# GLOBAL SANTIAGO

PROFILING THE METROPOLITAN REGION'S INTERNATIONAL COMPETITIVENESS AND CONNECTIONS



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GLOBAL CITIES INITIATIVE A Joint Project of Brookings and JPMorgan Chase

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#### PROFILING THE METROPOLITAN REGION'S INTERNATIONAL COMPETITIVENESS AND CONNECTIONS

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#### EXECUTIVE SUMMARY

ver the past two decades, the Santiago Metropolitan Region, like all of Chile, has emerged on the global stage. Accounting for nearly half of the nation's GDP, Santiago contains a significant set of economic assets-an increasingly well-educated workforce, major universities,

and a stable of large global companies and budding start-ups. These strengths position it well to lead Chile's path toward a more productive, technology-intensive economy that competes in global markets based on knowledge rather than raw materials. This type of economy, which fully embraces trade and foreign direct investment as a growth driver, requires the capacity to generate new ideas and process innovations, a broadly educated workforce, and sound infrastructure to connect firms and workers to each other and the rest of the world.

This report, developed as part of the Global Cities Initiative, a joint project of Brookings and JPMorgan Chase, benchmarks the Santiago Metropolitan Region against eight global peer regions based on its economic size, wealth, productivity, industrial structure, and competitiveness factors. In doing so, the report provides a global competitiveness framework for local and national leaders working to sustain the region's prosperity. Its key findings are:

Substantial economic progress has occurred since 2000, but macroeconomic shifts present new challenges to growth. Production of goods and services in the Santiago Metropolitan Region has expanded consistently over the past 15 years. Average standards of living and labor productivity are much higher today than they were in 2000. Gains in output, GDP per capita, and output per worker outpace most of Santiago's peer regions. But challenges remain: low job creation, slowing productivity growth in recent years, and continued high levels of income inequality. Shifts in the global economy–declining commodity prices, China's slowing demand for Chilean exports, and the broader slowdown among its Latin American neighbors-have the potential to exacerbate these challenges. In a composite economic performance index, Santiago placed third among nine regions.

The Santiago Metropolitan Region can take advantage of changing market, technology, and demographic trends, but it must focus on the core drivers and enablers of competitiveness. A competitive region is one in which firms can compete successfully in the global economy while supporting high and rising living standards for local households. Globally competitive traded sectors, functioning innovation ecosystems, and skilled labor are the key drivers of overall productivity, employment creation, and income growth. Two enablers support these three drivers: well-connected, spatially efficient infrastructure and a reliable governance structure and business environment. The Santiago Metropolitan Region contains notable strengths and significant opportunities to better deploy these five factors to increase its global competitiveness.

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**TRADE:** The Santiago Metropolitan Region can leverage its specialization in business services to boost exports and foreign direct investment. With a relatively small domestic market, trade and investment must be a critical component of Santiago's long-term economic strategy. To that end, it is encouraging that output and employment in traded sectors have grown at a faster clip than the national economy and many global peer regions. Exports have also posted superior growth rates to the national economy, led by the region's mining and food and beverage sectors. However, several macro trends confirm that the mining sector will not continue to be the economic engine it was in the past decade, indicating the need for diversification into new tradable industries. Santiago's status as Chile's transportation and business services hub (it houses over 90 percent of corporate headquarters in Chile) make those sectors compelling opportunities to boost exports and foreign investment. Yet, the national services trade deficit has steadily increased over the past decade. Inward foreign direct investment flows fall in the middle of global peers, with key sectors being communications, metals, and renewable and alternative energy. In a composite trade index, Santiago placed fifth among global peer regions.

INNOVATION: Anchored by leading research universities and a budding venture capital scene, Santiago's innovation ecosystem could benefit from greater cooperation between universities and firms. The region's research universities are important assets for knowledge creation and have the potential to accelerate technology transfer, but could collaborate more with the private sector to better align university research with the industrial demands of the region, and reach beyond Chile's border to collaborate internationally with other universities and firms. Venture capital markets do find Santiago start-ups an attractive proposition. Compared to international peers, the Santiago Metropolitan Region attracts a significant amount of venture capital given its size. However, patenting rates per capita lag most global peers, indicating that Santiago's innovation ecosystem is not yet on par with peer Asian metro areas. In a composite innovation index, Santiago placed fourth among peer regions.

TALENT: The education levels and skills of the region's workforce have increased substantially, but the education system must improve its quality, particularly at the primary and secondary level, while increasing access to the university level for lower-income students. Santiago has a relatively well-educated workforce, ranking in the upper tier of its peers, a defining achievement of the past couple decades. However barriers to accessing higher education persist, reducing potential productivity gains and perpetuating inequalities. Additional support to students with scarce resources, efforts to standardize training certifications, and a greater emphasis in technical skills in short supply can both increase social mobility and improve the competitiveness of the region. Additionally, effectively integrating the foreign-born population into Santiago's labor market and social life can help solidify a steady supply of workers to maintain growth. Santiago's relatively high quality of life offer can serve as an attractive asset in drawing international talent. In a composite talent index, Santiago placed fourth among global peer regions.

> "Chile's path to industrial diversification runs squarely through Santiago."

INFRASTRUCTURE: Santiago is the clear international access point for Chile, but it must continue to upgrade its digital, housing, and transportation infrastructure. The Santiago Metropolitan Region houses most of the country's international access points. The Comodoro Arturo Merino Benítez International Airport, while not moving the same volume of passengers as airports in peer regions, is Chile's clear connection to the rest of the world. Freight and logistics infrastructure in Chile lags most peer countries, largely because it is not as easy to arrange international shipments in Chile as in other countries. Even with this deficiency, firms in the Santiago Metropolitan Region benefit from relatively low exporting costs. Digital connectivity-as measured by Internet download speeds-fall in the middle of global peers but adoption rates could be improved, likely through lowering the cost of Internet access. Within the region, continued population and income growth continues to increase demand for housing and transportation, necessitating new investments in both. Equally important is the long-term coordination between housing, transportation, and land use

decisions along key corridors and nodes to improve the region's spatial efficiency. In a composite infrastructure index, Santiago ranked last among peer regions.

**GOVERNANCE:** Firms benefit from a sound Π business and regulatory environment, but sub-national governments currently have little autonomy to steward Santiago's economic future. The Santiago Metropolitan Region benefits from a good business and regulatory environment, reflecting Chile's legacy of pursuing free trade, macroeconomic soundness, and regulatory transparency. Where the region lags is in its overall autonomy to determine its economic future. Chile remains a very centralized country. New reforms that enhance sub-national autonomy and flexibility can position the country's metropolitan regions more centrally in issues of economic competitiveness. As debates unfold about the proper distribution of powers and responsibilities between central and regional governments, it is important to remember that economic development is increasingly a shared enterprise between government, the private sector, and educational and civic institutions.





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#### I. INTRODUCTION

Cities around the world must adapt to the forces redefining what it takes to excel in today's global economy.

First, globalization is intensifying. Revolutions in transportation, the rapid rise of emerging markets, the globalization of finance, and the advent of global value chains has intensified international exchange. Global flows of goods, services, and capital have expanded rapidly over the last two decades, increasing from \$5 trillion in 1990 to \$26 trillion in 2012.<sup>1</sup>

Second, technology is altering how we communicate, how firms create products and services and deliver them across the globe, and the very nature of work itself.<sup>2</sup> The McKinsey Global Institute predicts that 12 emerging technologies will generate an annual economic impact of \$33 trillion by 2025.<sup>3</sup> Risks accompany these breakthroughs; for instance, already demonstrated technologies have the potential to automate 45 percent of work activities in the United States.<sup>4</sup>

Third, urbanization's relentless shift of people from rural areas to cities is changing the geography of growth and economic activity in emerging markets, especially in Asia and Africa. The share of global population in metropolitan areas has grown from 29 percent in 1950 to half in 2009, and is predicted to reach 60 percent by 2030.<sup>5</sup>

Cities are on the frontlines of all of these shifts, creating both challenges and opportunities. Emerging markets-connected by technology and trade- have increased the possibilities for where firms and workers can locate their activities have expanded, generating new pressures on individual cities to provide a distinct value proposition to the market. This basic premise is not necessarily new; for hundreds of years firms have sought out supportive environments that provide them the inputs required to sell their products and services outside of their own borders, utilizing external demand as a critical route to expanded local wealth and prosperity.<sup>6</sup> However, the competition for firms and workers has heightened considerably today, due to the sheer number and size cities in the network. Of course, these same dynamics have created abundant market opportunities for cities as well. For those places that allow firms and people to successfully plug-in to the global economy, the returns are high.<sup>7</sup>

Political, business, and civic leaders across the world have thus become increasingly focused on understanding and enhancing their city-regions' economic competitiveness and connections. To help inform their efforts, the Global Cities Initiative-a joint project of Brookings and JPMorgan Chase-is exploring the competitiveness of global city-regions through a two-year series of "Global City Profiles," including Santiago. This report draws on Harvard Business School research to define a competitive region as one in which firms can compete successfully in the global economy while supporting high and rising living standards for local households.<sup>8</sup> It acknowledges that firms ultimately compete in the global marketplace, but that the public sector can support a healthy and vibrant private sector through investments in skills, innovation, and infrastructure. It also acknowledges that corporate success alone is unsustainable if it is not accompanied by flourishing workers and families, and that connecting residents to education, training, basic infrastructure, finance, and human services is also critical.<sup>9</sup> Competitive regions are, by this definition, supportive environments for both companies and people.

This profile draws upon a unique dataset of globally comparable performance indicators to offer new insights about the economic competitiveness of the Santiago Metropolitan Region. It uses international benchmarking to explore the overall economic performance of the region; its comparative strengths and weaknesses on five key competitiveness factors; and concludes with implications from this assessment and key topics for the city-region's network of government, business, civic, and community leaders to consider as it positions the Santiago Metropolitan Region the global stage in the coming years.

#### Defining and measuring competitiveness through international benchmarking

ountless definitions of competitiveness exist. This research draws on the Harvard Business School definition of a competitive market as one in which firms can compete successfully in the global economy while supporting high and rising living standards for local households.<sup>10</sup> Competitive regions are, by this definition, supportive environments for both companies and people. Building on an extensive literature review on regional economic development by researchers at George Washington University, this research analyzes competitiveness through a five-factor framework–trade, innovation, talent, infrastructure, and governance.<sup>11</sup> Globally competitive traded sectors, innovation ecosystems, and skilled labor are the key drivers of overall productivity, employment creation, and income growth. Enablers support these drivers: well-connected, spatially efficient infrastructure and reliable governance, public services, and business environment.<sup>12</sup> Focusing on these fundamentals positions metropolitan economies to compete based on the distinct long-term value their industries and people can provide, and avoids economic strategies that attract firms through "race-to-the-bottom" techniques that compete via one-time tax breaks or depressing wages.

