

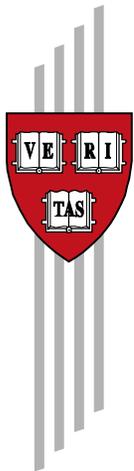
# **New Avenues for Colombia's Internationalization: Trade in Tasks**

Ricardo Hausmann and Sebastian Bustos

CID Faculty Working Paper No. 401

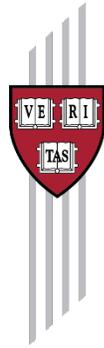
December 2021

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# NEW AVENUES FOR COLOMBIA'S INTERNATIONALIZATION: TRADE IN TASKS

RICARDO HAUSMANN AND SEBASTIAN BUSTOS

The objective of this study was to provide input to the Steering Committee of Colombia's Internationalization Mission (2020-2021), led by Colombia's Vice President Marta Lucía Ramírez and Professor Ricardo Hausmann (Harvard University). Financial support for this work was provided by Ministry of Trade, Industry and Tourism, Pro-Colombia, Colombia Productiva, iNNpulsa Colombia and the IADB. The research was conducted between September 2020 and April 2021.

Questions can be emailed to Sebastián Bustos ([Sebastian\\_Bustos@hks.harvard.edu](mailto:Sebastian_Bustos@hks.harvard.edu)).

## Acknowledgements

Financial support for this work was provided by the Government of Colombia. The work benefited from input and comments by Richard Baldwin, Douglas Barrios, Ana María Castillo, Gabriel Duque, Patricio Goldstein, Ana Grisanti, Juan Sebastian Robledo Botero, Nikita Taniparti, and Sarah Zadova.

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## Executive Summary

One of the consequences of COVID-19 is the recognition that many tasks can be done from home. But anything that can be done remotely, can be done from abroad.

Given large salary differences between white collar workers across countries, it would make sense for value chains to try to exploit them. This opens an opportunity for Colombia to further promote its integration into the world global value chains and access new markets.

This paper explores the possibility of exporting teleworkable services from Colombia. The goal is to provide useful information to guide strategic interventions to speed-up the development of such service industries in Colombia.

We first introduce a definition of teleworkable jobs and describe its occupations and industries along different dimensions. We show that there are many teleworkable jobs in the US, representing a significant share of industry costs. Then, we show that many industries intensive in teleworkable jobs are currently traded across borders. To quantify Colombia's advantage providing teleworkable services, we study the cost structure of industries and quantify the potential savings in overall costs if the tasks were performed by Colombians. Given Colombia's current presence and the density around teleworkable industries we can calculate a proxy of the latent advantage in teleworkable services. We propose an index that summarizes these dimensions and rank the potential gains from including telework from Colombia in an industry. We end with a set of policy recommendations to move this agenda forward.

## 1. The internationalization of Colombia's economy: Motivation and objectives

For Adam Smith, the secret to the wealth of nations was related to the division of labor. As people and firms specialize in different activities, economic efficiency increases. This division of labor, however, is limited by the extent of the market. Until recently most services were rarely traded internationally, a sharp contrast to industries producing goods. Services were synonym of non-tradable activities, and did not enjoy the benefits of an expanded market from trading with consumers and firms across borders. Thus, the deeper division of labor in service industries was limited to the size of local markets. Not surprisingly, investment in human capital and specialization in service industries was not a strong feature observed in developing countries. However, there are reasons to think this may change in the next years.

One of the consequences of COVID-19 was the recognition that many tasks can be done from home. This has given rise to occupation tele-working measures. For instance, Brynjolfsson et al. (2020) report that nearly half of the individuals they surveyed in the US in the first quarter of the pandemic said they were working from home. But anything that can be done remotely, can be done from abroad. Given large salary differences between white collar workers across countries, it would make sense for value chains to try to exploit them. Technological innovations, such as Zoom, Microsoft Teams, Webex and Google Hangouts among others, have been widely adopted, making remote interactions between workers more effective. This opens an opportunity for Colombia and other developing countries to further promote its integration with global value chains and access new markets

Colombia's globalization appears to be well below its potential, which suggests that there is plenty to gain from internationalizing sectors of its economy. Table 1 provides a couple of key indicators that puts Colombia's globalization in perspective, comparing trade intensity measures to a selected list of countries. Columns 1 and 2 show the income per capita (in purchasing parity terms or PPP) and the population. Next, the table shows the exports per capita of goods, services and services excluding travel and transport.<sup>1</sup> All export indicators are low, but Colombia is particularly low in the exports of services excluding transport and travel with US\$44 dollars per capita, only ahead of Mexico and Peru. Since exports as a share of GDP tend to be larger in smaller countries than in larger countries, in the table we provide an additional set of indicators adjusting for population size.<sup>2</sup> When taking into account the adjusted exports per capita we find Colombia ranked as the second country on the list, one of the least globalized countries in the exports of services.

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<sup>1</sup> Exports of travel and transport are different from other exports. Travel services, which is associated mostly to tourism—a large industry in Colombia—it is consumed in the host country with tourists travelling to the exporting country, while exports of transportation services are linked to the shipment of physical goods. We exclude both types of services because these are not susceptible of being produced from Colombia and consumed remotely in a different location.

<sup>2</sup> We can use an extreme example to illustrate the proposed adjustment. While an individual imports most of its consumption using (or exporting) its labor to pay it, there is no trade with other planets. To adjust trade values for the effect of population size, we run a regression of log exports per capita on log population. We use the estimated coefficient to adjust the trade of goods, services and services excluding travel and transport.

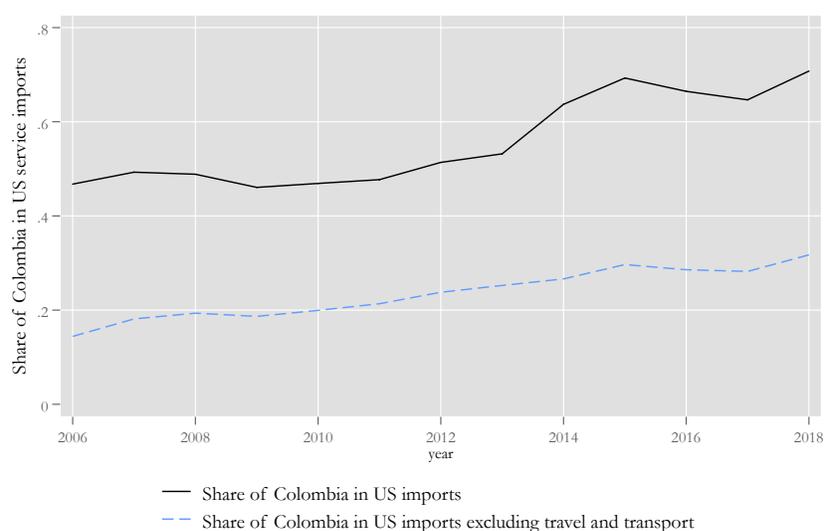
Table 1: Globalization of Colombia in perspective

Country	Income per capita		Exports per capita			Adjusted Exports per capita		
	US\$ (1)	Population Millions (2)	Goods (3)	Services (4)	excl. travel & transp. (5)	Goods (6)	Services (7)	excl. travel & transp. (8)
Peru	13,416	32.5	1,509	217	42	2,394	624	72
<b>Colombia</b>	<b>15,635</b>	<b>50.3</b>	<b>842</b>	<b>198</b>	<b>44</b>	<b>1,350</b>	<b>697</b>	<b>77</b>
Brazil	15,300	211.0	1,070	163	107	1,784	1,106	102
Argentina	23,040	44.9	1,450	315	155	2,319	1,049	117
Mexico	20,582	127.6	3,614	248	32	5,944	1,340	131
Chile	25,155	19.0	3,688	497	203	5,765	1,114	138
India	6,997	1,366.4	242	157	119	425	2,526	184
Philippines	9,302	108.1	495	380	262	810	1,897	190
Dominican Rep.	19,228	10.7	1,045	870	86	1,609	1,502	200
Costa Rica	20,444	5.0	2,303	1,902	1,006	3,475	2,319	339
Malaysia	29,620	31.9	6,457	1,257	483	10,236	3,584	417
Panama	32,851	4.2	3,386	3,281	532	5,087	3,694	553
Israel	42,146	9.1	6,653	6,113	4,799	10,197	9,753	1,328
United States	65,298	328.2	5,034	2,668	1,779	8,492	22,237	1,936
Ireland	88,241	4.9	51,536	50,117	46,994	77,729	60,511	8,881

Note: Calculations using data from the World Development Indicators for year 2019. Countries sorted by adjusted exports per capita excluding travel and transportation (column 8).

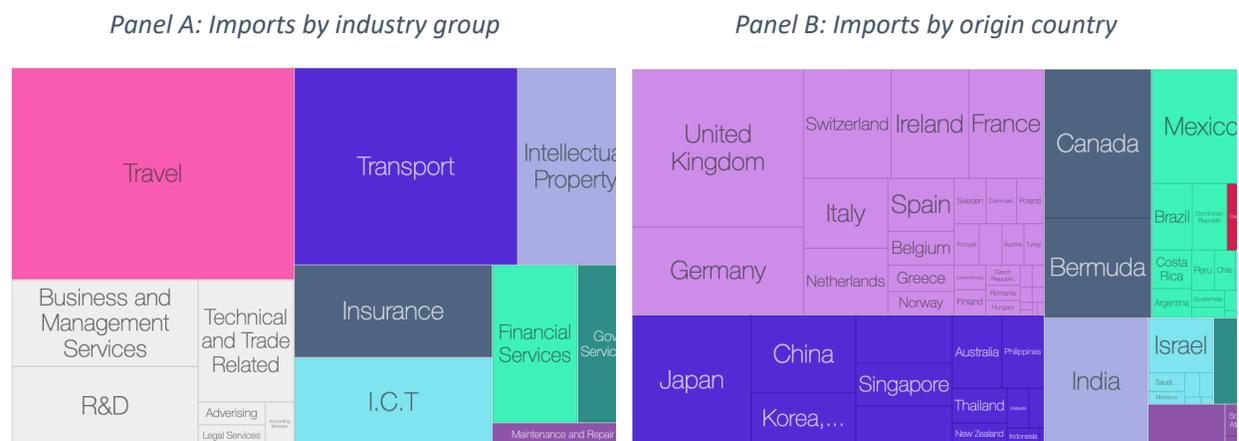
Colombia's export of services has increased over time, but remain small. To analyze the trend and composition of exports we focus on the US, a large importer of services that fortunately provides detailed statistics of its imports of services at the sectoral level. Figure 1 shows the imports of services from Colombia over time, while Figure 2 shows the composition of imports by major sectors and for origin countries for year 2018. While US imports of services from Colombia have been rising steadily for the last 12 years (Figure 1), the country remains a small player (Figure 2, panel B). As shown in panel A of Figure 1, travel and transport are a large component of the US\$ 520 billion US imports of services. Excluding travel and transport, the market US service imports represent US\$ 310 billion. Colombia is a marginal player in both representations of the data.

Figure 1: Share of Colombia in US service imports



Note: Calculations using data from the US Bureau of Economic Analysis.

Figure 2: The US service import market and Colombia's participation



Note: Calculations using data from the US Bureau of Economic Analysis.

Colombia's scant participation in global markets also extends in particular to business services. Rather than a problem, we think that this must be seen as an opportunity. The possibility of tele-workable tasks opens the possibility to trade tasks – export services from Colombia. Geographical distance and terrain ruggedness, often mentioned as problems for the export of Colombian goods, are less relevant for tele-workable services. To seize this opportunity, we need a strategy.

