Analysis of the Plastics Cluster
Sao Paulo, Brazil

Mariella Amemiya, Isabel Lira, David Plumb, Tomás Lopes Teixeira

Final Project for Microeconomics of Competitiveness
Professors: Michael Porter and Hirotaka Takeuchi
Advisor: Niels Ketelhohn

5/10/2013

Disclaimer: Please note that the co-author Tomás Lopes Teixeira is a Brazilian citizen.
The Plastics Cluster in Sao Paulo, Brazil

I. Executive Summary

This report analyzes the plastics cluster in the state of Sao Paulo in Brazil. The cluster is the second largest provider of manufacturing jobs in Sao Paulo and has prospered alongside Brazil’s remarkable economic growth. Plastics represent the 12th largest export cluster in Brazil.

The report describes the competitive strengths of the cluster, including its large, often sophisticated domestic demand, competition in some areas of the value chain, and research activity in Sao Paulo. The analysis also shows how global competitiveness is hampered by protectionist policies, monopoly actors in key areas of the cluster, insufficient transportation infrastructure and a lack of engineers. Based on this analysis the report suggests recommendations to reduce protectionism, enhance competition, increase applied research in areas in which Sao Paulo already shows strengths, reverse deficits in infrastructure and human capital, build local demand for more sophisticated and environmentally friendly plastics, and develop a unified voice for the cluster.

II. Brazil: A Giant and Dynamic Market

Brazil is the 5th largest country in the world and also the 5th most populous country with around 200 million people in 2012, of which 85% live in urban areas.\(^1\)

The country gained independence from Portugal in 1822 and is currently a federal republic comprised of 26 states and the capital Federal District of Brasília. Politically, Brazil is a stable multiparty democracy, led since 1996 by presidents from the center-left Worker’s Party. President Dilma Rousseff leads the current administration.

\(^1\) Area: 8,459,420 km\(^2\). World Development Indicators
A story of increasing economic prosperity

In 2011, Brazil overtook the UK and became the 6th largest economy with a GDP of $2.5 trillion. From 2000 to 2011 the country experienced an average annual growth rate of 3.64%. This sustained growth allowed Brazil to achieve a GDP per capita of $10,278 (purchasing power parity - PPP) (see Figure 1). However in 2012 Brazil’s growth slowed to 1.5%. The IMF expects growth of about 3.5% in 2013 and 2014 (IMF, 2013).

Figure 1. GDP growth and GDP per capita PPP (1980-2011)

Source: World Development Indicators (2013). World Bank

Home and host of important companies

In 2011 Brazil remained by far the largest foreign direct investment (“FDI”) target in South America, with inflows increasing by 37% to $67 billion – 55% of the total in South America and 31% of the total in the region (UNCTAD, 2012). In the Fortune 500 list, Brazil is described as the “Latin American powerhouse” that is home to oil giant Petrobras and seven other Global 500 companies.2

Drivers of Competitiveness

Despite the improvements made by Brazil in economic terms, the country still lags in terms of its competitiveness when compared to relevant competitors in the plastics cluster. In fact, Figure 3 shows Brazil’s lackluster in the Competitiveness Index of the Institute for Strategy and Competitiveness of Harvard Business School (hereinafter, “ISC”). In 2012, Brazil ranked 43 out of 71 countries.

Source: ISC.

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3 Comparator countries are: US, Germany, China and Mexico. These countries were selected considering their importance as plastics exporters (Ranking 1st, 2nd, 5th and 21st, respectively as of world exports 2010) and their similarity to Brazil.
An abundance of natural endowments has been the building block of Brazil’s largest industries. Brazil is the world’s largest producer of coffee, oranges; second largest producer of beef; the third largest reserve of bauxite (used to produce aluminum\(^4\)). Particularly, Brazil is also one of the main producers of sugar cane, with an annual production more than 2 times that of the second-largest producer, India. About 55% of it goes into ethanol production - intensively used as an automobile fuel in the country. For this reason, Brazil is the second largest producer of biofuels after the US. Ethanol is now also being used to produce plastics.

Additionally, Brazil currently has proven oil reserves of more than 14.0 billion barrels, positioning it as the second largest in South America after Venezuela. New oil discoveries have been consistently increasing Brazilian oil reserves, and its total oil production rose nearly 10 times since 1980. In 2007, a new giant oil field - the so-called Pre-Salt - was discovered (the biggest discovery in the Western Hemisphere in 30 years). Pre-Salt fields are estimated to add up 50 billions barrels to the country's oil reserves\(^5\).

Moreover, water is one of Brazil's greatest resources. The country has 12 percent of the earth's surface water and more than half of South America's fresh water\(^6\).

Finally, the country is rich in terms of biodiversity and is considered among the 17 mega diverse countries in the world\(^7\). Brazil’s biodiversity accounts for 20% of life on the planet, with at least 103,870 animal species and between 43,000 and 49,000 plant species\(^8\).