This report utilizes a group of carefully selected metropolitan peers to understand competitiveness beyond a national context. We selected the Santiago Metropolitan Region's peer cities through a combination of principal components analysis (PCA), k-means clustering, and agglomerative hierarchical clustering using 22 variables that measure economic size, wealth, productivity, industrial structure, and innovation.<sup>13</sup> This analysis revealed eight metropolitan economies that most closely resemble the economic profile of the Santiago Metropolitan Region. Table 1 compares the city-region to its peer metro areas on five of these variables. Similar to Santiago, these metro areas are large in terms of output and population, remain in the middle-income development stage, and tend to be important hubs of business and exchange in their respective countries and regions. Whenever possible, the analysis employs comparable metrics of economic performance and the five competitiveness factors to unveil areas of comparative strength and weakness.<sup>14</sup>



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| Table 1. Key mulcators for the Santiago and global peer metro areas |                |                |                |                   |                |
|---|----------------|----------------|----------------|-------------------|----------------|
| Rank  | Population     | Nominal GDP    | Employment     | GDP per<br>capita | GDP per worker |
| 1   | Mexico City    | Mexico City    | Mexico City    | Warsaw            | Warsaw         |
| 2   | Istanbul       | Istanbul       | Rio de Janeiro | Istanbul          | Istanbul       |
| 3   | Rio de Janeiro | Hangzhou       | Istanbul       | Nanjing           | Ankara         |
| 4   | Hangzhou       | Nanjing        | Hangzhou       | Santiago          | Nanjing        |
| 5   | Santiago       | Rio de Janeiro | Santiago       | Ankara            | Santiago       |
| 6   | Nanjing        | Santiago       | Nanjing        | Hangzhou          | Mexico City    |
| 7   | Johannesburg   | Warsaw         | Johannesburg   | Rio de Janeiro    | Hangzhou       |
| 8   | Ankara         | Ankara         | Ankara         | Mexico City       | Rio de Janeiro |
| 9   | Warsaw         | Johannesburg   | Warsaw         | Johannesburg      | Johannesburg   |
| Source: Brookings analysis of Oxford Economics data.                |                |                |                |                   |                |

#### Table 1. Key indicators for the Santiago and global peer metro areas

#### Defining the Santiago Metropolitan Region

Several geographic definitions of the Santiago Metropolitan region exist.<sup>15</sup> This report defines the Santiago Metropolitan Region as the regional administrative unit defined by the National Institute of Statistics (INE). This geography encompasses 52 communes and 6 provinces, and has a popula-

tion of more than 7 million.<sup>16</sup> While this definition includes some communes that are not considered urban and other small urban areas that are mostly independent from Santiago, the latter account for a very low proportion of the region and approximately 91 percent of the population lives in the central city. This, in addition to the lack of a standardized statistics that reflect commuting patterns from other distant and small urban areas led us to adopt the INE administrative delineation. Chile's administrative regional division is also the most frequent territorial disaggregation for most economic data, and thus pro-



vides us with a set of directly comparable indicators. Mentions of the "Santiago metro", "Santiago metro area", and "Santiago Metropolitan Region" refer to this geography.



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## II. THE STATE OF THE SANTIAGO METROPOLITAN REGION'S ECONOMY

hile's ascendance onto the global stage, which began in the 1980s, gained momentum in the last decade of the 20th century, when the country posted an average annual growth rate of 6 percent. The economy continued its good pace between 2000 and 2014, when Chile's economy grew by an average of 4.2 percent, one of the fastest rates in Latin America. GDP per person grew by an equally impressive 3.2 percent and GDP per worker increased by 1.4 percent. Much of Chile's economic expansion during the 2000s is attributable to mining and agricultural commodities, which experienced perennially high prices amid rising global demand. The inflation-adjusted price of copper, which accounts for a large share of national exports, increased by 184 percent between 2000 and 2014.<sup>17</sup> Notwithstanding the tremendous role of copper has in Chile's growth, its fastest growing sectors are transportation and communications, financial services, and business services, reflecting the country's transition into a more advanced service economy.

BROOKINGS Metropolitan Policy Program During this period, the Santiago Metropolitan Region has been the economic engine of Chile. The region of 7.2 million people accounted for approximately 41 percent of national population and 49 percent of the Chilean economy in 2014.<sup>18</sup> Since 2000, Santiago has generated dynamic economic growth and productivity gains, which have translated to notable advances in average standards of living. However, the region still faces significant challenges: high and lingering income inequality, a faltering employment growth rate, and the ongoing demands of its transition to a servicesoriented economy.

The Santiago metropolitan economy almost doubled its output since 2000, but employment growth has lagged both global peer regions and the national economy. The rate of change in the size of the regional economy can indicate the pace of its progress toward expanding economic opportunity. Real GDP growth averaged 4.7 percent between 2000 and 2014, third highest among peers and only behind two high-growth Chinese metro areas. Employment growth has been more modest, averaging 2.4 percent per year since 2000. Slower job creation stems partly from the capital-intensive nature of output growth in industries such as manufacturing and transportation, and to the adoption of more efficient IT platforms in the business services industry. While output growth has outpaced the national economy, employment growth has usually been lower than the national average since 2000.



GDP per capita and productivity are higher today than in 2000, but growth in both metrics has slowed during the first half of this decade. To create lasting prosperity, economic growth must keep pace with population and labor force growth so that individuals can continue to see their standard of living rise. Santiago's annual GDP per capita growth, a common measure of standard of living, has averaged 3.6 percent since 2000, higher than national trends and fourth among its peer group, trailing only Nanjing, Hangzhou, and Warsaw.<sup>19</sup> GDP per capita growth is in turn related to productivity, or the ability of firms and workers to transform the factors of production into more valuable products and services. Productivity– measured as GDP per worker–grew by a 2.3 percent average annual rate from 2000 to 2014. Over the past 15 years, both output per worker and GDP per capita grew faster in the Santiago Metropolitan Region than in Chile as a whole.





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## Income inequality remains a main obstacle to shared growth and prosperity in the Santiago

Metropolitan Region. High inequality can reduce the durability of economic growth if it undermines health and education access, limits productivity-enhancing investments, and diminishes social cohesion.<sup>20</sup> While many of the global economic trends that contribute to income inequality are beyond the control of any individual city, understanding how income gains are distributed within a regional economy can reveal who among the population is benefitting from local growth. One common income inequality measurement is the Gini coefficient, which defines inequality on a scale from zero (perfect equality) to one (perfect inequality). The Santiago Metropolitan Region registered a Gini (after taxes and transfers) of 0.52 in 2010, down from a historic high of 0.57 in 2003.<sup>21</sup> While declining over time, income inequality in the Santiago Metropolitan Region exceeds that of Chile (Gini of 0.50) and ranks third among its peers, trailing only Johannesburg and Rio de Janeiro.<sup>22</sup> Reduced poverty has accompanied reduced inequality; the share of Santiago's population living in poverty has declined from 20 percent in 2006 to 9 percent in 2013.<sup>23</sup> Despite this progress, persistent residential segregation has continued to curb opportunities for isolated vulnerable populations within Santiago.

#### Figure 5. Gini income inequality index, latest available year\*



Source: Brookings analysis of OECD data. \*Geographies shown here are the closest approximations to our peer metro regions available in the OECD regional

or other available database.

**BOTTOM LINE:** Significant economic progress occurred in Santiago over the past few decades. Production of goods and services in the Santiago Metropolitan Region has expanded consistently over the past 15 years. Average standards of living and labor productivity are higher today than they were in 2000. Gains in output, GDP per capita, and output per worker outpace most of Santiago's peer regions. But challenges remain: low job creation, slowing productivity growth, and continued high levels of income inequality. Shifts in the global economy–declining commodity prices, China's slowing demand for Chilean exports, and the broader slowdown in Latin American neighbors–have the potential to exacerbate these challenges. To solidify its international position for the coming decades the city-region's leadership must focus on the core drivers and enablers of competitiveness and prosperity.



#### III. COMPETIVENESS DRIVERS AND ENABLERS

#### A. TRADE

WHY IT MATTERS: Trade is a critical driver of prosperity and competitiveness. Firms selling internationally inject new wealth from abroad that, when spent locally, creates a multiplier effect in the regional economy, spurring new jobs, growth, and further tax revenue to be reinvested locally.<sup>24</sup> Participating in global trade also makes metro areas more competitive and productive. Firms that generate revenue from outside their home market must provide goods and services faster, better, and cheaper than their global competitors. Local companies that embed themselves in global value chains gain access to high-quality inputs, lower overall costs, and as a result become more globally competitive. This process tends to boost productivity and wages.<sup>25</sup> Therefore, the traded economy-as measured by trade in goods and services, and by foreign direct investment-is both an important signpost and a critical driver of competitiveness.

#### A1. TRADED SECTOR STRUCTURE AND GROWTH

The Santiago Metropolitan Region's traded sectors represented more than one-third of total employment and over 60 percent of total output. Manufacturing accounted for the largest share of traded sector employment in 2014, followed by business services (i.e., legal, accounting, and IT services), transportation and communications, and financial services. Business services generated the largest share of total output (33 percent), followed by manufacturing and transportation and communications. The nontradable portion of the economy absorbs the majority of employment, including significant concentrations in health, education, and other services as well as distribution and retail, reflecting Santiago's role as Chile's education and commercial capital. Compared to national trends, growth in Santiago's traded sector was higher in terms of both output and employment. Between 2000 and 2014, Santiago's output and employment in traded sectors posted annual growth rates of 5.0 and 2.7 percent, respectively, compared to national growth rates of 3.9 and 2.2 percent.

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| Table 2. Santiago Metropolitan Region's industrial structure, 2014 |               |                 |  |  |
|--|---------------|-----------------|--|--|
| Sector   | Share of jobs | Share of output |  |  |
| Tradable   | 37%           | 62%             |  |  |
| Manufacturing  | 13%           | 12%             |  |  |
| Business services  | 9%            | 33%             |  |  |
| Transport & communications   | 8%            | 6%              |  |  |
| Financial services   | 3%            | 10%             |  |  |
| Agriculture, forestry & fishing                                    | 2%            | 1%              |  |  |
| Mining   | 1%            | 1%              |  |  |
| Non-Tradable   | 63%           | 38%             |  |  |
| Health, education & other service                                  | 24%           | 14%             |  |  |
| Distribution & retail  | 22%           | 11%             |  |  |
| Construction   | 9%            | 5%              |  |  |
| Public administration  | 4%            | 4%              |  |  |
| Hotels & catering  | 3%            | 2%              |  |  |
| Utilities  | 0%            | 1%              |  |  |

Source: Brookings analysis of Oxford Economics data.

#### Figure 6. Share of traded sector in total output, 2014



Source: Brookings analysis of Oxford Economics data.

Output and employment have expanded in all portions of the Santiago Metropolitan Region's tradable economy. Overall, the Santiago Metropolitan Region's traded sector registered a robust 5 percent growth per year since 2000, doubling the pace of its Latin American peers but trailing Nanjing and Hangzhou. One simple way to gauge the health of individual sectors is to examine the change in jobs and output within each of them. This analysis reveals that over the past 15 years Santiago has increased output, employment, and productivity levels in many traded services. Output grew fastest in transport and communications since 2000, 168 percent versus a national expansion of 134 percent. Business services registered one of the fastest employment growth rates, reflecting the growing role of services in Santiago's economy as well as the central role that the region still plays in providing services, such as finance and research and development support to Chile's mining industry.





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Figure 9. Output growth in traded sectors,

"Since 2000, output and employment expanded in all portions of the Santiago Metropolitan Region's tradable economy."

#### A2. GOODS AND SERVICES TRADE

The Santiago Metropolitan Region accounted for 14 percent of national goods exports between 2009 and 2014. Santiago accounts for a relatively low share of national goods exports, given the dominance of other regions in commodities production.<sup>26</sup> Santiago's share is growing, however. Since 2009, the Santiago region's exports grew almost twice as fast as national exports (13 percent versus 6 percent). Three industries-food and beverages, mining, and metals and metallic products-accounted for 65 percent of Santiago's exports in 2014 and 72 percent of export growth since 2009. Mining and metallic products increased from 28 percent of Santiago's exports in 2009 to 42 percent in 2014. At the same time, advanced manufacturing products such as chemicals and electrical and electronic products dropped from 12 percent of Santiago's exports in 2009 to 10 percent in 2014. The dramatic increase in goods exports between 2009 and 2012 partly reflect a bounce back from the decline in exports, especially in metals and mining, induced by sagging global demand in 2008 and 2009. After plummeting 38 percent between 2007 and 2009, the World Bank's Base Metals index increased by 40 percent from 2009 to 2011, which no doubt helped boost Santiago's gross exports during that period.<sup>27</sup> While goods exports in Santiago are growing quickly, this mainly reflects a cyclical phenomenon. Indeed, the decline in metals prices have offered a stark reminder that relying on volatile commodities to power growth is not sustainable, highlighting the need for export diversification.