This paper explores the possibility of exporting teleworkable services from Colombia. The goal is to provide useful information to guide strategic interventions to speed-up the development of such service industries in Colombia. We first introduce a definition of teleworkable jobs and describe its occupations and industries along different dimensions. We show that there are many teleworkable jobs in the US, and they represent a significant share of industry costs. Then, we show that many industries intensive in teleworkable jobs are currently traded across borders. To quantify Colombia's advantage providing teleworkable services, we study the cost structure of industries in the US and the potential savings in overall costs if the tasks were performed by Colombians. Given Colombia's current presence and the presence of activities related to teleworkable industries, we can calculate a proxy of the latent advantage in teleworkable services. To summarize this dimension, we propose an index of the potential gains from including telework from Colombia in an industry.

## 2. The opportunity of exporting services

The COVID-19 crisis has forced countries across the world to impose social distancing measures, including costly lockdowns, to arrest the spread of the virus. This raises a number of fundamental questions about the modern economy and the division of labor: How many jobs can be performed at home? What share of total wages are paid to such jobs? How does the scope for working from home vary across industries, and countries?

It also opens an opportunity for developing countries, since tasks that can be performed remotely from home, it can be potentially done from abroad. Given large salary differences between white collar workers across countries, it would make sense for value chains to try to exploit them. Hence, developing countries such as Colombia may benefit from export services, performing tasks used or consumed remotely in other countries.

How do we estimate what are teleworkable jobs? We classify the feasibility of working at home for all occupations and merge this classification with occupational employment counts for the United States. For this, we follow Dingle and Nieman's work and calculate our measure based on responses to two Occupational Information Network (O\*NET) surveys covering work context and generalized work activities. For example, if answers to those surveys reveal that an occupation requires daily "work outdoors" or that "operating vehicles, mechanized devices, or equipment" is very important to that occupation's performance, we determine that the occupation cannot be performed from home.<sup>3</sup> An assumption we make is that those jobs that can be done from home are teleworkable jobs that can be performed remotely from other countries.<sup>4</sup>

What are teleworkable occupations? Figure 3 shows a treemap where rectangles are proportional to the share of occupations in total employment. Occupations at 4 digits are nested in major occupational groups. We have color coded the treemap; in colors we highlight those occupations in which at least two thirds of its jobs are classified as teleworkable. Non-teleworkable occupations are colored with light-gray. Our classification implies that 37 percent of U.S. jobs can plausibly be performed at home.<sup>5</sup>

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<sup>3</sup> In the appendix we explain in detail the construction of the Teleworkable Jobs index, and provide a guide of the questions of the O\*NET surveys used to distinguish jobs that can be done from home.

<sup>4</sup> The classification of Teleworkable jobs is similar to the work of Blinder (2009) that assessed the offshorability of jobs. While our approach is similar, we cannot simply use Blinder's index because the feasibility of working from home is quite distinct from estimating the likelihood of jobs being offshorable. For example, Blinder and Krueger (2013) write, "*we know that all textile manufacturing jobs in the United States are offshorable.*" Textile manufacturing jobs, of course, are not teleworkable since they cannot be performed remotely at home using current production technologies.

<sup>5</sup> Recent research estimates larger shares of potentially teleworkable jobs. Brynjolfsson et al. (2020) report that nearly half of the individuals they surveyed said they were working from home. Bick and Blandin (2020) report that more than 60 percent of their respondents' work hours were performed at home. Though these figures are higher than our estimate, these numbers are not necessarily comparable. First, in the short run, we expect many employees to perform parts of their jobs at home rather than being laid off. Second, those who can work from home may be overrepresented in online surveys.

Figure 3: Teleworkable Jobs



Note: Calculations using data from O\*NET, and US Bureau of Labor Statistics. Occupations are nested by major occupational groups. Teleworkable occupations are highlighted with strong colors, while non-teleworkable occupations are in light-gray.

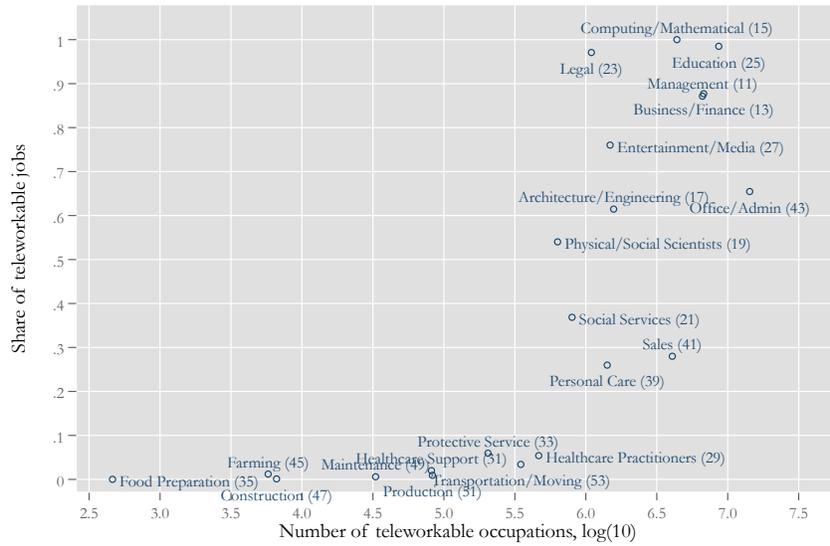
Teleworkable jobs are a large number of the jobs in the US, and tend to earn relatively higher wages. Figure 4 shows the share of teleworkable jobs in each major occupation group against the total number of teleworkable jobs (panel A), and against its median hourly wage (panel B).

As can be seen, there is significant variation of the occupations that can be done remotely. While only a few tasks in “Food Preparation” can be done remotely, and therefore represent a small number of jobs, most of the jobs in “Legal”, “Computing/Mathematical”, or “Education” are classified as potentially teleworkable jobs, as shown in panel A of Figure 4. There is a clear positive relationship between our Teleworkable Jobs measure and the typical hourly earnings at the occupation level. It’s plausible that teleworkable jobs are more biased toward more cognitive tasks. For instance, “Management”, “Legal”, and “Computing/Mathematical” in the top-right corner of panel B, appear as occupation with the higher wages, and that as occupation it contains the larger share of teleworkable jobs.

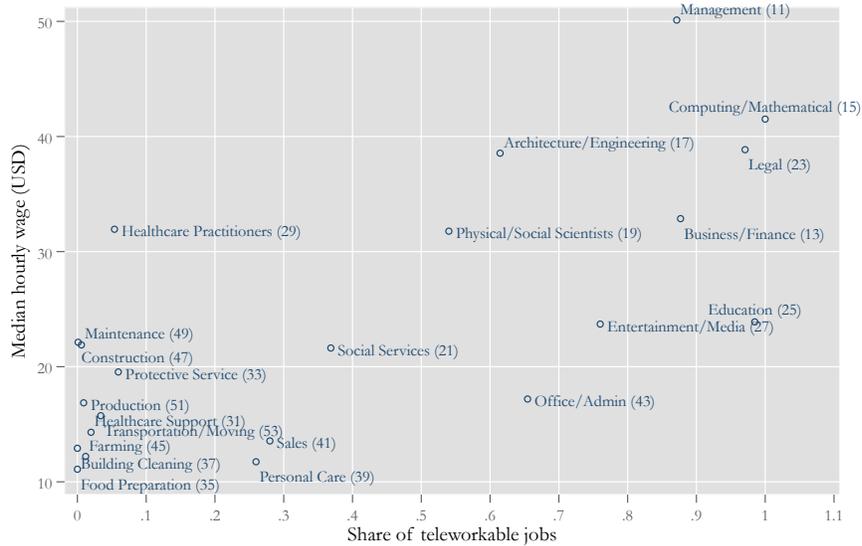
This has two important takeaways for workers in developing countries. First, there is a large number of jobs in the US that are teleworkable and therefore could be performed by workers in developing countries. Most likely, this observation is not restricted to the US but also true for other developed countries such as France, Germany, Japan or the UK. Thus, the potential market for telework and export services is huge. Second, since teleworkable jobs tend to earn relative higher wages in the US, there is potential of large savings by trading tasks from developing countries where white collar workers earn a fraction of the wages in those occupations in the US or in other developed countries.

Figure 4: Teleworkable jobs and its wages by occupation in the US

Panel A: Teleworkable jobs in the US by occupation



Panel B: Teleworkable jobs and wages



Note: Calculations using data from O\*NET, and US Bureau of Labor Statistics. Labels show the occupation major group titles and codes in parenthesis

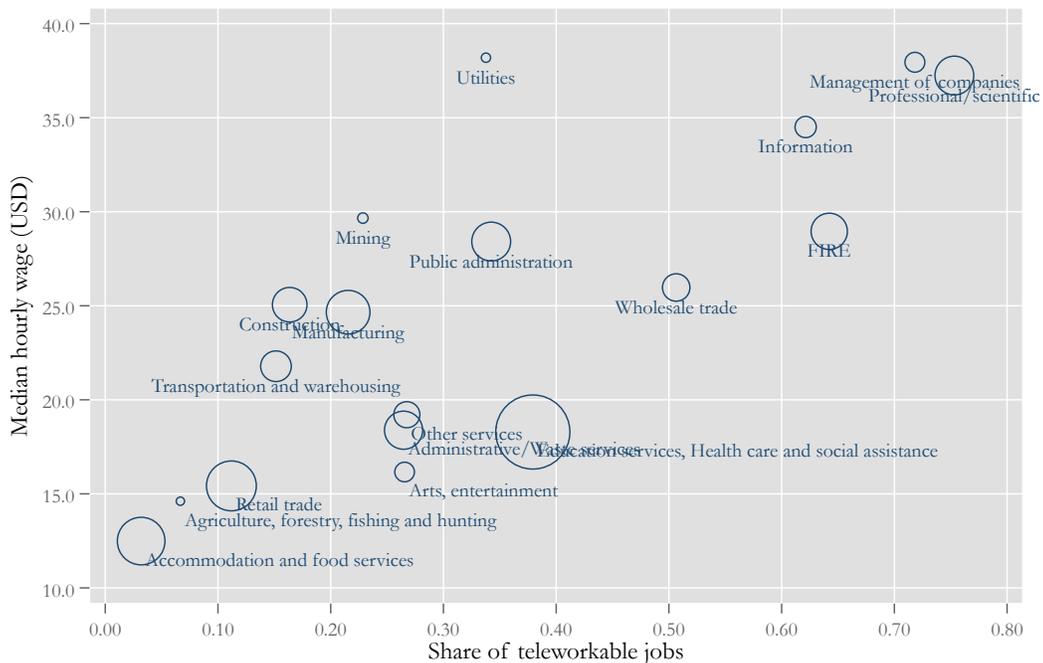
## 2.1 From occupations to industries

Industries employ an array of different occupations. For instance, we can find office clerks or accountants, among other prevalent occupations, present with different intensities in almost every

industry.<sup>6</sup> Thus, to calculate the share of teleworkable jobs in each industry we use the average composition of occupations across industries in years 2016-2018. Calculating the share of teleworkable jobs by industry will be useful when combined with other indicators and statistics –such as national accounts— available at the industry level.

What are the industries with a higher share of teleworkable jobs and what are their wages? Figure 5 plots the share of teleworkable against its median hourly wage.<sup>7</sup> Consistent with our result using occupations, there is a clear positive relationship between the share of teleworkable jobs measure and the typical hourly earnings at the industry level. Accommodation and food services is the industry with the lowest share of teleworkable jobs, and it's also the one with lower earnings, while Professional and Scientific services is the industry with the largest share of teleworkable jobs, and among the higher wages. As mentioned earlier, the combination of teleworkable and high wage makes some industries especially attractive as targets of exports of services, implicitly replacing workers in developed countries with similar workers in developing countries. But what is the incentive of businesses in developed countries? In the next section we explore how important are those teleworkable jobs in the wage bill and total production cost across industries.

Figure 5: Teleworkable jobs and wages across industries



Note: Calculations using data from O\*NET, and US Bureau of Labor Statistics. Nodes are proportional their share in total employment. Labels show the Naics chapter titles.