\(^4\) http://topics.bloomberg.com/brazil%3A-the-rise-of-a-natural-resources-superpower/
\(^5\) http://www.eia.gov/countries/cab.cfm?fips=BR
\(^7\) Ranking of Conservation International.
Brazil innovation

Brazilian science and innovation policy is coordinated by the Ministry of Science and Technology with states also playing an important role in terms of funding. In the past decade, there have been explicit policies to promote innovation, particularly to strengthen university research–private investment links, promote shared use of research infrastructure, provide incentives for R&D, incentives for key sectors like IT, biotechnology, etc. These policies include the Innovation Law (2004), Program for Accelerated Growth in Science, Technology and Innovation (2007) and Productive Development Program (2008) (Bound, 2008). Moreover, the country’s expenditure in R&D as share of GDP has been increasing over time; however the level is still lower than that of competitor countries.

![Figure 4. Research and Development Expenditure (% GDP)](image)

Source: WDI

Macroeconomic competitiveness: macro stability and social improvements

After a decade of high inflation and economic crisis, Brazil conducted major reforms in the second half of the 1990s in its macroeconomic institutions, including a monetary policy framework based on inflation targeting, a flexible exchange rate, and a Fiscal Responsibility Law which established limits and rules on government expenditure. These reforms allowed Brazil to achieve macroeconomic growth and stability (reducing inflation, public debt and exchange-rate
risk) and increase its capacity to respond to external shocks such as the 2008-2009 global financial crisis (Mourougane, 2011).

Even as Brazil makes progress in achieving macroeconomic stability, its tax system is considered to be cumbersome, fragmented, and complex. According to an International Monetary Fund study, “onerous social security contributions and additional levies on enterprise payroll imply a large burden on labor income with adverse effects on employment, especially in the formal sector” (Mourougane, 2011). In an effort to improve the business environment, President Rousseff launched a new industrial policy plan in August 2012, called Plano Brasil Maior (“Greater Brazil Plan”) (OECD, 2011).

Since mid 1990s Brazil has made improvements in the social area. Brazil has shown that sustained economic growth combined with effective social programs such as “Bolsa Familia”\(^9\) or the new plan “Brasil Sem Miséria”\(^10\) contribute to reduced poverty rates and inequality. In 1990 Brazil was considered one of the most unequal countries in the world with a Gini coefficient of 0.61; however, in 2011 it improved to 0.51. This reduction was accompanied by a significant reduction in the poverty rates from 21% in 2003 to 11% in 2011. The improvements in standards of living of poor people in Brazil also resulted in a rising middle class. According to a government study\(^11\) from 2003 to 2009, Brazil’s middle class grew by 24 million people for a total of 95 million people (52% of the total population).\(^12\)

Additionally, Brazil has made some improvements in terms of basic education. Based on the Program for International Student Assessment (PISA) in 2009, Brazil was one of the three

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\(^9\) Bolsa Familia consists in a conditional cash transfer program that benefits families in poverty and extreme poverty. [http://www.mds.gov.br/bolsafamilia](http://www.mds.gov.br/bolsafamilia)


fastest-improving countries in this decade\textsuperscript{13}. Notwithstanding, it still faces challenges in improving the quality of basic education as well as in tertiary education. Only 11\% of the population of working-age has a degree\textsuperscript{14}.

*Microeconomic competitiveness:*

Investment in Brazil is growing quickly, including domestic firms as well as FDI. Brazil is open to and encourages foreign investment. Moreover, the government uses a variety of tax incentives and attractive financing through the National Bank for Economic and Social Development (“BNDES”) to encourage both national and foreign investment, especially in underserved regions\textsuperscript{15}. However, the majority of lending continues to take place in the more developed regions of the country, such as Sao Paulo\textsuperscript{16}.

However, Brazil still lags in terms of its regulatory environment, reflected in its low performance in the Doing Business Index (130 out of 185 in 2013). Business representatives usually complain about excessive red tape and regulatory uncertainty, while the government has tried to make reforms but with modest results\textsuperscript{17}. According to the World Bank Enterprise Surveys\textsuperscript{18} conducted in Brazil in 2009 among 1802 firms, the country underperformed in most of the indicators regarding regulations and taxes (see Table 1).

