The implication is that successfully producing these goods would create capabilities with significant value for other new products. On the other hand, other products are located in the periphery, or in a part of the product space where Colombia has already achieved comparative advantage and acquired the requisite productive capabilities. Therefore, these products have a low strategic value, as successfully producing them would offer little in terms of future structural transformation, even if they are highly valuable in their own right (i.e. have a high PRODY).

We can measure this strategic value of every good not currently exported with comparative advantage using open forest. This is done by calculating what would happen to open forest if that good were added to the export basket. If a product is closely connected to a wide range of other valuable products not currently exported by Colombia, it would result in a large increase in open forest, and therefore have high strategic value as it would greatly expand the country's option set.

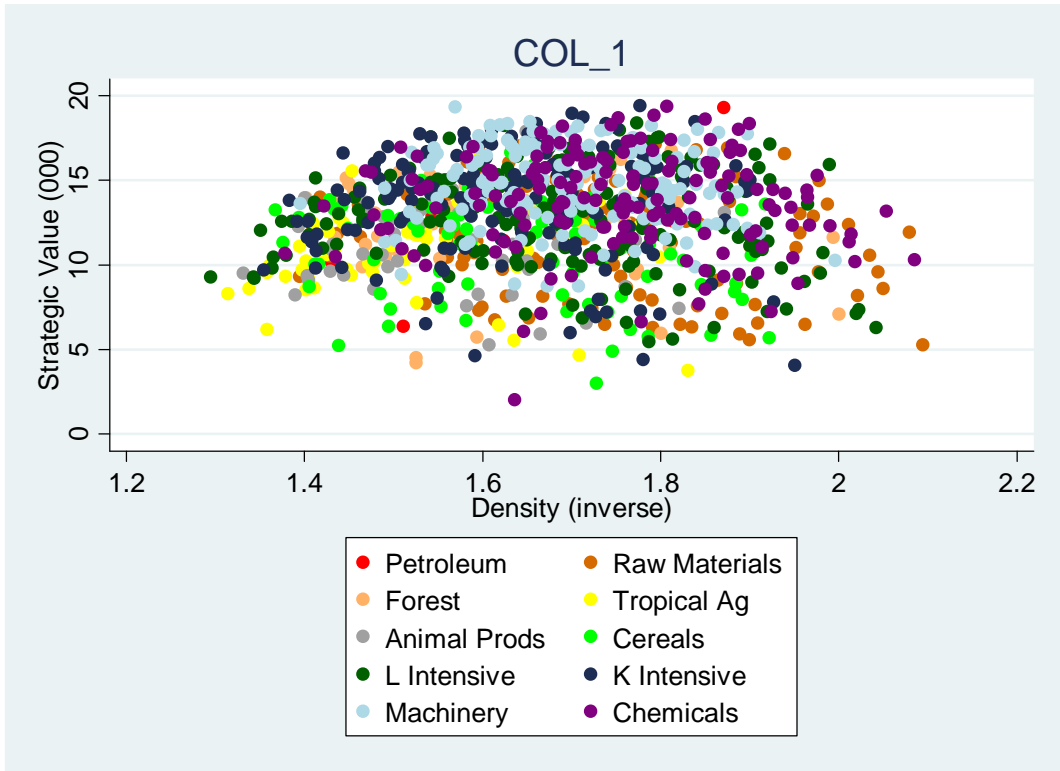
Repeating the same exercise performed above on export sophistication and distance, we plot the distance of all products not exported with comparative advantage by Colombia in 2005 against their strategic value. Again, the ideal location is the upper-left quadrant:

products that are nearby, meaning easier to move to, and that have high strategic value, meaning that they themselves lead to new and nearby opportunities for structural transformation. This is shown below for Colombia and its regions.

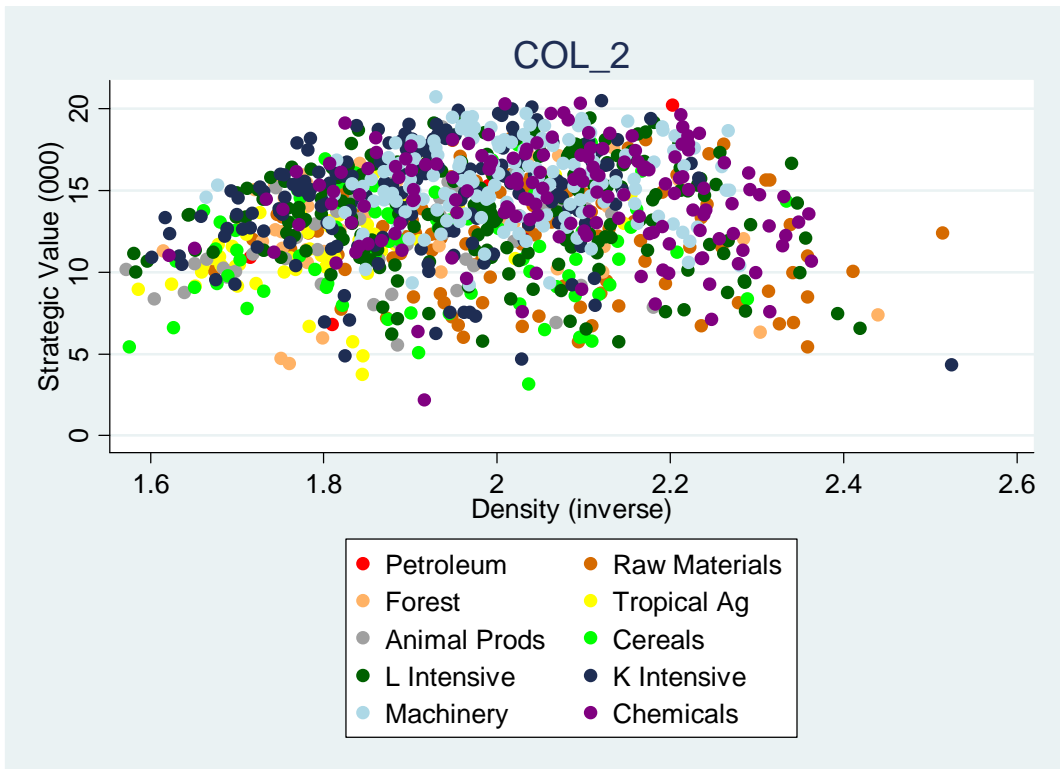
Figure 20
Distance vs Strategic Value of Unoccupied Products, 2005



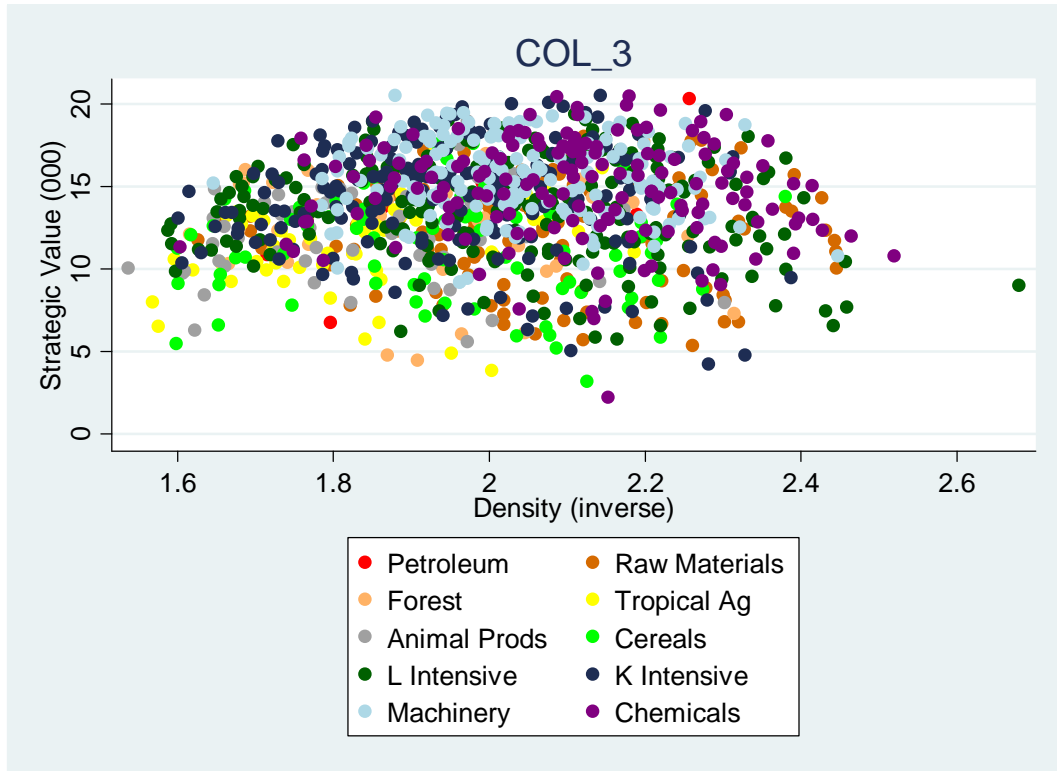
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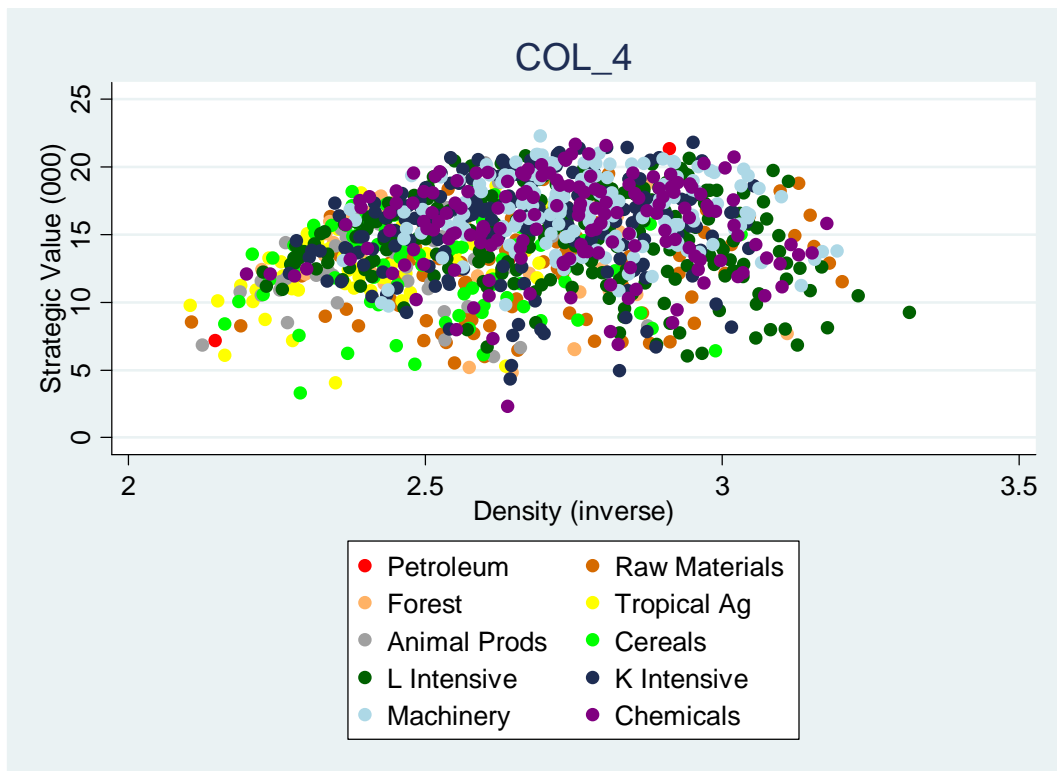
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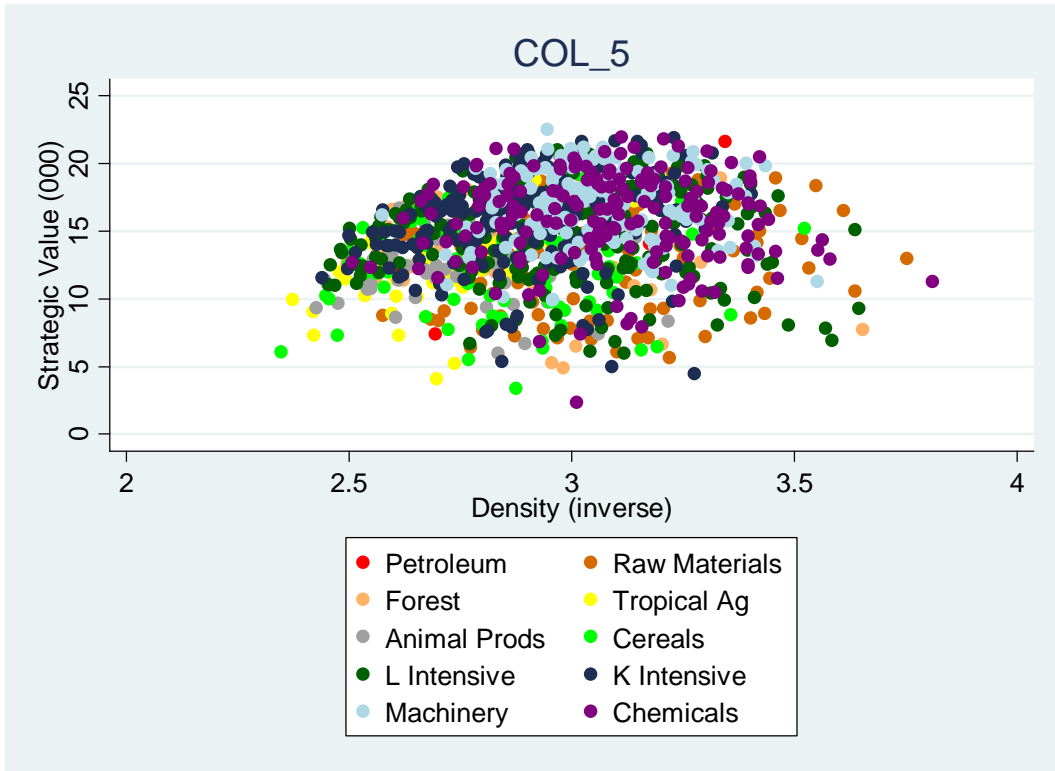
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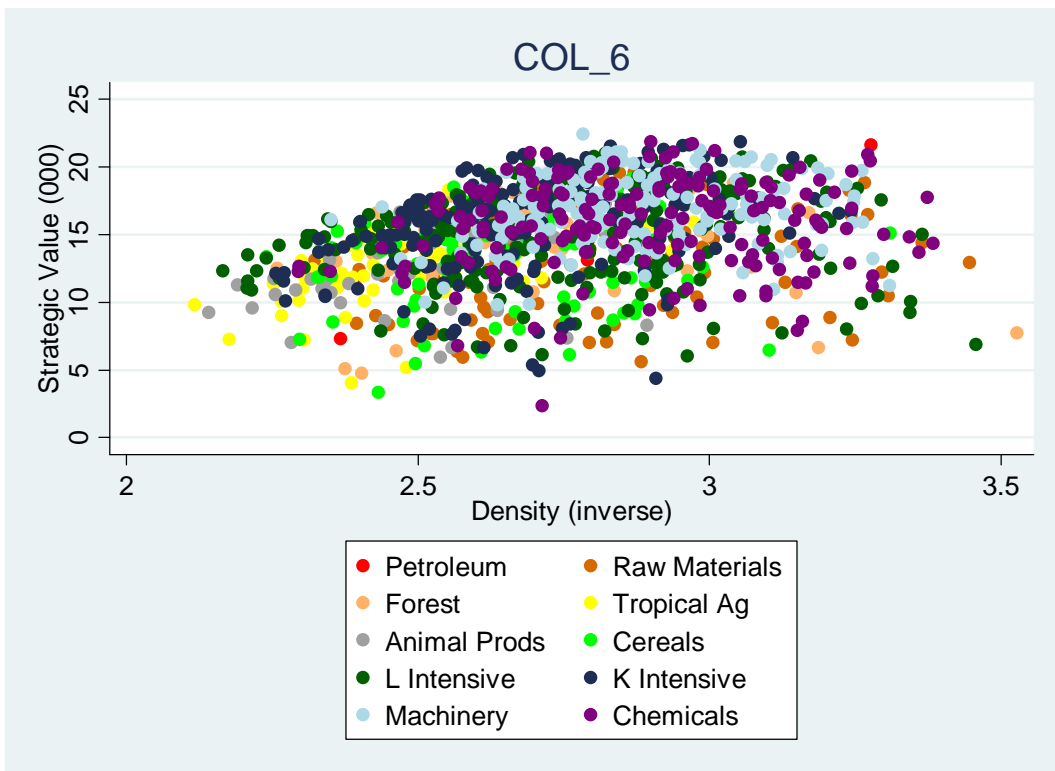
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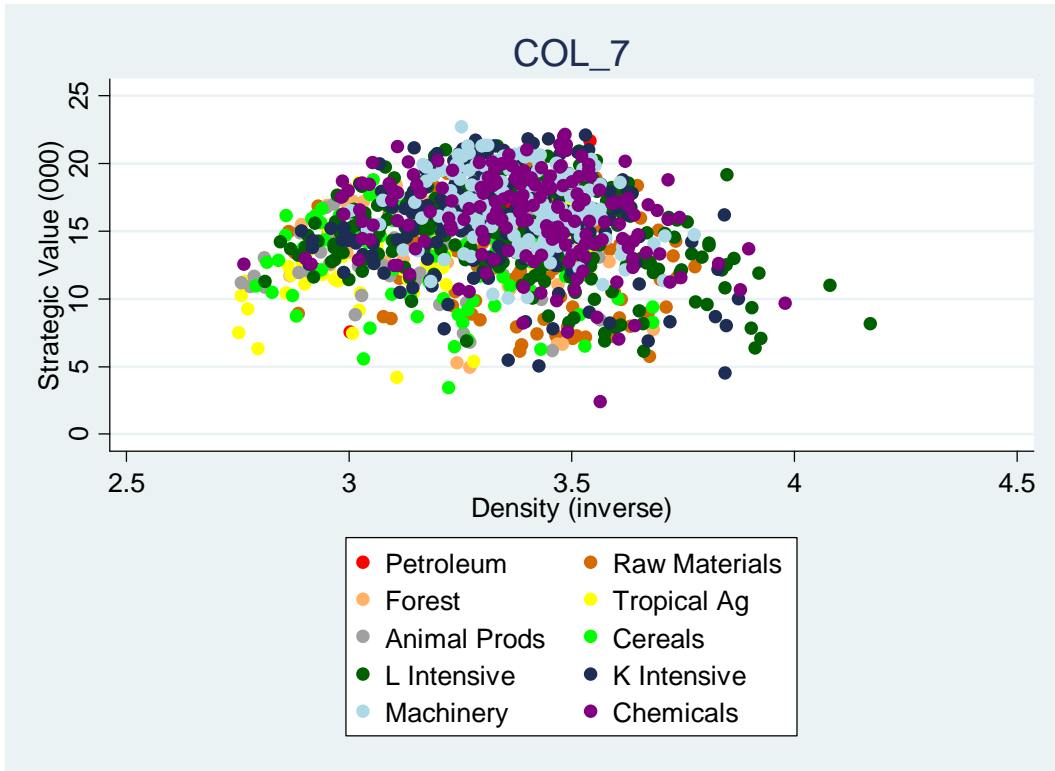
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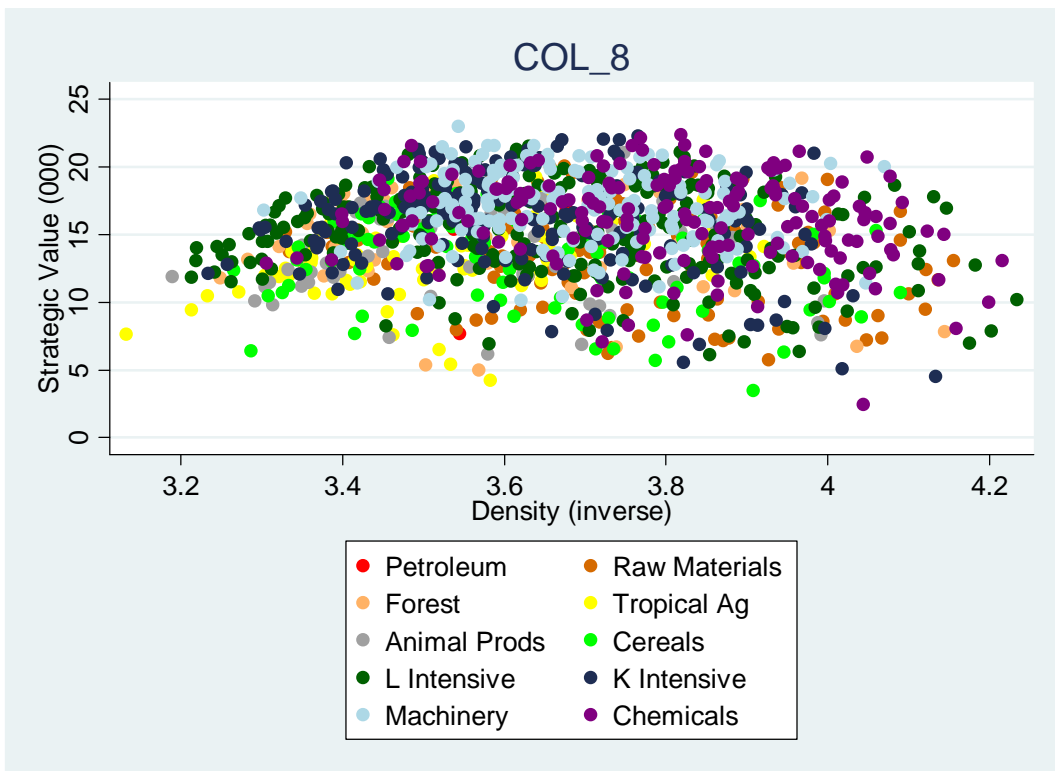
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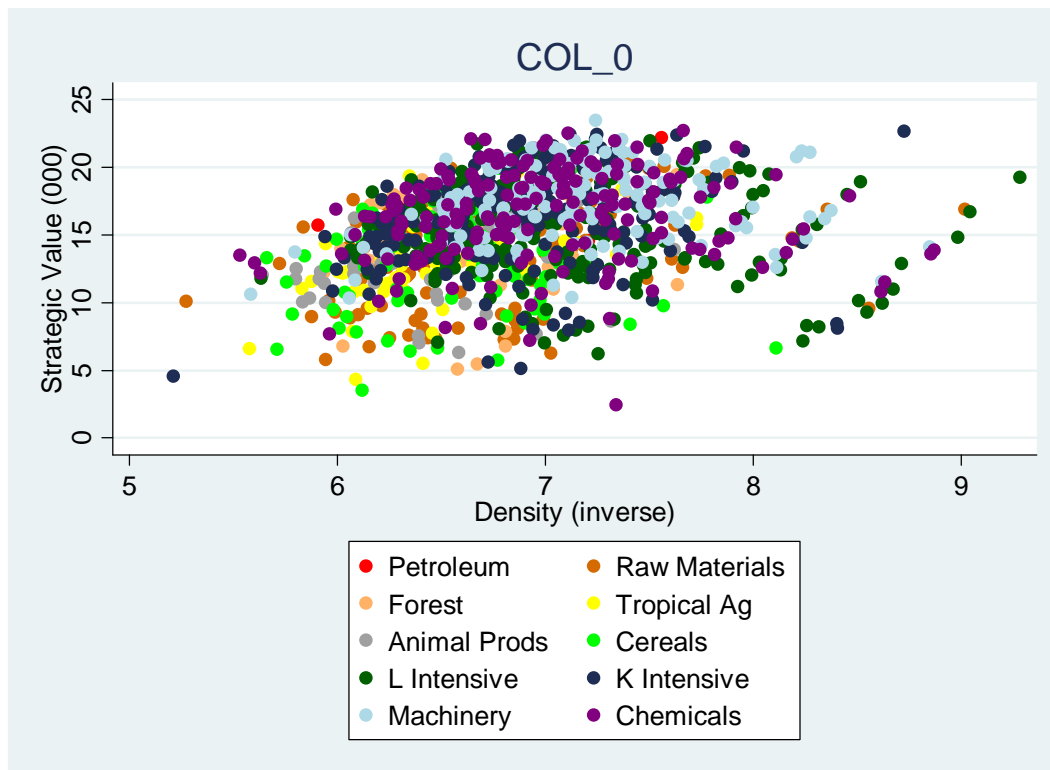
PACIFICO