#### Figure 10. Share of gross exports by products in Santiago Metropolitan Region

Source: Brookings analysis of ProChile Commercial Intelligence data.





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Source: Brookings analysis of fDi Intelligence data.

Europe and Asia are the predominant markets for

Santiago-made goods. Between 2009 and 2014, Europe remained Santiago's largest export market, while Asia displaced South America as the second most important destination for the region's goods. Approximately 35 percent of the region's exports are destined for Europe, followed by Asia (31 percent) and South America (12 percent). Mining and metals dominate trade with Asia and Europe, accounting for 57 and 33 percent of total exports to each market, respectively. Food and beverage manufactured goods are the largest export to South America, accounting for 29 percent of total exports to that market. While the United States, the Netherlands, and Mexico were among the top five markets for Santiago's exports in 2009, by 2014 Switzerland, China, and Japan replaced them in the top five destination countries. Switzerland's unique position stems from intraindustry trade with Chile in the mining industry. Along with South Korea and Brazil, these five countries accounted for 40 percent of total exports.

"The recent decline in metals prices offers a stark reminder that relying on commodities to power growth is not sustainable, highlighting the need for export diversification."





Source: Brookings analysis of Banco Central de Chile data. \*Includes exports and imports for professional services, computer and information services, and royalties and fees.

#### Expanding services exports can be an important growth driver for the Santiago Metropolitan

**Region.** In the absence of region-level data, national trade statistics can uncover Santiago's role in the global exchange of services. In 2014, Chile exported \$10.9 billion in services, 13 percent of its total exports, a much lower share than most peer countries. During that same year, Chile imported \$14.7 billion in services, amounting to a deficit of \$3.6 billion. This deficit has been widening over time. Since 2003, services imports have grown faster (8.9 percent annually) than exports (7.2 percent). Three sectors-transportation, other business services, and travel-account for 87 percent of exports and 72 percent of imports. The transportation sector has grown quickly, in terms of employment and output as well as exports, but that growth was not enough to offset growing transportation services imports. The existing deficit notwithstanding, there are clear opportunities to boost services exports. Chile has notable advantages: macroeconomic soundness, political stability, trade liberalization, and strong intra-regional integration with the rest of South America. The broad "other services" category, which includes business and financial services and intellectual property, drives the services deficit. This deficit masks certain high-growth sectors though. Business services exports, for instance, have grown by 342 percent since 2000; Santiago's specialization in auxiliary business services make it a potential platform for the IT outsourcing (ITO), business

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## Figure 12a. Export of services as Share of Total Exports, 2014



Source: Brookings analysis of United Nations Conference on Trade and Development Data (UNCTAD)

process outsourcing (BPO), and call center subsectors of outsourcing services.<sup>28</sup> The region has begun to attract firms such as Google and McAfee to serve customers in the United States and other countries in auxiliary IT services.<sup>29</sup>

#### A3. FOREIGN DIRECT INVESTMENT

#### The Santiago Metropolitan Region has attracted \$8.7 billion in new greenfield foreign direct investment since 2009, trailing most global peers.

Greenfield investments-the process by which companies open a new establishment in a foreign markethelp reveal the extent to which multinational firms find the Santiago Metropolitan Region an attractive

Figure 13. Total greenfield FDI, 2009-2015,

**USD** million

operational environment versus other global regions. Santiago ranked sixth among global peers in terms of total FDI inflows between 2009 and 2015. These investments created 17,100 new jobs, seventh among global peer cities, which represented 4.1 percent of total new employment generated during that period.<sup>30</sup>



## Figure 14. New employment supported by greenfield FDI, thousand of persons, 2009-2015



Source: Brookings analysis of fDi Intelligence data.

#### Half of Santiago's foreign direct investment is concentrated in technology-intensive industries.

Between 2009 and 2015, 50 percent of new FDI occurred among firms in R&D and STEM-intensive advanced industries-led by communications, software and information technology, and chemicals-the third highest share among global peers.<sup>31</sup> Yet Santiago faces stiff competition, as peer regions such as Nanjing, Rio de Janeiro, and Warsaw have increased FDI in tech-intensive industries at a faster clip between 2009 and 2015 growing annually at 39, 38 and 37 percent, respectively, three times faster than Santiago's 12 percent growth rate.

#### Figure 15. Share of total FDI in tech-intensive sectors, 2009-2015



Source: Brookings analysis of fDi Intelligence data.

**European and North American companies** accounted for 94 percent of all greenfield FDI flows into the Santiago Metropolitan Region. Foreign direct investment sources differ significantly from export destinations. The leading country investor in Santiago is the United States, which accounted for over one-third of total FDI since 2009 (\$3.1 billion), including major investments in the region's communications sector and renewable energy cluster. Emerging markets in South America and Asia are not yet major investors. While 43 percent of the metro region's exports are destined for South America and Asia, they only accounted for 5 percent of total greenfield FDI between 2009 and 2015.

"Total greenfield FDI inflows trail most global peer metro regions, but FDI remains an important source of technology-intensive industrial growth for the Santiago economy."

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#### Total FDI Industry (USD million) Communications\* 3,373 Metals 1,174 Alternative/renewable energy 902 **Financial services** 611 Transportation 599 Software & IT services\* 368 Food & tobacco 332 Warehousing & storage 204 Chemicals\* 187 Paper, printing & packaging 161

Source: Brookings analysis of fDi Intelligence data. \*Advanced industries

Table 3. Greenfield FDI by industry, 2009-2015



#### Map 2. Greenfield FDI into the Santiago Metropolitan Region, USD, 2009-2015

Source: Brookings analysis of National Customs Service data.

Santiago's concentration of large global companies has created a business ecosystem of advanced services such as finance, consulting, law, and marketing that cater to corporate headquarters. In 2012, the Santiago Metropolitan Region contained the headquarters of nine Forbes Global 2000 firms that together have assets of \$153 billion, led by the retail chains Falabella and Cencosud, major conglomerates like AntarChile and Quiñenco, and the industrial giants SQM and CMPC.<sup>32</sup> The density of multinational headquarters reflects Santiago's status as Chile's business hub. These large firms demand a diversity of advanced services such as finance, management consulting, legal services, advertising, and marketing. Among 525 urban areas, Santiago ranks 44th in terms of its centrality in global networks of advanced services firms (e.g. financial services, management consulting, legal services, etc.), fifth highest among global peer regions and fourth highest in Latin America (behind São Paulo, Mexico City, and Buenos Aires).

| City           | Country      | Number of<br>headquarters | Revenue<br>(USD billion) | Profits<br>(USD billion) | Assets<br>(USD billion) |
|----------------|--------------|---------------------------|--------------------------|--------------------------|-------------------------|
| Johannesburg   | South Africa | 14                        | 116                      | 18                       | 410                     |
| Mexico City    | Mexico       | 12                        | 106                      | 15                       | 168                     |
| Santiago       | Chile        | 9                         | 66                       | 5                        | 153                     |
| Istanbul       | Turkey       | 7                         | 89                       | 8                        | 411                     |
| Rio de Janeiro | Brazil       | 7                         | 246                      | 43                       | 598                     |
| Warsaw         | Poland       | 4                         | 27                       | 4                        | 99                      |
| Ankara         | Turkey       | 3                         | 16                       | 3                        | 107                     |
| Nanjing        | China        | 3                         | 14                       | 1                        | 57                      |
| Hangzhou       | China        | 1                         | 1                        | 0                        | 4                       |

#### Table 4. Global 2000 corporate headquarters, 2012 or most recent data available

Source: Brookings analysis of GaWC data. Note: Hangzhou data is as of 2009

**BOTTOM LINE:** With a relatively small domestic market, trade and investment must be a critical component of Santiago's long-term economic strategy. To that end, it is encouraging that output and employment in traded sectors have grown at a faster clip than the national economy and many global peer regions. Exports have also posted superior growth rates to the national economy, led by the region's mining and food and beverage sectors. However, several macro trends indicate that the mining sector will not be the economic engine going forward that it was in the past decade, indicating the need for diversification into new tradable industries. Santiago's status as the business services and transportation hub of Chile make those sectors compelling opportunities to boost exports. Yet, the national services trade deficit has steadily increased over the past decade. A burgeoning business services sector, led by IT and business processing outsourcing, can serve as the catalyst to boost both exports and FDI, as firms open facilities in Santiago to sell services abroad. While the opportunity is there, the Santiago regional economy has not yet been able to diversify its exports basket to capitalize on these industries. To do so requires addressing other elements driving regional competitiveness, including innovation, infrastructure, and human capital.



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#### **B. INNOVATION**

WHY IT MATTERS: A region's innovative capacity and levels of entrepreneurship both have implications for its ability to develop and deploy commercial applications, start new businesses, and maintain industrial competitiveness in the face of disruptive technological change.<sup>33</sup> Innovation takes many forms and can be hard to measure, especially innovations that improve processes, management techniques, or that occur in the informal economy. Yet, the most productive and technologically-advanced metropolitan economies in the world tend to combine a common set of institutions and assets into a rich, collaborative innovation ecosystem that can commercialize research and development into new products and services for the market.<sup>34</sup>

The Santiago Metropolitan Region contains nearly half of Chile's research and development activity, but is comparatively less R&D-intensive than other parts of the world.<sup>35</sup> Research and development (R&D) is an important measure of the resources invested in the discovery and commercialization of new products, processes, and technologies.<sup>36</sup> In 2012, the Santiago Metropolitan Region accounted for 47 percent of total research and development expenditures in Chile, reflecting its strong concentration of innovative industries, research universities, and corporate headquarters. Recent efforts to decentralize research and development investment to other parts of Chile have lowered the region's share of R&D from 53 percent in 2009. Industry accounted for the largest share of the region's R&D (47 percent), followed by universities and other institutions of higher education (28 percent), and the private/NGO sector (15 percent).<sup>37</sup> Despite its preponderance in absolute terms, the region is less R&D-intensive than emerging market competitors. In 2011, R&D expenditures in Santiago amounted to 0.27 percent of GDP, trailing Asian and European peers like Nanjing, Hangzhou, and Warsaw, which allocated 2.2, 1.9 and 1.4 percent of GDP to R&D, respectively.<sup>38</sup>

The Santiago Metropolitan Region houses internationally relevant research universities and demonstrates significantly higher research impact than peer regions. Research universities play a major role in driving innovation by providing basic research that underlies scientific discovery and understanding, facilitating the translation of research results into consumable goods and services, and attracting and supporting the growth of other research-intensive industries.<sup>39</sup> To measure the scientific performance of universities, the Centre for Science and Technology Studies (CWTS) and Leiden University has compiled metrics for 750 major universities worldwide. This index ranks two universities in the Santiago Metropolitan Region, the University of Chile and Pontificia Universidad Católica de Chile (Pontifical Catholic University of Chile), within the top 750 research universities. The Santiago region ranks second among peer regions, only behind Johannesburg, in overall scientific impact as measured by its share of published papers among the top 10 percent most cited publications.<sup>40</sup> Santiago's research universities rank fourth in the share of scientific publications developed in conjunction with industry, a key indicator that illustrates the degree of collaboration between the private sector and universities to spur innovation.<sup>41</sup>

#### Figure 16. Share of total publications in top 10 percent most cited papers in all fields, 2010-2013



Source: Brookings analysis of Centre for Science and Technology Studies (CWTS) and Leiden University data.