\textsuperscript{14} http://www.economist.com/node/21562955
\textsuperscript{15} In 2010, BNDES lending surpassed $ 95 billion, making it the largest development bank in the world.
\textsuperscript{16} http://www.state.gov/eh/rls/othr/ics/2011/157245.htm
\textsuperscript{17} http://www.reuters.com/article/2009/10/19/us-brazil-investment-idUSTRE59I5M320091019
\textsuperscript{18} Enterprise Surveys (http://www.enterprisesurveys.org), The World Bank.
Also impacting Brazil’s competitiveness are significant protectionist measures through import tariffs and non-tariff measures. These policies are not new to Brazil, which implemented aggressive import substitution industrialization in the 1950s-1970s. In the 90s Brazil reduced its tariffs significantly from a simple average of 32% in 1990 to 13% in 1995, but then peaked again at the end of the decade to almost 16%. Tariffs were reduced to an average of 12.2% by 2007, but since the crisis of 2008-2009 tariffs have increased, rising to 13.7% in 2011\(^{19}\). This is relatively high compared to the average tariffs of US (3.5%), European Union (5.3%), Mexico (8.3%) and even China (9.6%). Moreover, it is important to note that 37% of Brazilian product lines in 2011 have applied tariffs above 15%, with a maximum tariff of 35%. (WTO, ITC, UCTAD 2012)

Figure 5 shows the Brazilian Competitiveness Diamond which summarizes the key factors that promote Brazil’s competitiveness as well as those that may hold the country back\(^{20}\).

\(^{19}\) WITS. World Bank.
\(^{20}\) The competitiveness diamond has been constructed using the Competitiveness Framework developed by Professor Michael Porter. (Porter, 1998)
Brazil Trade and Cluster Development

Brazil is an important player in global trade. In 2011 it was the 19th world exporter with an export value of $251 billion, and the 21st largest importer with imports worth $226 billion. Both exports and imports have registered upward trends since 2002, except 2009 (see Figure 6). During this period, Brazil registered trade surpluses even though on average the growth rate of exports (CAGR 17%) has been lower to the growth of imports (CAGR 19%).
Brazil’s exports are still highly dependent in commodities and natural resources. In 2011 Brazil’s most important export products were: iron ore, crude oil, soy beans, sugar cane, coffee, soybean oil cake, chemical wood pulp, frozen poultry, beef, iron products, airplanes and other aircrafts, vehicles, tobacco, maize and gold. The main export destinations were China (18%), US (10%), Argentina (9%), Netherlands (5%) and Japan (3%). Brazil’s most important clusters are increasing their global market share.

Figure 7. Export cluster performance

Source: ISC

III. Outline for the regional context: Sao Paulo

The Brazilian plastic cluster is concentrated in the region of Sao Paulo, considered as the core of the national economy and as the best platform to do business in the country. Sao Paulo state represents only 3% of Brazilian territory and is located in the coast of the Atlantic Ocean, in the Southeast Region of Brazil.

21 Map: http://i931.photobucket.com/albums/ad155/orionbeta1/Estado%20de%20Sao%20Paulo/613px-Brazil_State_Sao_Paulosvg.png
Sao Paulo is the most populous state and concentrates a significant percentage of the country’s economy. Sao Paulo is responsible for 32% of the Brazilian GDP ($690 billion) and has a GDP per capita of $16,757, which is 1.5 times the national average. Furthermore, the State of Sao Paulo is responsible for, approximately, 38% of the country’s manufacturing ($129 billion in 2009), 43% of the services sector and 28% of the commercial establishments. It is home to the Brazilian Stock Exchange, the largest stock exchange in Latin America.

The population of Sao Paulo amounts to 41 million (21% of the national population). 97% of the region’s population is urban, making Sao Paulo one of the biggest urban agglomerations in the world. Moreover, Sao Paulo has the second highest percentage of middle class population, percentage that represented the 61% of the population.

State of Sao Paulo is deemed to have higher levels of education than the rest of the country. In 2009 approximately 56% of its population had 11 or more years of education while 15% had 15 years or more (compared to national average of 43% and 11%, respectively). In accordance with the above, studies have showed that average income of the employed population is higher. In December 2009 the average income in São Paulo Metropolitan Region was 22% higher than

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The income level data of 2009 showed that only Santa Catarina had a higher percentage of middle class population (64%) than Sao Paulo. (Brazil Middle Class in Numbers. Available at: http://www.brasil.gov.br/para/press/press-releases/august-1/brazils-middle-class-in-numbers/br_model1?set_language=en (Last reviewed: May 6, 2013)
other Brazilian metropolitan areas. Several renowned educations institutions are located in Sao Paulo; this includes three highly well known State universities (i.e. State of Sao Paulo, Universidade Estadual de Campinas and Universidade Estadual Paulista), 572 college institutions and 1274 technical schools.

The state also has specialized entities working in Research & Development such as (i) the state of São Paulo Research Foundation, (Fapesp), which supports and funds research as well as the dissemination of technology (it has an annual budget of 1% of the total tax revenue of the State), (ii) top-tier universities, (iii) 19 research institutes, and, (iv) 30 initiatives of technology parks. Approximately 13% of the state revenue is invested in education, research and development.