ORINOQUIA



OTROS



The x-axis is distance ($-1 \cdot \log(\text{density})$), meaning that smaller values indicate the product is closer to the current basket), and the y-axis is the marginal increase in open forest if that product were added to the export basket. Source: Author's calculations using UN COMTRADE.

Just as was the case with the plots of distance versus PRODY, we see an initial tradeoff between distance and strategic value. Countries are more likely to successfully move to goods that are close to what they currently produce, because such goods require similar capabilities. Yet, such goods may or may not have much strategic value. They may be in a sparse part of the product space or may be so close that they do not imply the development of new capabilities that can be redeployed in other directions. So moving closer is easier, but moving further may be more valuable in terms of future structural transformation. Moreover, there is an efficient frontier in this tradeoff, as some potential exports are both closer to the current export basket and more strategically valuable than others. The profile of the efficient frontier illustrated above differs greatly from region to region. This distance versus strategic value tradeoff is a key feature we will consider when measuring a product's attractiveness for productive diversification.

GROWTH STRATEGIES

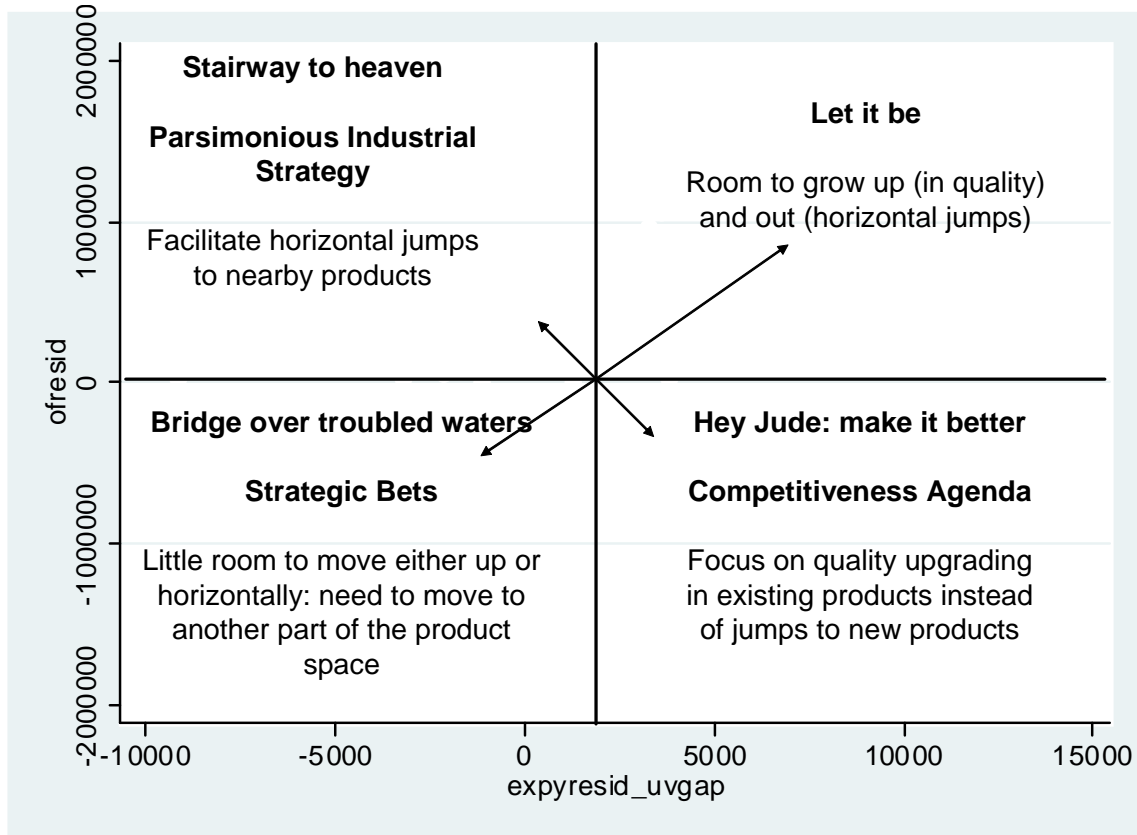
Using these key concepts, we can consider what type of export-led growth strategy is most appropriate for Colombia.

One dimension of growth is within existing products. Countries can simply export more of the same, or upgrade quality within products. The suitability of this dimension depends on how much room there is to upgrade quality within the existing basket, and how sophisticated that basket is.

The other dimension for growth is by moving from existing products to new products. If the current export basket is in a central part of product space, resulting in a high open forest, then there is an apparent path towards new products. However, if the current export package is intensive in capabilities that are not easily redeployed to alternative products, then there is not an obvious path to other parts of the product space, and a jump to a new part of the space is necessary.

These two dimensions are summarized in the figure below, which provides a framework for determining the appropriate policy stance given the values presented above. The x-axis is the room for growth in the current basket, which depends on 1) whether unit value gaps are high, meaning there is room for quality upgrading, and 2) whether EXPY is high given the level of income, meaning that there is room to grow through more of the same. A value further to the right indicates that there is more room for upgrading quality and growing in the existing export basket. The y-axis is the ease of transforming the basket by adding new products, measured by open forest. Higher values indicate a more obvious path of structural transformation with attractive new products nearby. A low value indicates that there are not many nearby products to move to: larger and more difficult jumps will be needed. The appropriate policy stance for each quadrant of this space is summarized.

Figure 21
A Policy Map for Structural Transformation



Where would Colombia fall in this map? The analysis in the previous section found that Colombia had very little room to upgrade quality: the country has one of the lowest distances from the price frontier within existing products in the world. Moreover, EXPY is not high enough vis a vis GDP per capita to leave room for growth through more of the same. Therefore, on the x-axis, Colombia is to the left: movement to new products is necessary.

When considering the connectedness of Colombia's export basket in the product space, we found that there were valuable products nearby. That is, Colombia is higher up on the y-axis. It is not the case that Colombia is in a completely unconnected part of the product space with no obvious candidates for new exports, requiring strategic industrial policy. Instead, an appropriate policy stance is a more parsimonious industrial policy, where the government facilitates jumps to new products by providing the necessary sector-specific public goods and coordination.

How should this be done? It is important that appropriate institutions be in place to interact with the private sector and learn what new activities are being considered and what public action is required for them to successfully emerge. However, we can also use the metrics for distance, sophistication, and strategic value presented above to determine what sectors make up the efficient frontier. This identification, which is taken up in the

following section, will allow scarce public resources to be allocated to the most promising sectors first.

PARSIMONIOUS INDUSTRIAL STRATEGY IN COLOMBIA: A DATA-DRIVEN SECTOR IDENTIFICATION

‘Picking Winners’

Before we begin, it is important to be clear about what this analysis is saying and what it is not saying. A cursory look at this research may make some believe it is simply ‘picking winners’ with a new methodology, but repeating the same mistakes of the past. While some may be tempted to use this methodology to ‘pick winners’, that is not our intention.

When capabilities are product-specific, as suggested and supported in Hausmann & Klinger 2006, then thinking in terms of particular activities is necessary. Even if considering what are usually thought of as ‘cross-cutting’, non-specific public goods like public safety or infrastructure, they have sector or activity-specific consequences. Installing more road capacity instead of port capacity has sector-specific consequences. Investing in security in urban areas instead of rural areas has sector-specific consequences. Governments aren’t ‘picking winners’ when they make these decisions, rather they are “doomed to choose” (Hausmann & Rodrik 2006). And if doomed to choose, it is best that that choice be as informed as possible, which is the goal of this analysis.

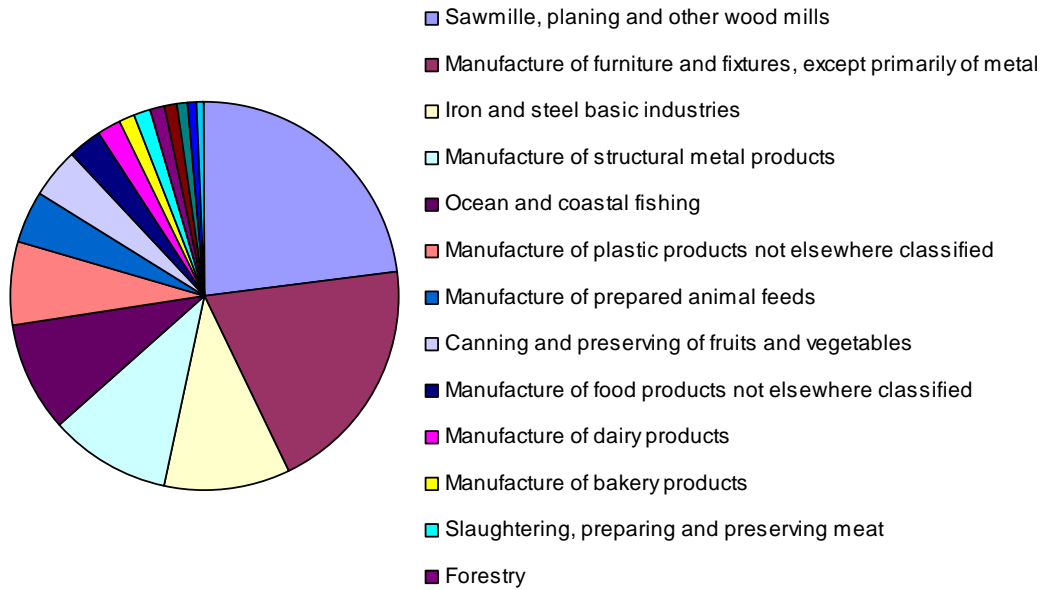
Moreover, as discussed above a critical public function is to interact with the private sector to learn what public actions by act or omission are negatively affecting their sectors. Yet the private sector is large and government officials’ time limited. This analysis therefore can be used to direct this learning process and determine which private actors to talk to first. It is also informative to the private sector in order to facilitate the search process of new business opportunities in areas where the chance of success might be larger because the requisite capabilities are already present in the country and are being used in the production of nearby products.

National-Level Analysis

We first use data on distance, PRODY, and strategic value to study the efficient frontier for Colombia as a whole. To do this, we focus on products in 2005 not exported with comparative advantage, and limit ourselves to ‘upmarket’ products (whose PRODY is greater than Colombia’s EXPY) and non-minerals. First, we focus on the low-hanging fruit: products with a density at least 1.5 standard deviations above the average for all non-exported products. We take all products satisfying these criteria, group them by ISICr2 sector, and weight each by its strategic value and then by its total world trade.

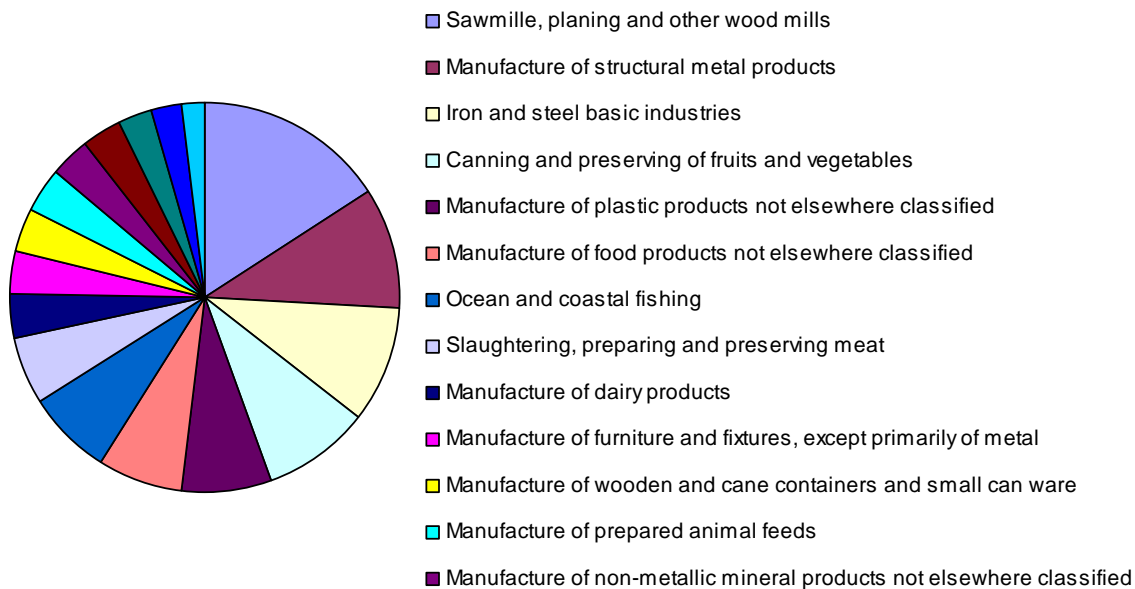
This gives an overall image of which sectors are low-hanging fruit while also representing valuable strategic investments and having large market potential. These figures are provided below.

Figure 24
Unoccupied Products 1.5 σ above Average Density, Colombia 2005
Weighted by World Trade



Source: UN Comtrade. All products not exported with $RCA > 1$ in 2005, dropped those with $PRODY < EXPY$, dropped minerals, dropped those with density that is not at least 1.5 standard deviations above the mean for all of Colombia's non-exported products, combined into ISIC sectors, weighted by 2005 world exports of all those products in that sector meeting the above criteria.

Figure 25
Unoccupied Products 1.5 σ above Average Density, Colombia 2005
Weighted by Strategic Value



Source: UN Comtrade. All products not exported with $RCA > 1$ in 2005, dropped those with $PRODY < EXPY$, dropped minerals, dropped those with density that is not at least 1.5 standard deviations above the mean for all of Colombia's non-exported products, combined into ISIC sectors, weighted by the total strategic value of all those products in that sector meeting the above criteria.

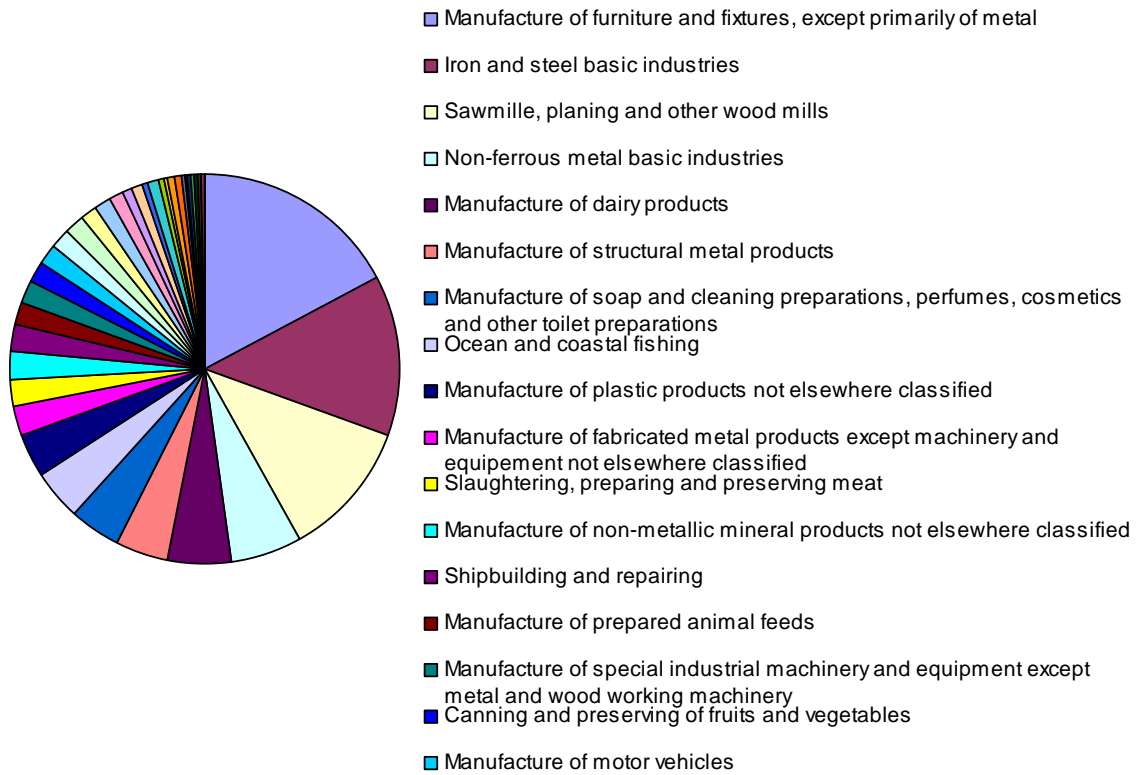
The themes that emerge from this analysis are:

- Wood (wood mills, wood furniture & forestry)
- Iron & steel basic industries and metal products
- Food manufacturing (canned fruit & vegetables, dairy, sauces, bakery, meats)
- Coastal fishing (fresh, salted, chilled, canned)
- Plastics manufactures (pipes, tubes, etc.)

These sectors are very nearby current production, and enjoy both large global demand and strategic value.