## Figure 17. Share of total publications done with industry, 2010-2013



Source: Brookings analysis of Centre for Science and Technology Studies (CWTS) and Leiden University data.

#### The Santiago Metropolitan Region generates almost three-quarters of Chile's patents, but lags most global peer regions in patenting intensity.

Patents provide a reliable and comparable, if imperfect, measure of new inventions that spur economic development.<sup>42</sup> As with research and development, the Santiago Metropolitan Region demonstrates an outsized contribution to patenting activity within Chile, accounting for 73 percent of patents between 2008 and 2012. While clearly the innovation hub of Chile, the regional economy's ability to generate new commercial inventions lags when compared to most of its global peers, exceeding only Rio de Janeiro, Mexico City, and Johannesburg in the number of patents generated per 10,000 workers between 2008 and 2012.

More than three-quarters of the Santiago Metropolitan Region's patents belong to three major families of technology: advanced manufacturing (40 percent), life sciences (28 percent), and energy and infrastructure (13 percent). Within those sectors, five sub-groups of technologies-organic fine chemistry, biotechnology, chemical engineering, metals and metallurgy, and coating technology-account for 35 percent of Santiago's total patents. The industries in which Santiago has a comparative advantage such as mining, food and beverages processing, and

## Figure 18. Share of national patents, 2008-2012



Source: Brookings analysis of OECD REGPAT data.

## Figure 19. Patents per 10,000 workers, 2008-2012



Source: Brookings analysis of OECD REGPAT data.

winemaking tend to demand applied research in these fields. The high concentration in these technologies reveals two conclusions. First, technological advancement in these legacy sectors can still propel the regional economy up the value chain in areas of comparative advantage. Second, there is still a need to diversify the technology base as Santiago continues its industrial transition.

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#### Patent linkages in the Santiago Metropolitan Region

ne of the core drivers of economic growth is a metropolitan area's capacity to develop new technologies and trade them on the global market. An important measure of research and development impact is the number of patents filed under the Patent Cooperation Treaty (PCT), which Chile signed in June 2009. PCT patents offer protection to organizations doing business in any of the 148 signatory countries, and is especially useful for global technology commercialization.

There are several benefits associated with joint research: These patents have more claims, more backward citations, list more technology subclasses, and display more original technology combinations.<sup>43</sup>

Santiago's universities are major patent producers. Between 2008 and 2014 they accounted for almost half of all the patents produced in the Santiago Metropolitan Region. However, the large majority of these patents were created without external collaboration. For example, the Universidad de Santiago de Chile, the leading patenting institution in Santiago, developed 97 percent of their patents with researchers from the same university. The lack of collaboration with other institutions, particularly the private sector, may explain why one previous study found that universities are not a significant source of research that can lead to commericalization in the private sector.<sup>44</sup> The mining and engineering sector is one particularly patent-intensive industry. Increased collaboration with local industrial partners in Chile's mining and engineering sector (e.g. New Tech Copper S.A., Weir Minerals Australia, and Vulco S.A., etc.) may help to stimulate technology transfer and enhance the impact of university research on the local economy.

Another opportunity facing Santiago's universities is fostering more international collaborations. Over 96 percent of co-inventors participating in university patents live in Chile. Since 2008 these patents featured only 13 foreign co-inventors with four from the Universitat de Barcelona, one from the Centre National de la Recherche Scientifique in Paris, and another from the Consejo Superior de Investigaciones Cientificas in Madrid. In Santiago the most internationally collaborative organizations are often foreign multinationals such as Nestec S.A. from Switzerland, BASF SE from Germany, and Cytec Corp from Philadelphia. Given the notable positive spillovers from international collaborations on R&D, regional universities could explore more opportunities to expand their R&D networks in order to raise the profile of local universities and establish new partnerships that would benefit the region.





#### Source: Brookings analysis of OECD REGPAT data

#### $\rightarrow$ Sidebar continued on page 26.

#### $\rightarrow$ Sidebar continued from page 25.

| Rank | Organization                                | Primary<br>technology       | Primary research<br>location | No. of pat-<br>ents involv-<br>ing Santiago<br>inventors | No. of<br>inven-<br>tors on<br>patents | Percent of<br>inventors<br>residing in<br>Chile |
|------|---|-----------------------------|------------------------------|--|--|---|
| 1    | Universidad de<br>Santiago de Chile         | Organic fine<br>chemistry   | Santiago (Chile)             | 28   | 92                                     | 99%   |
| 2    | Pontificia Universidad<br>Catolica de Chile | Organic fine<br>chemistry   | Santiago (Chile)             | 26   | 61                                     | 96%   |
| 3    | Universidad de Chile                        | Biotechnology               | Santiago (Chile)             | 22   | 53                                     | 100%  |
| 4    | Nestec S.A.                                 | Food chemistry              | Vaud (Switzerland)           | 9  | 21                                     | 19%   |
| 5    | BASF SE                                     | Organic fine<br>chemistry   | Rheinpfalz (Germany)         | 8  | 15                                     | 33%   |
| 6    | New Tech Copper S.A.                        | Surface technology          | Santiago (Chile)             | 7  | 10                                     | 100%  |
| 7    | Weir Minerals<br>Australia                  | Engines, pumps,<br>turbines | Sydney (Australia)           | 7  | 6                                      | 100%  |
| 8    | Vulco S.A.                                  | Chemical<br>engineering     | Santiago (Chile)             | 7  | 5                                      | 100%  |
| 9    | Sika Tech                                   | Macromolecular<br>polymers  | Zug (Switzerland)            | 5  | 8                                      | 63%   |
| 10   | Hatch Associates                            | Chemical<br>engineering     | Perth (Australia)            | 4  | 15                                     | 20%   |

#### Table 5. Top patenting organizations, Santiago Metropolitan Region, 2008-2014

## "While clearly the innovation hub of Chile, the regional economy's ability to generate new commercial inventions lags when compared to most of its global peers."

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Santiago ranks third among peer regions in venture capital investment per capita, receiving more than \$150 million since 2005 (about \$21 per person).

Venture capital (VC) provides funds for innovative enterprises positioned for high growth and the potential to create and capture entire new markets.<sup>45</sup> Firms that receive venture capital can be particularly important stimulants to regional economies; VC recipients are three to four times more patent-intensive than other firms, and are much more likely to translate their R&D activities into high-growth ventures.<sup>46</sup> Compared to its peers, Santiago ranks third in venture capital per capita, trailing only Hangzhou and Nanjing (but by a wide margin). Three industries concentrate more than three quarters of all venture capital: retail services (43 percent), software (27 percent), and other financial services (12 percent). Over 85 percent of venture capital investments come from outside Chile, revealing strong connections to global sources of venture capital, but a relatively nascent local venture capital market.





Source: Brookings analysis of Pitchbook data.





Source: Brookings analysis of Pitchbook data.

**BOTTOM LINE:** Santiago concentrates the vast majority of Chile's innovation investments, institutions, and outputs. The region's research universities are important assets for knowledge creation and have the potential to accelerate technology transfer, but could collaborate more with the private sector to better align university research with the industrial demands of the region, and reach beyond Chile's border to collaborate internationally with other universities and firms. The intensity of new commercial inventions in the region lags most global peers, indicating that Santiago's commercialization abilities are not yet on par with Asian and European metro areas. However, venture capital markets do find Santiago start-ups an attractive proposition. Compared to international peers, the Santiago Metropolitan Region attracts a significant amount of venture capital given its size.

#### C. TALENT

WHY IT MATTERS: Human capital-the stock of knowledge, skills, expertise, and capacities embedded in the labor force-is of critical importance to enhancing productivity, raising incomes, and driving economic growth.<sup>47</sup> Producing, attracting, and retaining educated workers; creating jobs for those workers; and connecting those workers to employment through efficient labor markets all matter for regional competitiveness and ensuring broad-based economic opportunity for a metropolitan area's population.<sup>48</sup>

The Santiago metropolitan population is becoming more educated, but still trails its European peers in tertiary educational attainment. A well-educated workforce is a key requirement to reduce inequality, increase social mobility, raise productivity, and to transition toward a higher value-added economy.<sup>49</sup> As compared to other emerging market metro areas, Santiago has a high share of its population with a college degree. A quarter of the population aged 15 to 65 has a university education, which places Santiago only behind European peers like Warsaw (39 percent), Ankara (34 percent), and Istanbul (26 percent). Despite the impressive progress that Santiago and Chile have made over the past 20 years in increasing access to higher education, important challenges remain.<sup>50</sup> Low-income students have historically had limited access to college. Part of this stems from the high cost of education in Chile, which recent reforms that provide tuition-free college to low-income students aim to address. But part of it also arises from the fact that some students are not adequately prepared by the primary and secondary education system for entry into university. High-quality higher education can be a route to greater social mobility for Chileans at the lower end of the income distribution, but only if those students participate in a curriculum that is designed to provide the skills demanded in the labor market, and have access to the financial means to thrive. New research suggests that, depending on the types of qualifications students obtained, a university degree did not guarantee an increase in lifetime earnings that recouped the up-front tuition investment.<sup>51</sup> These findings do not diminish higher

BROOKINGS METROPOLITAN POLICY PROGRAM Figure 23. Share of population above 15 years old with tertiary education, 2014 or most recent data available



Source: Brookings analysis of data from Oxford Economics. Note: Hangzhou and Nanjing data are from 2009 and measures share of population aged 6 years old and over; Ankara, Istanbul and Warsaw data are from 2013 measures share of population 15+ years old that is economically active; Rio de Janeiro data is from 2010 and measures the 10+ years old population; and Mexico City data are from 2010. All other data measure the population aged above 15 years old and are from 2014.

education as a means for upward mobility and higher worker productivity, but rather caution against generic claims that more education automatically translates into greater prosperity.<sup>52</sup>

Santiago's current demographic profile may portend workforce challenges in the coming decades. The Santiago Metropolitan Region has historically attracted migrants from Chile's rural areas, which spurred population growth at rates above 2 percent in the 1980s and the beginning of the 1990s.<sup>53</sup> However, two positive trends–increased incomes and higher female workforce participation– have lowered fertility rates.<sup>54</sup> As a result, the current rate of population growth is barely sufficient to replace the people leaving the workforce. Workforce shortages could lower the potential growth of the metro region. If Santiago wants to sustain and increase its workforce, additional efforts to attract new families and migrants are required.

Figure 24. Workforce replacement rate coverage in 2034\*



Source: Brookings analysis of Oxford Economics data. \*Note: Replacement rate cover is the ratio of workforce supply (population below 25 years old) to workforce demand (population above 45 years old). Comparable data for Nanjing and Hangzhou are not available.

Successfully integrating immigrants can increase the supply of workers and contribute to long-term economic growth. Santiago's foreign-born population currently accounts for about 4 percent of its total populace, trailing only Johannesburg. Chile has a long tradition of immigration, particularly over the last half-century.<sup>55</sup> Over the past decade, Chile has seen an increase in migration, particularly from South American countries, which currently account for 59 percent of the total migrant population.<sup>56</sup> Despite the increase in the number of migrants, the current migratory policy does not favor labor mobility and does little to promote the political and social integration of migrants.<sup>57</sup> Successfully integrating this population has the potential to boost economic growth by filling middle and low-skilled workers that are scarce in industries such as retail and construction.<sup>58</sup> In the global competition for talent, Santiago has established a better quality of life offer than its global peers. Mercer's Quality of Living Survey uses qualitative responses to measure urban quality of life based on 10 categories (consumer goods, economic environment, housing, medical and health considerations, natural environment, political and social environment, public services and transport, recreation, schools and education, and socio-cultural environment). Among 230 cities, Santiago ranked 93rd, second highest among its peers and only behind Warsaw.