The State of Sao Paulo also has a better infrastructure platform than the rest of the country. Its 35 airports include the country’s two most important (Airport of Congonhas and International Airport of São Paulo). Sao Paulo also has two of the most important Brazilian seaports of the country (Santos and São Sebastião) and nearly 35,000 kilometers of highways. It also has a developed telecommunications network (41% and 33% of the fixed and mobile broadband accesses of the country, respectively). Notwithstanding, Sao Paulo continues to face significant infrastructure challenges, reflected in high levels of traffic congestion. The state needs important upgrades in road and rail transport.

Sao Paulo’s government structure includes the governor, the legislative branch (i.e. Assembleia Legislativa do Estado de São Paulo) and judiciary entities. The state is divided in 645 municipalities, being Sao Paulo city the state’s capital. Currently the governor of the state is

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Geraldo Alckmin, one of the founders of the Brazilian Social Democracy Party (PSDB). Alckmin also acted as governor of the state between 2001 and 2006 and was the Secretary of Development for the previous state administration.

The Brazilian Investment Competitiveness Ranking considered Sao Paulo as the best place to invest. The state also ranked first in: political environment, economic environment, policies for foreign investment, human resources, infrastructure, innovation and sustainability. However, the performance of Sao Paulo in the category of tax and regulatory regime was deemed as “moderate” and the State was placed in the third group out of four. These tax and regulatory burdens contribute to a problem of high informality in the Sao Paulo economy. The following chart summarizes the key factors that impact Sao Paulo’s competitiveness versus the rest of the country.

Figure 7. Sao Paulo Diamond

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IV. The Plastics Cluster

1. Introduction to the plastics value chain

Plastics are present in most of the consumer goods of modern life, from mobile phones, to automobiles and food packages. Brazil’s plastics industry was born in Sao Paulo in 1949 with a single manufacturer and was promoted by the government during the country’s import substitution model for decades. Sao Paulo state remains the center of plastics activity in Brazil.

The value chain of producing plastics starts with the raw ingredients of oil and gas. The fossil fuels are transformed to actual products, such as a plastic bottle, in three stages (or three generations, in industry lingo). The first two stages transform the fuels into plastic resins, which often take the form of little pellets and have names such as polyvinyl chloride (PVC), polyethylene (PE), and polypropylene (PPP). Then manufacturers convert the resins into a wide range of products, which are typically bought by other industries, such as car manufacturers, food and beverage companies and construction firms (see Figure 8).
2. Sao Paulo Plastics Cluster

The entire plastics value chain is present in Sao Paulo. The cluster also consists of plastic recyclers, resin distributors and manufacturers of molding machinery. Financial, logistics and bio-tech clusters provide important inputs, while the auto, construction and food and beverage industries provide important sources of demand. Chemical and rubber clusters are related industries. Many institutions for collaboration (IFCs) support the cluster (see Figure 9).

The production of plastic resins in Brazil is dominated by a near-monopoly (Braskem SA) and heavily depends on raw materials provided by a state-owned oil and gas near-monopoly (Petrobras SA). In contrast, thousands of plastic manufacturers produce a wide range of plastic products from the resins.

Resin production is extremely capital intensive and is concentrated among large companies globally. Braskem is based in the city of Sao Paulo and has plants located in the state, including industrial complexes in the cities of Paulinia, Cubatao and the metropolitan area of Sao Paulo city. Its main research activities, the Innovation & Technology Center, are also located in Sao Paulo state. The company has expanded globally and is now the 8th largest resins producer in the
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world, as well as the largest in the US. Braskem is the result of a consolidation of the resin industry that began in 2002.

In addition to oil and gas, Brazil uses ethanol derived from sugar cane to make plastic resins. Though a small portion of total production today, ethanol-based plastics (known as “Green Plastic”) are growing, as they are viewed as more sustainable and can biodegrade. Brazil is a world leader in sugar-cane ethanol.

Figure 10. The Monopolies

<table>
<thead>
<tr>
<th>Corporate Profile - Braskem SA</th>
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</thead>
<tbody>
<tr>
<td>• Incorporated in 2002, began aggressive consolidation</td>
</tr>
<tr>
<td>• Owned by local conglomerate Odebrecht (50.1%) and Petrobras (47%)</td>
</tr>
<tr>
<td>• More than 90% of local resins production</td>
</tr>
<tr>
<td>• 8th largest resin producer in the world, largest in US</td>
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<tr>
<td>• 36 plants around the world</td>
</tr>
<tr>
<td>• R&amp;D centers in US and Brazil</td>
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<tr>
<td>• $22 billion gross revenue in 2012</td>
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<tr>
<td>• Traded in Sao Paulo and New York</td>
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</table>