<sup>6</sup> See Figure A.4 in the appendix that shows an example of how different occupations compose the jobs in selected industries.

<sup>7</sup> Table A.1 in the appendix provides a list (NAICS at 4-digit) with the top 20 teleworkable industries in the US.

### 3. Cost structure and the advantage of developing countries

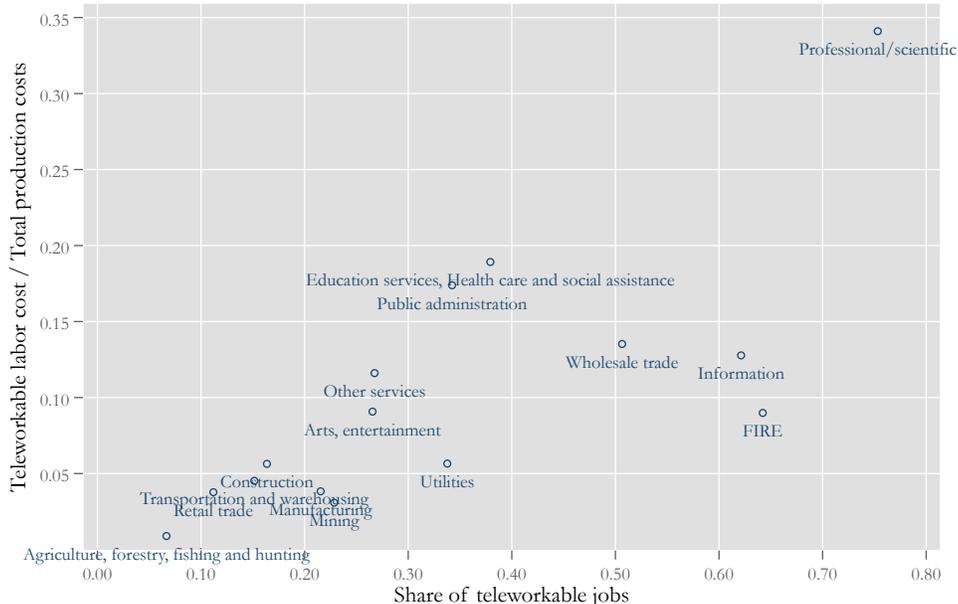
How relevant are teleworkable costs relative to overall production costs? For firms, the potential benefit of replacing tasks performed domestically with tasks imported from abroad is the savings from lower wages and costs. Hence, to target industries and firms that could be attracted to source services from Colombia it is important to know how relevant are the potential savings for each industry.

We calculate the share of teleworkable labor costs in total production costs using the input-output tables for the US. The input-output table is a summary of the production costs of every industry, as well as the interdependencies between different economic industries. Using the estimate of industry teleworkable jobs of the previous sections, we estimate the fraction of the total wage bill accounted for by teleworkable jobs. We then divide this teleworkable-wage bill by the estimate of production costs from the input-output tables for each industry.

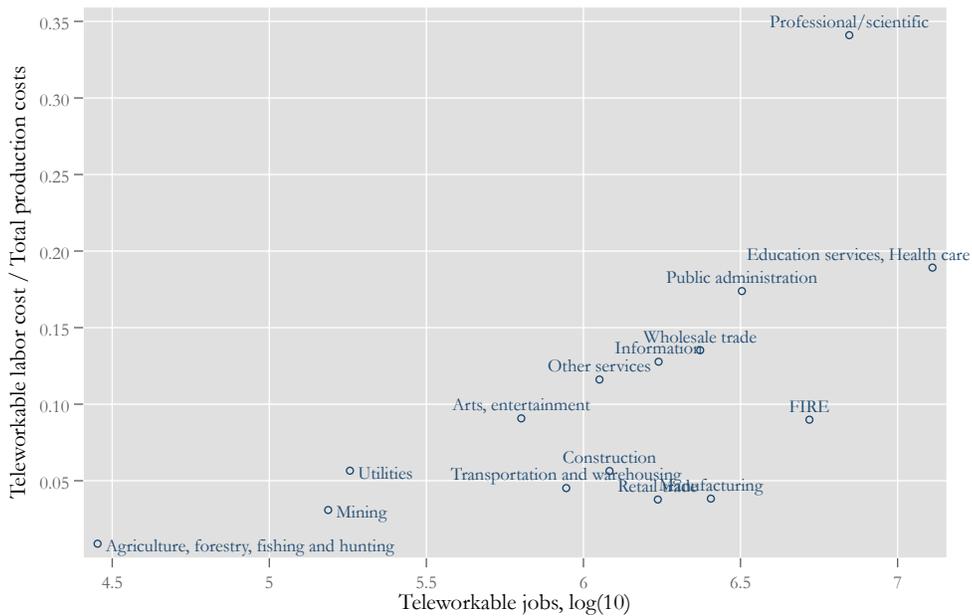
Figure 6 provides a visual description of the relevance of teleworkable jobs in the cost structure of industries in the US. Panel A shows the share of teleworkable costs over total costs against the share of teleworkable jobs, while panel B shows teleworkable costs against the number of teleworkable costs. For instance, “Professional and Scientific services” have on average 34% of their costs coming from teleworkable jobs which account for a large share (approx. 75%) of all the jobs in that industry (panel A), and is the second industry in terms of number of jobs just behind “Education” and “Health care” (panel B).

Figure 6: Teleworkable labor costs in total production costs

Panel A: Share of teleworkable jobs



Panel B: Number of teleworkable jobs, logs



Note: Calculations using data from O\*NET, US Bureau of Labor Statistics, and US Bureau of Economic Analysis.

Overall, we conclude that there are many teleworkable jobs in the US. Moreover, we have shown that they represent a significant share of industry costs. But, can they be traded? We explore the possibility of trading services in the next section.

#### 4. Comparative advantage in trading services

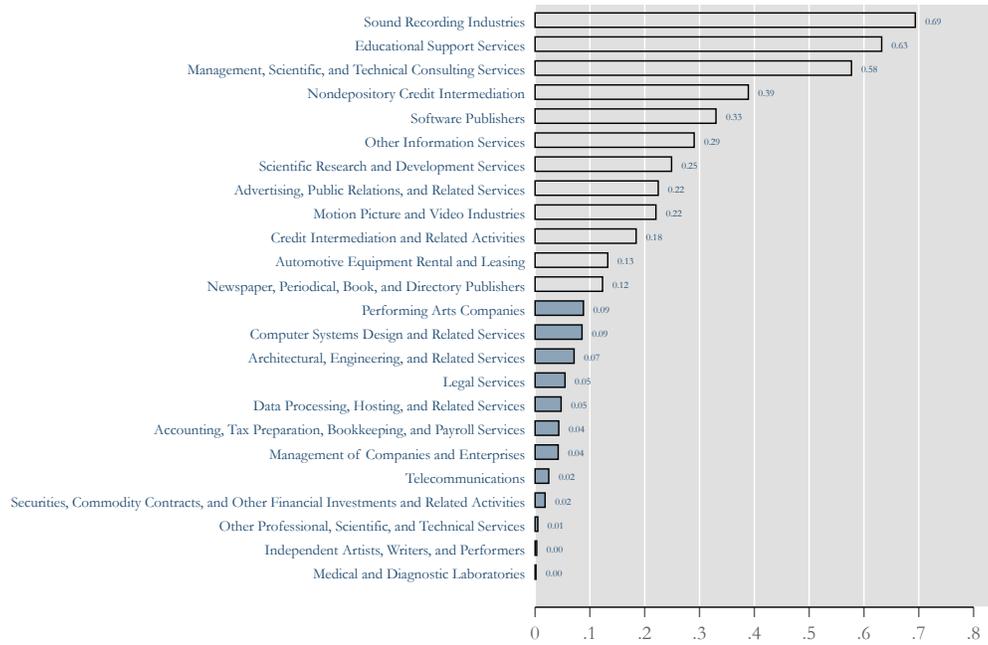
Can services be traded? Some services are traded across borders, and their total value traded has increased in recent decades. Some services have a long tradition of being traded internationally—like finance and insurance—, but others services such as “educational support” or “medical and diagnostic services” have only been traded across borders in recent years. The technical feasibility or the cost differentials are not necessarily proof that services can be traded. For this reason, we turn to the data and look at the intensity of international trade as a revealed measure of tradability.

To calculate an index of services (current) revealed tradability we use US service exports and imports statistics by the US Bureau of Economic Analysis (BEA). Data on bilateral trade in services following a disaggregated industry classification is not often available for many countries. Fortunately, the BEA publishes disaggregated industry statistics, including origin and destination of exports and imports of services. Since we want a proxy of services that could be traded across borders, we compute the total US trade in services (exports and imports) as a share of the total production of those industries in the US. We purposely include exports by the US in the index because it proves that some industries can be traded despite current imports being low. Computing the index only using imports does not qualitatively change our conclusions. It’s important to emphasize that the index must be taken as a measure of current intensity, which may change with the likely increase in trade of services in coming years from countries taking advantage of the arbitrage opportunities discussed in this paper.

Figure 7 shows the list of industries sorted according to the index of revealed tradability. At the top we have “sound recording industries”, with exports and imports representing 69% of total production of

those industries in the US, followed by “educational support services” (63%), and “management, scientific and technical consulting services” (58%). At the bottom of the index, we have “medical and diagnostic laboratories”, a large industry in the US that has recently started to increase the value of exported and imported services.

Figure 7: Revealed tradability



Note: Calculations using data from the US Bureau of Economic Analysis. Revealed tradability is calculated as exports and imports over industry output.

Many industries that are intensive in teleworkable jobs are currently traded across borders. Figure 8 plots the revealed tradability index against our estimate of teleworkable labor cost. Interestingly, this figure shows that some of the industries where telework has the larger share of total costs are among the least traded industries (e.g., “computer systems design and related services”). On the other hand, sound recording industries, the top industry according to the revealed tradability index, has approximately only 10% of its costs stemming from teleworkable jobs. This finding suggests that in many industries in developed countries there is plenty of room to reduce costs by importing tasks produced in developing countries.

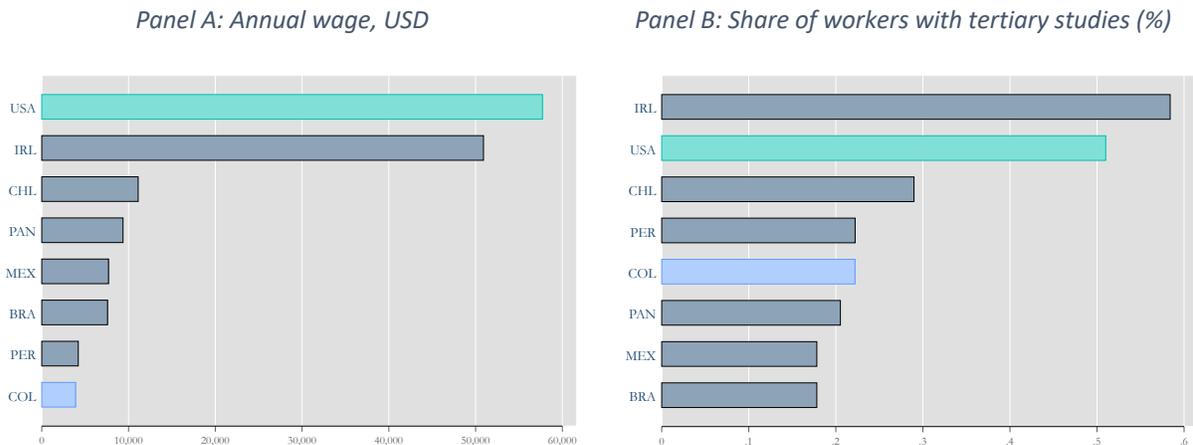
Figure 8: Revealed tradability and the share of teleworkable labor costs



Note: Calculations using data from O\*NET, US Bureau of Labor Statistics, and US Bureau of Economic Analysis.