## Figure 25. Foreign-born share of total population, 2011 or most recent data available



Source: Brookings analysis of Oxford Economics data.

#### Figure 26. Rank in Mercer Quality of Living Survey 2015 (out of 230 cities)



Source: Mercer Quality of Living Survey

**BOTTOM LINE:** Santiago has a relatively well-educated workforce, ranking in the upper tier of its peers. However barriers to higher education persist, perpetuating inequalities. Providing more young people access to quality education can achieve the twin goals of boosting social mobility and increasing labor productivity. Specifically, extending additional support to students with scarce resources, standardizing the qualifications and certifications process, and establishing a greater emphasis in technical skills that are in short supply in the labor market should be a focus. Additionally, effectively integrating the foreign-born population into Santiago's labor market and social life can guarantee a steady supply of workers to maintain growth. Santiago's relatively high quality of living offer can serve as an attractive asset in drawing international talent.

"Santiago's demographics portend potential workforce shortages. Global talent can be an important boost to the local labor supply, for which Santiago's relatively high quality of life will be an important attractor."

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#### D. INFRASTRUCTURE

WHY IT MATTERS: Infrastructure and the spatial layout of a metropolitan area matter for competitiveness in two ways. First, firms rely upon global access, both physically through ports, airports, and logistics systems and digitally through the Internet, to bring their products and services to markets outside the region at low cost.<sup>59</sup> Second, the competitiveness of a regional economy also hinges on its ability to connect its people and physical assets to their best use within the region through a spatially efficient alignment of local land use, transportation, and housing policies.<sup>60</sup>

The Santiago Metropolitan Region relies upon a national transportation and logistics system that lags most global peer countries. Metropolitan areas rely on the exchange of goods to allow for economic specialization and, ultimately, long-term growth and prosperity. Freight transportation networks are critical to forge these economic connections.<sup>61</sup> Given its landlocked position, firms in the Santiago Metropolitan Region must rely upon Chile's national logistics infrastructure to trade goods with the global marketplace. According to the World Bank's Logistics Performance Index, Chile's transportation and logistics systems are relatively well-developed globally, ranking 42nd out of 160 countries, but rank only fifth among global peer countries in 2014.62 The index, which surveys logistics professionals and business executives, rates Chile higher on the efficiency of customs, and lower on the ease in which firms can arrange international shipments. At the same time, however, it costs less to ship a container from Santiago (\$910) than in most its global peer city-regions.63

#### Table 6. Logistics Performance Index Rank, 2014 Rank Country China 28 Turkey 30 Poland 31 South Africa 34 Chile 42 Mexico 50 Brazil 65 Source: World Bank Logistics Performance Index

#### Figure 27. Cost to export, real USD per container, 2014



Source: World Bank Logistics Performance Index and World Bank Doing Business data.

The Santiago Metropolitan Region is not yet a prominent global aviation hub, but serves as Chile's clear connection point to the rest of the world. In addition to goods, metropolitan economies must efficiently move people. Airports serve as key exchange points in the domestic and international flow of people and ideas, and in doing so help stimulate regional employment and GDP per capita growth.<sup>64</sup> In 2014, 16.2 million passengers moved through Santiago's major international airport, a much lower total than most global peer regions.<sup>65</sup> Just under half (48 percent) of these passengers are traveling within Chile, led by routes to Calama (1.7 million), Antofagasta (1.6 million), and Iquique (880,000). Of the remaining passengers, South America is by far the Santiago Metropolitan Region's largest international market (53 percent of total international passengers), followed by North America (26 percent), Europe (16 percent), and Asia (2.5 percent). Origin-destination flows are highest with the following countries (metropolitan destinations with more than 100,000 passengers included): Brazil (São Paulo, Rio de Janeiro), United States (Miami, New York, and Los Angeles), Argentina (Buenos Aires), Colombia (Bogota), Peru (Lima), and Spain (Madrid).



The Santiago Metropolitan Region's passenger growth over the last decade has been robust, falling in the middle of global peers, and demonstrating its growing international connectivity. Passenger flows have grown by 11 percent per year since 2004. This impressive growth places Santiago in the middle of its peer group, lagging very high-growth metro areas in China and Turkey but exceeding Latin American, European, and African city-regions. Among routes with more than 20,000 passengers in 2014, flows have grown fastest with Colombia (26 percent per year), Dominican Republic (24 percent), South Korea (17 percent), Peru (14 percent), Cuba (13 percent), and China (12 percent).

Santiago Metropolitan Region nearly quintupled in just six years, from 3.3 megabits per second in 2009 to 15.5 megabits per second in 2015.<sup>67</sup> Yet, as of 2015, the region fell within the middle of its peer group in terms of the average download speed. Nationally, only about 4 percent of total broadband subscriptions had access to high-speed fiber connections, well below the OECD average of 17 percent.<sup>68</sup> National broadband policies seem to really matter in improving access and performance. For instance, Nanjing and Hangzhou's rapid growth occurred as the Chinese State Council rolled out its national "Broadband China" plan.69

Figure 30. Internet download speed, mbps, 2015



Source: Brookings analysis of Sabre data.

Average broadband speeds in the Santiago

Metropolitan Region have improved significantly

since 2009, but digital connectivity still falls in

the middle of global peers. Mobile technologies

and the Internet have revolutionized communica-

tion across the globe. Today, consistent and quality

broadband access is increasingly a prerequisite for

students, workers, and firms to tap the knowledge

available online in ways that spur regional economic

development.<sup>66</sup> One common way to measure broadband quality is the speed at which it transfers data

through the network. By this metric, the average

download speeds reported by Internet users in the





0 2009 2010 2011 2012 2013 2014 2015

Source: Brookings analysis of Ookla data.

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#### While broadband adoption rates in Santiago are among the highest in Chile, they trail most OECD

countries. In 2012, half of households in the Santiago Metropolitan Region had access to broadband Internet in their homes, below metro peers such as Warsaw (75 percent), Istanbul (63 percent) Ankara (55 percent), and Mexico City (53 percent), but well ahead of the national rate of 36 percent.<sup>70</sup> Nationally, Chile ranked second to last among OECD countries in the share of households with broadband access, just ahead of Mexico.<sup>71</sup> A significant determinant of access is affordability. Among 34 OECD countries, Chile has the fourth highest fixed broadband price per megabit per second of advertised speed, suggesting that the relatively high price of Internet may be slowing adoption rates within the Santiago Metropolitan Region.<sup>72</sup>

Figure 32. Share of Households with Broadband

Access, 2012

Warsaw 75% stanbul 63% Ankara 55% Mexico City 53% Santiago 50%



Santiago's housing supply has increased amid rising demand due to population growth and increases in disposable income, but rising home prices call for increased housing construction to enable future growth. Housing supply matters for broader economic growth and competitiveness because firms cannot expand if potential workers cannot find adequate and affordable housing.<sup>73</sup> Santiago added about 1 million residents between 2000 and 2014, a 16 percent increase. The metropolitan area's housing stock has grown vigorously, 26 percent between the

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#### Figure 33. House Price Index, Santiago Metropolitan Region and Districts, 2002-2014



2002 and 2011, both absorbing population growth and gradually reducing the housing deficit.<sup>74</sup> However, even with these increases in the metropolitan region's housing supply, Santiago's home price index has grown by nearly two-thirds since 2002. Increased housing construction, especially in the region's most transit-connected and centralized communities, can help alleviate these demand pressures while maintaining spatially efficient land use patterns.

Santiago's growth is also placing pressure on the regional transportation system. Santiago's motor vehicle stock has grown much faster (99 percent between 2001 and 2014) than population (16 percent between 2000 and 2014), reflecting the regions' increased incomes. More cars on the road have led to increased congestion and travel times (while also contributing to air pollution); average car speeds dropped 15 percent between 2001 and 2012.75 Traffic congestion is, in some ways, an indicator of prosperity because it reflects the success of the economy: More people moving through the regional economy traveling for work, school, and leisure.<sup>76</sup> However, there are clear economic and environmental costs of congestion as well, and moving residents through the region-whether to work, school, or to socializeremains a clear focus of the region's policymakers.<sup>77</sup> Since 2000, Santiago has built a modern network of expressways, 25 kilometers of bus rapid transit lines,

and 60 kilometers of subway lines (the region plans to expand the subway system by an additional 41 percent by 2018).<sup>78</sup> The city of Santiago has 14.1 km of rail and bus rapid transit per 1 million residents, fourth highest among its global peers. While households will inevitably keep demanding cars as they see their income grow, the region needs to encourage alternative transportation modes to help alleviate congestion. To this end, TranSantiago, Santiago's transit provider, has slowly improved but still must address bus quality, reduce passenger fare evasion, and increase overall commute speeds. Worryingly, average commuting times on public transportation increased from 45 minutes in 2001 to 57.4 minutes in 2012.<sup>79</sup> Aligning land use, housing, and transportation investments can help reduce these average commute times.



Nanjing 2.7

Source: ITDP Rapid Transit Database





Source: CEP analysis of data from the 2001 and 2012 Santiago Origin-Destination Survey.

**BOTTOM LINE:** The Santiago Metropolitan Region contains most of the country's international access points. The Comodoro Arturo Merino Benítez International Airport, while not moving the same volume of passengers as airports in peer regions, is Chile's clear connection to the rest of the world. Freight and logistics infrastructure in Chile lags most peer countries, but firms in the Santiago Metropolitan Region benefit from relatively low exporting costs. Digital connectivity-as measured by Internet download speeds-fall in the middle of global peers but adoption rates could stand improvement, likely through lowering the cost of Internet access. Within the region, continued population and income growth continues to increase demand for housing and transportation. Santiago needs new investments in both, but equally important is the coordination between housing, transportation, and land use decisions along key corridors and nodes to improve the region's spatial efficiency.

#### E. GOVERNANCE

WHY IT MATTERS: Broadway and Shah  $\square$ define governance as "the formulation and execution of collective action at the local level."80 Therefore, we consider governance to include formal government structure as well as the quality and capacity of public, private, and civic institutions to positively influence competitiveness.<sup>81</sup> Governance matters for competitiveness because proactive government, public, and civic groups can marshal investment from a wide variety of domestic and international sources to enable new growth strategies. Central, regional, and municipal governments also have unique and complementary roles to play in enabling firms and their wider regions to succeed in global markets.82

Municipal and regional governments in Chile, including the Santiago Metropolitan Region, account for a relatively low share of government expenditures and revenues. The OECD provides several useful metrics of sub-national fiscal power, including the share of sub-national government expenditures and the share of sub-national tax collections. In 2013, only 13 percent of total government spending in Chile was undertaken by sub-national governments (including central government transfers

Figure 36. Sub-national share of total government expenditures and revenues, 2013



Source: Brookings analysis of OECD data.