<table>
<thead>
<tr>
<th>Corporate Profile - Petrobras SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Created in the 1950s</td>
</tr>
<tr>
<td>• 90% of Brazilian oil production</td>
</tr>
<tr>
<td>• Publicly traded in Sao Paulo and New York</td>
</tr>
<tr>
<td>• Brazilian government is controlling shareholder</td>
</tr>
<tr>
<td>• Involved in exploration all the way through retail</td>
</tr>
<tr>
<td>• Investments in 25 countries.</td>
</tr>
<tr>
<td>• 2013-2017 Business Plan calls for investments of about $230 billion</td>
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<tr>
<td>• 7th biggest energy company in the world</td>
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<tr>
<td>• 15 refineries</td>
</tr>
<tr>
<td>• Net revenue 2012: US$ 160 billion</td>
</tr>
</tbody>
</table>

3. Sao Paulo Plastics Cluster Performance

The plastics cluster in Sao Paulo is focused on the country’s vast domestic market. Brazilian local consumption of plastic products surged 37% over 5 years to reach $27.6 billion in 2011. Almost 90% of this consumption is met by Brazilian production. The cluster is the second largest source of manufacturing jobs in Sao Paulo, and third largest nationally. Plastic product manufacturers employed 351,000 people nationwide in 2011, with 45% those jobs concentrated in Sao Paulo (Abiplast, 2011).
Recent trends around exports and imports highlight the power of this domestic market, as well as a potential global competitiveness challenge for the cluster. The share of national production going to exports declined to 4% in 2011 from 6% in 2007. At the same time, the share of Brazilian plastics consumption coming from imports rose to 11% in 2011, from 7% five years earlier (Abiplast, 2011). These two trends – exports falling as a percentage of production and imports rising as a percentage of consumption – signal that Brazilian products are losing ground in the global marketplace.

Plastics represent Brazil’s 12th largest export cluster, with $3.7 billion exported in 2010 (ISC). About 60% of exports are unprocessed plastic resins, while the remainder is processed plastics (Abiplast, 2011). The cluster is a fraction of the size of Brazil’s biggest export industries, such as agricultural products ($57 billion), metal mining / manufacturing ($41 billion), oil and gas products ($23 billion), and automotive ($15 billion) (ISC).

Brazil ranked 27th among plastics exporters in 2010, with 0.75% of the global market. The country’s share grew 0.15% in the previous decade (2000-2010), though its global ranking slipped four spots as China surged ahead to become the world’s 5th largest plastics exporter, up from 12th place in 2000. Germany and the U.S., the two leading exporters, lost share during the same period (ISC).
Brazil is a larger player globally when measured by production, representing 2% of the world’s production in 2010 (Abiplast, 2011). Another signal of the industry’s domestic focus.

4. Cluster Diamond Analysis

Context for Strategy and Rivalry

Similar to the global plastics industry, competition in the Sao Paulo plastics cluster has different characteristics among resin producers and plastic products manufacturers. In general, the resin industry requires very high capital investments and fixed costs, which naturally incentivizes the creation of large companies. Examples of such companies include Exxon Mobil and Dow Chemicals in the U.S., BASF in Germany and SABIC in Saudi Arabia. In contrast, plastic manufacturing generally consists of small- and medium-sized firms that serve specific industries, such as autos, food packing or construction. These firms generally are not capital intensive and produce products that reflect specific technical requirements of clients.

CSR- Resins Industry

Braskem’s near-monopoly is protected by a 20% import tariff (increased from 14% in January 2013). Braskem controls more than 90% of the domestic production of resins, which corresponds to a 70% market share including imports. Thus, Braskem’s competition is basically imports, not other national companies.
Moreover, Petrobras is the second largest shareholder of Braskem with 47% of voting shares, as well as being its main supplier. This raises concerns about lack of transparency in the negotiation of input prices.

On the positive side, Braskem’s internationalization and research and development activities contribute to innovation in the cluster. Braskem has three research centers in Brazil and the United States with more than 240 research professionals. Also, Braskem has over 420 patents filed. In the last three years, about 12% of Braskem’s earnings have come from products developed in-house (Braskem, 2013). One example of Braskem’s innovation is the Brazilian “Green-Plastics”, a new and emerging plastic component made out of ethanol from sugar-cane. Braskem’s Green plastics represent an important innovation in the plastics industry worldwide towards more sustainable practices.

**CSR – Plastic Converters**

More than 11,500 plastic converters compete in the country with 45% of them located in Sao Paulo (ABIPLAST, 2011). Competition in this environment is aggressive.

However, this segment suffers from high levels of informality, related to the high cost and bureaucracy required to open a formal business in the country. Almost 50% of the firms have less than 10 employees.

Similarly to the resins, this segment is also protected by import tariffs averaging around 25%. Plastic molding machinery— the main capital good used by the plastic manufacturers—has a 40% import tariff.