Colombia’s potential advantages in teleworkable activities stem from wage differentials that are larger than education differentials. As shown above, teleworkable labor costs represent a large share of total costs in many industries, which makes attractive the possibility of importing some of the tasks from countries with relative lower wages. Panel A of Figure 9 compares annual wage income for a selected list of countries. Colombia wage differentials are large vis-à-vis regional comparators and Ireland, with Colombia at the bottom of the list. Interestingly, these wage differentials are mainly a reflection of differentials in education. Panel B of Figure 9 shows the share of workers in each country with tertiary studies. It shows Colombia in the middle of the list, with an intensity of tertiary studies that is not significantly different from that of Panama or Mexico, countries for which we observe significantly larger wages.

Figure 9: Colombia’s wage differentials are larger than education differentials

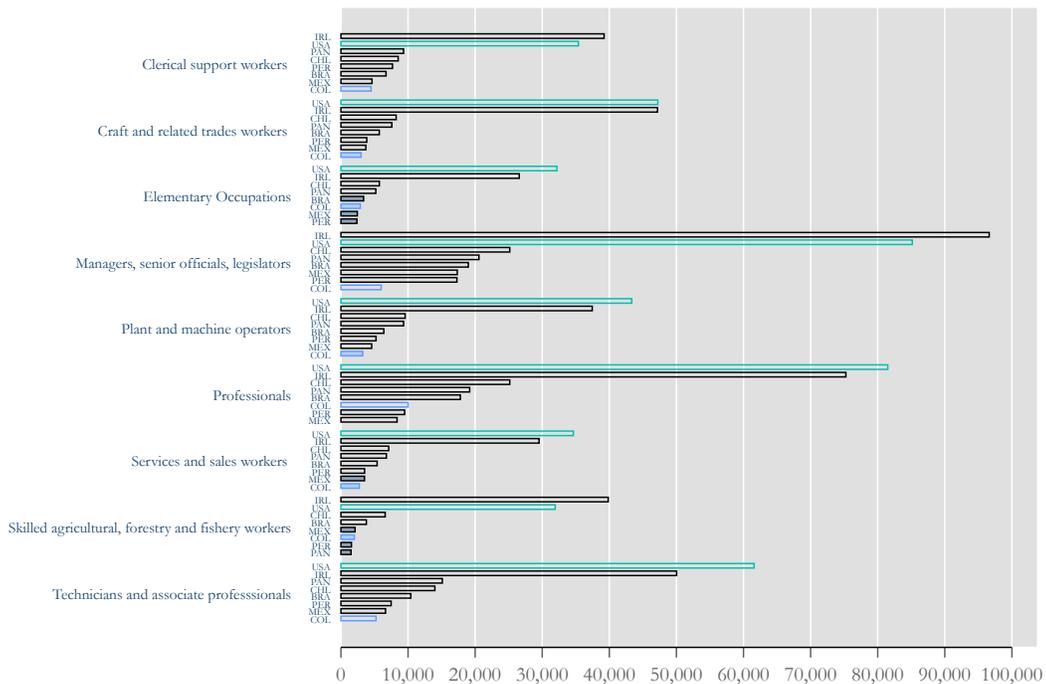


Note: Own calculations using the Great Integrated Household Survey (GEIH) (Colombia), Current Population Survey (CPS) - Annual Social and Economic Supplement (ASEC) (United States), National Socio-Economic

Characterization Survey (CASEN) (Chile), National Household Survey (ENAHO) (Peru), Survey on Income and Living Conditions (SILC) (Ireland) and Household Income and Expenditure Survey (ENIGH) (Mexico). Local currencies were turned into dollars at the exchange rate at end of the year of the survey, and then inflation adjusted to represent 2019 values. All surveys accessed using the LIS cross-national data center.

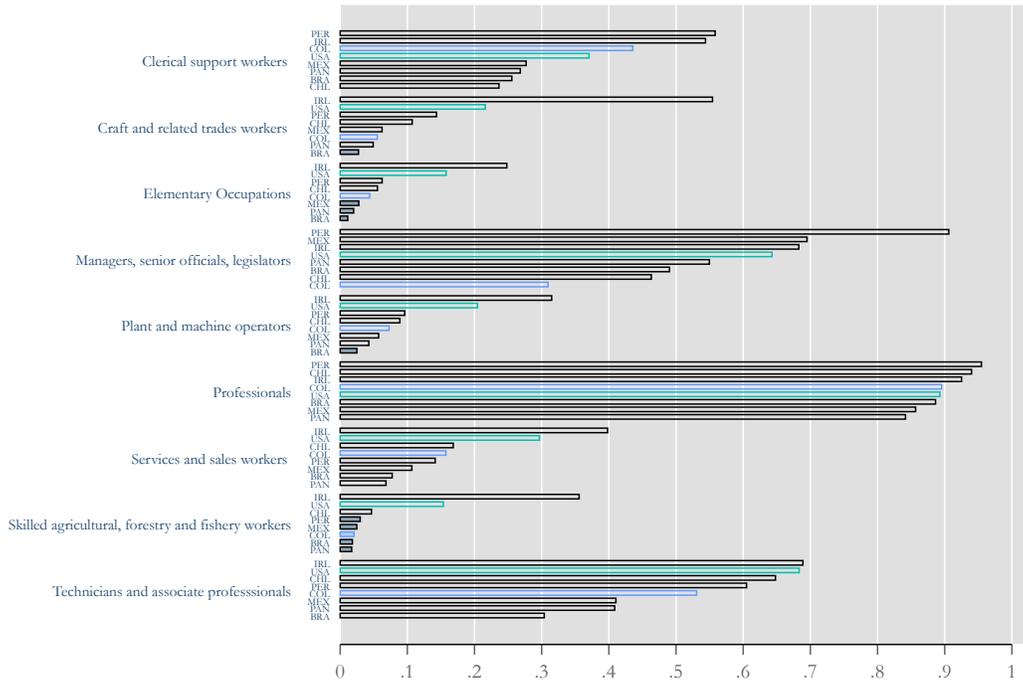
The analysis can be deepened by studying wages and education differentials by occupation. Figure 10 and Figure 11 show the comparison by occupation for wages and education, respectively. The two main takeaways hold: first, there is a very large wage differential for the same occupation, compared to the US and even to other countries in the region and Ireland. Second, education differentials are much smaller. The difference is particularly narrow for professionals, technicians and clerical support.

Figure 10: Wage differentials by occupation



Note: see notes to Figure 9.

Figure 11: Education differentials by occupation



Note: see notes to Figure 9.

## 5. Colombia's cost advantage

Comparative advantage in services can be summarized as the possibility to provide a given service at a lower cost. To calculate Colombia's advantage in exporting services we take into account some aspects discussed so far in this report. First, the share of the payroll that is estimated to be teleworkable as a share of total production costs (including the cost of intermediate inputs). Second, the wage differential between Colombia and the US. In simple terms, our Cost Advantage could be thought as a proxy that indicates the savings in overall costs for a firm if those tasks (or jobs) were performed by workers in Colombia. The implicit assumption in this calculation is that services are of the same quality and produced with the same productivity as in the US, but at a lower cost. Therefore, these Cost Advantages could be seen as an upper bound of the potential savings. But, as we will see below, potential savings for some industries are so large that punishing the index by a large factor to discount for lower quality or productivity still result in large savings.

There are many industries where Colombia presents a significant cost advantage. Figure 12 shows the cost advantage calculated using the teleworkable jobs estimate, the cost structure of each industry, and the wage differential of Colombia vis-à-vis the US. The estimate places "computer systems design and related services" at the top of the list, and it suggests that if the teleworkable jobs were performed by Colombians, that industry would have a 52% reduction in its total costs. Figure 12 suggest ample dispersion across industries in the potential cost savings from importing teleworkable services from Colombia.

Figure 12: Cost Advantage



Note: Calculations using data from O\*NET, US Bureau of Labor Statistics, US Bureau of Economic Analysis, and Colombia’s Great Integrated Household Survey (GEIH)

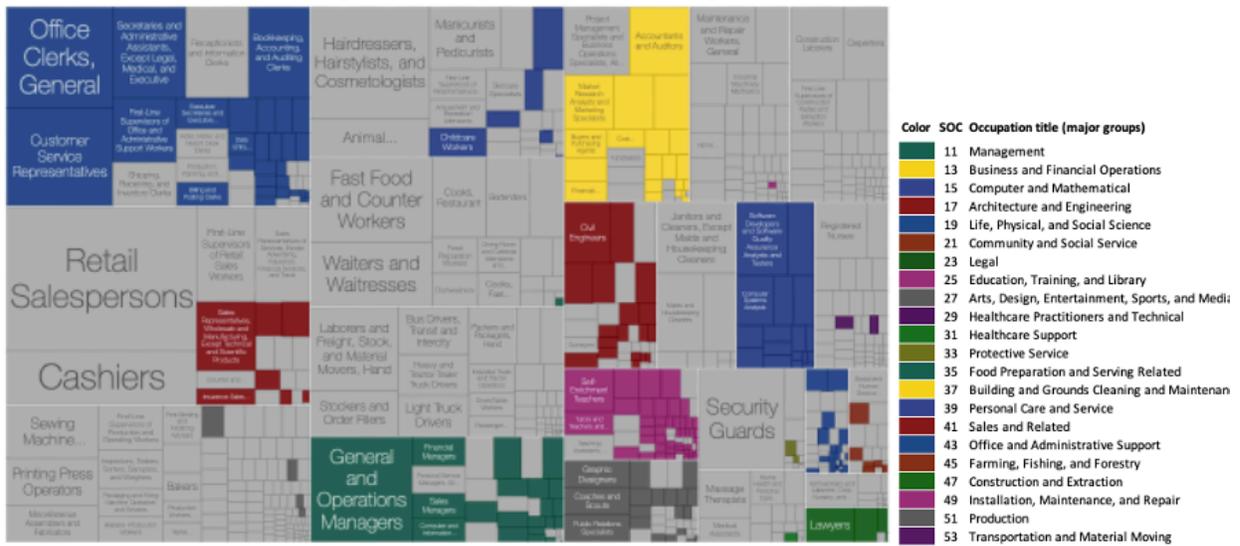
It is interesting to note that despite significant cost advantage, some industries are not yet significantly traded (see Figure 7). But this may change as new business models are developed to exploit this arbitrage opportunity. As mentioned earlier, COVID-19 may have kick-started a process that forced companies to structure themselves to operate with remote workers. Across countries, in the second quarter of 2020, workers had to switch to online platforms and learn to use new tools to work remotely and coordinate tasks among people in different locations. Given large wage differentials, the transition to move some of these tasks abroad may be faster than it otherwise would have been without the COVID-19 shock.

What teleworkable occupations and industries are present in Colombia? To take advantage of the cost advantage calculated for Colombia we need to assess the current extent of teleworkable jobs in Colombia. To answer this question, we estimate the number teleworkable jobs using data for Colombia from the Dunn and Bradstreet dataset for year 2019. This dataset reports the number of jobs by firm, which we tabulate at the industry level. Then we estimate the number of jobs by occupation assuming that the occupation composition of each industry is similar to that of the US.

A treemap of our estimate of teleworkable jobs in Colombia is shown in Figure 13. Occupations are nested within major occupational groups, and those occupations that are teleworkable are highlighted using colors. The estimate is that approx. 30% of the jobs in Colombia are teleworkable.<sup>8</sup> This number is not significantly different from other countries in Latin America.

<sup>8</sup> The share of teleworkable jobs estimated using the Great Integrated Household Survey (GEIH) is 22%. We chose to keep our somewhat larger estimate due to consistency with industry classifications used throughout the paper.