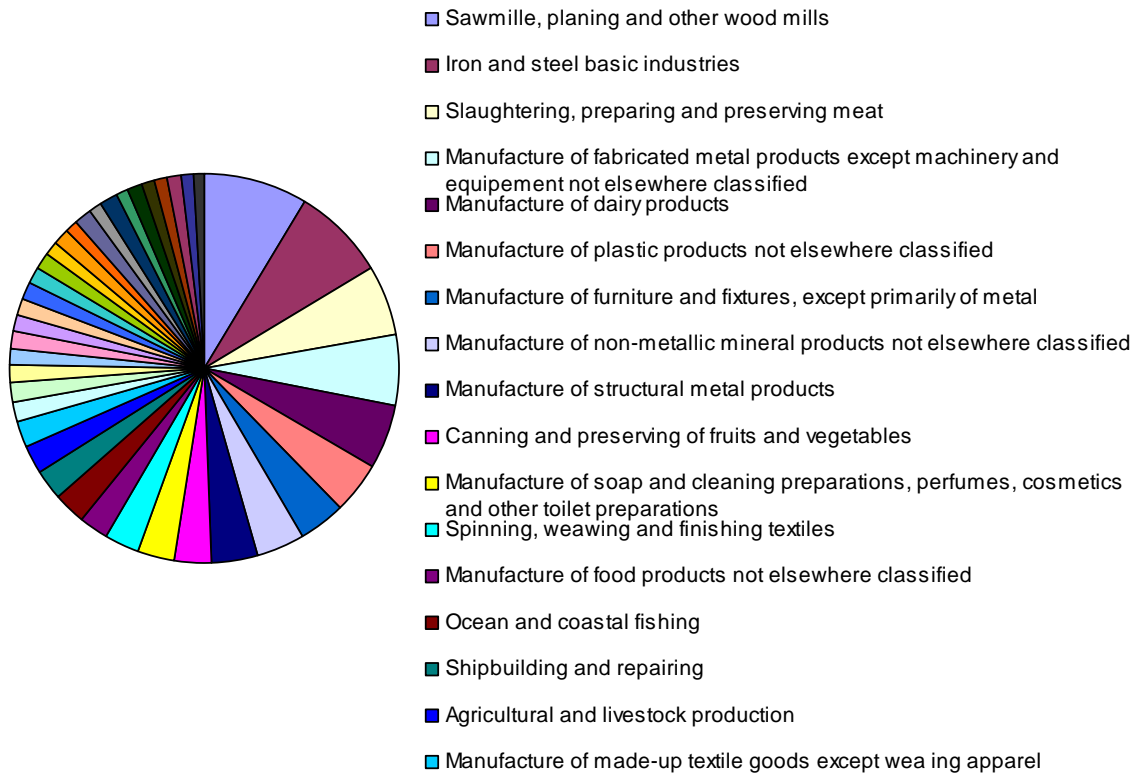
However, as we saw above, there is a tradeoff between strategic value and distance: the nearest products do not involve the development of new capabilities that have many alternative uses not yet exploited. Therefore, any attempt to increase the option value of the export package would require movement to further away products. We therefore repeat the analysis above, decreasing the minimum distance from 1.5 standard deviations to 1, and then 0.5. This gives an idea of how, as ambition increases, the composition of the efficient frontier changes.

Figure 26
Unoccupied Products 1σ above Average Density, Colombia 2005
Weighted by World Trade



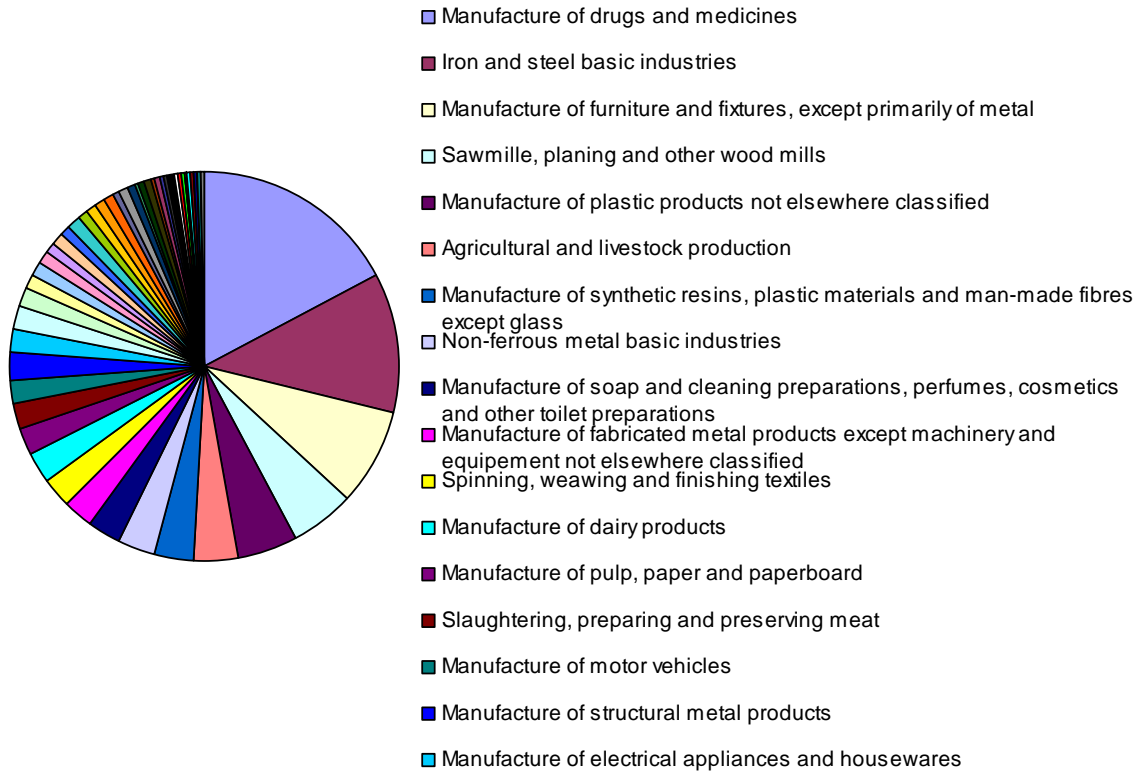
Source: UN Comtrade. All products not exported with $RCA > 1$ in 2005, dropped those with $PRODY < EXPY$, dropped minerals, dropped those with density that is not at least 1.5 standard deviations above the mean for all of Colombia's non-exported products, combined into ISIC sectors, weighted by 2005 world exports of all those products in that sector meeting the above criteria.

Figure 27
Unoccupied Products 1σ above Average Density, Colombia 2005
Weighted by Strategic Value



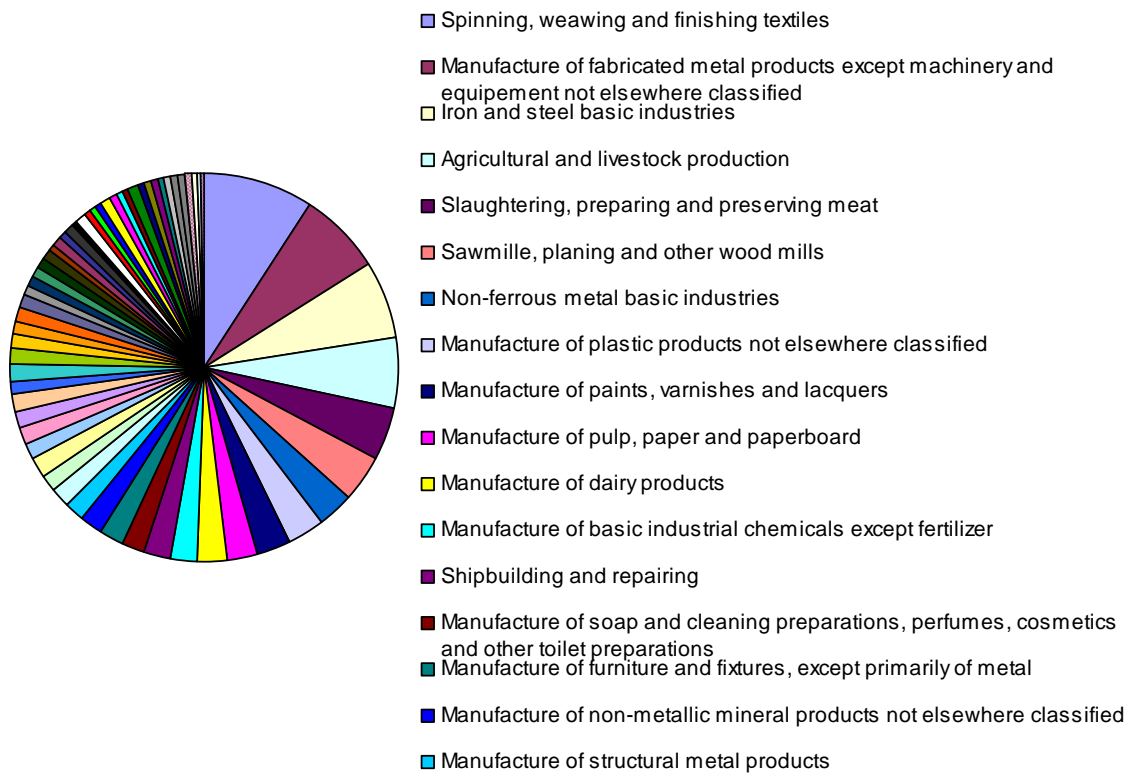
Source: UN Comtrade. All products not exported with $RCA > 1$ in 2005, dropped those with $PRODY < EXPY$, dropped minerals, dropped those with density that is not at least 1.5 standard deviations above the mean for all of Colombia's non-exported products, combined into ISIC sectors, weighted by total strategic value of all those products in that sector meeting the above criteria.

Figure 28
Unoccupied Products 0.5 σ above Average Density, Colombia 2005
Weighted by World Trade



Source: UN Comtrade. All products not exported with $RCA > 1$ in 2005, dropped those with $PRODY < EXPY$, dropped minerals, dropped those with density that is not at least 1.5 standard deviations above the mean for all of Colombia's non-exported products, combined into ISIC sectors, weighted by 2005 world exports of all those products in that sector meeting the above criteria.

Figure 29
Unoccupied Products 0.5σ above Average Density, Colombia 2005
Weighted by Strategic Value



Source: UN Comtrade. All products not exported with $RCA > 1$ in 2005, dropped those with $PRODY < EXPY$, dropped minerals, dropped those with density that is not at least 1.5 standard deviations above the mean for all of Colombia's non-exported products, combined into ISIC sectors, weighted by total strategic value of all those products in that sector meeting the above criteria..

As one allows for potentially further jumps, some new themes are added to the efficient frontier. First, moving from 1.5 to 1 standard deviation above the average distance as the cutoff, the following emerges:

- Manufacture of cosmetics, soaps, perfumes, etc.
- Non-metallic mineral manufactures (plaster, cement, etc.)
- Some automotive & small shipbuilding

Reducing the minimum density even further, to 0.5 standard deviations above the mean, other themes emerge:

- Medicaments
- Fabricated metal products
- Yarn, wool & fabrics
- Shipbuilding & repairing
- Motor vehicles
- Electrical appliances and housewares

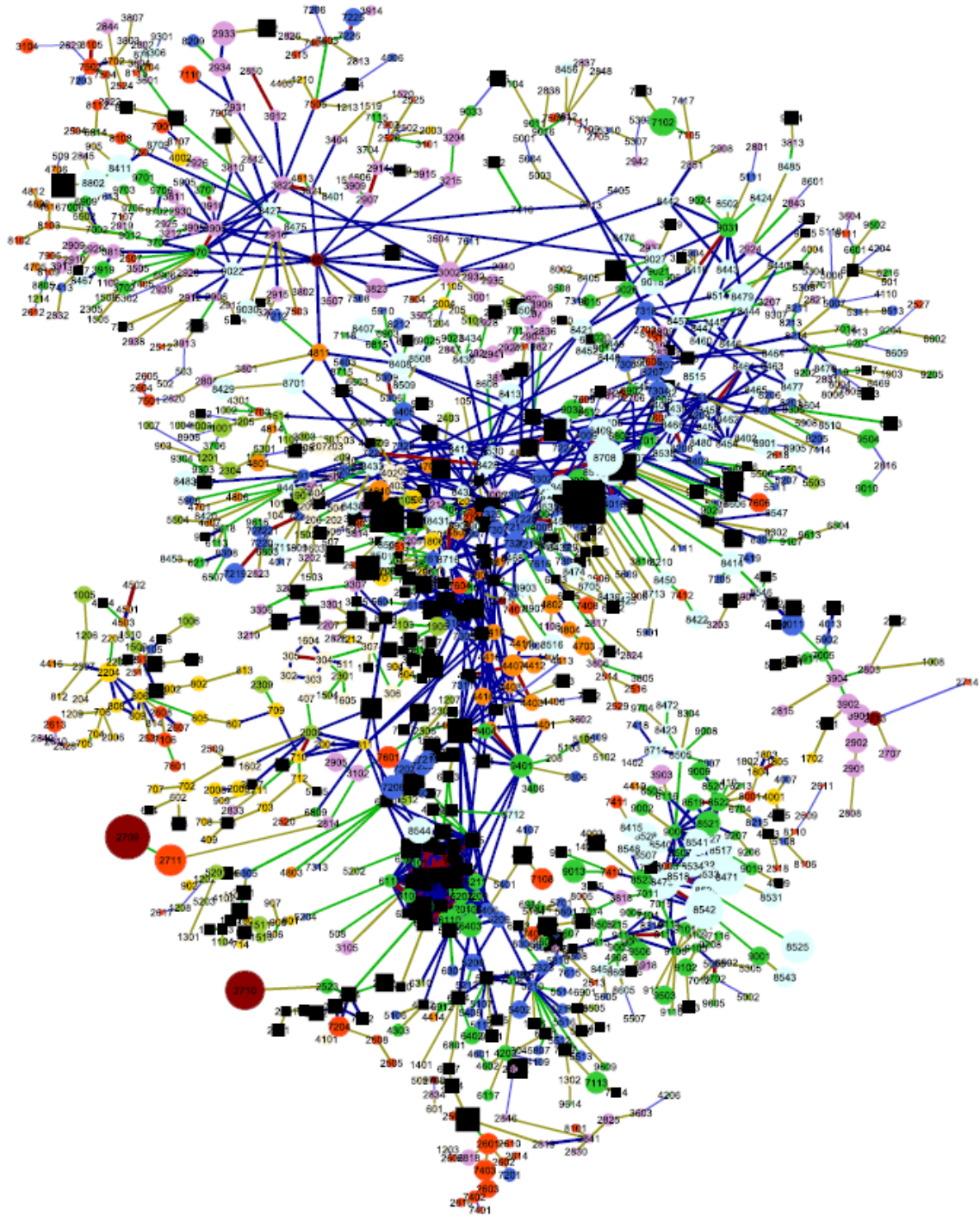
The data used in this analysis has been provided in electronic form as a data appendix, so other weightings and cutoffs can be explored. But according to our analysis, these industries seem like the first that should be explored. The first list is the lowest-hanging fruit, so the question is why isn't the private sector moving into these sectors more heavily? Are there problematic regulations holding them back? Does the right kind of infrastructure or property rights not exist? Are there limitations in the supply of specific skills? Questions such as these should be answered through significant interaction with the private actors themselves.

Products that are further away may have fewer private actors in the economy existing at present. What would it take for a vibrant and internationally competitive medicaments industry to emerge in Colombia? What type of investments in training and education would be required? What type of intellectual property rights regime would be needed? What is the cost-benefit of such investments? The answers to these questions should also draw on the relevant private sector actors, either local or international.

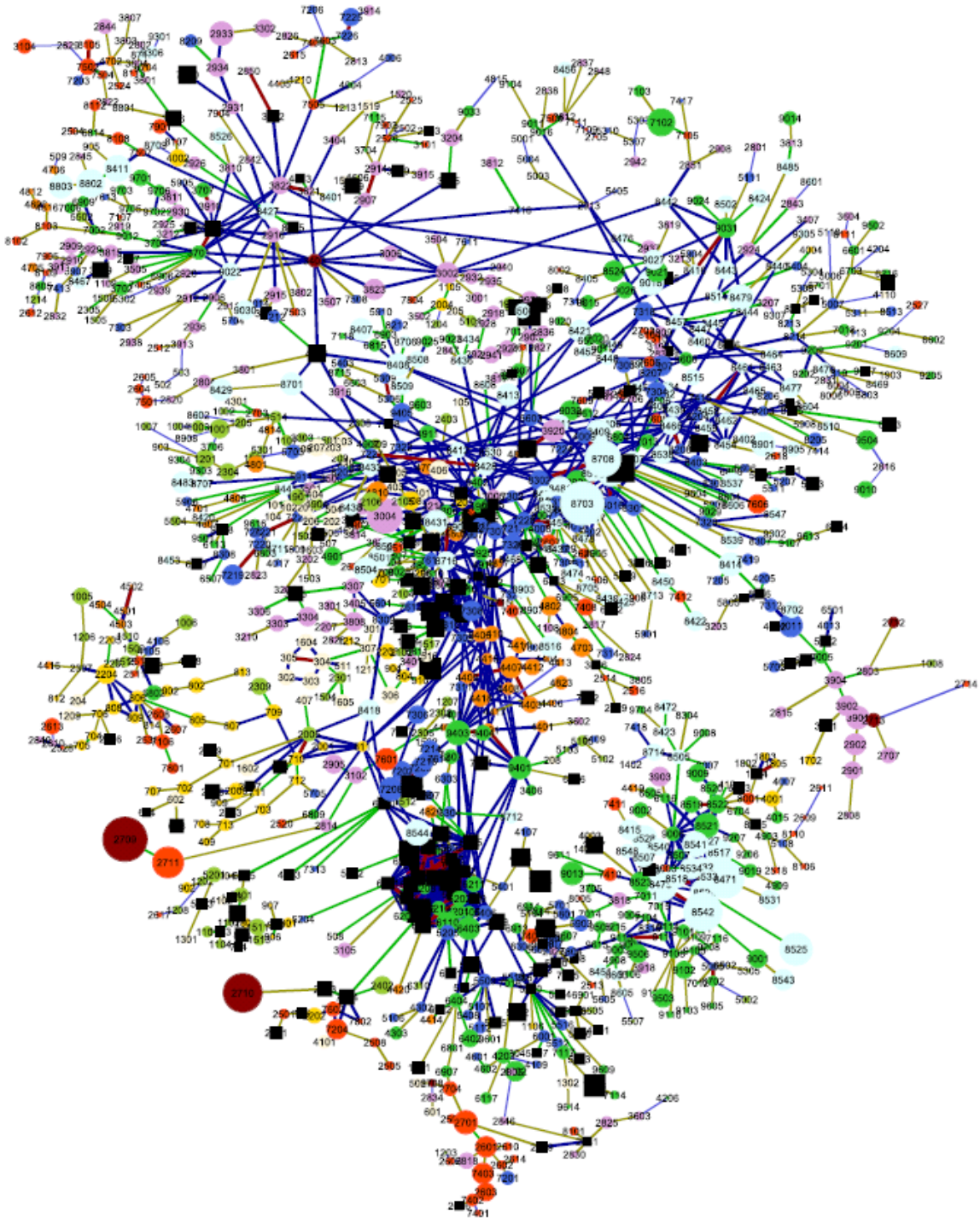
Regional Analysis

Before examining the efficient frontier by region, we will briefly consider the how comparative advantage varies across regions using network diagrams of the product space. These are equivalent in methodology to the product space pictures used above for Colombia as a whole, however they are created using the HS system at 4 digits, which is the coding for our data from 2000 onwards, and has roughly double the number of products as the STIC system used for the historical graphs above. The maps for 2005 by region are shown below.