Overall, the context for rivalry for the plastics cluster is problematic, because of the monopolistic behavior in parts of the value chain and protectionist measures across the industry.
Institutions for collaboration, related and supporting industries

There are many institutions for collaboration (IFCs) in the Sao Paulo plastics cluster. Two of the main institutions are: the Brazilian Association of Plastics, which represents the largest plastic converters; and Think Brazil Think Plastics, which acts as a facilitator for Brazilian plastics exporters. The main functions of the IFCs are coordination among firms, trade promotion, engaging with government, and training activities. For example, the Service for Industrial Training (SENAI) created by the Sao Paulo Federation of Industries provides training to more than 2,000 industrial workers per year (including the petrochemical sector) as a way to compensate for the low quality of basic education in the country.

Although there are many industry associations representing different segments of the cluster (such as plastic converters that serve specific final industries), there is no single “voice” of the cluster as whole to advocate or facilitate the pursuit of higher competitiveness levels for the entire cluster.

In terms of supporting industries, the financial sector plays an important role. Sao Paulo is the most important financial center in Latin America, and hosts South America’s most active stock exchange. Other supporting industries include logistics and bio-tech companies.

Many industries are related to the plastics cluster in the sense that they share input, product development initiatives, and human capital. For example, the chemical industry demands not only the same inputs, but also the same type of professionals as the plastics cluster. Chemicals are the 6th largest export cluster in Brazil (19th largest of the world). Overall, related and supporting industries contribute to the competitiveness of the cluster.
Demand Conditions

Cluster growth is driven by robust internal demand. Three industries in particular – construction, food & beverage, and automotive – account for nearly half of all purchases. All three industries have experienced sharp growth, and two of the three support innovation through adoption of sophisticated products.

Construction: In public infrastructure alone, Brazil spent US$220 billion in 2007-2010, and plans another US$526 billion from 2011 to 2014.\(^{31}\) Construction is also spiking around preparations for the World Cup (2014) and Olympics (2016).\(^{32}\)

Food & Beverage: The industry has almost tripled in a decade.\(^{33}\) A quest for innovative packaging solutions makes the industry a sophisticated buyer.

Automotive: Output has doubled in the last decade, making Brazil the 6\(^{th}\) largest automobile producer.\(^{34}\) The industry requires light-weigh plastics, helping to drive innovation.

The force behind this growth is Brazil’s ballooning middle class, 3rd fastest growing in the world after India and China.\(^{35}\) Per capita consumption of plastics is expected to double from 2005 to 2015 to 46 kg. Yet there is still room for growth towards levels seen in North America (105 kg in 2005) (Abiplast, 2011).


\(^{32}\) Figures for the Construction Supply Index come from the Brazilian Chamber of Construction http://www.cbicdados.com.br/menu/materiais-de-construcao/pim-pesquisa-industrial-mensal

\(^{33}\) Sales figures obtained from the Brazil Food and Beverage Association website: http://www.abia.org.br/vst/o_setor_em_numeros.html


\(^{35}\) Paulo Rogério, “Challenges for the New Brazilian Middle Class” in Americas Quarterly, accessed here: http://www.americasquarterly.org/challenges-new-brazilian-middle-class
Factor Conditions

Sao Paulo’s plastics industry benefits from a clustering of research institutions in the state. At the same time, it is held back by a lack of qualified engineers, high energy costs, costly raw materials and inadequate infrastructure to move products quickly and cheaply around the state.

**Research institutions:** Sao Paulo has the largest cluster of research institutions in the country, and nearly all of them are working on technology related to plastics. The Institute for Technological Research (IPT) is working on biopolymers that could lead to new “green” biodegradable plastics. São Paulo State University (UNESP) is researching how to use local natural fibers, such as curauá, banana, and pineapple, instead of glass fibers in polypropylene. The Chemistry Institute (IQ) at the University of São Paulo (USP) is researching new polymers. In addition, the São Paulo Research Foundation (FAPESP) funds plastics research. At Unicamp, located at the Campinas Technology Center, a technology transfer program called Inova seeks to transform university research into business applications (Ceron Di Giorgio, 2009).

**High cost of raw materials and energy:** Brazil has abundant oil, gas and ethanol resources that form the inputs into plastic resins. However, the plastic products industry estimates that locally produced resins are more expensive than those of main competitors. The higher costs reflect the monopoly behavior already described in the discussion about Braskem and Petrobras. Also, natural gas – currently the most cost-efficient raw material for plastics given its low international prices – is more expensive in Brazil than in its global competitors.

Brazilian natural gas currently costs US$ 16.80 per cubic foot, which is 231% higher than the U.S. gas and 25% more expensive than in Brazil.

<table>
<thead>
<tr>
<th>Country</th>
<th>$ per MM Btu</th>
</tr>
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<tbody>
<tr>
<td>Brazil</td>
<td>16.84</td>
</tr>
<tr>
<td>US</td>
<td>5.09</td>
</tr>
<tr>
<td>Germany</td>
<td>20.59</td>
</tr>
<tr>
<td>China</td>
<td>13.52</td>
</tr>
<tr>
<td>India</td>
<td>5.23</td>
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than gas in China. One of the main reasons for high natural gas prices in Brazil is related to the lack of transparency and competition in the way Petrobras sets prices (Firjan 2011). Petrobras has discretionary power to set natural gas prices based on the prices of a basket of different oil-derivate products, instead of international natural gas prices. The Brazilian National Agency for Oil (ANP) – the oil and gas regulatory agency – has no direct institutional role of overseeing the method Petrobras uses for setting natural gas prices (ANP, 2010).