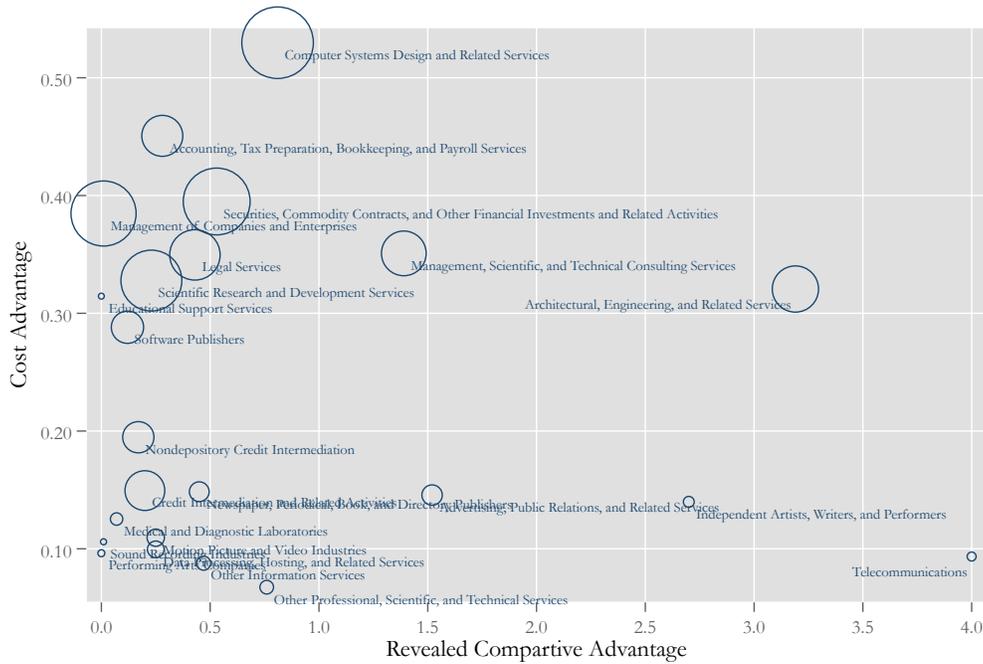
Figure 13: Teleworkable jobs in Colombia



Note: Calculations using data from O\*NET, US Bureau of Labor Statistics, US Bureau of Economic Analysis, and Dunn and Bradstreet data for Colombia. Teleworkable occupations are highlighted with strong colors, while non-teleworkable occupations are in light-gray.

Does Colombia currently have capabilities in telework-intensive industries? Figure 14 shows the relative presence of industries in Colombia and the country's cost advantage in those industries. As an indicator of relative presence, we calculate the Revealed Comparative Advantage (RCA) of each industry relative to the same industries in the US. Thus, industries with an RCA larger than one have a larger employment presence in Colombia than in the US. Most of the industries in which Colombia has a significant cost advantage have employment size below that of the US.

Figure 14: Cost advantage and current presence of industries in Colombia



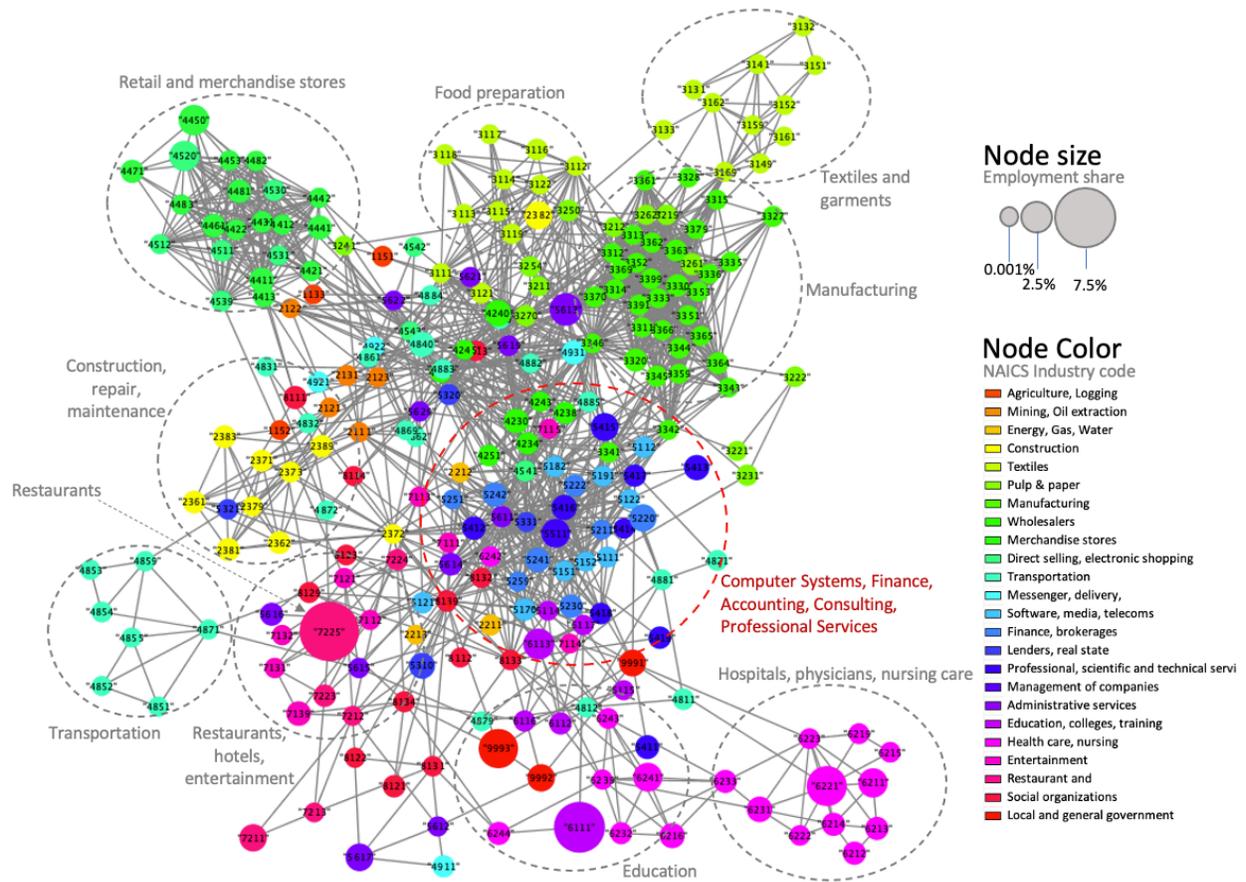
Note: Current presence measured as revealed comparative advantage (RCA). Node size is proportional to industry wage bill.

## 6. Could Colombia reassign resources to teleworkable industries from related industries?

To answer this question, we look at the presence of industries with similar human capital requirements. Any pair of products or industries differ in the knowhow and other productive capabilities they require. Shirts for men and trousers for men share more relevant know-how, skills, and other capabilities than either of them with cars. And the manufacture of cars is closer to that of trucks than either is to chocolate. Industries demand workers with different knowledge, skills and abilities, but there is differential overlap in the skills and abilities used across industries. For instance, “general operation managers”, “accountants” or “office clerks are occupations found in many different industries (see for instance Figure 5). The intuition is that if two industries require similar capabilities, countries or cities that have what it is needed to make the first one is more likely to have what is needed to make the second one. Thus, one approach is to estimate the similarity between industries using the correlation between the occupation vectors used by every pair of industries.

Using this approach, we built an industry space based on occupational similarity. In other words, for each industry we estimate the similarity with every other industry based on the correlation of the occupation vectors of each pair of industries. We use a network representation to visualize this industry space. In Figure 15 each node represents an industry, and its size is proportional to its share in total employment in the US. To simplify the visualization, nodes are connected by links to its three most similar industries in terms of occupation similarity. In this type of network visualizations, a first order question is to see if clusters or nodes emerge naturally or not. As it can be seen in Figure 15, industries cluster together, with some clusters of industries appearing in the core and others in the periphery.

Figure 15: Industry Space - Occupation Similarity



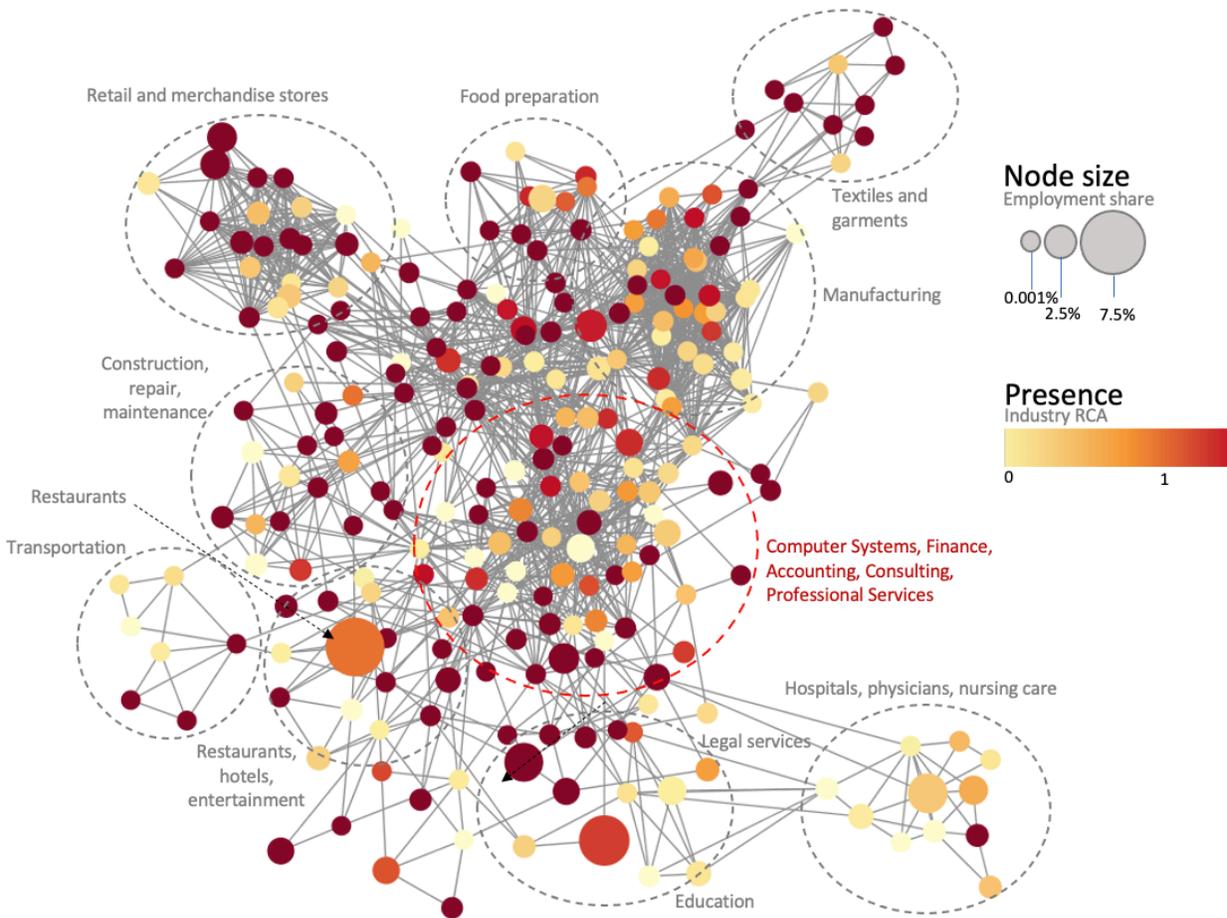
Note: Calculations using data from the Occupational Employment and Wage Statistics (OEWS) elaborated by the U.S. Bureau of Labor Statistics, and data from Dunn and Bradstreet for Colombia. Nodes are labeled using 4-digit NAICS industry codes.