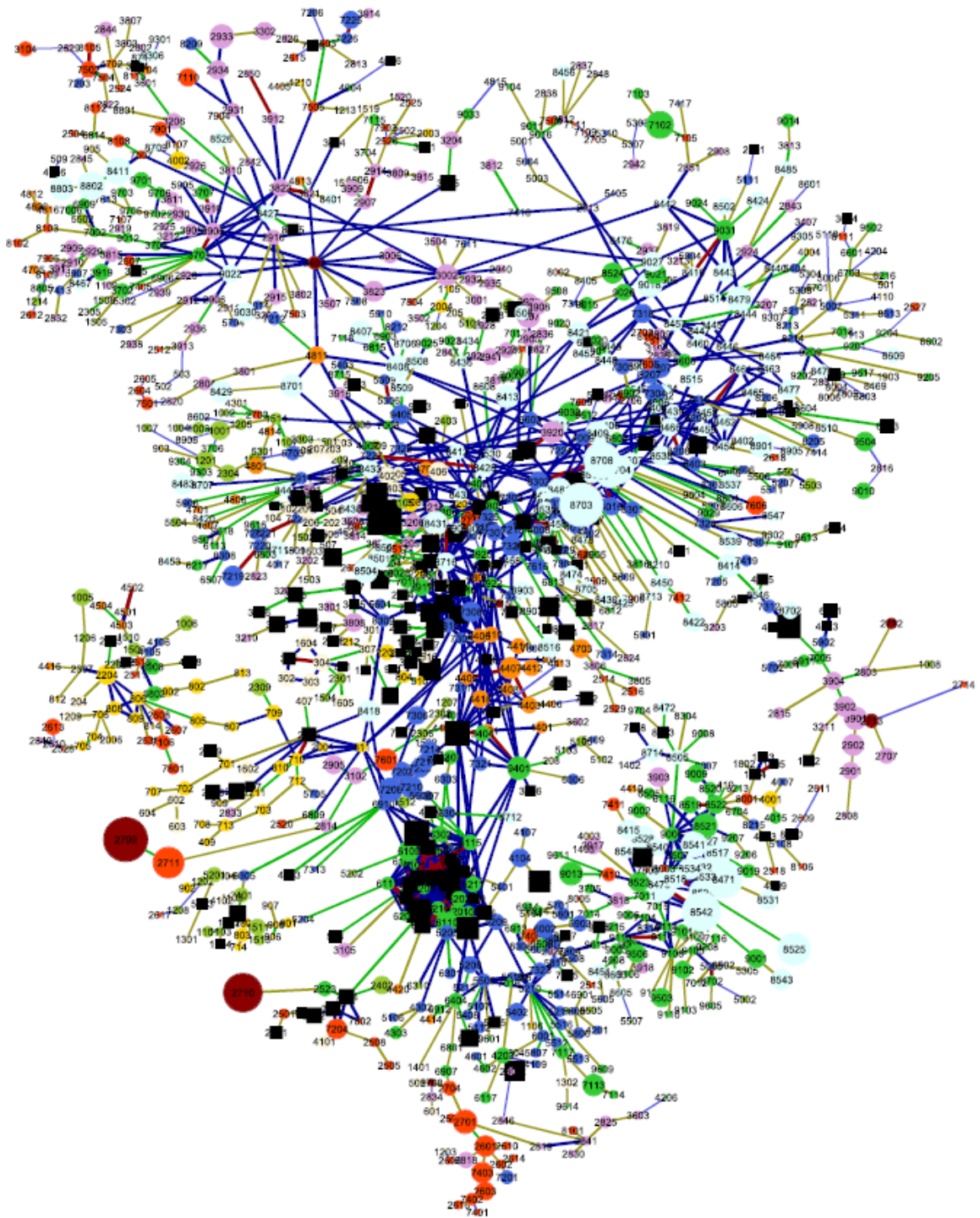
Figure 30
Product Space Map, 2005
SANTAFE DE BOGOTA