In addition, Brazil’s electricity costs are higher than those of key competitors. For instance, Brazil’s industrial electricity rates were about USD $0.18 in 2012, compared with 12 cents in Germany, 8 cents in China and 7 cents in the U.S.\(^{37}\)

**More engineers needed:** In addition to the education challenges discussed earlier in this report, Brazil has a large gap of qualified engineers to support industrial innovation. The Federal Council of Engineering, Architecture and Agronomy estimates the country needs 20,000 more engineers to fill current positions and demand.\(^{38}\)

**Inadequate infrastructure:** The plastics cluster in Sao Paulo depends on notoriously crowded highways to ship resins and products. The Economist Intelligence Unit highlighted Sao Paulo’s “severe transport bottlenecks” in its 2011 report on Brazilian public transportation. The report suggests that businesses in the city of Sao Paulo lost $21 billion in 2008 to wasted time and fuel while stuck in congested traffic, equal to 10% of the city’s total economic activity (Economist Intelligence Unit, 2011). In the U.S., 90% of plastic resins move by rail (American Chemistry Council, 2003).


\(^{38}\) Cited in Automotive World, 18 July 2011, “The Engineering Deficit: Brazil’s Quest For Engineers,” accessed at [http://www.automotiveworld.com/comment/88153-the-engineering-deficit-brazil-s-quest-for-engineers/](http://www.automotiveworld.com/comment/88153-the-engineering-deficit-brazil-s-quest-for-engineers/)
5. Cluster challenges and summary of diamond

The plastics cluster in Sao Paulo benefits from good research institutions, strong and sophisticated local demand, intense competition among plastic products manufacturers and a deep supplier network. Many institutions for collaboration also exist, even though no one organization speaks for the entire cluster.

Yet plastic product manufacturers feel like they are constantly swimming upstream. A monopoly player controls the production of resins and is protected by a 20% import tariff. Monopolistic pricing of oil and gas further limits competition, while high electricity rates also drive up the costs. Domestic molding machinery is protected by a 40% tariff, and plastic products themselves have protective tariffs as well. Infrastructure gaps are raising transportation costs, while a lack of skilled engineers limits innovation. Burdensome regulations and rampant informality create bureaucratic costs. R&D is happening, but is not strongly linked to new product development.

All of these headwinds limit the cluster’s international competitiveness and have kept the industry focused on domestic markets. Even the domestic market is increasingly turning to imports, showing the limits of the protectionist policies.

Figure 12 presents the Competitiveness Diamond for the Plastics Cluster in Sao Paulo Brazil, which highlights the main factors that enhance or hamper the competitiveness of this industry.
The Plastics Cluster in Sao Paulo Brazil

Figure 12. Plastics Cluster Diamond

6. Competing Cluster

The following chart shows some of the main drivers of competitiveness of global leaders and relevant benchmarks for Brazil in the plastics cluster considering ISC ranking.39

U.S. (1st world plastic exporter)
- Availability of raw materials (huge increases in the reserves of shale gas, which have led to a sharp drop in international prices from more than $11 per cubic feet in 2008 to currently less than $4).
- Advance railway system (e.g. 90% resins moves on rails).
- Huge demand showing rapid recovery after recession. E.g. (i) biggest world economy (measured by GDP), and, (ii) apparent consumption of plastics industry goods grew 11.9% in 2011.

Germany (2nd world plastic exporter)
- German federal government’s cluster strategy enhancing competitiveness.
- Plastics Industry Networks Clusters (multi-producer site overseen by a third-party), 40+ regional clusters.
- Significant investments in innovation (e.g. In 2008 it was registered at the European Patent Office more than twice the number of patents that UK and France together).
- Demand side: highly developed industries (e.g. world major exporter of automotives and food processing).
- Significantly higher productivity rate and level of workforce education.

China (5th world plastic exporter)
- Lower electricity costs (8 cents/Kwh v. 18 cents in Brazil).
- China is the country which plastic production capacity is expected to grow the most in the next years (from 23 million tons in 2012 to 34.2 million tons in 2017) (Holbrook, 2012).
- Also, huge domestic demand. E.g. (i) second biggest world economy (measured by GDP), and, (ii) consumption was expected to increase between 5-7% in 2012 (Reuters, 2012)

Mexico (21st world plastic exporter)
- Advantages from the demand perspective: (i) key location besides the U.S. (ii) several free trade agreements signed, (iii) growing demand industries (ranked 4 in 2010 in world automotive exports, 6 in motor driven products and 11 in aerospace).
- Low wages cheaper than nearby countries but higher than Asia.