In Figure 15, broadly speaking, we can observe ten groupings of industries. It is natural to think that, for instance, workers in one manufacturing industry learn valuable skills that could be used by other manufacturing industries. That’s why when looking at the similarity between industries, some clusters are tightly connected. To the top left of the figure, we observe a cluster formed mostly by retail and merchandise stores, in the middle we find the cluster of food preparation, while at the top right we see the cluster of textile and garments industries. Just below the textiles cluster we observe a tight cluster of manufacturing industries. Towards the left of the industry space, we find a cluster of construction, repair and maintenance industries, and a more sparse cluster of industries related to different kinds of transportation. Next to transportation in the figure we see a cluster of “restaurants, hotels and entertainment” industries, which includes the largest employer industry – Restaurants and other eating places — accounting for almost 7.5% of employment (NAICS code 7225). At the bottom right of the figure we find the cluster formed by “education and health industries”. At the core of the industry space there is a large cluster of service industries related to “professional, scientific and technical services”. It is interesting to note that this last cluster is at the center of the industry space, which suggest that those industries have similar human capital needs to the surrounding clusters. The rest of the industries are scattered in the network, mostly in the periphery.

The precise location of the nodes in the industry space is less informative than the links they possess and the relative position of industries and the clusters found in the network. It is the links that express the interconnectedness of the industries. The position of the nodes in the visualization is decided by a so-called spring algorithm that tries to equalize the tension that the different links impose on the node. Some industries are highly connected to other industries, and some are very poorly linked. This differential connectedness of industries will be important in what comes next. The industry space can be seen as a representation of technological relatedness. However, we can use this space to express the industries that a location has mastered. A metaphor here is useful. Consider the industry space as a forest where every industry is a tree. Hence, the industry space and specially its shape is informative about the links between trees in the forest. A location (country or city) can be represented as a collection of firms that exploit certain products. As such we can think of each firm as a monkey that lives in a particular tree. At any point in time, the monkeys are located in certain parts of the forest. Over time, monkeys move in the forest. At the core of this analogy, we have the idea that reassignment of resources is not random, but highly path-dependent. As capabilities are difficult to develop and accumulate, the success of an emerging industry depends on whether there is significant density of industries that use related capabilities. Hence, it is important to describe the starting point of this dynamic process by highlighting the industries in which a country – say Colombia – has significant presence, as expressed in their relative market share.

Since the possibility to reassign resources to teleworkable industries depend on the presence of related industries, the next step is to show where does Colombia have comparative advantage. There are different ways to show this, one is using RCA as shown in Figure 15. Another is to use the visualization of the industry space. Figure 16 shows the presence of Colombia in the industry space, using the same layout used in Figure 15. The interpretation of the industry network is the same as before, but now we have color-coded the nodes following the relative presence of each industry. The darker the color, the more employment is found in those industries in Colombia, relative to the same industries in the US. For instance, the cluster of retail and merchandise stores (top left), appears to be very well developed, but the cluster of health industries (bottom right) is less developed than in the US. The central cluster of the industry space --related to professionals, scientific and technical services, were most the exports of services occur— has mixed results in Colombia, with some industries showing very little employment while other industries have a strong presence. This opens the question of the possibility of reallocating workers to this central cluster from surrounding industries.

Figure 16: Colombia's presence in the industry Space (Occupation Similarity)



Note: Calculations using data from the Occupational Employment and Wage Statistics (OEWS) elaborated by the U.S. Bureau of Labor Statistics, and data from Dunn and Bradstreet for Colombia. Nodes are color-coded using darker tones to indicate the increased presence of employment in Colombia in each industry.

To answer whether it is possible to reassign workers from related industries we explore empirically the development of new industries, and whether the shape of the industry space and differential presence plays a role. Specifically, we explore whether the likelihood of developing a new and thriving industry, previously not existent in a location, is related to the presence and strength of industries that use similar labor, i.e., that are close in the industry space. The intuition is that the larger the presence of related industries (i.e., industries that use intensively a similar type of skills and abilities), the more probable it is that a new industry would develop. Previous research showed that diversification tends to occur in the direction of highly related industries: in the language of the forest metaphor used above, monkeys jump short distances as captured by the industry space. This makes the process somewhat path dependent and partially predictable. To show that this is actually the case, we introduce a variable we call density. Density is a measure of the proximity of existing industries to a particular industry that is not yet significantly developed in a location. In the language of the metaphor, it measures the proximity of monkeys to other trees.

Density predicts the appearance of a new industry – the jump of a monkey to a tree. Table 2 shows an empirical exercise of predicting new industries computing density using different measures of similarity between industries. Hence, we will be testing whether density predicts the appearance of an industry

and, in particular, what measure of relatedness between industries is more predictive of industry appearance.

We use data for two cohorts (2005-2010, 2010-2015) using 246 industries and 900 cities in the US. We estimate a linear probability model, where the dependent variable is whether five years after the baseline period an industry achieves presence ( $RCA > 1$ ), conditional on not having strong presence ( $RCA < 0.25$  in the baseline period). In all regressions we control for city-year and industry-year fixed effects, to account for any common patterns within cities or industries in each period, and control for initial RCA. In column 1 we test density calculated using the co-location of industries in the same cities in the US. The estimated coefficient is such that a one standard deviation increase in density is associated with a 3.0% increase in the probability of developing presence in absent industries in 5 years.<sup>9</sup> One benchmark to compare this magnitude is that the (unconditional) probability of developing a previously absent industry is 2.5% on average, so this more than doubles the random probability of appearance of the new industry. Next, we estimate the regression with our proposed measure of density calculated using occupation similarity and find a coefficient of 12% which is four times larger than the previous case. In column 3 and 4 we estimate the regression with two additional variables using two different metrics that have been used in the literature: first, firm co-production or the probability that the same establishment is active in two industries; second, occupation transitions, which measures the frequency with which workers move between every pair of industries.<sup>10</sup> In both cases we estimate positive and statistically significant coefficients that are considerably smaller than those of column 2. Finally, in column 5 we estimate a regression using all definitions of density and find that occupational similarity remains as the most important predictor of industry appearance. Overall, the empirical exercise validates our choice to focus on density using occupation similarity.

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<sup>9</sup> In table 3, density of industry co-presence is the most analogous measure to the density variable introduced by Hidalgo et. Al (2007).

<sup>10</sup> For firm co-production we compute an industry squared matrix using data from Dunn and Bradstreet that register up to 6 industries in which firms have sales. To construct density from occupation transitions, we use data from Schubert, Stansbury and Taska 2020 who compute transitions using data from Burning Glass Technologies for 2013-2016 in the US.

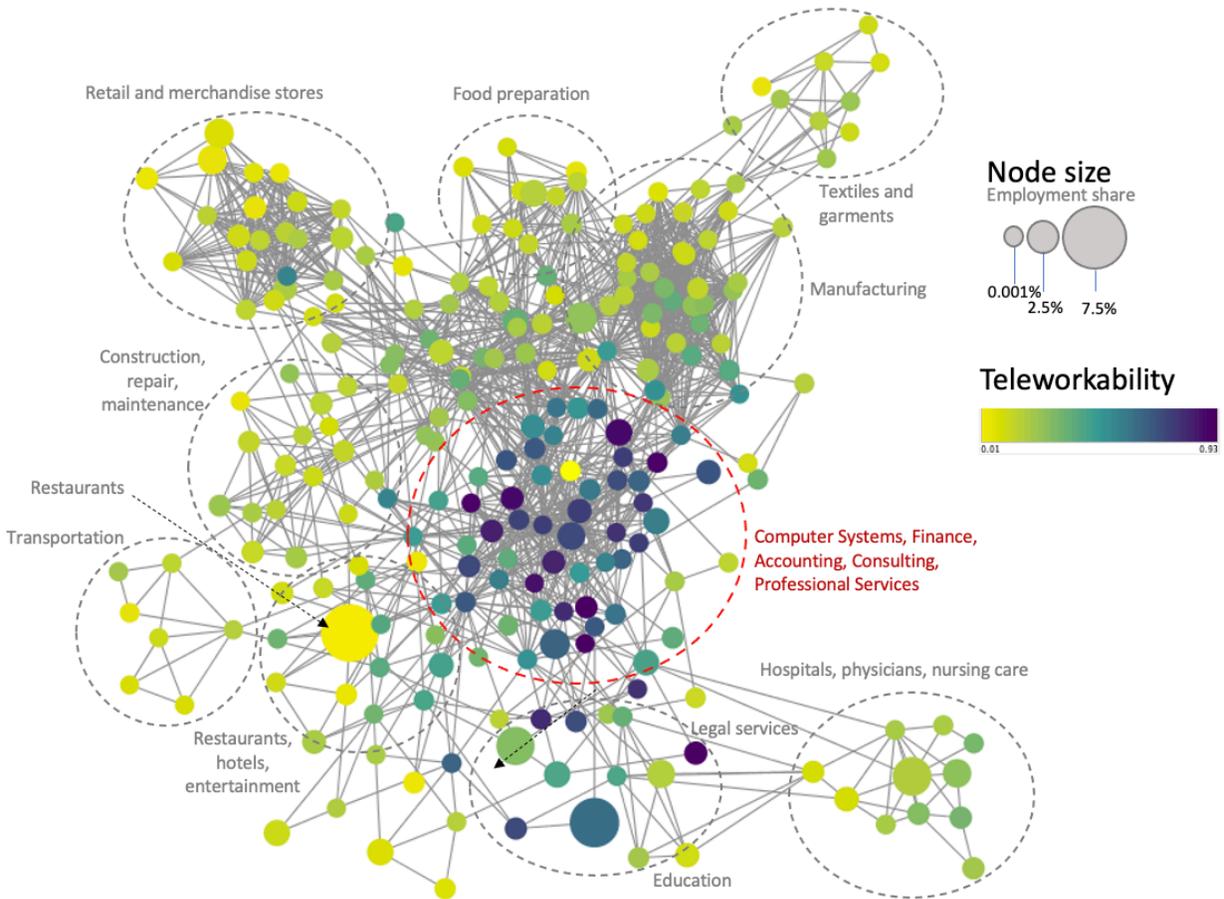
Table 2: Density predicts the appearance of new industries in U.S. cities

VARIABLES	(1) presence	(2) presence	(3) presence	(4) presence	(5) presence
Density - co-presence	0.030*** (0.002)				0.021*** (0.002)
Density - Occupation similarity		0.120*** (0.006)			0.091*** (0.006)
Density - Firm co-production			0.003*** (0.001)		0.002*** (0.001)
Density - Occupation transitions				0.007*** (0.002)	-0.002 (0.002)
rca	0.067*** (0.007)	0.069*** (0.007)	0.076*** (0.007)	0.076*** (0.007)	0.064*** (0.007)
Observations	176,660	176,660	176,660	176,660	176,660
R-squared	0.040	0.041	0.038	0.038	0.042
MSA x Year FE	y	y	y	y	y
Ind x Year FE	y	y	y	y	y
int rca	0.25	0.25	0.25	0.25	0.25

Note: Standard errors clustered by city (MSA) in parentheses \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Presence indicates whether the industry has developed RCA larger than 1 after 5 years, conditional on having RCA of less than 0.25 in the initial period. All density measures are standardized to have mean of zero and standard deviation of one in each period.

Where are the teleworkable jobs in the industry space? In Figure 17 we show the network visualization of the industry space coloring the industry nodes by their teleworkability propensity. The darker the color, the higher the share of teleworkable jobs in those occupations. Interestingly, the cluster of professional, scientific and technical services coincides almost completely with the set of highly teleworkable activities. This suggests that some of the human capital needs of this cluster are similar to other surrounding clusters. As can be seen many of the nodes of the central cluster have links to clusters like manufacturing, or education. It's possible to think that surges in labor demand are sourced with workers from industries in other clusters that use similar occupations.