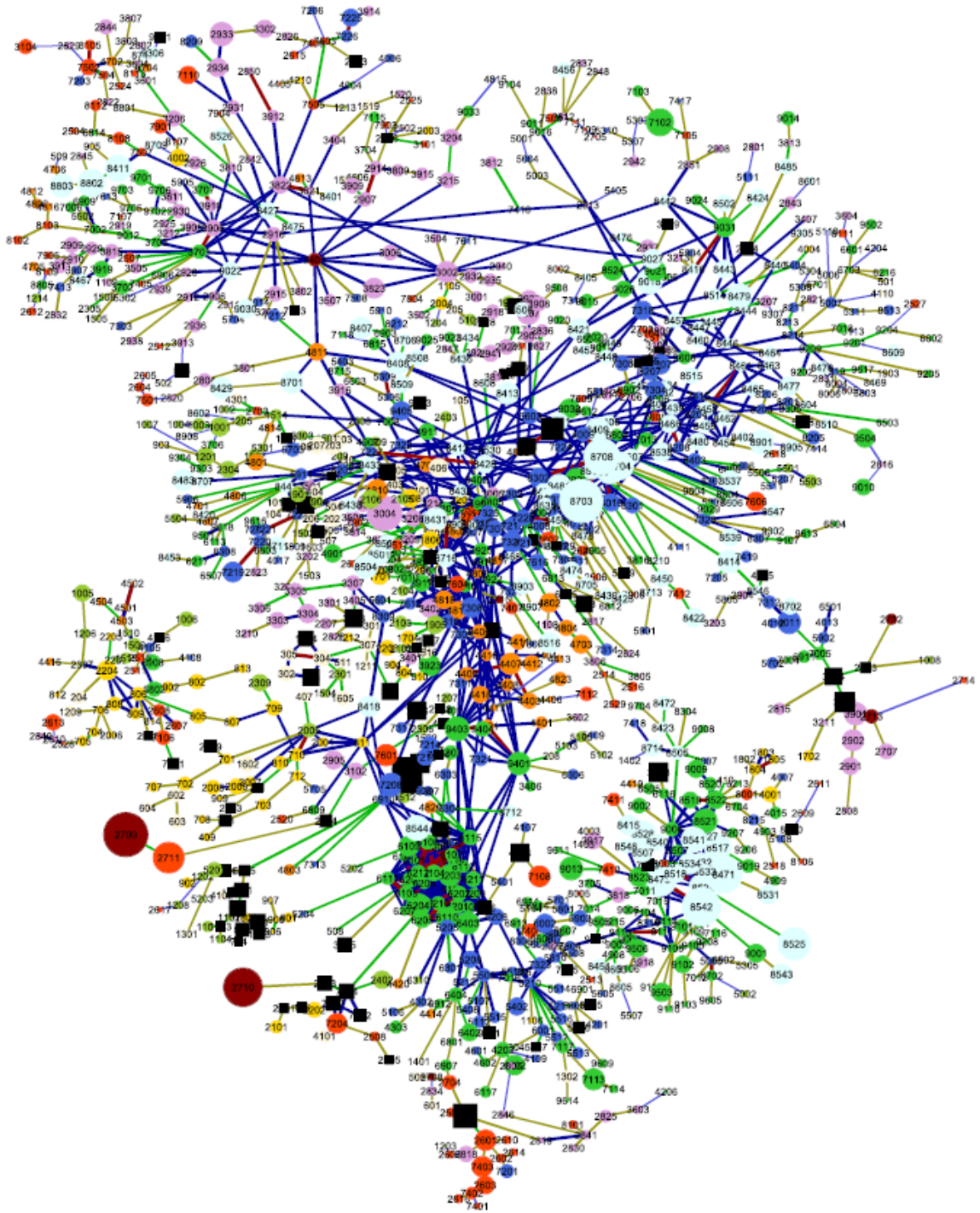
ANTIOQUIA



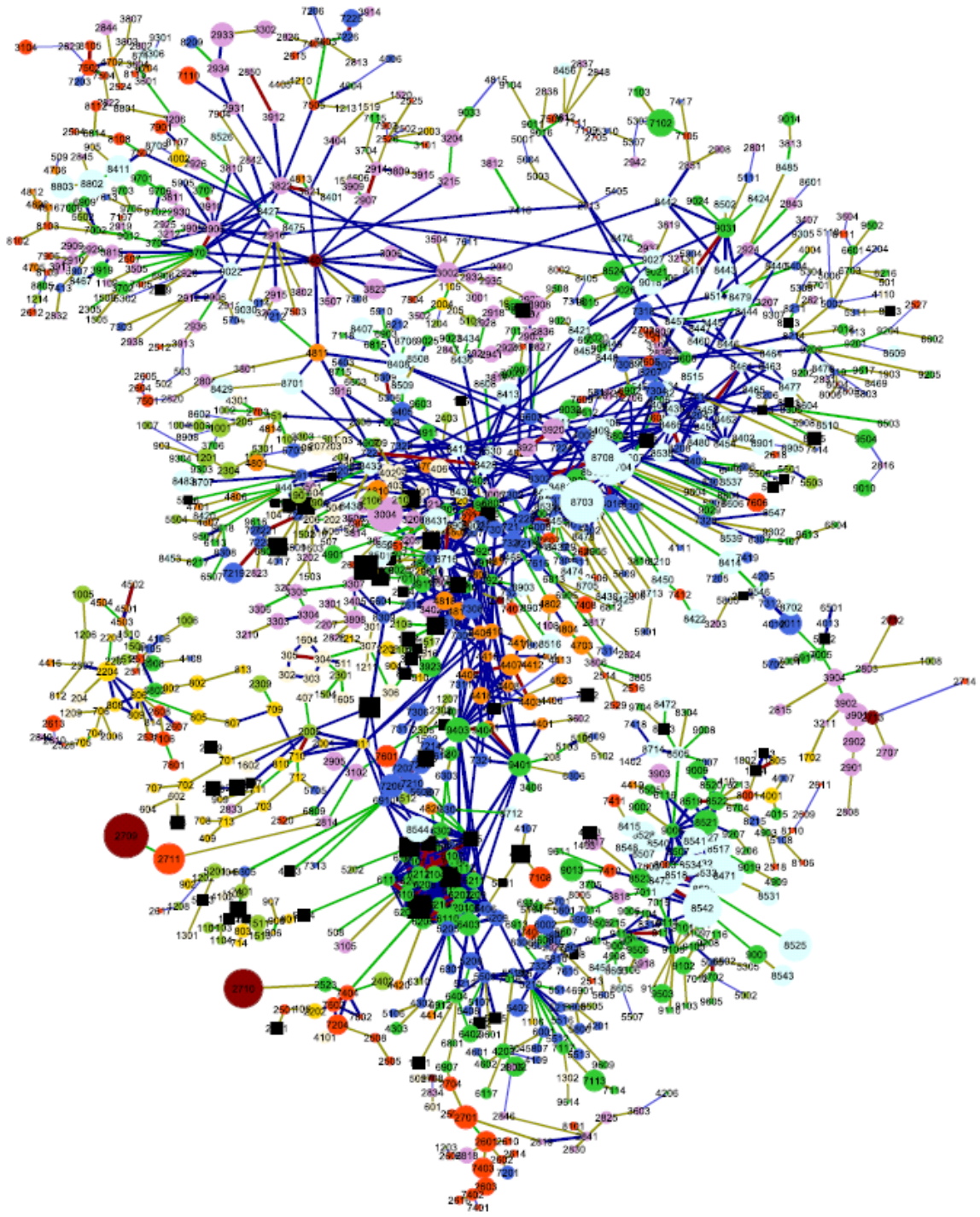
VALLE



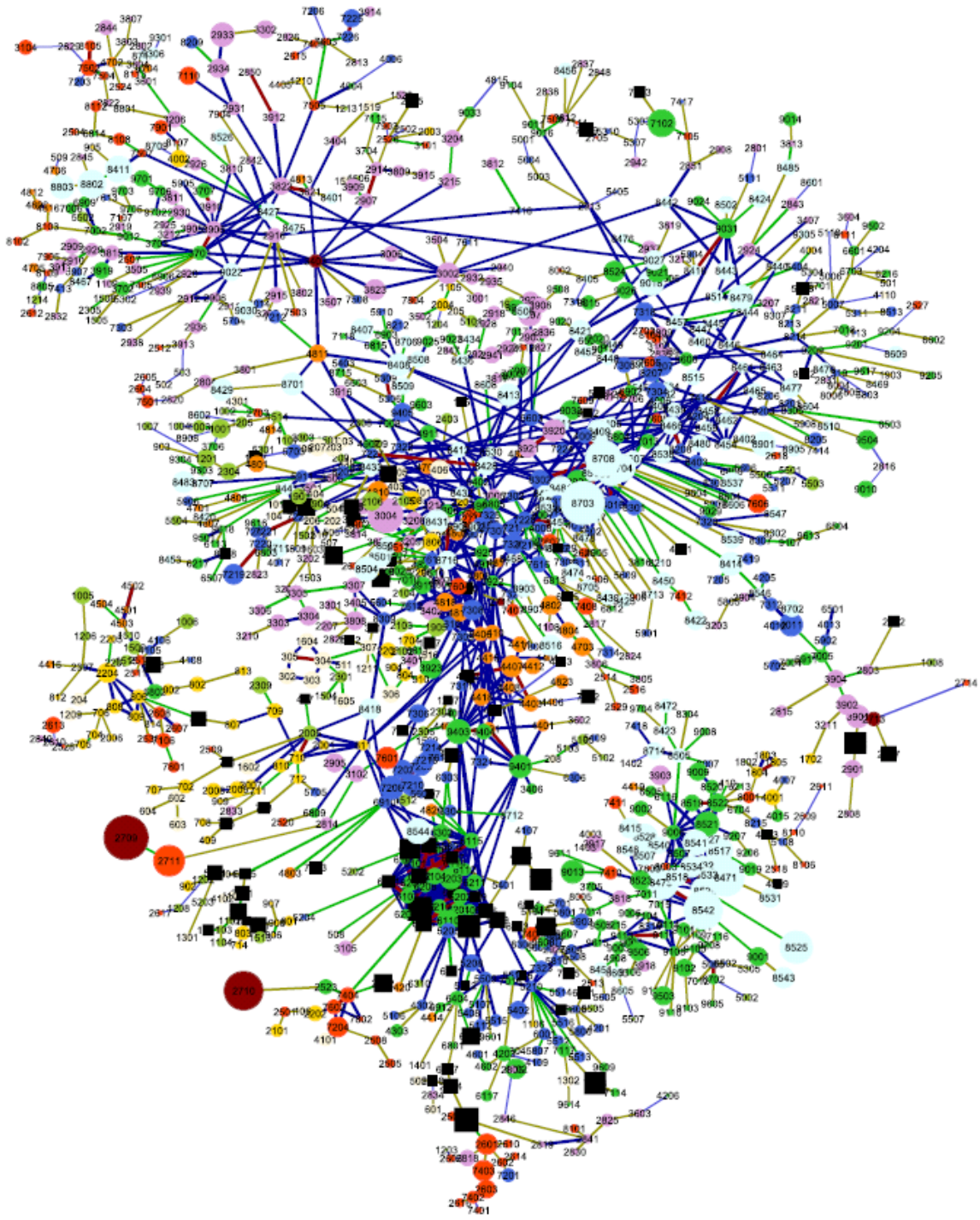
CARIBE



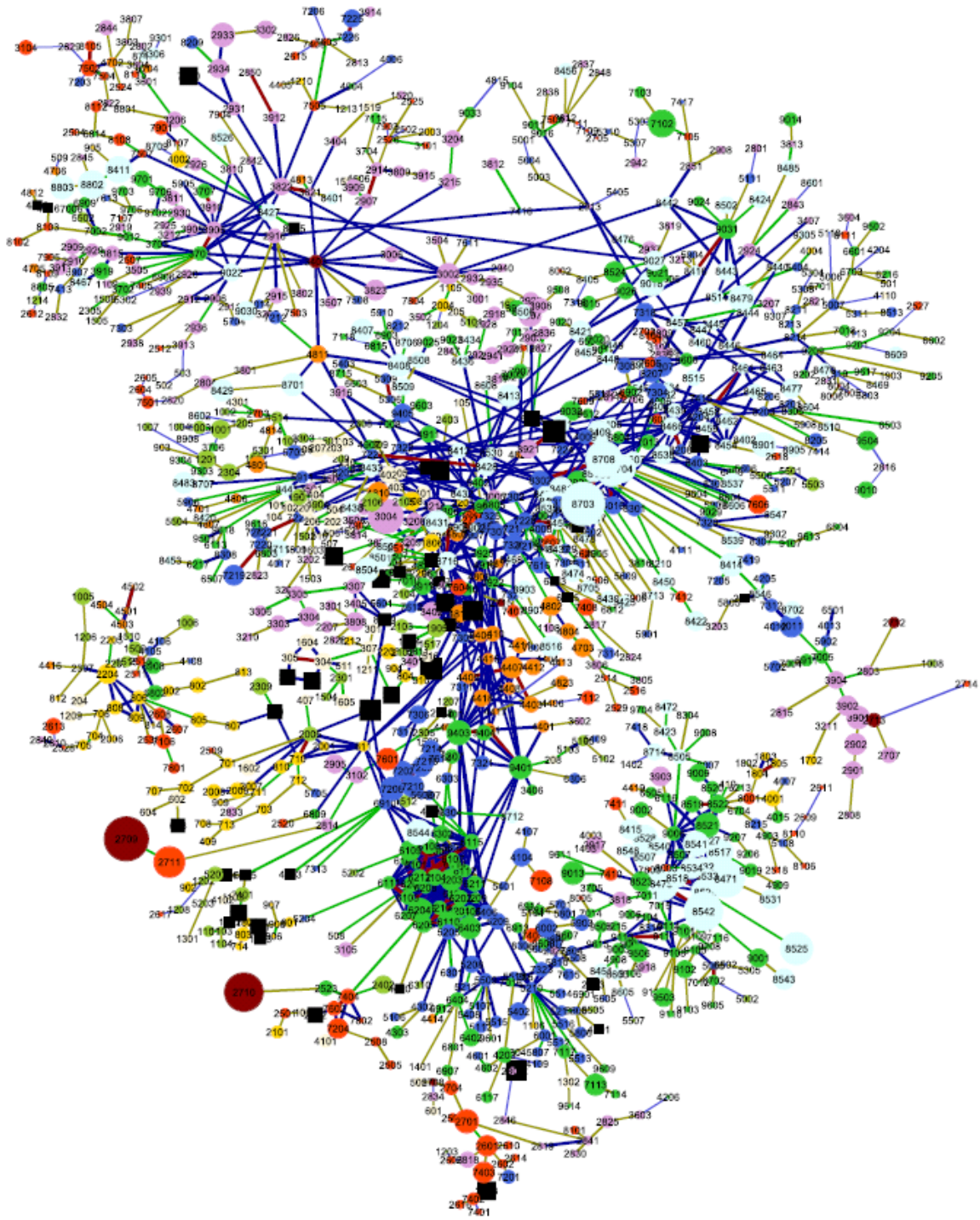
CENTRAL



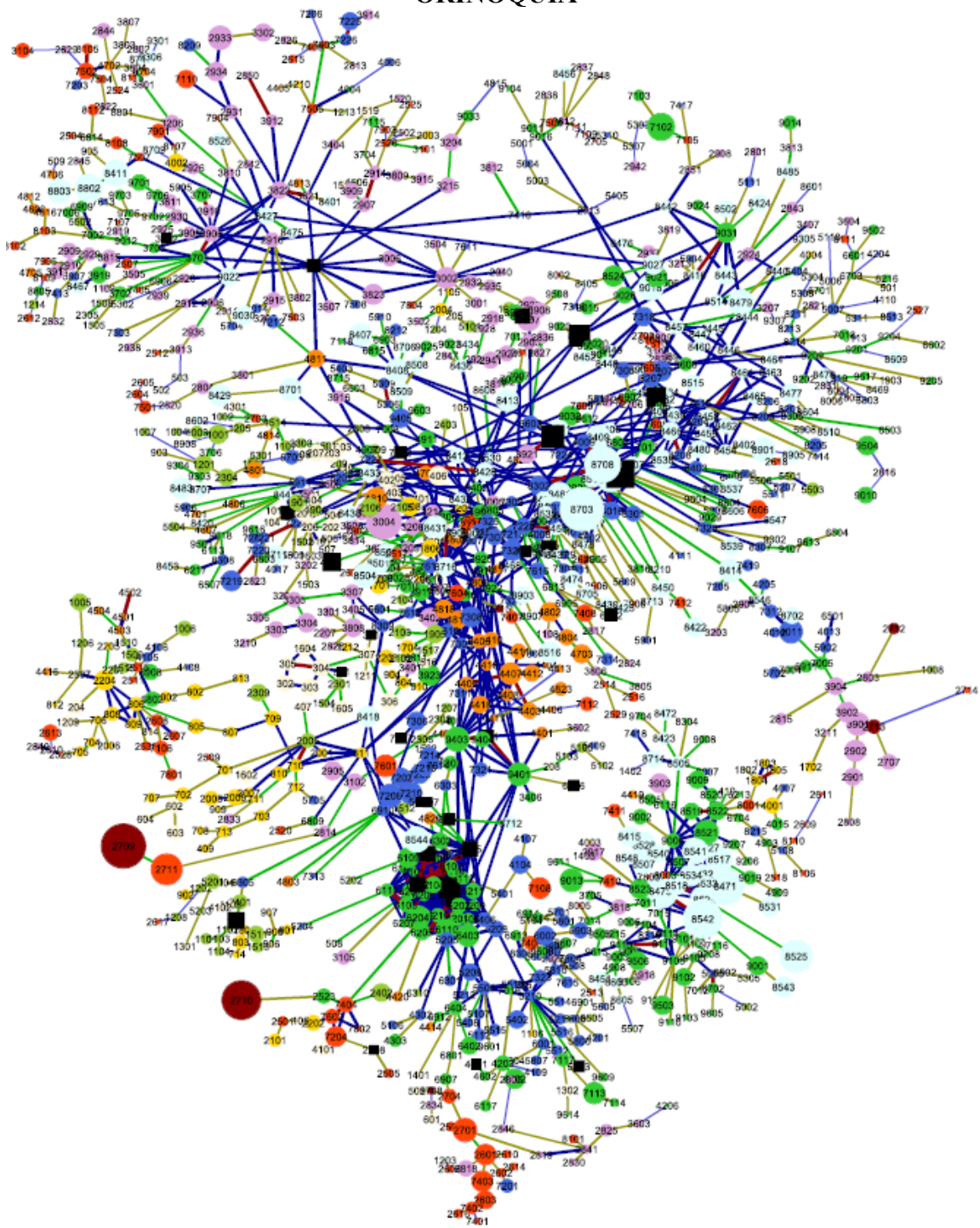
ORIENTAL



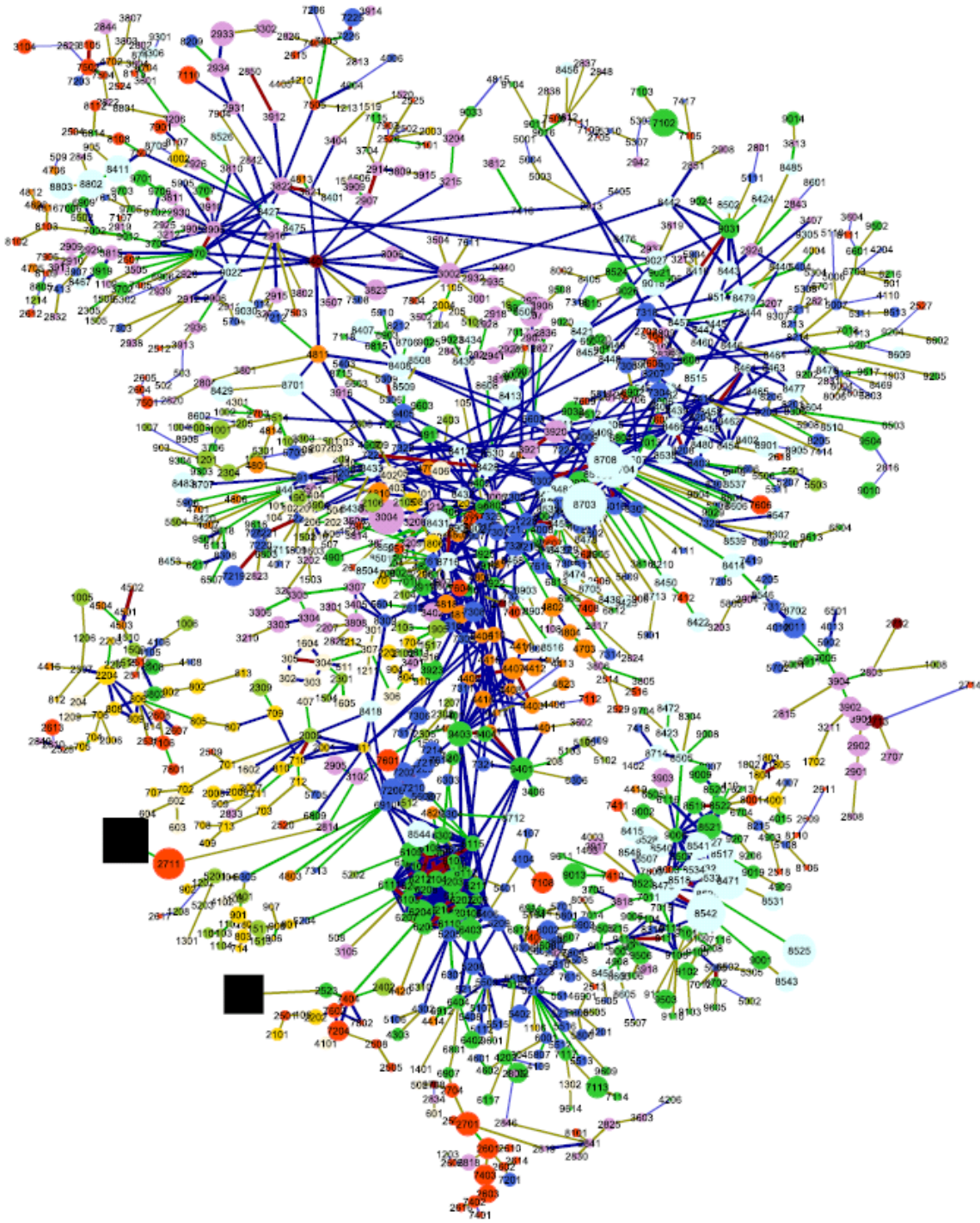
PACIFICO



ORINOQUIA



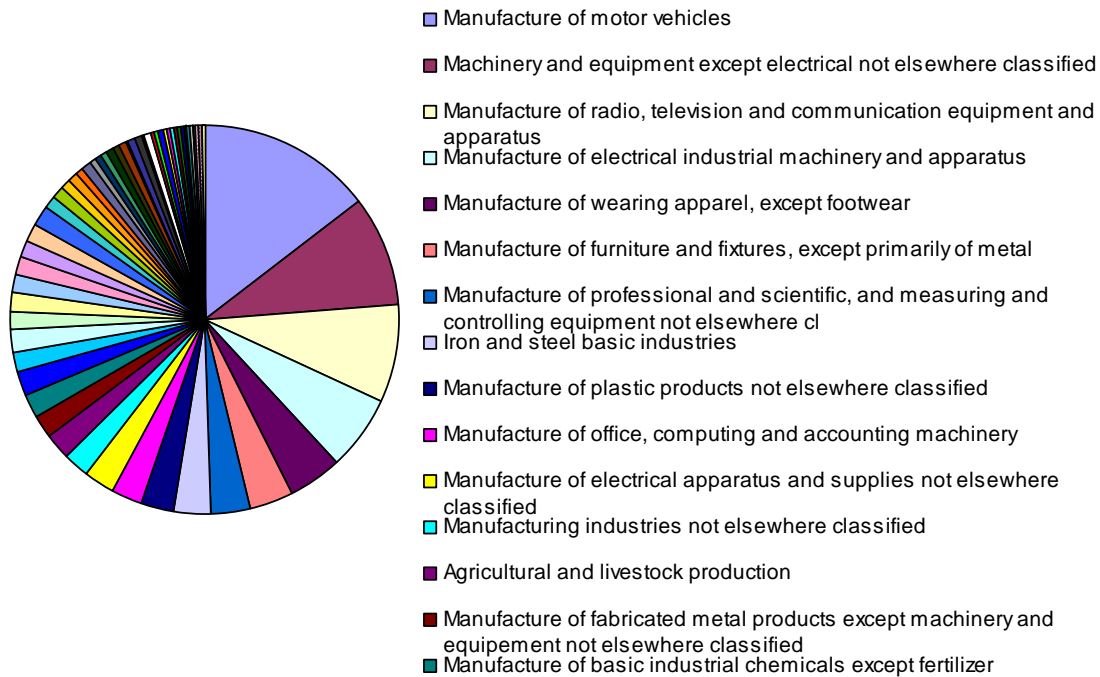
OTROS



These figures show how productive capacity relating to exports is quite different across regions. The broad-based export capacities identified at the national level are concentrated in Bogota, Antioquia, and to a lesser extent, Valle. Pacifico, Oriental, Occidental, and Caribe have some export capacity, but this is largely confined to the periphery of the product space. Orinoquia is completely specialized in cattle, and Others in Petroleum products.

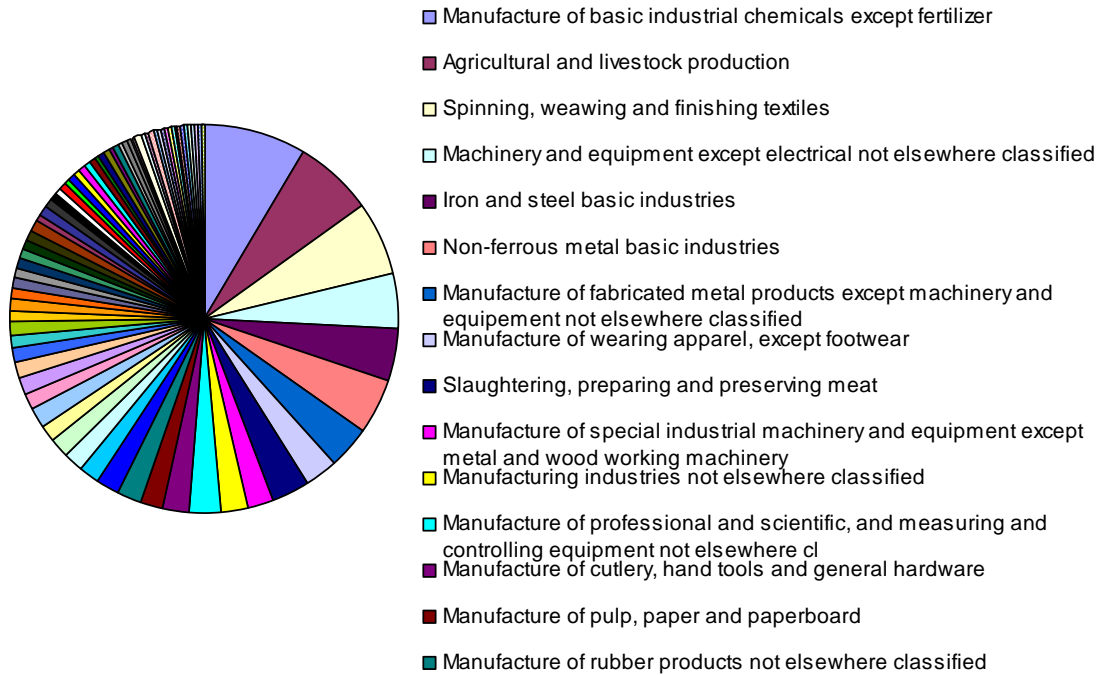
We now repeat the analysis of the efficient frontier conducted at the national level separately for Colombia's regions. Given the regional product space maps above, one would expect that the efficient frontiers are quite different between regions. The differences are actually quite stark: Bogota is the only region that has any unexported products within the 1.5 standard deviation and 1 standard deviation cutoffs. Only when we go to the 0.5 standard deviation cutoff do other regions enter the analysis, and in that case it is only the three regions (containing Colombia's three major urban centers): Bogota, Antioquia and Valle. We therefore move directly to this 0.5 cutoff in order to consider how the ambitious efficient frontier differs between these three regions. The pie charts for each of the three regions, aggregated both by world trade and by strategic value, are provided below.

Figure 31
Unoccupied Products 0.5 σ above Average Density, Bogota 2005
Weighted by World Trade



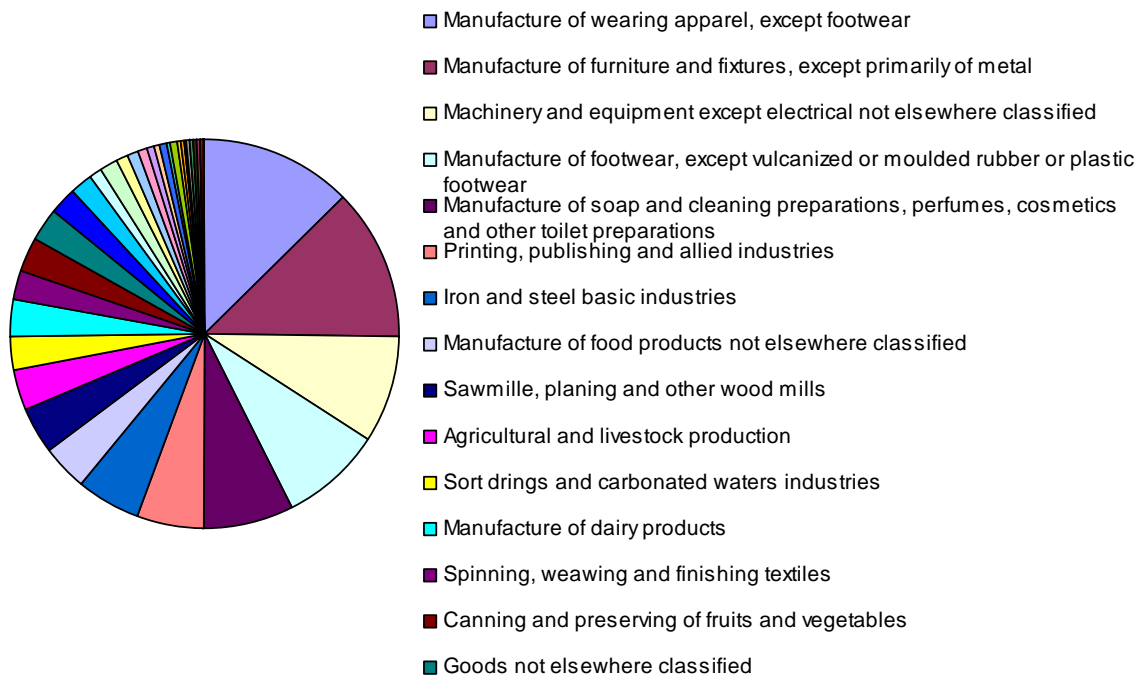
Source: UN Comtrade. All products not exported with $RCA > 1$ in 2005, dropped those with $PRODY < EXPY$, dropped minerals, dropped those with density that is not at least 1.5 standard deviations above the mean for all of Colombia's non-exported products, combined into ISIC sectors, weighted by 2005 world exports of all those products in that sector meeting the above criteria.

Figure 32
Unoccupied Products 0.5σ above Average Density, Bogota 2005
Weighted by Strategic Value



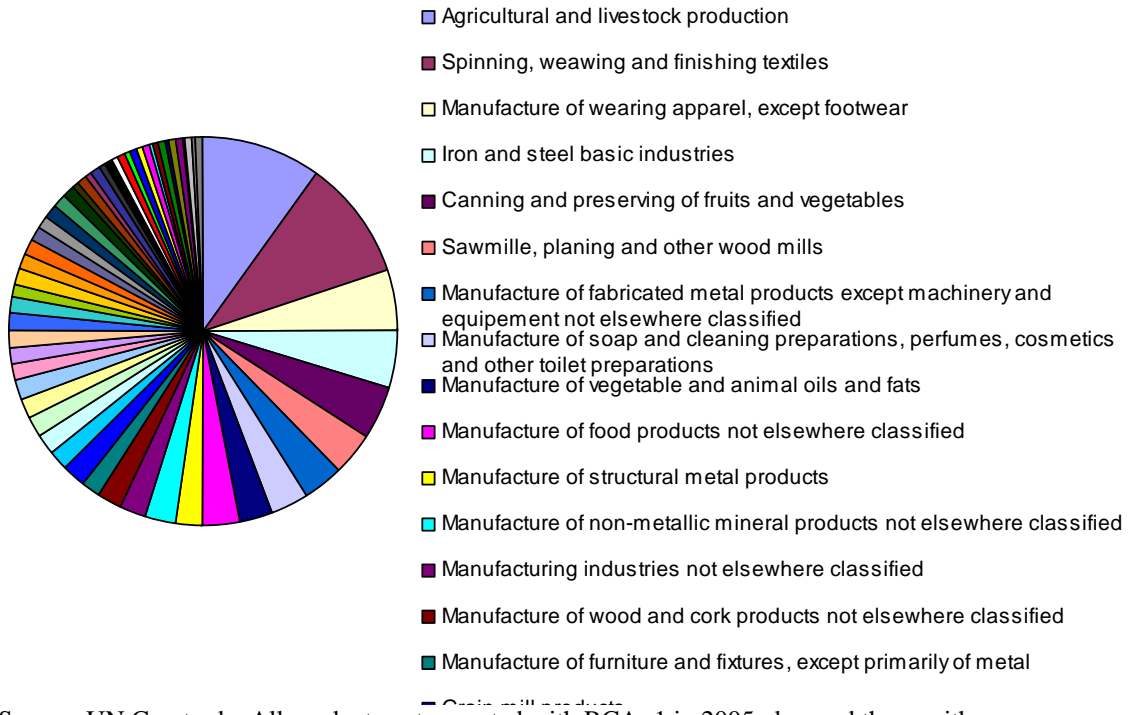
Source: UN Comtrade. All products not exported with $RCA > 1$ in 2005, dropped those with $PRODY < EXPY$, dropped minerals, dropped those with density that is not at least 1.5 standard deviations above the mean for all of Colombia's non-exported products, combined into ISIC sectors, weighted by 2005 strategic value of all those products in that sector meeting the above criteria.

Figure 33
Unoccupied Products 0.5 σ above Average Density, Antioquia 2005
Weighted by World Trade



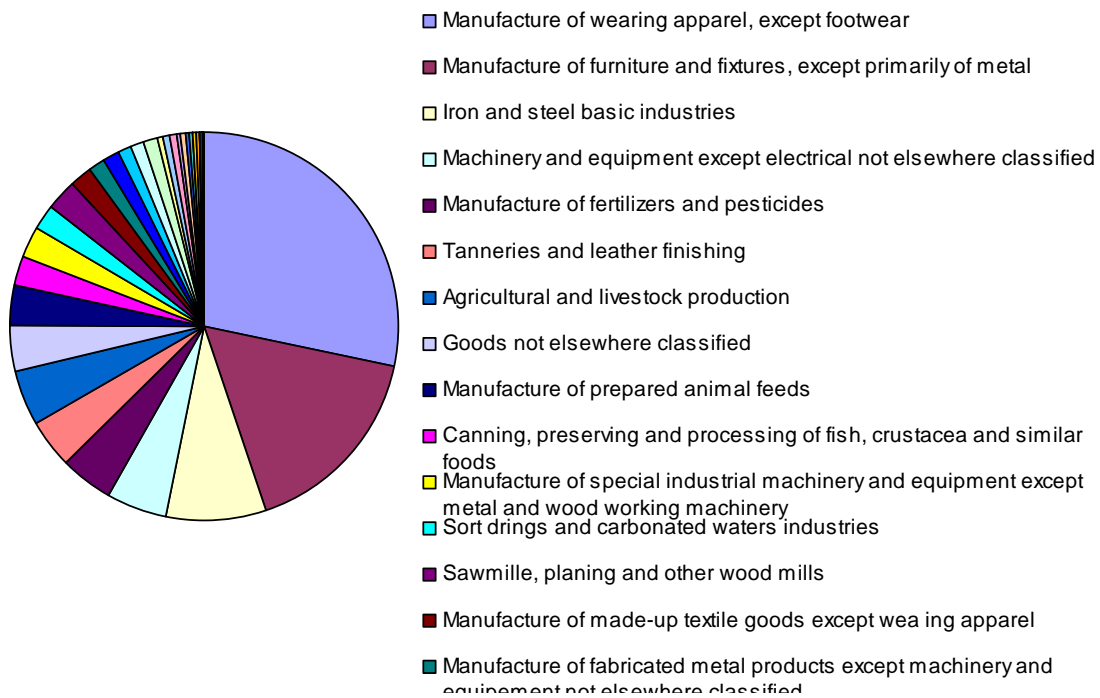
Source: UN Comtrade. All products not exported with $RCA > 1$ in 2005, dropped those with $PRODY < EXPY$, dropped minerals, dropped those with density that is not at least 1.5 standard deviations above the mean for all of Colombia's non-exported products, combined into ISIC sectors, weighted by 2005 world exports of all those products in that sector meeting the above criteria.

Figure 34
Unoccupied Products 0.5σ above Average Density, Antioquia 2005
Weighted by Strategic Value



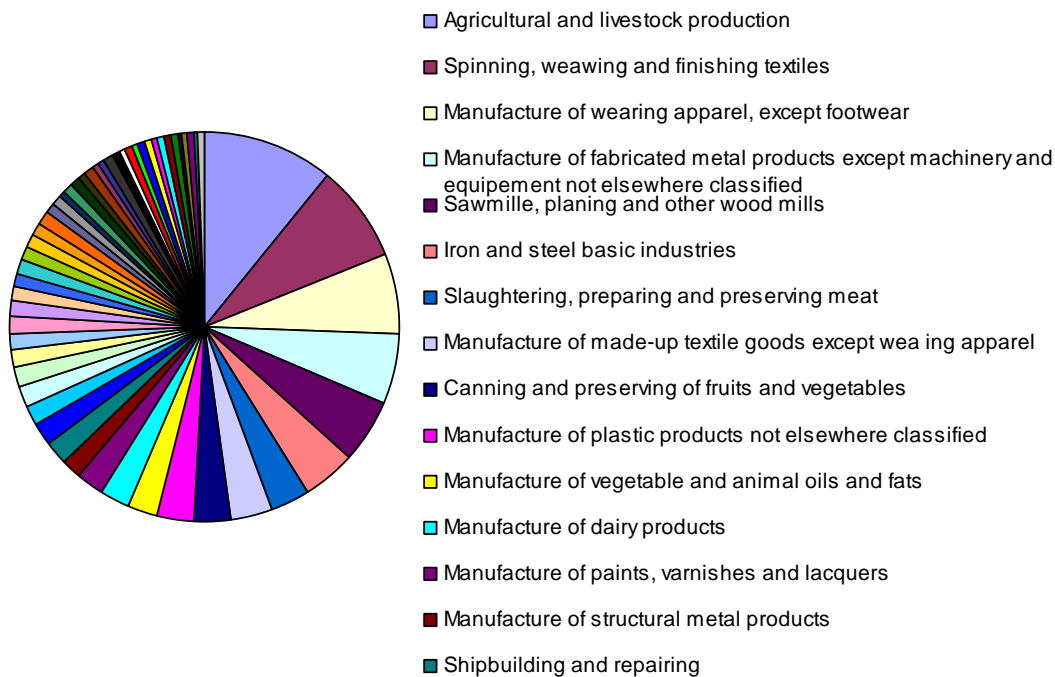
Source: UN Comtrade. All products not exported with $RCA > 1$ in 2005, dropped those with $PRODY < EXPY$, dropped minerals, dropped those with density that is not at least 1.5 standard deviations above the mean for all of Colombia's non-exported products, combined into ISIC sectors, weighted by 2005 strategic value of all those products in that sector meeting the above criteria.