BROOKINGS METROPOLITAN POLICY PROGRAM and subsidies), much lower than the 29 percent average across the OECD's 25 unitary countries. Fiscal autonomy is also relatively low. Sub-national governments in OECD unitary countries account for approximately 20 percent of public tax revenues; in Chile that same figure is 7 percent.<sup>83</sup> This lack of fiscal autonomy not only limits the ability of municipal and regional governments to carry out critical functions, it also reduces the responsibility of local authorities in the eyes of city residents, as these officers are less accountable in contexts where they lack resources and decisionmaking powers.<sup>84</sup>

The Santiago Metropolitan Region has relatively low levels of territorial fragmentation, but aligning local, regional, and central government functions remains a challenge and formal interaction with private and civic leaders on economic development could be improved. Horizontal fragmentation refers to multiple governments within one broader regional economy.<sup>85</sup> The OECD uses territorial fragmentation-the number of local governments in comparison to the total population of the metropolitan area-as a proxy for horizontal fragmentation. By this metric, Santiago has relatively low levels of territorial fragmentation. The metropolitan area has 0.7 local governments per 100,000 inhabitants, well below the OECD median of 2.3 governments per 100,000 inhabitants. This government structure and coordination matters for competitiveness; the OECD finds that, all else equal, more fragmented metropolitan economies are less productive.<sup>86</sup> Earlier studies by the OECD reveal, however, that the Santiago Metropolitan Region should better integrate land use, transportation, and housing policy among municipalities and between localities and the central government.<sup>87</sup> Part of this lack of coordination stems from the relative lack of power bestowed upon the intendente's (regional administrator) office. Making the intendente an elected office (as it will be in the next cycle), rather than a presidential appointee will strengthen this office, but only as long as relevant decisions are in fact delegated to this level of government with sufficient resources. A stronger intendente could also solidify a singular public sector presence with which the private and civic sectors can interact. Interviews with public, private, and civic leaders revealed that

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there could be more collaboration between government actors and their business and civic counterparts on competitiveness issues such as export promotion, entrepreneurship, joint research and development, job training, and infrastructure finance and delivery. Local organizations like the Santiago Chamber of Commerce and national agencies like CORFO are well positioned to solidify these types of partnerships. The Santiago Metropolitan Region's business and regulatory environment compares favorably to other cities. Firms often cite the "business environment" as a determining factor in where they locate operations.<sup>88</sup> This environment is based partly on factors outside the remit of local or regional officials (e.g. property rights, national taxes, quality of financial markets, distance to export markets, etc.) as well as those squarely within their control (e.g. local tax rates, permitting processes, other regulatory structures, corruption, etc.). The World Bank's Doing Business project, which collects measures of the business environment, assembles its analysis from the perspective of a firm located in the largest city in the country. In this way, it actually provides a window into the business environment of Santiago, as well as several other global peer cities. Chile performs well overall (41 of 189 countries) in terms of the overall ease of doing business, behind Poland and Mexico but ahead of South Africa, Turkey, China, and Brazil. Firms in Santiago find it relatively easy to start a business, obtain construction permits, get electricity, pay taxes, and trade internationally. Aspects of the legal environ-

ment, particularly enforcing contracts and resolving

insolvency, are Chile's major weaknesses.89

"Making the intendente an elected position will strengthen metropolitan governance, but only as long as relevant decisions are in fact delegated to this level of government with sufficient resources."



**BOTTOM LINE:** The Santiago Metropolitan Region operates from a good position in terms of business and regulatory environment relative to global peer countries, reflecting Chile's legacy of pursuing free trade, macroeconomic soundness, and regulatory transparency. Where the region lags is in its overall autonomy to determine its economic future. Chile remains a very centralized country. New calls for enhanced sub-national autonomy and flexibility could position the country's metropolitan regions more centrally in issues of economic competitiveness. As debates unfold about the proper distribution of powers and responsibilities between central and regional governments, it is important to remember that economic development is increasingly a shared enterprise between government, the private sector, and educational and civic institutions.

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#### IV. IMPLICATIONS AND OPPORTUNITIES

#### A. TRADE:

Consolidate the Santiago Metropolitan Region as one of South America's leading global business capitals by boosting services trade.

For decades, Chile has embraced trade as a means to economic advancement, executing more than 20 free trade agreements with over 60 countries and becoming one of the world's leading exporters of raw materials like copper and agricultural products. Its participation in the Trans-Pacific Partnership, which it signed in early 2016 along with 12 other countries and is awaiting approval by the Chilean Congress, creates new opportunities for trade and investmentled growth. Chile's integration into global markets is all the more impressive when you consider that it is a relatively small country (17 million) physically situated on the global periphery. While the Santiago Metropolitan Region has not historically been the main export hub for Chile, accounting for only 14 percent of Chile's goods exports in 2014, this analysis reveals that Santiago's goods exports have expanded at double the rate of Chile's as a whole since 2009, led by mining, food and beverages, and metallic products.

Notwithstanding the recent growth of goods exports, it is in tradable services where the region has a unique opportunity to gain a new foothold in the global marketplace. Santiago boasts a strong agglomeration of corporate headquarters, business services providers, and financial institutions that provide a mix of financial, accounting, marketing, and IT services. The existence of a sophisticated network of business services can facilitate the establishment of multinational companies in Santiago, firms that inject capital in the region and consume services produced locally. Santiago enjoys a business environment that embraces trade, political stability, relatively low levels of corruption, and a high quality of life relative to other Latin American peer cities. All these elements offer a strong set of incentives for foreign companies interested in establishing a presence in South America, and should be marketed by national trade and investment promotion agencies like ProChile and the Foreign Investment Committee. As Chilean officials consider their integrated business services package, Mexico's unique shelter model represents one model for providing supportive services to foreign companies entering the domestic market (see sidebar).

#### Mexico bets on an innovative model of supportive services for foreign firms

A special services to start and run a company without the expenditure required to develop operations on the ground (e.g. legal services, tax and payroll, administrative services, and human resources recruiting and management, etc.).<sup>90</sup> As the inflow of foreign firms grew, including higher value-added manufacturers, shelter firms also evolved and specialized into higher added services such as information technology, communications, legal and human resources. As a result, a cluster of competitive firms offering business services to foreign firms was born.

While the shelter model was primarily led by the private sector, public officials at the federal and state level are actively promoting the diversification of the shelter model to business processing outsourcing, with the creation of call centers and data centers. As a report by the Boston Consulting Groups states, countries and firms from developing nations are looking for new ways to find niche specializations.<sup>91</sup> Mexico's shelter model is one example of a country offering tailored, competitive and internationally oriented services to foreign firms.

In addition to breaking into new sectors, Santiago can also serve as a knowledge center that adds value to the industries in which Chile already enjoys comparative advantage, such as mineral extraction, agriculture, and engineering services for the mining and energy industry. Joint research conducted by firms and universities can spur new technologies and services that are demanded by nearby resource extraction economies such as Bolivia, Colombia, and Peru three of the main markets for Chile's services exports.<sup>92</sup> Other business services offer an additional avenue to boost exports in the region. The high concentration of corporate headquarters, a relatively well-educated workforce, and a nascent BPO and IT services cluster can position Santiago as a business services hub for South America.

#### **B. INNOVATION:**

Improve the region's innovation ecosystem by incentivizing scientific collaboration between universities and the private sector.

This report found that the Santiago Metropolitan Region has many of the characteristics required to bolster growth through the increased commercialization of new technologies and processes. Innovation has long been considered a critical element for the success of the Chilean economy. The creation of CORFO in 1939 is a testament to the emphasis placed on innovation in Chile's industrial development process. Notwithstanding these efforts, this report reveals that much more is required to bolster Santiago's innovation ecosystem.

The Santiago Metropolitan Region remains the central hub for advancing national goals on technological innovation. Major research universities and a large share of national R&D expenditure position Santiago with the necessary ingredients to produce basic and applied research. Yet currently these assets are not being translated into new technologies. Santiago trails most of its global peers in its patenting intensity. Both basic and applied research tends to occur in isolation by universities and private firms. Our research found that only 3 percent of research papers produced in collaboration with industrial partners, a rate that places Santiago in the middle of its peer group but low relative to the rest of the world. Furthermore, less than one in five university patents involve collaboration with other institutions. Research done in collaboration with industry is more likely to be commercialized.<sup>93</sup>

A recent debate in Chilean innovation policy involves decentralizing public resources away from the Santiago Metropolitan Region to other parts of the country. While there is undoubtedly a need to expand expenditures and R&D activities in other parts of Chile, Santiago represents Chile's most significant concentration of firms, research institutes and universities, and government and private investment required for new ideas and processes to flourish on the level of its European and Asian peer regions. The nascent software cluster, bolstered by initiatives such as Startup Chile, could benefit from increased support and more resources. Given its comparatively small size when compared to other Latin American peers such as Buenos Aires and Mexico City, diffusing resources too widely risks diluting their impact and losing the benefits of agglomeration in key industry clusters.

In this effort, more alignment of the core competencies of the research ecosystem with the industrial structure of the region needs to occur.94 Priorities for expenditure ought to be based on industrial advantages, and executed in a way that incentivizes collaboration across government, universities, and the private sector. Government can help spur joint research and development by incentivizing universityfirm collaboration when issuing funding. At the same time, industry can better utilize university researchers, who are producing significant amounts of scientific research according to this analysis, through grants and consulting contracts. Santiago is home to the firms and research universities that together can help cultivate the next wave of technology-led growth, but this requires better blending the distinctive cultures of industry and academia.95 While many regions try to leap forward and generate innovation in

BROOKINGS METROPOLITAN POLICY PROGRAM disruptive industries, Germany offers lessons on using local institutions to develop an innovation ecosystem that produces knowledge for both legacy and new industrial sectors.

## Lessons from the German innovation ecosystem

Germany's innovation ecosystem thrives via a dense network of research institutions producing basic and applied research, intermediary organizations that channel and incentivize research relevant for local economies, and by the existence of coordinated strategies and incentives to spur innovation both at the federal and state level.<sup>96</sup>

The innovation process starts with universities and other research institutions. These actors align their research agendas with the priorities of local industries, or in technology priorities defined by both regional and federal institutions.<sup>97</sup> Another key component of the innovation ecosystem is institutions of applied research such as the Fraunhofer Society, with a network of 67 institutes spread across Germany. Fraunhofer creates the necessary applied research to translate basic research into new products and technologies. Its institutes also play a critical role in incentivizing public-private collaboration, by leading joint research efforts between firms, its own researchers and universities. Other intermediary organizations, such as industrial chambers and business associations, ensure that the research produced by the other actors aligns with the needs of their constituent members. Finally, national and regional institutions provide research that incentivizes collaboration between different institutions and that contribute to the development of technologies in legacy and emerging economic clusters.

#### C. TALENT:

Ensure a future quality workforce by expanding access to education and embracing and integrating new in-migrants into the labor market.

This report found that Santiago has a relatively welleducated population, and offers two considerations to improve the quality of its workforce. First, Santiago should continue to invest heavily in basic and secondary education, particularly for students from disadvantaged backgrounds. This approach recognizes that a broad base of the population must have the foundational skills required to pursue higher education and training and, eventually, gainful employment. Second, reducing the costs of higher education and aligning educational programs with the needs of employers can reduce unemployment and generate the specialized human capital that industries need to thrive. The recent university reform to offer free tuition lowincome students is a step in this direction.<sup>98</sup>

Santiago will also face labor supply challenges as its fertility rate declines. Integrating new migrants, both from the rest of Chile and internationally, can help maintain labor supply. Among global peers, Santiago ranks second, only behind Johannesburg, in the share of its population born abroad. The region needs to pursue a dual strategy to attract and integrate both low-skill and high-skill migrants. Low-skill immigrants continue to flock to Santiago in search of economic opportunity. This wave requires institutional reforms to ensure integration, including providing them with training and education opportunities that match these new workers to industries that demand their skill set. In addition to an immigrant-friendly national immigration policy, regional leaders should focus on maintaining Santiago's advantage as a livable Latin American city. As international metro areas compete with each other for top talent, maintaining a vibrant and densely populated urban center is one the best strategies to attract top talent, the principal ingredient of an advanced economy.

#### D. INFRASTRUCTURE:

Increase investments in Santiago's housing and transportation infrastructure to maintain the region's quality of life offer amid further population and economic growth.

As local households become wealthier and further demand higher living standards and greater mobility, Santiago must invest in its housing stock and transportation infrastructure.