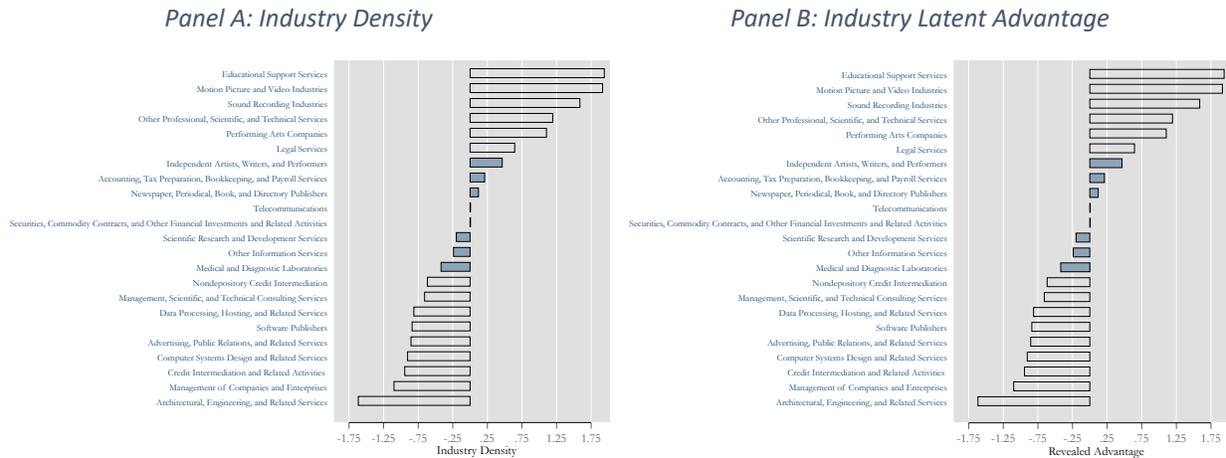
Figure 17: Industry Space and teleworkable industries



Note: Calculations using data from the Occupational Employment and Wage Statistics (OEWS) elaborated by the U.S. Bureau of Labor Statistics, and data from Dunn and Bradstreet for Colombia. Nodes are color-coded using darker tones to indicate the increased propensity of teleworkable jobs.

One of the implications of the industry space is that some countries or cities are better positioned in the sense that their industries are close to many potential new industries that are still absent. Some locations have fewer options because they start with fewer industries, or are in very peripheral and poorly connected parts of the industry space. This insight is useful to go back to the question of whether Colombia could reassign resources to teleworkable services. Industry density gives us an idea of whether an industry is in the adjacent possible of existing capabilities even though it may not have a relevant presence in employment today. Figure 17 shows in panel A the industries sorted according to industry density calculated using occupation-similarity and the current presence of industries in Colombia. Interestingly, “educational support services” comes at the top of the list, despite having a weak current development (see Figure 14). This indicates that there are many similar and related industries from which it would be possible to reassign resources to further develop this industry. To approximate what industries may be likely to appear in Colombia, we combine the current observed employment and density around each industry. Given Colombia’s current presence and the density around teleworkable industries we can calculate a proxy of the Latent Advantage. The result is shown in Panel B of Figure 18.

Figure 18: Colombia's industry density and latent advantage



Note: Calculations using data from the US Bureau of Labor Statistics, and data from Dunn and Bradstreet for Colombia. Industry density and latent advantage have mean zero and standard deviation of one.

## 7. Building an index of the potential gains

Guiding a strategy, with the goal of further promote Colombia's integration with global value chains and access new markets, requires specific actions. To prioritize policy, we rank industries according to the different dimensions discussed in this paper.

Table 3 shows the list of teleworkable service industries evaluated along four pillars: cost advantage, revealed tradability, latent advantage, and market size. Industries are sorted by a composite index of the three first dimensions, which we labeled Teleworkable Services Attractiveness index (TSA). The first pillar is Cost Advantage, and it is an estimate of the potential savings from performing those tasks from Colombia (score 1). We also report the variable standardized with mean zero and standard deviation of one (index1), which will be used to calculate the TSA index, and the ranking of industry within the pillar. For instance, Computer systems design is the industry with the largest cost advantage, almost two standard deviation more advantageous that the average industry in the list. Next, we have a pillar corresponding to the Revealed Tradability of each industry. As mentioned before, this provides an idea of how intensively these industries are being traded, but that may change with the likely increase in service tradability in coming years. The third pillar is what we called Latent advantage, which summarizes Colombia's current revealed comparative advantage, and the implicit comparative advantage we estimate given how industries are related.

We combine these 3 pillars into the Teleworkable Services Attractiveness index, computed as the simple average of the respective standardize index of each pillar. The TSA places "educational support services" as the top industry, while at the bottom it ranks "data processing, hosting and related services".

Table 3: Teleworkable Services Attractiveness Index Summary

NAICS	NAICS Title	Pillar 1: Cost Advantage			Pillar 2: Revealed Tradability			Pillar 3: Latent Advantage			Pillars 1 to 3		Pillar 4: Market size		
		score1	Index1	rank1	score2	Index2	rank2	score3	Index3	rank3	TSA Index score	rank	Market TW Payroll	Index4	Rank4
6117	Educational Support Services	0.31	0.62	9	0.63	2.04	2	1.5	1.94	1	1.53	1	1,473	-0.83	23
5122	Sound Recording Industries	0.11	-0.90	18	0.69	2.33	1	1.3	1.59	3	1.01	2	1,547	-0.83	22
5416	Management, Scientific, and Technical Consulting Services	0.35	0.88	5	0.58	1.77	3	-0.1	-0.66	16	0.67	3	84,602	0.39	7
5121	Motion Picture and Video Industries	0.11	-0.87	17	0.22	0.07	10	1.5	1.92	2	0.37	4	12,631	-0.67	14
5412	Accounting, Tax Preparation, Bookkeeping, and Payroll Services	0.45	1.61	2	0.04	-0.78	18	0.4	0.21	8	0.34	5	71,018	0.19	8
5411	Legal Services	0.35	0.87	6	0.05	-0.73	16	0.7	0.65	6	0.26	6	107,301	0.72	5
5417	Scientific Research and Development Services	0.33	0.71	7	0.25	0.20	8	0.2	-0.20	12	0.24	7	156,822	1.45	4
5415	Computer Systems Design and Related Services	0.53	2.18	1	0.09	-0.58	14	-0.2	-0.90	20	0.23	8	216,491	2.32	1
5230	Securities, Commodity Contracts, and Other Financial Investments and Related Activities	0.39	1.20	3	0.02	-0.90	20	0.3	0.01	11	0.10	9	188,860	1.92	2
5112	Software Publishers	0.29	0.43	10	0.33	0.59	6	-0.2	-0.84	18	0.06	10	44,089	-0.21	10
5222	Nondepository Credit Intermediation	0.19	-0.25	11	0.39	0.87	4	-0.1	-0.62	15	0.00	11	41,317	-0.25	11
5170	Telecommunications	0.09	-0.99	21	0.38	0.84	5	0.3	0.01	10	-0.05	12	3,396	-0.81	20
7111	Performing Arts Companies	0.10	-0.97	20	0.09	-0.57	13	1.0	1.10	5	-0.14	13	2,059	-0.83	21
5511	Management of Companies and Enterprises	0.38	1.13	4	0.04	-0.79	19	-0.4	-1.10	22	-0.25	14	179,142	1.77	3
5111	Newspaper, Periodical, Book, and Directory Publishing	0.15	-0.59	13	0.12	-0.40	12	0.4	0.12	9	-0.29	15	16,513	-0.61	13
5191	Other Information Services	0.09	-1.03	22	0.29	0.40	7	0.2	-0.24	13	-0.29	16	8,330	-0.73	16
5419	Other Professional, Scientific, and Technical Services	0.07	-1.18	23	0.01	-0.97	21	1.0	1.19	4	-0.32	17	7,863	-0.74	17
7115	Independent Artists, Writers, and Performers	0.14	-0.65	15	0.00	-0.98	22	0.6	0.47	7	-0.39	18	5,015	-0.78	19
5418	Advertising, Public Relations, and Related Services	0.15	-0.61	14	0.22	0.09	9	-0.2	-0.85	19	-0.46	19	17,526	-0.60	12
5413	Architectural, Engineering, and Related Services	0.32	0.66	8	0.07	-0.65	15	-0.7	-1.62	23	-0.53	20	90,545	0.47	6
5220	Credit Intermediation and Related Activities	0.15	-0.58	12	0.18	-0.11	11	-0.3	-0.94	21	-0.54	21	66,888	0.13	9
6215	Medical and Diagnostic Laboratories	0.13	-0.76	16	0.00	-0.98	23	0.1	-0.42	14	-0.72	22	6,489	-0.76	18
5182	Data Processing, Hosting, and Related Services	0.10	-0.94	19	0.05	-0.76	17	-0.2	-0.81	17	-0.84	23	11,725	-0.68	15

Note: Calculations using data from O\*NET, US Bureau of Labor Statistics, US Bureau of Economic Analysis, and Dunn and Bradstreet data for Colombia.

Market size is another important dimension to consider when designing a strategy. Table 3 provides an estimate of the potential market size of each industry calculated as the value of teleworkable payroll in the US. It's important to emphasize that Colombian workers exporting services would not be competing with the final production of each industry, but would be replacing labor currently performed locally. For instance, accounting firms in the US that currently provide services to other domestic industries, such as motor vehicle manufacturing, could import some tasks of their business from services providers in Colombia.

Figure 19 plots the Teleworkable Services Attractiveness Index against the proxy of Market Size. There is not clear relation between TSA and market size. For instance, the figure makes salient that, although “educational support services” and “sound recording industries” are very attractive according to the index, their market size is relatively small compared to other industries.

Figure 19: Teleworkable Services Attractiveness Index and Industry Market Size



## 8. Industries and actions: policy guidelines

This paper argues that service exports are poised to grow significantly in the coming years, as more tasks can be organized remotely, potentially opening new opportunities for Colombia and other developing countries. Having a larger portion of the labor force engaged in production processes abroad can have many effects on the Colombian economy. It could directly increase exports and incomes, and reassign workers to new jobs. More indirectly, it will increase the returns on teleworkable skills, creating incentives for Colombians to accumulate those skills. In addition, it will expose Colombians to other opportunities and business experiences that may spur further transformations of the economy.

To guide a strategy that seizes on these opportunities, we provide a ranking of industries according to different dimensions such as cost advantage, tradability, and potential market size. This strategy needs to target actions to industries that are more likely to succeed and where the potential promise is larger.

How to boost these activities? As suggested by this paper, given the large salary differentials with developed countries, there are a significant cost savings if some tasks are performed and exported from Colombia. But this is true for other developing countries as well. To speed-up the arbitrage opportunity, more information is needed to identify and quantify the constraints that may hinder the productivity of the different industries. This requires including these industries in the target for investment promotion (“Pro-Colombia”), and dig into the specific constraints or requirements faced by each of the industries by convening a public-private task force along the lines of what is referred to in Colombia as “Iniciativas cluster”.

Moreover, the platforms that will facilitate the arbitrage that this paper highlights are emerging. Baldwin et al (2020) study platforms such as Upwork identifying types of tasks that are in highest

demand. Torre.co, a new Silicon Valley platform developed by Colombian-born Alejandro Torrenegra is facilitating the formation of networks of suppliers and demanders of teleworkable services, especially in the programming and ICT space. These initiatives already point out to a very large return to English proficiency as a skill that is highly complementary to other skills demanded through these platforms, as are front-end and back-end website development capabilities for business. Information about these demands should inform the provision of education and training services and be shared with potential students as they make decision choices on career paths.