Figure 35
Unoccupied Products 0.5 σ above Average Density, Valle 2005
Weighted by World Trade



Source: UN Comtrade. All products not exported with $RCA > 1$ in 2005, dropped those with $PRODY < EXPY$, dropped minerals, dropped those with density that is not at least 1.5 standard deviations above the mean for all of Colombia's non-exported products, combined into ISIC sectors, weighted by 2005 world exports of all those products in that sector meeting the above criteria.

Figure 36
Unoccupied Products 0.5 σ above Average Density, Valle 2005
Weighted by Strategic Value



Source: UN Comtrade. All products not exported with $RCA > 1$ in 2005, dropped those with $PRODY < EXPY$, dropped minerals & seafood, dropped those with density that is not at least 1.5 standard deviations above the mean for all of Colombia's non-exported products, combined into ISIC sectors, weighted by 2005 strategic value of all those products in that sector meeting the above criteria.

There are noticeable difference between Bogota and the Antioquia and Valle regions. In Bogota, when one allows for jumps to products with densities of only 0.5 standard deviations above the mean, more advanced products such as automobiles, electronics, and industrial chemicals, enter the efficient frontier. In Antioquia and Valle, the efficient frontier is dominated by apparel and agriculture, as well as wood mills (Antioquia).

In order to get a sense of the nearest products facing each region, below we simply take the 20 nearest upmarket products (where $PRODY > EXPY$) for each region. We also show that product's strategic value and density values, which give an immediate sense of how the export opportunities differ for each region.

Table 4
Top 20 Nearest Unoccupied Up-Market Products By Region, 2005

SANTAFE DE BOGOTA

Product	Product Name	Exports,	World	PRODY	Strategic	Density
		US M	Market		Value	
		(2005)	(2005)	(ppp)	(score)	
1905	Bread, pastry, cakes, etc; communi	2.55	14.69	13803	-0.18	0.25
7310	Tanks,casks,drums,cans,boxes and an	1.45	4.07	14651	-0.03	0.25
2008	Fruit, nuts and other parts of plan	1.37	6.51	14370	-0.77	0.25
1601	Sausages and similar products; food	0.00	2.41	15387	0.00	0.25
1902	Pasta, such as spaghetti, macaroni,	0.30	4.15	14681	-1.11	0.24
6810	Articles of cement,of concrete/arti	0.02	3.42	19623	0.27	0.24
7311	Containers for compressed or liquef	0.14	1.69	14695	-0.56	0.24
7604	Aluminium bars,rods and profiles	0.05	9.02	15554	0.02	0.24
4418	Builders' joinery and carpentry of	1.04	11.15	15190	-0.61	0.24
4803	Toilet... similar paper, in rolls o	0.10	2.12	26149	-0.02	0.24
7610	Aluminium structures(excluding of h	0.18	5.37	13899	0.11	0.24
7326	Other articles of iron or steel	3.47	25.28	17809	0.59	0.24
4808	Paper and paperboard, corrugated, c	0.09	1.12	14927	0.27	0.24
5807	Labels, badges... of textiles, in p	0.02	1.11	14353	-0.49	0.23
4817	Envelopes, letter cards...; boxes,	0.06	1.12	15950	0.20	0.23
7216	Angles,shapes and sections of iron	0.63	10.64	31607	-0.19	0.23
1806	Chocolate and other food preparatio	1.51	12.20	17078	0.37	0.23
4410	Particle board and similar board of	0.02	7.49	20345	0.12	0.23
7217	Wire of iron or non-alloy steel	0.80	4.47	19709	0.10	0.23
9401	Seats whether or not convertible in	11.48	38.99	15259	0.14	0.23

ANTIOQUIA

Product	Product Name	Exports,	World	PRODY	Strategic	Density
		US M	Market		Value	
		(2005)	(2005)	(ppp)	(score)	
1902	Pasta, such as spaghetti, macaroni,	0.02	4.15	14681	-0.91	0.20
7214	Other bars,rods of iron/non-alloy s	0.01	11.79	12213	-0.81	0.20
2002	Tomatoes prepared or preserved othe	0.01	2.33	12611	-1.43	0.19
7306	Other tubes,pipes and hollow profil	0.05	15.69	12860	-0.13	0.19
2005	Other vegetables preserved other th	1.44	5.94	11530	-0.05	0.19
8544	Insulated wire,cable,other insulate	0.13	55.51	11167	0.15	0.19
8418	Refrigerators,freezers electric or	7.65	25.85	16120	0.32	0.19
2102	Yeasts; other single-cell micro-org	0.00	0.94	12714	-0.23	0.19
5607	Twine, cordage, ropes and cables	0.29	1.29	10890	-0.33	0.18
7310	Tanks,casks,drums,cans,boxes and an	0.50	4.07	14651	0.24	0.18
4302	Tanned or dressed furskins (excl. 4	0.02	1.72	15872	-0.11	0.18
6403	Footwear, with rubber, plastics, le	7.02	34.72	11342	0.21	0.18
710	Vegetables, frozen	0.09	3.44	10938	-0.29	0.18
6210	Garments, made up of fabrics of 56.	0.02	4.51	24469	-0.15	0.18
1510	Other oils and their fractions, obt	0.00	0.25	18576	-1.97	0.18
6905	Roofing tiles,chimney-pots,cowls,et	0.11	0.53	13408	0.27	0.18
7311	Containers for compressed or liquef	0.03	1.69	14695	-0.32	0.18
7309	All types of reservoirs with or wit	0.15	2.16	11984	-0.09	0.18
4415	Packing cases... of wood; cable-dru	0.08	2.03	13484	0.26	0.18
5804	Tulles and other net fabrics; lace	0.08	1.41	10944	-0.64	0.18

VALLE

Product	Product Name	Exports,	World	PRODY	Strategic	Density
		US M	Market		Value	
		(2005)	US B	(ppp)	(score)	
7310	Tanks,casks,drums,cans,boxes and an	0.00	4.07	14651	0.18	0.20
4418	Builders' joinery and carpentry of	0.28	11.15	15190	-0.47	0.20
402	Milk and cream, concentrated or swe	0.10	10.40	13162	-0.65	0.19
8418	Refrigerators,freezers electric or	1.31	25.85	16120	0.29	0.19
1103	Cereal groats, meal and pellets	0.00	0.56	12690	-0.34	0.19
1601	Sausages and similar products; food	0.00	2.41	15387	0.21	0.19
2309	Preparations of a kind used in anim	0.90	11.33	13571	0.07	0.19
6908	Glazed ceramic flags and paving,hea	0.01	8.49	14001	-0.59	0.19
4407	Wood sawn or chipped lengthwise, sl	0.00	29.29	13218	-1.01	0.19
7306	Other tubes,pipes and hollow profil	0.02	15.69	12860	-0.13	0.19
3925	Builders' ware of plastics, nes	0.14	6.00	18387	0.37	0.19
4409	Wood, continuously shaped along any	0.00	4.37	12601	-0.40	0.19
9406	Prefabricated buildings	0.01	5.28	19152	0.28	0.19
6905	Roofing tiles,chimney-pots,cowls,et	0.03	0.53	13408	0.25	0.19
4410	Particle board and similar board of	0.00	7.49	20345	0.29	0.19
6912	Ceramic table/kitchenware,household	0.00	1.25	13768	0.11	0.19
1902	Pasta, such as spaghetti, macaroni,	0.01	4.15	14681	-0.88	0.19
4808	Paper and paperboard, corrugated, c	0.06	1.12	14927	0.47	0.18
3917	Tubes, pipes and hoses, and fitting	0.16	11.72	15539	0.38	0.18
7308	Sructures and parts of structures(b	0.35	21.23	16681	0.42	0.18

CARIBE

Product	Product Name	Exports,	World	PRODY	Strategic	Density
		US M	Market		Value	
		(2005)	US B	(ppp)	(score)	
2301	Flours, etc, of meat, fish, etc, un	0.00	2.94	15027	-1.72	0.12
304	Fish fillets and other fish meat, f	0.07	10.96	13627	-0.87	0.11
305	Fish,salted,dried...;smoked fish,fi	0.28	3.41	21799	-0.96	0.11
2008	Fruit, nuts and other parts of plan	0.34	6.51	14370	-0.25	0.10
4407	Wood sawn or chipped lengthwise, sl	0.22	29.29	13218	-0.70	0.10
810	Other fruit, fresh, nes	0.01	4.14	13616	0.02	0.10
7601	Unwrought aluminium	0.00	32.42	25116	-0.52	0.10
1905	Bread, pastry, cakes, etc; communi	0.06	14.69	13803	0.39	0.10
4418	Builders' joinery and carpentry of	1.04	11.15	15190	-0.12	0.10
6908	Glazed ceramic flags and paving,hea	0.08	8.49	14001	-0.26	0.10
4818	Toilet paper..., bed sheets, etc, a	0.29	14.27	14540	0.45	0.10
7604	Aluminium bars,rods and profiles	1.97	9.02	15554	0.54	0.10
2309	Preparations of a kind used in anim	1.58	11.33	13571	0.39	0.10
1605	Crustaceans... and other aquatic in	1.00	5.78	22072	-0.52	0.10
4401	Fuel wood, in logs..., etc; wood ch	0.00	2.94	13609	0.11	0.10
4011	New pneumatic tyres, of rubber	0.00	40.48	20419	0.73	0.10
1902	Pasta, such as spaghetti, macaroni,	0.00	4.15	14681	-0.57	0.10
4102	Raw skins of sheep or lambs, but no	0.00	0.72	13464	-1.14	0.10
1702	Other sugars in solid form; sugar s	0.01	2.17	16804	0.33	0.10
7310	Tanks,casks,drums,cans,boxes and an	1.76	4.07	14651	0.54	0.09

CENTRAL

Product	Product Name	Exports,	World	PRODY	Strategic	Density
		US M	Market		Value	
		(2005)	(2005)	(ppp)	(score)	
6305	Sacks and bags, used for packing go	0.00	2.02	7260	-0.64	0.09
1604	Prepared or preserved fish; caviar	0.00	7.91	8581	-0.68	0.09
6104	Women's or girls' suits, ensembles,	0.22	8.71	7972	-0.37	0.09
709	Other vegetables, fresh or chilled	0.85	7.00	10274	-0.52	0.08
6206	Women's or girls' blouses, shirts a	0.45	7.70	7221	-0.08	0.08
6107	Men's or boys' briefs and similar a	0.18	2.85	8302	-0.13	0.08
4820	Registers, account books, etc; albu	0.01	3.23	9959	-0.34	0.08
7214	Other bars,rods of iron/non-alloy s	0.04	11.79	12213	-0.44	0.08
1517	Margarine; edible preparations of a	0.00	2.63	7530	-0.37	0.08
6910	Ceramic sinks,wash basins/pedestals	0.01	3.33	9292	0.17	0.08
6212	Brassieres, girdles, corsets, brace	0.50	6.69	8822	0.29	0.08
5202	Cotton waste (incl. yarn waste and	0.00	0.25	8012	-0.11	0.08
6209	Babies' garments and clothing acces	0.02	1.74	7791	0.11	0.08
3105	Mineral or chemical fertilizers, ne	0.00	6.02	9891	-0.31	0.08
7313	Barbed,twisted,single wire of iron/	0.00	0.13	8644	-0.13	0.08
6208	Women's or girls' slips, petticoats	0.01	2.24	6767	-0.76	0.08
6110	Jerseys, pullovers, cardigans and s	0.22	29.88	9302	-0.39	0.08
2402	Cigars, cigarillos, cigarettes, etc	0.00	14.63	9627	-0.34	0.08
7010	Carboys,bottles,flasks,jars,etc. of	0.00	5.09	9992	0.00	0.08
2005	Other vegetables preserved other th	0.10	5.94	11530	0.30	0.08

ORIENTAL

Product	Product Name	Exports,	World	PRODY	Strategic	Density
		US M	Market		Value	
		(2005)	(2005)	(ppp)	(score)	
6104	Women's or girls' suits, ensembles,	0.38	8.71	7972	-0.42	0.11
1604	Prepared or preserved fish; caviar	0.00	7.91	8581	-0.72	0.11
6110	Jerseys, pullovers, cardigans and s	0.13	29.88	9302	-0.42	0.11
5202	Cotton waste (incl. yarn waste and	0.01	0.25	8012	-0.15	0.11
6203	Men's or boys' suits, ensembles, ja	1.51	28.77	8214	-0.17	0.11
5205	Cotton yarn, with >=85% cotton, not	0.16	6.59	7928	-0.48	0.10
4820	Registers, account books, etc; albu	0.00	3.23	9959	-0.37	0.10
6115	Panty hose, tights, etc, and footwe	0.01	6.95	12435	0.06	0.10
6207	Men's or boys' underpants, briefs,	0.02	1.13	8145	-0.57	0.10
2002	Tomatoes prepared or preserved othe	0.00	2.33	12611	-1.11	0.10
7214	Other bars,rods of iron/non-alloy s	0.16	11.79	12213	-0.46	0.10
3105	Mineral or chemical fertilizers, ne	0.01	6.02	9891	-0.34	0.10
2008	Fruit, nuts and other parts of plan	0.04	6.51	14370	-0.22	0.10
709	Other vegetables, fresh or chilled	0.00	7.00	10274	-0.53	0.10
6302	Bed linen, table linen, toilet line	0.13	9.70	12108	0.10	0.10
6202	Woman's or girls' overcoats, and si	0.12	6.82	9164	0.22	0.10
6201	Men's or boys' overcoats, and simil	0.02	6.09	9643	0.23	0.10
6910	Ceramic sinks,wash basins/pedestals	0.00	3.33	9292	0.17	0.10
5204	Cotton sewing thread	0.00	0.17	10574	-0.06	0.10
1902	Pasta, such as spaghetti, macaroni,	0.00	4.15	14681	-0.56	0.10

PACIFICO

Product	Product Name	Exports,	World	PRODY	Strategic	Density
		US M	Market		Value	
		(2005)	(2005)	(ppp)	(score)	
304	Fish fillets and other fish meat, f	0.19	10.96	13627	-0.75	0.06
106	Other live animals, nes	0.00	0.54	9384	-0.83	0.06
1604	Prepared or preserved fish; caviar	0.00	7.91	8581	-0.61	0.06
402	Milk and cream, concentrated or swe	0.00	10.40	13162	-0.23	0.06
305	Fish,salted,dried...;smoked fish,fi	0.05	3.41	21799	-0.85	0.06
1517	Margarine; edible preparations of a	0.03	2.63	7530	-0.31	0.06
2402	Cigars, cigarillos, cigarettes, etc	0.00	14.63	9627	-0.28	0.06
7010	Carboys,bottles,flasks,jars,etc. of	0.00	5.09	9992	0.06	0.06
2102	Yeasts; other single-cell micro-org	0.00	0.94	12714	0.17	0.06
1905	Bread, pastry, cakes, etc; communio	0.00	14.69	13803	0.49	0.06
2009	Fruit juices (incl. grape must) and	0.00	8.71	7766	-0.41	0.06
7602	Aluminium waste and scrap	0.00	6.20	10662	0.24	0.06
4407	Wood sawn or chipped lengthwise, sl	0.02	29.29	13218	-0.60	0.06
6203	Men's or boys' suits, ensembles, ja	0.00	28.77	8214	-0.07	0.06
2301	Flours, etc, of meat, fish, etc, un	0.00	2.94	15027	-1.58	0.06
6109	T-shirts, singlets and other vests,	0.00	23.00	9464	-0.18	0.06
407	Birds' eggs, in shell, fresh, prese	0.00	1.54	9992	0.22	0.06
7404	Copper waste and scrap	0.00	7.74	11350	0.26	0.06
4819	Cartons, boxes, etc; box files, etc	0.30	12.91	10041	0.36	0.06
6910	Ceramic sinks,wash basins/pedestals	0.00	3.33	9292	0.25	0.06

ORINOQUIA

Product	Product Name	Exports,	World	PRODY	Strategic	Density
		US M	Market		Value	
		(2005)	(2005)	(ppp)	(score)	
1604	Prepared or preserved fish; caviar	0.00	7.91	8581	-0.53	0.04
6104	Women's or girls' suits, ensembles,	0.00	8.71	7972	-0.22	0.04
6107	Men's or boys' briefs and similar a	0.00	2.85	8302	0.01	0.04
6204	Women's or girls' suits, ensembles,	0.04	42.67	7970	0.04	0.04
4420	Wood marquetry, inlaid wood; casket	0.00	1.24	8256	-0.56	0.04
6109	T-shirts, singlets and other vests,	0.00	23.00	9464	-0.12	0.04
7214	Other bars,rods of iron/non-alloy s	0.00	11.79	12213	-0.29	0.04
6110	Jerseys, pullovers, cardigans and s	0.00	29.88	9302	-0.24	0.04
1902	Pasta, such as spaghetti, macaroni,	0.00	4.15	14681	-0.41	0.04
4820	Registers, account books, etc; albu	0.00	3.23	9959	-0.20	0.04
6209	Bables' garments and clothing acces	0.00	1.74	7791	0.26	0.04
7306	Other tubes,pipes and hollow profil	0.00	15.69	12860	0.35	0.04
6910	Ceramic sinks,wash basins/pedestals	0.00	3.33	9292	0.32	0.04
6205	Men's or boys' shirts	0.00	9.31	7869	0.13	0.04
8544	Insulated wire,cable,other insulate	0.00	55.51	11167	0.63	0.04
6201	Men's or boys' overcoats, and simil	0.00	6.09	9643	0.39	0.04
7010	Carboys,bottles,flasks,jars,etc. of	0.00	5.09	9992	0.13	0.04
6202	Woman's or girls' overcoats, and si	0.00	6.82	9164	0.39	0.04
6207	Men's or boys' underpants, briefs,	0.00	1.13	8145	-0.39	0.04
6112	Track-suits, ski-suits and swimwear	0.00	3.08	10939	0.60	0.04

OTROS

Product	Product Name	Exports,	World	PRODY	Strategic	Density
		US M	Market		Value	
		(2005)	(2005)	(ppp)	(score)	
2905	Acyclic alcohols and their halogena	0.00	16.92	13953	-0.11	0.00
2814	Ammonia, anhydrous or in aqueous so	0.00	3.68	11593	-0.46	0.00
7601	Unwrought aluminium	0.00	32.42	25116	-0.27	0.00
2301	Flours, etc, of meat, fish, etc, un	0.00	2.94	15027	-1.43	0.00
8904	Tugs and pusher craft	0.00	1.22	12260	-0.06	0.00
4407	Wood sawn or chipped lengthwise, sl	0.00	29.29	13218	-0.45	0.00
1704	Sugar confectionery (incl. white ch	0.00	6.07	10513	0.10	0.00
2802	Sulphur, sublimed or precipitated;	0.00	0.18	10617	-2.02	0.00
1204	Linseed	0.00	0.36	20230	-1.31	0.00
3901	Polymers of ethylene, in primary fo	0.00	37.57	17388	0.65	0.00
4701	Mechanical wood pulp	0.00	0.37	20871	-2.42	0.00
1504	Fats and oils and their fractions,	0.00	0.61	20360	-1.49	0.00
402	Milk and cream, concentrated or swe	0.00	10.40	13162	-0.07	0.00
8405	Producer of gas or water gas genera	0.00	0.59	24001	0.25	0.00
511	Animal products, nes; dead of Chapt	0.00	0.93	12633	0.28	0.00
7604	Aluminium bars, rods and profiles	0.00	9.02	15554	0.79	0.00
4301	Raw furskins (excl. raw hides and s	0.00	2.27	24664	-0.48	0.00
4108	Chamois (incl. combination chamois)	0.00	0.14	18064	0.24	0.00
1605	Crustaceans... and other aquatic in	0.00	5.78	22072	-0.28	0.00
1522	Degras; residues of fatty substance	0.00	0.06	12513	0.51	0.00

Source: Author's Calculations using UN COMTRADE. Product codes are HS 1988/1992 4-digit. Products with PRODY >= EXPY in 2005, non-minerals, non-seafood (except for Pacific and Caribbean), sorted by density. Strategic value score is the strategic value less the mean across all regions divided by the standard deviation across all regions. It is therefore a standardized measure.