In this context, and while the city's public transit system (TranSantiago) falters in the midst of its unpopularity and increasing requirements for government subsidies, Santiago will have to consider both more stringent regulation of private transportation and new investments to improve the public transit system. Given the good experience with the paid expressway system, which already extensively uses a free-flow tolling mechanism, authorities should seriously consider following London and Stockholm in the implementation of congestion charges as a way to reduce traffic in critical spots during peak hours. Both London and Stockholm have implemented successful systems that have managed to reduce the volume of commuters entering restricted areas, using the revenues to invest in public transit.<sup>99</sup> Complementary measures such as reducing parking spots in streets, increasing parking fees, and eliminating parking requirements for new buildings in central areas would both improve traffic flows and disincentivize car use by internalizing the costs of congestion.

Santiago's growing pains also reflect themselves in the increasing opposition of communities toward new housing investments that may have very localized costs (either during construction or in the long run). A specific example of this is the rising pressure from local communities to limit densities and building heights or, consequently, to block any amendment proposed to increase them. Constricting new housing development limits supply, further inflates home prices, and lessens affordability regionwide. Similar situations occur when attempting to develop infrastructure projects with acknowledged metro-wide benefits but that have local costs that residents (and

BROOKINGS METROPOLITAN POLICY PROGRAM therefore local authorities) will not tolerate. The negotiation of mitigations has often led to unaffordable budgets and delays, which affects the degree at which the city keeps up with its infrastructure requirements. New investments in transit will be a critical tool in addressing the increases in average public transit commute times in the 2000s.

In many ways, the challenges that the Santiago Metropolitan Region faces around infrastructure are a result of its success. Households and businesses continue to find the region an attractive place to live and work. However, without new investment Santiago's growth could overwhelm the region's existing infrastructure. Moreover, beyond simply reacting to the demand for greater investments, a well-coordinated transportation, housing, and land use regime can proactively support the clustering of firms in neighborhoods that are accessible to the region's workforce. In this way, infrastructure planning becomes a platform for increased industrial competitiveness.

#### E. GOVERNANCE:

Strengthen metropolitan governance to better align regional policies and investments around housing, transportation, land use, and economic development.

The Santiago Metropolitan Region encompasses 52 municipalities and the city's continuous urban extension covers 34 to 40 municipalities depending on the criteria employed. Coordinating the urban planning decisionmaking process is as crucial as it is difficult, especially when decision scopes overlap and incentives are misaligned.

Santiago's need to keep up with demand for more and better infrastructure and manage the inexorable growth of its housing stock poses a relevant public policy challenge in this context. Currently, three different central government ministries determine Public Works, Transportation and Housing policies. Local authorities (including mayors) define specific zoning regulations independently from each other within the broad framework defined in the metropolitan zoning plan.

In this context, Santiago would benefit from redefining the institutional framework to formalize metropolitan governments. In the case of the Santiago Metropolitan Region where the central city includes more than 90 percent of the region's population, the most natural way to pursue this is by strengthening the roles and responsibilities of the intendente position (regional administrator). However, this path may not necessarily be appropriate for other metropolitan areas in the country (current and future) that are part of much broader regions. Whatever arrangement is decided, it would necessarily imply local governments (municipalities) conveying certain prerogatives up to the metropolitan level, while the central government would outline general policy requirements and leave certain definitions and investment decisions to metropolitan authorities. As in the case of London recently, this kind of reform takes time to mature and even longer to enact, but some modification in this direction seems necessary in the attempt to better coordinate initiatives and to integrate different policies in the urban planning decision making process.

The main thrust behind devolution of power to the regional scale is that integrating sectoral views is easier when issues relate to specific territories and actual problems. Therefore, in the context of urban policies and investments, a responsible and well-designed decentralization process is not only the goal, but also a means to achieve better cities by better sequencing transportation investments with a regional land use strategy and denser housing development. Given current levels of fragmentation and the limited fiscal and budgeting powers of Chilean metropolitan areas, strengthening regional governments seems like a reasonable first step.

Governance improvements can also occur beyond the public sphere, especially increased engagement from the private and civic sector in economic development. The Santiago Chamber of Commerce is a local business group that engages in public policy issues. Central ministries such as CORFO have regionally focused programs that convene crosssector advisory groups. But there is no formal subnational economic-focused organization or business leadership group that convenes stakeholders from the public, private, and civic sectors committed to public-private collaboration around issues of trade, investment attraction, and global competitiveness. Increasingly, more city-regions are establishing these types of organizations. For instance, Rio de Janeiro created Brazil's first public-private international promotion agency, Rio Negócios, in 2010 (see sidebar).

#### Rio de Janeiro: Public-private partnerships to boost foreign direct investment

Despite the recent economic slowdown in Brazil, Rio de Janeiro has attracted over \$17 billion in new greenfield foreign direct investment since 2009. Several factors account for this investment boom-new energy discoveries, large infrastructure investments to prepare for the 2012 World Cup and 2016 Summer Olympics, and the city's rapid growth during the 2000s. To steward these investments, Rio's leadership developed a comprehensive city-level business promotion strategy. In a country with a famously complex set of rules and regulations governing foreign entrants, and notoriously strained relations between cities and states, Rio Mayor Eduardo Paes established a joint public-private business development agency, Rio Negócios.<sup>100</sup> The agency partners with state-level promotion agencies, markets the city internationally, incentivizes foreign direct investment, and streamlines red tape for incoming firms. Founded in 2010, Rio Negócios is modeled after the widely heralded Think London, London's investment promotion arm, even hiring Think London's former chief executive to head Rio Negócios' international business development efforts. Rio Negócios claims a role in attracting \$3 billion worth of new investment projects in its first two years, including from multinationals like GE, Siemens, and L'Oreal.<sup>101</sup>



#### V. CONCLUSION

hile's engagement with the global marketplace-through its exportled growth model, commitment to free and fair trade, and growing immigrant base-has fueled three decades of economic success. The Santiago Metropolitan Region has been at the heart of these developments, emerging as Chile's dominant regional economy and most internationally relevant city. Now, as the latest cycle of commodities-fueled growth wanes, reinforcing again the need to pursue industrial diversification, Chile has embraced a path toward a more productive, technology-intensive economy that competes in global markets based on knowledge rather than raw materials. To accomplish this vision, local leaders can build on Santiago's sound quality of life, upgrade regional governance, and boost collaboration between public, private, and academic stakeholders to sustain another three decades of prosperous growth.

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#### METHODOLOGICAL APPENDIX

#### **Selection of Peers**

Global peer cities were selected based on economic characteristics and competitiveness factors. Classifying and identifying peers allows policymakers and stakeholders to better understand the position of their economies in a globalized context as well as to conduct constructive benchmarking.

To select peers we utilized a combination of principal components analysis (PCA), k-means clustering, and agglomerative hierarchical clustering.<sup>1</sup> These commonly used data science techniques allowed us to group metro areas with their closest peers given a set of economic and competitiveness indicators. For this report we selected 14 economic variables: population, nominal GDP, real GDP per capita, productivity (defined as output per worker), total employment, share of the population in the labor force, and industry share of total GDP (8 sectors).<sup>2</sup> We included seven additional variables that measure one of the four quantitative dimensions of the competitiveness analysis framework used in this report. The variables included are: share of the population with tertiary education (talent), stock of Greenfield foreign direct investment (FDI) (trade), number of international passengers in 2014 (infrastructure), number of highly cited papers between 2010 and 2013 (innovation), mean citation score between 2010 and 2013 (innovation), and average internet download speed in 2014 (infrastructure).

Our analysis proceeded in three steps. First, we applied PCA to reduce the number of dimensions of our data by filtering variables that are highly interrelated while retaining as much variance as possible. PCA generates "components" by applying a linear transformation to all the variables.<sup>3</sup> To successfully perform our clustering algorithm we selected the number of components that explain 80 to 90 percent of the variance of a dataset. For this report we selected the first seven components, which accounted for 84 percent of the total variation of the data.

The second stage applied a k-means algorithm to the seven components, a process which calculates the distance of every observation in our dataset to each other, then generates a cluster centroid and assigns each data point to the closest cluster.<sup>4</sup> K-means repeats this procedure until a local solution is found. This algorithm provides a good segmentation of our data and under most circumstances it is a sufficient method for partitioning data.<sup>5</sup> However k-means sometimes generates clusters with multiple observations, thus obscuring some of the closest economic relationships between metro areas. To improve the results of k-means we implemented a third step, hierarchical clustering, which follows a similar approach to k-means. Hierarchical clustering calculates Euclidean distances to all other observations, but generates a more granular clustering that permits clearer peer-to-peer comparison.

#### Key variables

#### Table 1. Main indicators used in the report

| Dimension               | Indicator  | Source  |  |  |
|-------------------------|--|---|--|--|
|                         | Gross Domestic Product   | Oxford Economics, Moody's Analytics                               |  |  |
|                         | Employment   | Oxford Economics, Moody's Analytics                               |  |  |
| Economic<br>Performance | Gross Domestic Product per capita                                      | Oxford Economics, Moody's Analytics,<br>U.S. Census Bureau        |  |  |
|                         | Output per worker  | Oxford Economics, Moody's Analytics                               |  |  |
|                         | GINI coefficient   | OECD and National Statistical Offices                             |  |  |
|                         | Traded sector output   | Oxford Economics, Moody's Analytics                               |  |  |
|                         | Traded sector employment   | Oxford Economics, Moody's Analytics                               |  |  |
| Trade                   | Exports and imports  | National Statistics Institute and Cent<br>Bank of Chile           |  |  |
|                         | Greenfield foreign direct investment                                   | fDi Intelligence data   |  |  |
|                         | Global 2000 corporate headquarters                                     | GaWC data   |  |  |
|                         | Share of total publications in top 10 percent cited papers             | Centre for Science and Technology<br>Studies (CWTS) and           |  |  |
| Innovation              | Share of total publications done with industry                         | Leiden University data  |  |  |
| movation                | Patent output per 1,000 inhabitants                                    | REGPAT  |  |  |
|                         | Venture Capital Investments, millions of dollars per 1,000 inhabitants | Pitchbook   |  |  |
| Tolont                  | Share of Population 15+ with Tertiary Education                        | Oxford Economics, U.S. Census Bureau                              |  |  |
| laient                  | Foreign-Born Share of Total Population                                 | Unemployment rate   |  |  |
|                         | Total Aviation Passengers  | SABRE   |  |  |
| Infrastructure          | Average Download Speed   | Net Index   |  |  |
|                         | Km of Rapid Transit Infrastructure                                     | The Institute for Transportation and<br>Development Policy (ITDP) |  |  |

#### DATA SOURCES

#### **Oxford Economics:**

Economic indicators as well as selected indicators corresponding to talent for non-U.S. metropolitan areas were provided by Oxford Economics (OE). Economic variable such as GDP, Gross Value Added (GVA), employment, unemployment rates, educational attainment, and industry-level employment and output were collected by OE from national statistics bureaus in each country or from providers such as Haver, ISI Emerging Markets, and Eurostat. Population estimates and the share of the foreign-born population were based on official population projections produced by national statistical agencies and or organizations such as Eurostat, adjusting migration assumptions on a case-by case basis. The study uses gross value added (GVA) and Gross Domestic Product (GDP) in nominal terms at purchasing power parity rates, and in real terms at 2009 prices and expressed in U.S. dollars. All the indicators were provided at the metropolitan level.

#### Moody's Analytics:

Economic indicators for U.S. metro areas were provided by Moody's Analytics. Moody's uses data published by the Bureau of Labor Statistics (BLS) and by the Bureau of Economic Analysis (BEA) to generate their estimates of employment and GDP at the county level. We aggregated those estimates to metropolitan areas using the current Census Bureau definition. For

BROOKINGS METROPOLITAN POLICY PROGRAM real GDP, both total and at the industry level, Moody's provides 2009 chained dollars. For nominal analysis they report their estimates in current dollar.