V. **Recommendations and Action Plan**

The cluster has opportunities to make significant strides in global competitiveness. The recommendations presented here are divided into four big ideas:

1. **Take the leap from protected industry to global competitiveness**

   Brazil plastics cluster needs to gradually shake off the significant protectionist barriers and anti-competitive elements of the cluster. This includes reducing import tariffs on resins, plastic products and machinery. The government should also promote domestic competition to Braskem, and ensure that Petrobras shows no preference towards Braskem if competitors emerge. In addition, the government should reduce distortions in raw material pricing by Petrobras. At the same time, the government should minimize bureaucracy around import and export procedures, simplify and reduce the tax burden on labor, and incentivize small firms to join the formal economy.

2. **Aggressively promote innovation, while plugging gaps in talent and infrastructure**

   The regional government and business can more aggressive promote research and development in plastics, and strengthen technology transfer from research centers to firms, particularly around the country’s unique strengths, such as bio-plastics from ethanol and use of natural fibers. Industry and the government can also work together to plug the gap in engineers, perhaps promoting immigration of skilled workers as a short-term fix. Finally, the government’s infrastructure plans should closely reflect the industry’s transportation needs. A significant rail investment should be considered.

3. **Increase domestic demand sophistication around “green” plastic**

   Brazil has an opportunity to become a center for bio-plastics that are more friendly for the environment, considering its sugar cane endowments and research to date in this area.
Government and business could work together to promote more domestic consumer demand for these products, as well as greater government procurement.

4. *Create a cluster voice*

The cluster has many industry associations, but lacks a single voice to carry forward the types of reforms suggested in this report. This more unified voice could come from a new institution or better coordination among existing associations.

Table 2. Recommendations

<table>
<thead>
<tr>
<th>Action</th>
<th>Responsible Party</th>
<th>Impact</th>
<th>Feasibility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aggressively promote innovation, while plugging gaps in talent and infrastructure</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Innovation — Increase R&amp;D and its commercialization</td>
<td>Government (Sao Paulo, National), Universities &amp; Research Institutes, Firms</td>
<td>Very High</td>
<td>High</td>
</tr>
<tr>
<td>Skills — Generate skilled workforce, encourage skilled immigration</td>
<td>Government (Sao Paulo, National), firms, universities</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Infrastructure — Upgrade, consider rail</td>
<td>Government (National, Sao Paulo)</td>
<td>Very High</td>
<td>Medium</td>
</tr>
<tr>
<td><strong>Take the leap from protected industry to global competitiveness</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduce import tariffs (resins, plastic products and machinery)</td>
<td>Government (National)</td>
<td>Very High</td>
<td>Low</td>
</tr>
<tr>
<td>Promote domestic competition to Braskem — avoid discrimination by Petrobras</td>
<td>Government (National)</td>
<td>Very High</td>
<td>Low</td>
</tr>
<tr>
<td>Reduce distortions in the raw material pricing by Petrobras.</td>
<td>Government (National)</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Reduce bureaucracy around imports / exports</td>
<td>Government (National)</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Encourage small firms to join formal economy. Reduce hurdles. Simplify tax regime; Reduce tax burden on labor</td>
<td>Government (National, Sao Paulo)</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td><strong>Create a cluster voice</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop a cluster voice – perhaps through a new institution or better coordination among IFCs to set cluster’s priorities.</td>
<td>Firms, IFCs</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td><strong>Increase domestic sophistication around “green” plastic demand</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Promote bio-plastics (from ethanol) to consumers and through govt procurement</td>
<td>Government (National, Sao Paulo), Firms</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>
VI. **Priorities and Conclusions**

All of the above recommendations are important steps to inject greater competitiveness into the Sao Paulo plastics cluster. As a priority, this report recommends a particular emphasis on the actions that would have the highest impact and are relatively feasibility. Using this filter, the suggestions around promoting greater innovation and better infrastructure emerge as the highest priority items.

In addition, actors in the clusters should begin now to create the political conditions for the other “Highest” Impact recommendations to become more feasible, in particular the reduction in tariffs and the greater competition in resin production.

Even as Sao Paulo plastics face a variety of headwinds, the cluster is currently exporting products to dozens of countries, including plastic tubes to Japan, other plastic products to U.S., Europe and Latin America, and resins to Argentina, China and Belgium\(^40\). This is a sign of the cluster’s potential for growth in the global market.

\(^{40}\) Based on data from UN Comtrade.
VII. References

- National Agency for Oil, Natural Gas and Biofuels (ANP) (2010). “Current formation of natural gas prices in Brazil”. Available at: <www.anp.gov.br/?dw=31187>
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o Economist Intelligence Unit (2011), “Making up for lost time: Public transportation in Brazil’s metropolitan areas”.