Again, there is quite a stark difference between the low-hanging fruit for the different regions. Bogota's nearest products are all quite close, with a density above 0.22, and good strategic value. These are mainly industrial products, food product, and paper products. Valle and Antioquia's nearest products are somewhat similar, perhaps with more food products although with smaller densities. Caribe's nearest products feature a great deal of seafood and agriculture, and their densities quite a bit lower in comparison to the three major regions. Central's nearest products are even slightly further, but are concentrated more in heavy industry with higher strategic value. In the East, we see quite a few garments and food products. Finally, the Pacific and Orinoquia regions' low hanging fruit is not very low-hanging, with densities of less than 0.06. The Others region is basically disconnected from the global market.

Agriculture

Here we examine the agricultural efficient frontier. We examine both the 20 nearest products, and the 20 products with the best combinations of density, strategic value, and PRODY. It is not clear whether one would include foodstuffs in the category of agriculture, so we first consider only a narrow definition of agriculture which does not include foodstuffs (all HS codes below 1500), followed by a broader definition of agriculture to include processed food products (all HS codes below 2500).

Table 5
The 20 Nearest Products in Agriculture (Narrow), Colombia 2005

Product	Product Name	World		PRODY (ppp)	Strategic Value (score)	Density
		Exports, US M (2005)	Market US B (2005)			
1207	Other oil seeds and oleaginous frui	1.50	1.14	3030	-1.30	0.23
804	Dates, figs, pineapples...etc, fres	1.28	3.05	6692	-1.03	0.23
709	Other vegetables, fresh or chilled	3.54	7.00	10274	-0.78	0.23
304	Fish fillets and other fish meat, f	1.93	10.96	13627	-1.05	0.23
305	Fish,salted,dried...;smoked fish;fi	1.23	3.41	21799	-1.13	0.22
807	Melons and papaws, fresh	0.24	1.93	6825	-1.28	0.22
302	Fish, fresh or chilled (excl. those	3.69	8.11	12231	-1.01	0.22
1101	Wheat or meslin flour	3.73	2.02	5652	-1.11	0.22
1212	Seaweeds, algae, sugar beet and can	1.46	0.90	7190	-0.90	0.21
710	Vegetables, frozen	0.86	3.44	10938	-0.17	0.21
307	Molluscs & aquatic invertebrates,ne	0.50	5.49	7883	-0.76	0.21
811	Fruit and nuts, frozen	1.00	1.64	12005	0.04	0.21
409	Natural honey	0.00	0.69	11294	-0.03	0.21
508	Coral; shells of molluscs, crustace	0.04	0.09	11269	-0.57	0.20
708	Leguminous vegetables, shelled or u	0.10	0.55	2514	-0.94	0.20
910	Ginger, saffron, turmeric (curcuma)	1.58	0.90	7234	-0.28	0.20
812	Fruit and nuts,provisionally preser	0.00	0.13	9727	-0.44	0.20
805	Citrus fruit, fresh or dried	2.22	6.79	9485	-0.91	0.20
401	Milk and cream, not concentrated or	4.24	4.58	17027	0.39	0.20
604	Other parts of plants for ornamenta	1.14	0.92	10597	0.03	0.20

All products with HS<1500 not exported by Colombia in 2005 with RCA>1, sorted by density.

Table 6
The 20 'Best' New Products in Agriculture (Narrow), Colombia 2005

Product	Product Name	World		PRODY (ppp)	Strategic Value (score)	Density
		Exports, US M (2005)	Market US B (2005)			
401	Milk and cream, not concentrated or	4.24	4.58	17027	0.39	0.20
305	Fish,salted,dried...;smoked fish;fi	1.23	3.41	21799	-1.13	0.22
406	Cheese and curd	11.24	17.13	17123	0.21	0.19
208	Other meat and edible meat offal, f	0.00	0.73	18837	0.41	0.18
203	Meat of swine, fresh, chilled or fr	0.00	18.10	23296	0.97	0.15
405	Butter and other fats and oils deri	0.58	4.22	18465	0.09	0.19
105	Live poultry	1.82	1.35	16217	0.25	0.19
103	Live swine	0.44	2.63	24079	0.12	0.17
403	Buttermilk, curdled milk and cream,	1.02	2.75	15715	0.34	0.18
209	Pig and poultry fat, fresh, chilled		0.52	22659	0.80	0.15
811	Fruit and nuts, frozen	1.00	1.64	12005	0.04	0.21
404	Whey and other natural milk constit	0.64	2.24	20578	0.63	0.15
409	Natural honey	0.00	0.69	11294	-0.03	0.21
304	Fish fillets and other fish meat, f	1.93	10.96	13627	-1.05	0.23
710	Vegetables, frozen	0.86	3.44	10938	-0.17	0.21
706	Carrots, turnips, salad beetroot...	0.01	0.87	13917	0.63	0.17
709	Other vegetables, fresh or chilled	3.54	7.00	10274	-0.78	0.23
408	Birds' eggs, not in shell, and egg	0.01	0.46	20122	0.59	0.15
302	Fish, fresh or chilled (excl. those	3.69	8.11	12231	-1.01	0.22
511	Animal products, nes; dead of Chapt	0.94	0.93	12633	-0.05	0.19

All products with HS<1500 not exported by Colombia in 2005 with RCA>1. Calculate standardized scores for density, prody and strategic value & combine with 1/3rd weight on each.

Table 7
The 20 Nearest Products in Agriculture (Broad), Colombia 2005

Product	Product Name	World		PRODY (ppp)	Strategic Value (score)	Density
		Exports, US M (2005)	Market US B (2005)			
2401	Unmanufactured tobacco; tobacco ref	12.15	6.46	2166	-1.39	0.23
1207	Other oil seeds and oleaginous frui	1.50	1.14	3030	-1.30	0.23
804	Dates, figs, pineapples...etc, fres	1.28	3.05	6692	-1.03	0.23
709	Other vegetables, fresh or chilled	3.54	7.00	10274	-0.78	0.23
2009	Fruit juices (incl. grape must) and	6.04	8.71	7766	-0.73	0.23
304	Fish fillets and other fish meat, f	1.93	10.96	13627	-1.05	0.23
305	Fish,salted,dried...;smoked fish;fi	1.23	3.41	21799	-1.13	0.22
807	Melons and papaws, fresh	0.24	1.93	6825	-1.28	0.22
302	Fish, fresh or chilled (excl. those	3.69	8.11	12231	-1.01	0.22
1101	Wheat or meslin flour	3.73	2.02	5652	-1.11	0.22
1512	Sunflower-seed, safflower or cotton	0.13	2.84	5523	-0.80	0.22
2207	Ethyl alcohol, undenatured of >=80%	0.69	2.27	7515	-0.66	0.22
2005	Other vegetables preserved other th	5.72	5.94	11530	0.06	0.22
2001	Vegetables, fruit, etc, preserved b	0.32	1.04	9141	-0.05	0.21
1212	Seaweeds, algae, sugar beet and can	1.46	0.90	7190	-0.90	0.21
2201	Waters, (incl. mineral waters and a	0.18	2.22	9265	-0.86	0.21
710	Vegetables, frozen	0.86	3.44	10938	-0.17	0.21
2007	Jams, fruit jellies, marmalades, et	3.17	1.47	10452	-0.17	0.21
307	Molluscs & aquatic invertebrates,ne	0.50	5.49	7883	-0.76	0.21
1902	Pasta, such as spaghetti, macaroni,	0.33	4.15	14681	-0.74	0.21

Source: Author's calculations using UN COMTRADE. All products with HS<1500 not exported by Colombia in 2005 with RCA>1, sorted by density.

Table 8
The 20 'Best' New Products in Agriculture (Broad), Colombia 2005

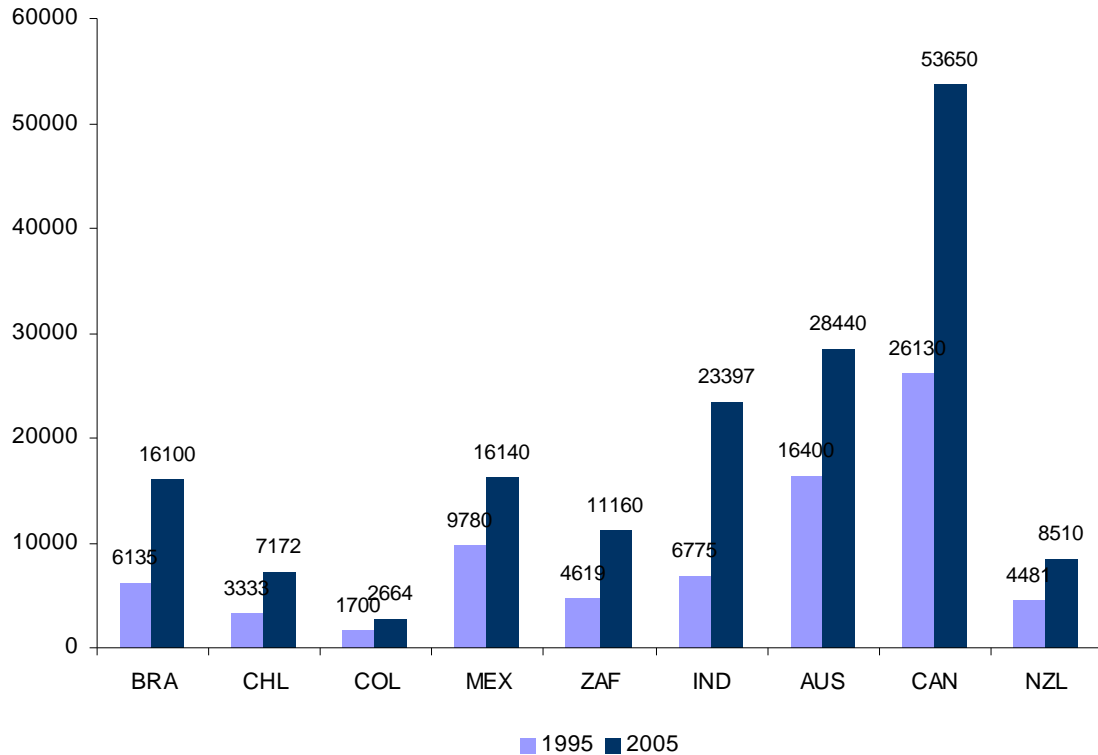
Product	Product Name	World		PRODY (ppp)	Strategic Value (score)	Density
		Exports, US M (2005)	Market US B (2005)			
2403	Other manufactured tobacco and subs	0.00	2.17	27836	0.10	0.19
1601	Sausages and similar products; food	0.00	2.41	15387	0.39	0.20
401	Milk and cream, not concentrated or	4.24	4.58	17027	0.39	0.20
305	Fish,salted,dried...;smoked fish;fi	1.23	3.41	21799	-1.13	0.22
406	Cheese and curd	11.24	17.13	17123	0.21	0.19
208	Other meat and edible meat ofal, f	0.00	0.73	18837	0.41	0.18
2309	Preparations of a kind used in anim	6.50	11.33	13571	0.25	0.20
2005	Other vegetables preserved other th	5.72	5.94	11530	0.06	0.22
1901	Malt extract; food preparations of	11.04	7.44	17152	0.63	0.18
203	Meat of swine, fresh, chilled or fr	0.00	18.10	23296	0.97	0.15
405	Butter and other fats and oils deri	0.58	4.22	18465	0.09	0.19
105	Live poultry	1.82	1.35	16217	0.25	0.19
103	Live swine	0.44	2.63	24079	0.12	0.17
1518	Animal or vegetable fats and oils..	0.12	0.51	17148	1.20	0.15
2105	Ice cream and other edible ice, whe	0.54	2.04	12546	0.37	0.20
1514	Rape, colza or mustard oil and frac	0.00	2.20	20465	0.98	0.15
403	Buttermilk, curdled milk and cream,	1.02	2.75	15715	0.34	0.18
209	Pig and poultry fat, fresh, chilled		0.52	22659	0.80	0.15
2103	Sauces and sauce preparations; mixe	8.03	5.12	12505	0.21	0.20
811	Fruit and nuts, frozen	1.00	1.64	12005	0.04	0.21

All products with HS<1500 not exported by Colombia in 2005 with RCA>1. Calculate standardized scores for density, prody and strategic value & combine with 1/3rd weight on each..

Services

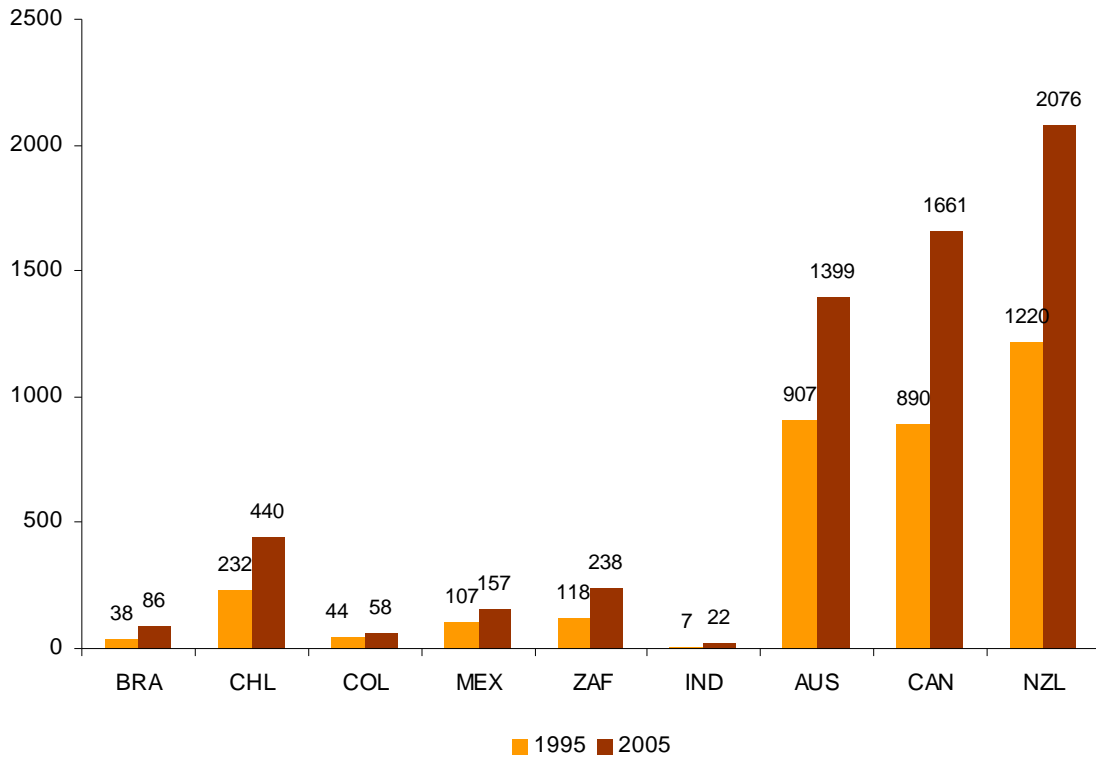
We now take up the topic of services, which are not included in the broader analysis above due to a lack of worldwide data disaggregated by service type. Below are figures for total service exports to the entire world, both total and per capita.

Figure 37
Worldwide Service Exports, 2005 (US Millions)



Source: World Bank WDI, taken as the difference between total exports of goods and services and merchandise exports.

Figure 38
Worldwide Service Exports Per Capita, 2005



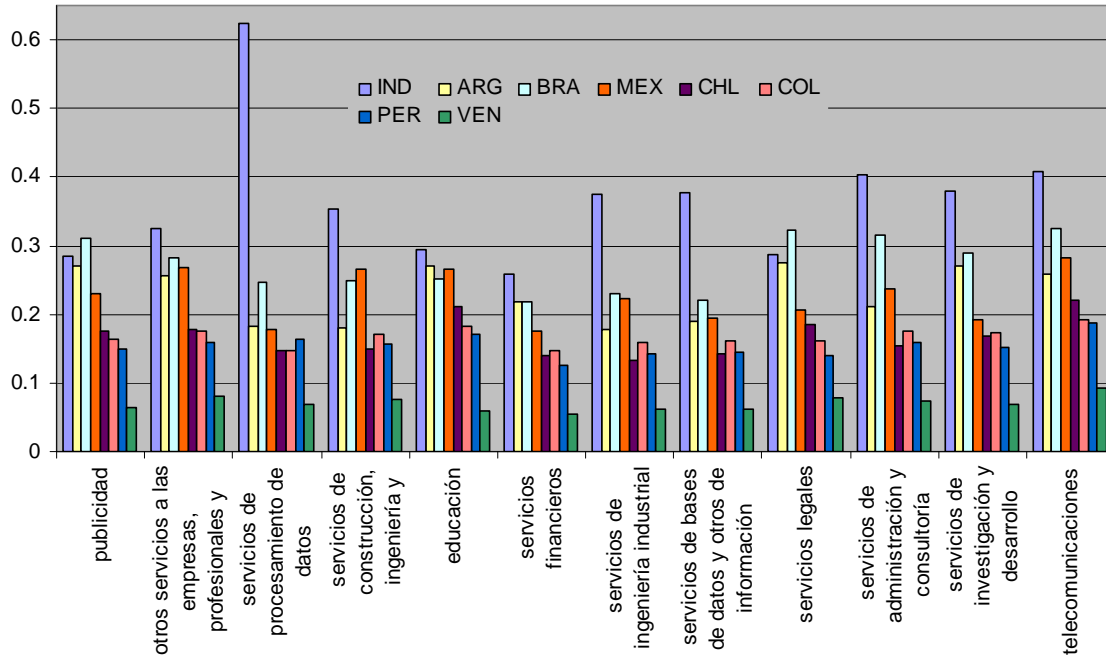
Dollars per person. Source: World Bank WDI, taken as the difference between total exports of goods and services and merchandise exports, divided by population.

We see that Colombia is not currently a major exporter of services, and compared to its Latin American neighbors, has not enjoyed much growth over the past 10 years. What is Colombia's potential for service exports? Services have been omitted from the product space analysis thus far because there are no reliable data on worldwide service exports, disaggregated both by product and country.

However, the United States Bureau of Economic Analysis gathers data on international purchases of services by US firms, and disaggregates this data by service type and source country¹. Although imperfect as it only captures service exports to the United States, this is the best data available. Unfortunately, only 30 source countries are disaggregated in the BEA dataset, and Colombia is not among them. But we can use these 30 countries to estimate distances to various service exports from both service and non-service export goods. Then, using these distances, we can estimate densities around service exports based on non-service export baskets. The results for Colombia and other comparators are shown below.

¹ This data was assembled by the Colombian DNP, for which we are grateful

Figure 39
Densities for Service Categories, by Country



Source: Author’s calculations using BEA and UN COMTRADE. 2000-2005 average.

We see that in most service sectors there is a ‘first-tier’ of Latin America countries with export potential that, at least in some cases, approaches that of India: Brazil, Argentina, and to a lesser extent, Mexico. Colombia is in the ‘second-tier’, with no service categories above the 0.2 density level². Compared to Chile and Peru, it seems that Colombia’s current productive structure is closer to construction and engineering services, industrial engineering services, and business administration and consulting services. Colombia also doesn’t see to be at a significant disadvantage in the areas of R&D and data processing.

However, what matters is absolute density, not relative density. Below we show PRODY, strategic value, and density across these service categories for Colombia, sorted by density.

² This is in part by construction, as Colombia is not recorded separately in BEA service data and therefore does not have RCA in any service categories, while Mexico Brazil and Argentina are and do. However, the BEA disaggregation is endogenous: they lump together as ‘other’ those countries with relatively minor service trade with US firms.

Table 9
Service Potential in Colombia

Service Sector	Density	PRODY	Strategic Value
servicios de procesamiento de datos	0.15	16622	6618
servicios financieros	0.15	22559	14943
servicios de ingeniería industrial	0.16	20815	16035
servicios legales	0.16	20175	14716
servicios de bases de datos y otros de información	0.16	21228	16939
publicidad	0.16	20299	16191
servicios de construcción, ingeniería y arquitectura	0.17	19724	12515
servicios de investigación y desarrollo	0.17	20783	16397
servicios de administración y consultoría	0.18	18446	14710
otros servicios a las empresas, profesionales y técnicos	0.18	20523	14578
educación	0.18	19883	16946
telecomunicaciones	0.19	11475	13175

Source: Author's calculations using BEA, World Bank WDI, and UN COMTRADE. 2000-2005 average.

This table shows that in absolute terms, data processing services are extremely far away, in addition to being of low strategic value and low direct value. Telecommunications is the closest, but it also has a relatively low PRODY and strategic value. Research and development, construction, and business administration and consulting services are in the top-half in terms of density, and also enjoy high direct value. Yet it is important to keep in mind that none of these service sectors has a density above 0.2: they are all far away. It is also important to keep in mind the total size of the market. The table below shows total US imports of each service type.