#### **Census Bureau:**

The indicators for talent for U.S. metro areas come from a variety of surveys published by the U.S. Census Bureau. The population estimates were created using intercensal population estimates at the county level and then aggregating those estimates to the metro level using the current definitions of metropolitan areas. For the foreign-born share of the population and unemployment rates, we utilized American Community Surveys at the county levels and aggregated them at the metropolitan level. The educational attainment variables were obtained through the Integrated Public Use Microdata Series platform (IPUMS) from the Minnesota Population Center. Data was built up from PUMA level microdata on the educational attainment and age of residents. These age intervals were utilized to comport with the international education attainment levels.

For more information, see Steven Ruggles, Katie Genadek, Ronald Goeken, Josiah Grover, and Matthew Sobek. Integrated Public Use Microdata Series: Version 6.0 [Machine-readable database]. Minneapolis: University of Minnesota, 2015.

#### **REGPAT:**

The source of the patents data is the OECD's REGPAT database. The OECD manages this database as part of the Patent Cooperation Treaty, which offers patent protection to organizations and individuals planning to do business in multiple countries. A number of research decisions went into the construction of the patent estimates. Patent locations correspond to the inventor's place of residence or workplace. In cases when there are multiple inventors, the patent was fractionally-counted and apportioned in equal shares to each co-inventor. Patents that fall under multiple International Patent Classification (IPC) technology codes were also apportioned in equal shares to each technology class in order to account for the cross-cutting nature of technological development. To mitigate year-to-year fluctuations in invention activity, patents were summed in five-year intervals. The time dimensions represents the "priority year" when the patent was first filed. This year is closest to the actual date of invention and is the most relevant reference date when assessing an areas technological activity at a specific point in time. Since patent filing is a costly and administratively burdensome process the analysis excludes patents submitted in 2013 and 2014 since patents filed in these years only account for a portion of patents actually invented and may bias places and organizations with better systems for shortening lag time between the date of invention and the application year.

For more information see Maraut, Stephane. Helene Dernis, Colin Webb, Vincenzo Spiezia, and Dominique Guellec. 2008. "The OECD REGPAT Database: A Presentation." June 3, 2008.

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#### http://www.oecd.org/sti/inno/40794372.pdf

#### Leiden:

The source of the university scientific impact data is the Centre for Science and Technology Studies (CWTS) at Leiden University. This publically available database tracks bibliometric performance data for 750 universities with the largest publication output in internationally recognized journals. The database relies on the Thomson Reuters Web of Science citations indices which researchers cleansed, geocoded, and classified into fields of study. CWTS reports publications based on full-counting methods which gives equal weight to all publications from a university and fractionally-counting methods which apportion shares to each collaborator. Brookings' analysts focused on fully-counted publications and aggregated the raw university-level citations data into metro-level estimates (see geocoding section below). Mean citation scores were aggregated based on the metro average weighted according to university-level publication count. Brookings analysis primarily focused on two measures. First, the mean normalized citation score is the average number of citations of the publications of a university, normalized for field differences and publication year. A value of two for instance means

that the publications of a university have been cited twice above world average. Second, the percent of publication in the top ten percent most cited is the proportion of the publications of a university that, compared with other publications in the same field and in the same year, belong to the top ten percent most frequently cited.

For more information see Waltman, L., Calero-Medina, C., Kosten, J., Noyons, E.C.M., Tijssen, R.J.W., Van Eck, N.J., Van Leeuwen, T.N., Van Raan, A.F.J., Visser, M.S., & Wouters, P. (2012). The Leiden Ranking 2011/2012: Data collection, indicators, and interpretation. Journal of the American Society for Information Science and Technology, 63(12), 2419-2432. http://www.leidenranking.com/methodology

#### PitchBook:

The source of the venture capital data is PitchBook, a private financial research firm that collects and tracks global private equity activity. Pitchbook analysts deploy web crawlers to perform a daily systematic scan of media reports and public filing information on deals which they then record and validate through a manual review process. In assembling their database they include address level data for both investors and recipient companies, industry, investor details along with the deal value. Brookings' analysts took the data and then assigned the investors and recipients to metropolitan geographies (see geocoding section below). The primary statistic in the analysis is the cumulative stock of venture capital which is the sum total of yearto-year investment flows. Secondary statistics examine the number of investors and companies along with data between different geographies, deal categories, and industries. The advanced industries classification is an approximate grouping based of detailed industry categories matched to Brookings' NAICS-based definition. All value measures were inflation-adjusted to 2014 dollars.

For more information see **PitchBook.com http://blog. pitchbook.com/wp-content/uploads/2014/06/3Q-2014-PE-Breakdown-Methodology.pdf** 

#### Net Index:

The source of the internet download speed data is Ookla's "Net Index" (now rebranded as "Speedtest Intelligence"). Ookla is a web service that offers free internet speed tests to users as part of an internet intelligence business. The coverage is global in scope because the service relies upon user-submitted tests logged through the speedtest.net website that gauges internet speeds. Ookla reports the raw data at the city-level at the daily frequency which Brookings' aggregated into annual metro-level averages weighted according to the number of tests in each city-day record (see geocoding section below). Since the data is crowd-sourced from users it may be susceptible to bias if users disproportionately share characteristics that diverge from the average internet user in their metro area. One reason to trust the data is that it is unlikely that this bias would systematically vary between metro areas so if there is a "slow" or "fast" bias it would likely affect all places equally. In addition, the vast majority of metros display normal distributions and the sample size is quite large with the average largest 100 metro areas by population recording over 30 million tests in 2014.

For more information see Ookla.com https://www. ookla.com/speedtest-intelligence

#### Sabre:

The source of the aviation data is Sabre Aviation Solutions' global demand dataset (GDD). The dataset includes a record for every international itinerary entering and leaving the United States or any large global metro area with economies larger than \$100 billion in 2014. Each record includes the origin and destination airports, plus up to three connecting airports with the number of passengers and total revenue generated from that specific itinerary for that year. The GDD is based on a variety of sources including information developed from direct business relations between Sabre and over 400 global airlines. For international itineraries not reflected in their database, Sabre imputes missing flights and passenger levels based on additional market data. The result is a complete dataset of travel into and out of major global aviation centers. Brookings' performs a number

BROOKINGS METROPOLITAN POLICY PROGRAM of additional value-adds. These include: assigning all airports to global metropolitan areas (see geocoding section below), obtaining latitude and longitude coordinates to derive distance measures, cleansing anomalous records, and aggregating the passenger and revenue flows to better facilitate regional analysis. All value measures were inflation-adjusted to 2014 dollars.

For more information see Tomer, Adie, Robert Puentes, and Zachary Neal. 2012. "Global Gateways: International Aviation in Metropolitan America." Brookings Institution. October 25, 2012.

http://www.brookings.edu/~/media/research/files/ reports/2012/10/25-global-aviation/25-globalaviation.pdf

#### FDI Intelligence:

The source of the Greenfield FDI data is the Financial Time's fDi Markets database. This database tracks all cross-border investment into new physical projects or expansions of an existing investment, otherwise known as "Greenfield" investment. Company announcements form the basis for the database and each submission is manually verified before being published. In cases when the capital investment and job counts are not publicly released, analysts impute the value invested and jobs created using an econometric model. The primary sources of the data are newswires, internal sources, top business journals, industry organizations, investment agencies, and data purchased from private vendors. Brookings' analysts assigned metro areas to the city-level information available in the database and processed the flows between different investor and recipient geographies and industry levels. The preferred metric is the cumulative stock of FDI invested and jobs created over the reference period from 2009 to 2015. All value measures were inflation-adjusted to 2014 dollars.

For more information see fDi Markets.com http:// www.fdimarkets.com/faqs/

#### **Geocoding Process**

An addition layer of data assignment was required for data that was not available at the metropolitan scale. Geographic identifiers were used to process individual data points through the Google Maps Geocoding API to obtain latitude, longitude and other geographic information.<sup>6</sup> Using the latitude and longitude information, we assigned an observation to a metropolitan area using defined geographic boundaries through a geo-intersection.<sup>7</sup> Finally we aggregated observations and created a metropolitan level indicator. We iterated this process several times to ensure data consistency and the adequate allocation of observations to its corresponding geographic boundaries.

#### APPENDIX ENDNOTES

- 1. For an overview of the three methods utilized see Trevor Hastie, Robert Tibshirani, and Jerome Friedman, *The Elements* of Statistical Learning: Data Mining, Inference, and Prediction, Springer: New York, 2011.
- 2. For industry analysis we collected industry-level data and estimates for Real Gross Value Added (GVA). Given the heterogeneity of the industrial classification used among the different metro areas we reclassified all the GVA information into eight major industrial sectors: transportation; utilities; business, financial and professional services; local non market services; construction; trade and tourism; manufacturing; and commodities. To see a complete list of the industries included in these 8 categories see: Parilla and others, *Global Metro Monitor 2014: An uncertain recovery*, Brookings Institution: Washington DC, 2015.
- 3. See I.T. Jolliffe, Principal component Analysis: Second Edition, Springer: New York, 2002.
- 4. Similar approaches to quantify complexity of data have been implemented at the national level, see: Ricardo Hausmann, César A. Hidalgo, Sebastián Bustos, Michele Coscia, Alexander Simoes, and Muhammed A. Yildirim, The atlas of economic complexity : mapping paths to prosperity, MIT press: Boston, 2014.
- 5. Trevor Hastie, Robert Tibshirani, and Jerome Friedman, *The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Springer: New York, 2011*
- For more information on the Google Maps Geocoding API see: https://developers.google.com/maps/documentation/geocoding/ intro
- Wilpen L. Gorr and Kristen S. Kurland, GIS Tutorial 1: Basic Workbook, Esri Press: California, 2013.

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- 1. James Manyika and others, "Global flows in a digital age," (San Francisco: McKinsey Global Institute, 2014).
- James Manyika and others, "Disruptive technologies: Advances that will transform life, business, and the global economy," (San Francisco: McKinsey Global Institute, 2013). Michael Chui, James Manyika, and Mehdi Miremadi, "Four fundamentals of workplace automation," McKinsey Quarterly, November 2015.
- 3. Ibid.
- 4. Ibid.
- 5. Rapid urbanization offers rural households access to higher-paid jobs, better education, and more social services. But urbanization also comes with potential downsides if it overwhelms existing infrastructure, degrades the environment, and heightens social and ethnic tensions. Edward Glaeser, Triumph of the City: How Our Greatest Invention Makes Us Richer, Smarter, Greener, Healthier, and Happier (New York: Penguin Press, 2011). United Nations, "World Urbanization Prospects: 2014 Revision," (2014).
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true value of new information to be realized, assimilated and

commercialized (e.g. sufficient human capital, complementary

between broadband expansion and economic growth, which is

technologies, etc.). Kolko (2010) finds a positive relationship

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BROOKINGS METROPOLITAN POLICY PROGRAM strongest in industries that rely more on information technology and in areas with lower population densities. Finally, a study from Copenhagen Economics indicates that the greatest productivity gains from broadband speed increases occur at lower ends of the speed spectrum. For instance, an increase from 5 to 10 Mbps gives a gain of approximately 1.9 percent while an increase from 25 to 30 Mbps gives a gain of approximately 0.5 percent. Emmanouil Tranos, *The Geography of the Internet: Cities, Regions and Internet Infrastructure in Europe* (Cheltenham: Edward Elgar, 2013). Jed Kolko, "Does Broadband Boost Local Economic Development?" (San Francisco: Public Policy Institute of California, 2010). *Copenhagen Economics*, "The Socio-economic Value of Digital Infrastructures" (2010).

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