Table 10
Total US Imports by Service Type, 2005

Product	2005 US Imports (M)
servicios financieros	6549
telecomunicaciones	4656
educación	4029
otros servicios a las empresas, profesionales y técnicos	3833
servicios de investigación y desarrollo	2316
servicios de procesamiento de datos	1916
servicios de administración y consultoría	1640
publicidad	1006
servicios legales	913
servicios de bases de datos y otros de información	467
servicios de construcción, ingeniería y arquitectura	422
servicios de ingeniería industrial	114

In summary, Colombia is currently not a major service exporter, and over the past 10 years has not grown in this area as fast as other countries like Chile and Brazil. Telecommunications, business consulting, construction, and R&D seem to be relatively closer and have good value and market size. However, in absolute terms, services are far away from Colombia's current structure of production and do not seem to be low-hanging fruit.

Examination of the Araújo Ibarra & Asociados Targets

In anticipation of the new free trade agreement with the United States, the Colombian government commissioned a study that identified 500 new products with high potential in the United States market that Colombia could export. We can analyze these targets in light of the above analysis to determine if the products are on the efficient frontier in the tradeoffs between strategic value, proximity, and PRODY. Moreover, these numbers could be used to prioritize the Ibarra list and select within the 500 products, which represent the best combination of proximity, strategic value, and direct value.

As the Ibarra products were identified at the 6-digit level with the United States market in mind, we re-constructed our dataset at the 6-digit level for distances for exports from all countries in the world *to the US market only*. Therefore, if particular infrastructure or marketing requirements for sales to the United States create special proximities that are somewhat different than those identified for the world as a whole, this would be included in our results. This represents the most direct way to analyze and complement the Ibarra analysis.

Of the 500 products identified, 46 are in HS codes that were added to the nomenclature after the 1992 revision, and therefore can not be analyzed with our data. This leaves us with 454 targeted products. These are provided below.

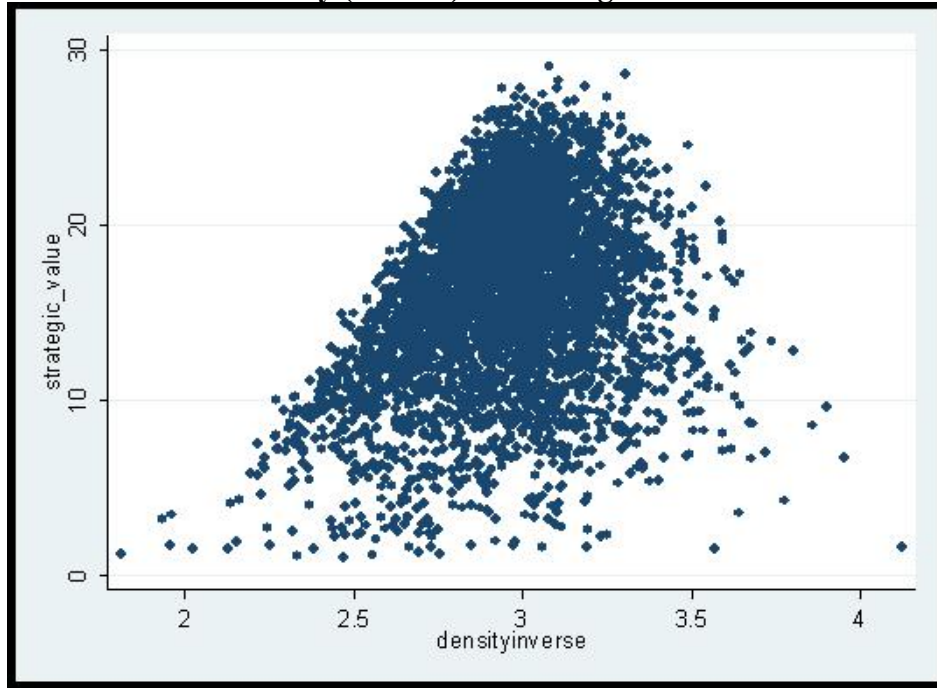
Table 11
Summary Statistics

	Targeted	Not Targeted
Average Density	.0633	.0562
Average Strategic Value	16370	15860
Average PRODY	16014	16854

The Ibarra basket is somewhat closer to Colombia's current export package than the remaining products in the world, and is of more than average strategic value. In terms of direct value, they are slightly lower, but the difference is negligible.

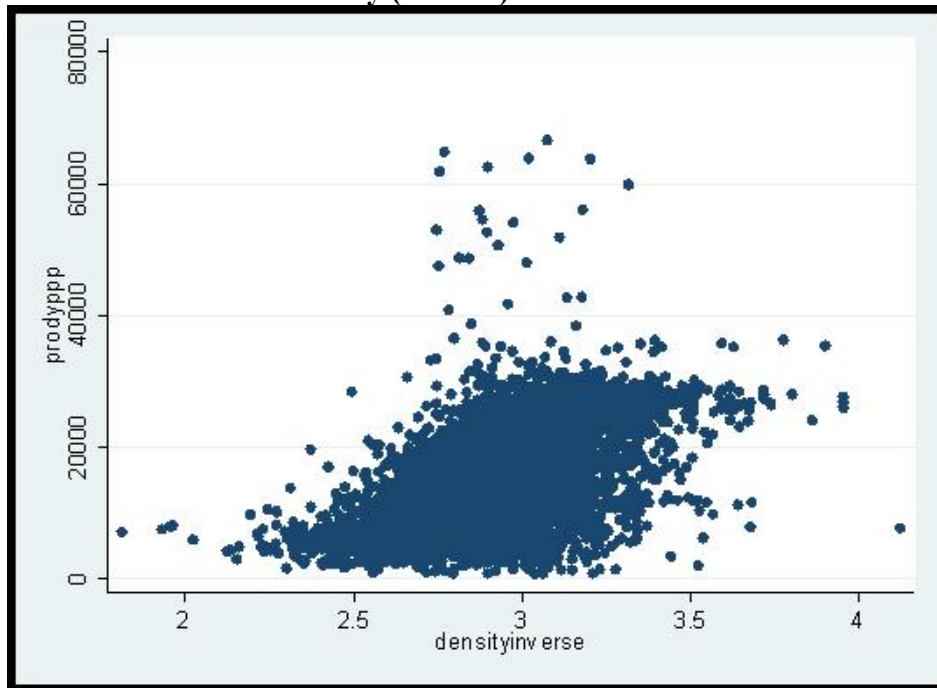
A more accurate picture can be provided by reproducing the scatterplots above using the 6-digit US data, and marking the Ibarra targets. Below is the plot of all unexported products at the 6-digit level in 2005, plotting their distance (where, as above, further to the left signifies closer to the current export basket) against the strategic value.

Figure 40
Density (inverse) vs. Strategic Value



The x-axis is distance ($-1 \cdot \log(\text{density})$), meaning that smaller values indicate the product is closer to the current basket), and the y-axis is the marginal increase in open forest if that product were added to the export basket. Source: Author's calculations using UN COMTRADE.

Figure 41
Density (inverse) vs. PRODY



The x-axis is distance ($-1 \cdot \log(\text{density})$), meaning that smaller values indicate the product is closer to the current basket), and the y-axis is PRODY (PPP). Source: Author's calculations using UN COMTRADE.

How do the Ibarra targets map into this space? They are shown below, highlighted in red.

Figure 42
Density (inverse) vs. Strategic Value, Targeted 500

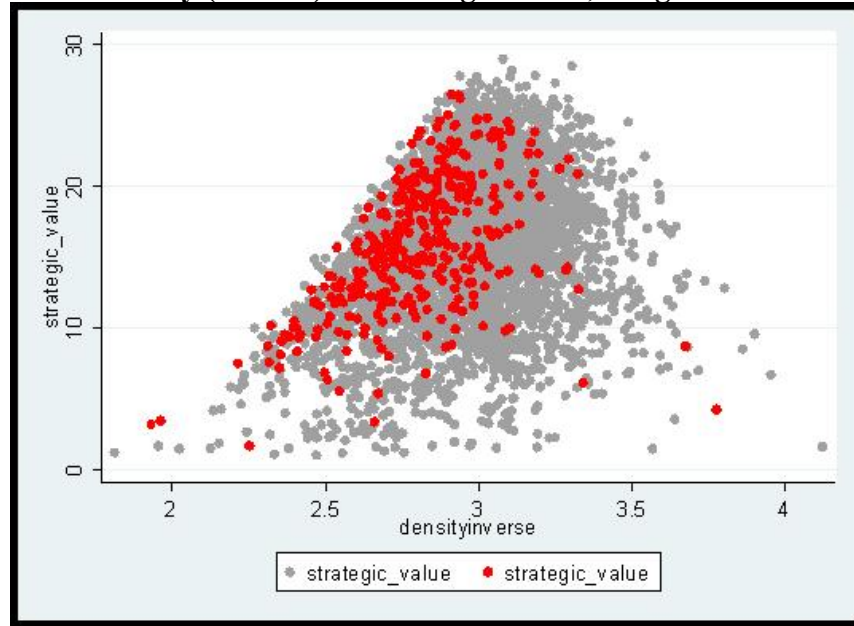
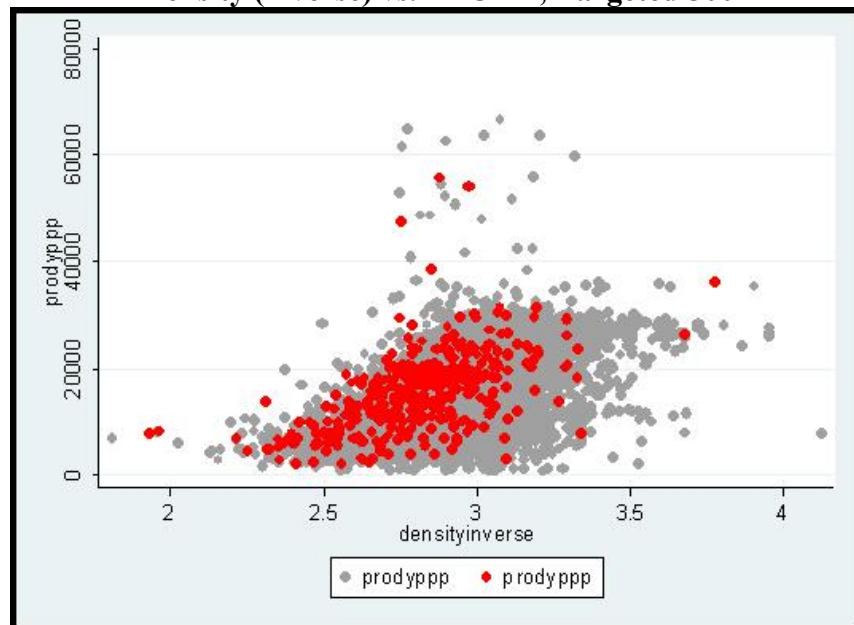


Figure 43
Density (inverse) vs. PRODY, Targeted 500



The x-axis is distance ($-1 \cdot \log(\text{density})$), meaning that smaller values indicate the product is closer to the current basket). The y-axis in Figure 42 is the marginal increase in open forest if that product were added to the export basket, and the y-axis in Figure 43 is PRODY (PPP). Ibarra targets are shown in red, all other products in grey. Source: Author's calculations using UN COMTRADE.

We see in the above two figures that the Ibarra targeted 500 products are not randomly distributed in the space: they are closer to the current export basket than those goods not selected, and are of higher strategic value. In terms of the tradeoff between strategic value and distance, the study has done a particularly good job at targeting those goods on the efficient frontier, rather than goods that are both further away and simultaneously of lower strategic value.

However, we can also see in these two figures that some goods have been chosen that are well off the efficient frontiers in these two tradeoffs. These products are both of lower strategic value than other potential targets, meaning that they will provide less in terms of transferable capabilities, and they are further away than other potential targets, meaning they will be harder to move towards.

Rather than a competing methodology, these measures of distance, PRODY, and strategic value should be a complement to the Ibarra list. The Ibarra list can be further rationalized and prioritized using global trade experience as represented in these three variables. To this end, in the Appendix we include a table that provides PRODY, strategic value, and density for all of the 456 Ibarra targets that are in our dataset.

Examination of the Agenda Interna Targets

We can perform a similar analysis of the sectors singled out as priorities in the Internal Agenda (*Agenda Interna*), which have been provided by DNP at the 2 (and in some cases, 4) digit HS level.

In the following table we provide summary statistics by ‘AI sector’ for 2005.

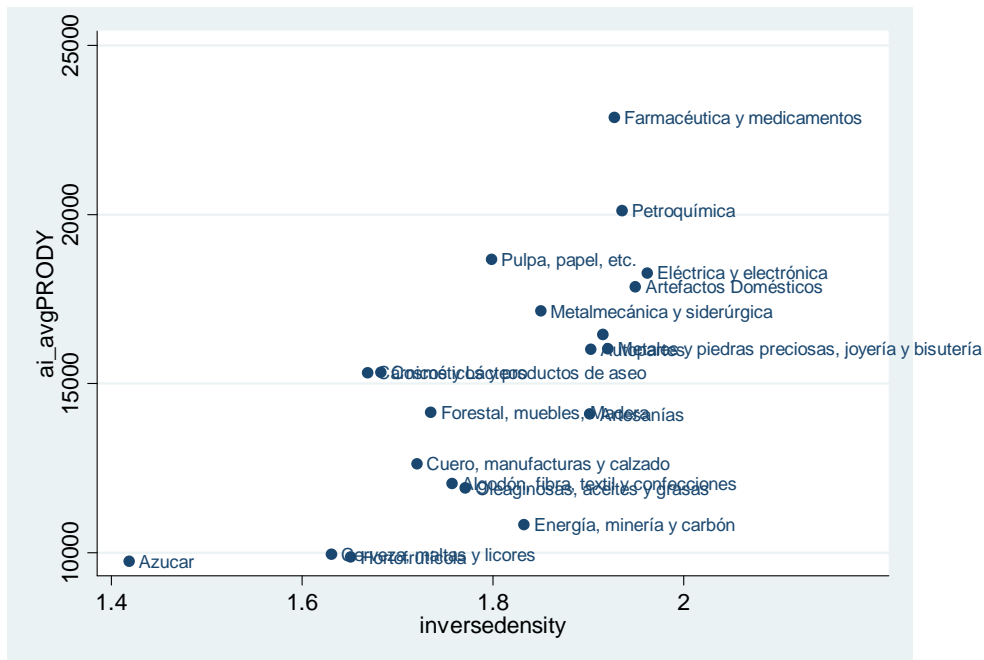
Table 12
Summary Statistics by Agenda Interna Sector, 2005

Sector	World Trade (US B)	Colombia's Exports (US M)	RCA	Average PRODY	Average Strategic Value	Average Density
Algodón, fibra, textil y confecciones	461	1269	1.23	12032	12659	0.17
Artefactos Domésticos	424	75	0.08	17862	14264	0.14
Artesanías	19	44	1.06	14089	13661	0.15
Autopartes	902	675	0.33	16014	15710	0.15
Azucar	21	456	9.65	9738	10693	0.24
Cárnicos y Lácteos	183	270	0.66	15309	12772	0.19
Cerveza, maltas y licores	58	51	0.39	9952	10936	0.20
Cosméticos y productos de aseo	58	180	1.39	15323	14031	0.19
Cuero, manufacturas y calzado	89	222	1.12	12615	12820	0.18
Eléctrica y electrónica	972	202	0.09	18271	15490	0.14
Energía, minería y carbón	1138	8352	3.29	10830	10294	0.16
Farmacéutica y medicamentos	247	260	0.47	22866	17081	0.15
Forestal, muebles, Madera	242	151	0.28	14142	13027	0.18
Hortofrutícola	134	1491	4.97	9867	11182	0.19
Metales y piedras preciosas, joyería y bisutería	176	750	1.90	16027	12960	0.15
Metalmecánica y siderúrgica	651	1411	0.97	17148	14566	0.16
Oleaginosas, aceites y grasas	70	143	0.92	11909	11165	0.17
Petroquímica	418	1126	1.21	20109	15832	0.14
Pulpa, papel, etc.	134	361	1.20	18670	15027	0.17

Averages across all 4-digit products comprising the sector (according to DNP). RCA is calculated at the level of the sector, not as an average of products comprising the sector. Source: Author's calculations using UN COMTRADE and DNP.

These can also be shown graphically, using the same methodology as that above. We first show (inverse) density versus PRODY, where sectors further to the left on the x-axis are closer to the current structure of production, and sectors higher on the y-axis have a higher average PRODY.

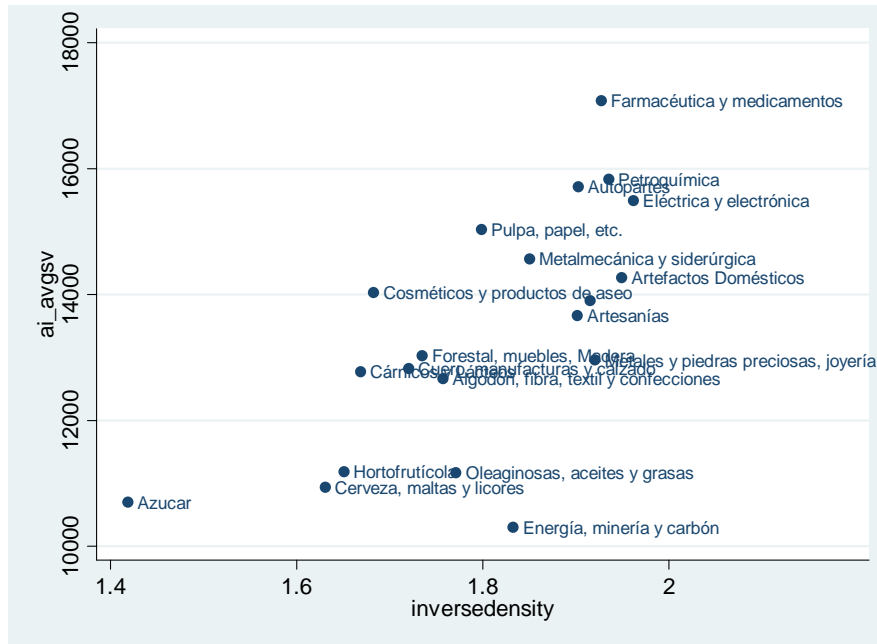
Figure 44
Density (inverse) vs. PRODY, AI Sectors, 2005



X-axis is $-1 * \ln(\text{density})$, where density is the average for all 4-digit products comprising the sector. The y-axis is average PRODY for all 4-digit products comprising the sector. Source: DNP & UN COMTRADE.

Below we show the equivalent figure, but with the y-axis showing the average strategic value of the sector.

Figure 45
Density (inverse) vs. Strategic Value, AI Sectors, 2005



X-axis is $-1 \cdot \ln(\text{density})$, where density is the average for all 4-digit products comprising the sector. The y-axis is average strategic value for all 4-digit products comprising the sector. Source: DNP & UN COMTRADE.

These figures show that some of the sectors featured in the *Agenda Interna* are already well-occupied by Colombia, particularly Sugar. Not surprisingly, the Sugar sectors is the nearest, but also suffers a low PRODY and strategic value. Just as with similar figures above, we can see an efficient frontier in the tradeoff between distance and strategic value or PRODY across these sectors. Pharmaceutical and medical products is far away, but has high direct value and option value. Cosmetics and pulp and paper products are closer, but still relatively attractive. On the other hand, sectors such as Artisan products and energy, mining and carbon are not on the efficient frontier: there are other sectors that are either of the same distance but much more attractive, or equally attractive but much closer.

Using the data provided to the DNP, this analysis can also be done within the *Agenda Interna* sectors. Each sector is made up of multiple products, which may be quite dissimilar in their required capabilities from one another. The product-level data on density, PRODY, and strategic value could be used to determine which specific products in each of these sectors represent the best tradeoff. As with the Ibarra list, these measures of distance, PRODY, and strategic value should be seen as a potential compliment, rather than necessarily a substitute, to the *Agenda Interna*.

Conclusion

In this section we have identified sectors representing the best tradeoffs between proximity and value, both for Colombia as a whole as well as its regions, along with subsections considering agricultural goods, services, and other external studies of high-potential sectors. As discussed above, this identification of nearby, high-potential, and strategically valuable sectors is not meant to be a definitive list for ‘picking winners’. Rather, it provides a robust data-driven approach to inform the next steps in a parsimonious industrial strategy for Colombia. Which private sector actors should be consulted first? What sector-specific reforms should be stressed? How should public spending on infrastructure and training, which have sector-specific consequences, be prioritized? What foreign firms should be targeted by FDI promotion agencies? These decisions can be informed by this analysis and the accompanying data.

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