Other issues are bound to be identified as different industries are consulted or participate in the above-mentioned cluster initiative. Global players in the narrow list of industries could also provide insights on what are the specific conditions they see as relevant for either engaging with local providers, or establishing affiliates in Colombia.<sup>11</sup>

There are four general issues that are likely to arise. First, the value-added tax is meant to be an indirect tax on consumption that is collected through the chain of value addition in order not to cause a cascading effect. It is not meant to be applied to exports. As a consequence, mechanisms exist to not tax the export of goods and to return the VAT paid on inputs. Customs often play a role in these schemes. However, applying this principle to service exports is always easier in theory than in practice because it is hard to distinguish whether or not these services are provided to customers abroad. Services rendered in Colombia used exclusively abroad by companies without business or activities in Colombia are exempted from VAT subject to some conditions. Any uncertainty and difficulty qualifying for this exception could very radically represent a large and uncompetitive tax on these exports. Given that Colombia's VAT rate is 15%, exported services unable to qualify for the mentioned exemption, on average, would decrease their cost advantage significantly.<sup>12</sup>

Second, as mentioned above, language skills are central to the ability to communicate with clients abroad, not only because the US is a potentially large market, but because English acts as a lingua franca for business across the world.

Third, the coverage, quality, and price of internet services is a key enabler and one that is constantly being upgraded. Making sure that Colombia remains competitive in this key input is bound to be important.

To assess the significance of English skills and availability of internet services we look at their importance in explaining the US imports of services in recent years, following the work of Freund and Weinhold (2002). The idea is to gauge the extent that some frictions may play a role in the imports of services in a gravity-type regression. This is, it is assumed that countries that are closer trade and that are more productive trade more. English skills, one potential source of friction, are proxied by the English-speaking proportion of the population, and an index of English Proficiency (see figure A.8 and A.9 in the appendix).<sup>13</sup> The estimates, shown in Table A.2 in the appendix, suggest that English skills are strongly

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<sup>11</sup> Figure A.6 in the appendix shows an example of current presence in Colombia and global a list of players for two selected industries "Computer systems design" and "management, scientific and technical consulting services". Figure A.7 provides for each teleworkable industry a sample list of three global players.

<sup>12</sup> To get an idea of what the disadvantage could mean, compare the 15% VAT rate to the Telework-cost advantage shown in Figure 9 for a more detailed list of industries.

<sup>13</sup> The two variables are informative of different aspects of the language skills available in each country. While the English-speaking proportion of the population doesn't control for the quality of those skills, on the other hand the English Proficiency Index (EPI) is biased to test takers. In the EPI, Colombia ranks 77 of 100 countries, with a score of 488 out of 800.

associated with higher exports of services to the US, and that language skills are particularly important for professional and business services. The importance of Internet for trade in services is proxied using the proportion of individuals using internet. We also use the Inclusive Internet Index (3-i) developed by the Economist Intelligence Unit (see figure A.10 and A.11 in the appendix).<sup>14</sup> The results shown in tables A.2 and A.3 (where we analyze the components of the 3-I index) do not show a significant correlation of trade in services with the proxies used to assess the importance of internet for trade. This result must be taken with a grain of salt since we are studying trade flows that happened before the pandemic. If the intensive use of online platforms remains high after the pandemic, or increases, the relevance of internet for cross-border business could become crucial.

Finally, it is important to think through the general equilibrium implications of the growth of the teleworkable service sector. Evidence, anecdotal and otherwise, is starting to accumulate suggesting that the demand for Colombians with teleworkable skills is already growing and that it is having an effect on wages and on the difficulty of local firms to access those skills. This competition for local talent should focus the government in having an agenda to expand the supply of skills as quickly as possible: through its university system, its training institutions, such as SENA, and its migration policy to attract and retain foreign-born talent.

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<sup>14</sup> The Inclusive Internet Index ranks countries along four dimensions; availability, affordability, readiness, and relevance. Colombia in the overall index is ranked 44 out of 120, and 64, 33, 41 and 14 in each of the aforementioned components of the index.

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## Appendix: Additional figures and tables

### Section A: Teleworkable Jobs Index

This section describes how we classified occupations as Teleworkable, following the work of Dingle and Neiman 2020. We classified U.S. occupations based on O\*NET survey responses to designate any given occupation as able or unable to be performed at home. We assume that anything than jobs than can be performed remotely from home are susceptible of be done remotely from other country as well. Our teleworkable job measure is based on responses to two Occupational Information Network (O\*NET) surveys covering work context and generalized work activities. We then merge this information with BLS data on the number and wages of workers in each SOC in the country and industries.

If any of the following conditions in the "Work Context" survey responses are true, we

code the occupation as one that cannot be performed at home:

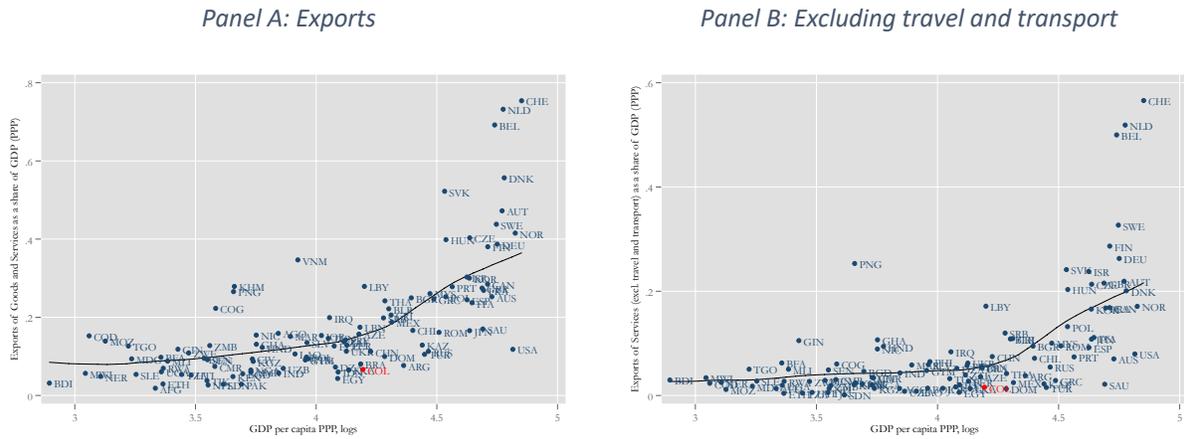
- Average respondent says they use email less than once per month (Q4)
- Majority of respondents say they work outdoors every day (Q17)
- Average respondent says they deal with violent people at least once a week (Q14)
- Average respondent says they spent majority of time wearing common or specialized protective or safety equipment (Q43)
- Average respondent says they spent majority of time walking or running (Q37)
- Average respondent says they are exposed to minor burns, cuts, bites, or stings at least once a week (Q33)
- Average respondent says they are exposed to diseases or infection at least once a week (Q29)

If any of the following conditions in the "Generalized Work Activities" survey responses are

true, we code the occupation as one that cannot be performed at home:

- Performing General Physical Activities is very important (Q16A)
- Handling and Moving Objects is very important (Q17A)
- Controlling Machines and Processes [not computers nor vehicles] is very important (Q18A)
- Operating Vehicles, Mechanized Devices, or Equipment is very important (Q20A)
- Performing for or Working Directly with the Public is very important (Q32A)
- Repairing and Maintaining Mechanical Equipment is very important (Q22A)
- Repairing and Maintaining Electronic Equipment is very important (Q23A)
- Inspecting Equipment, Structures, or Materials is very important (Q4A)

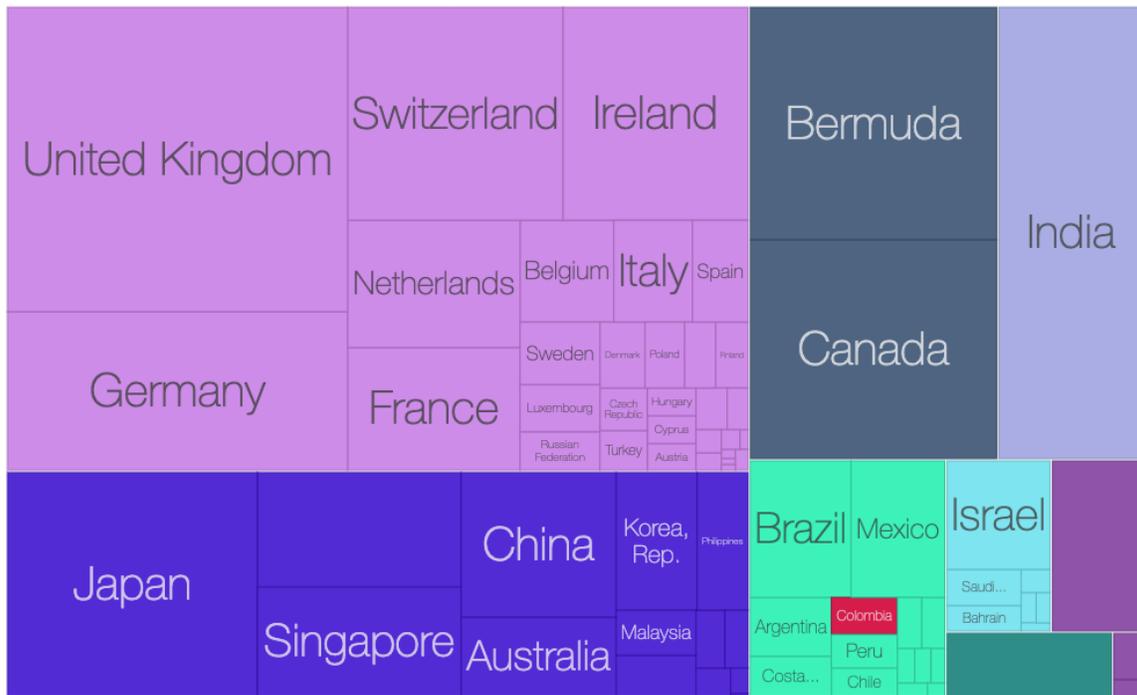
Figure A1: Exports of goods and services as a share of GDP



Note: Calculations using data from the World Development Indicators for year 2019. Panel A shows exports of goods and services as a share of GDP per capita at PPP. Panel B excludes exports of travel and transport.

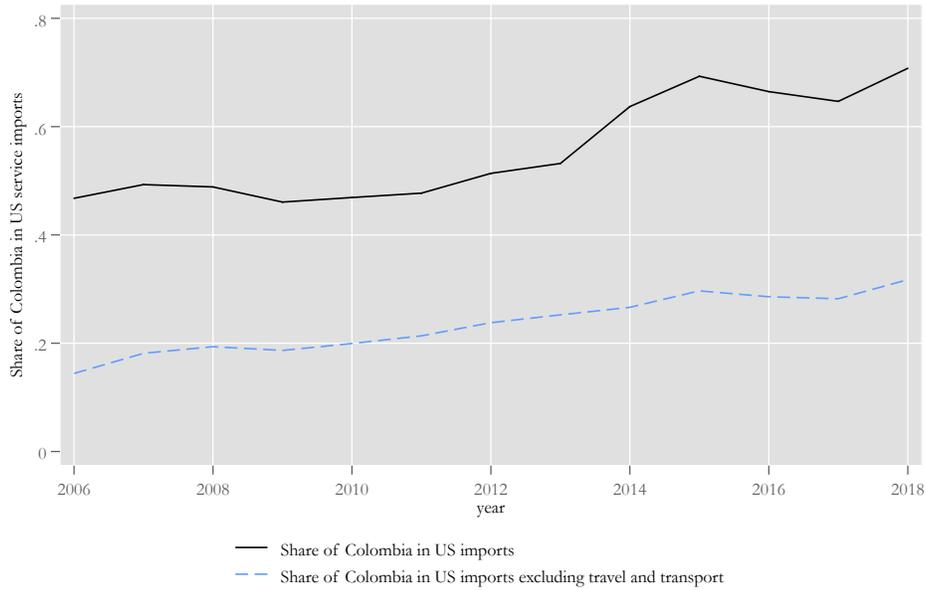
Colombia is a huge outlier in terms of exports of goods and services as a share of GDP. This is particularly true if we exclude travel and transportation

Figure A2: Excluding travel and transport, Colombia is also marginal.



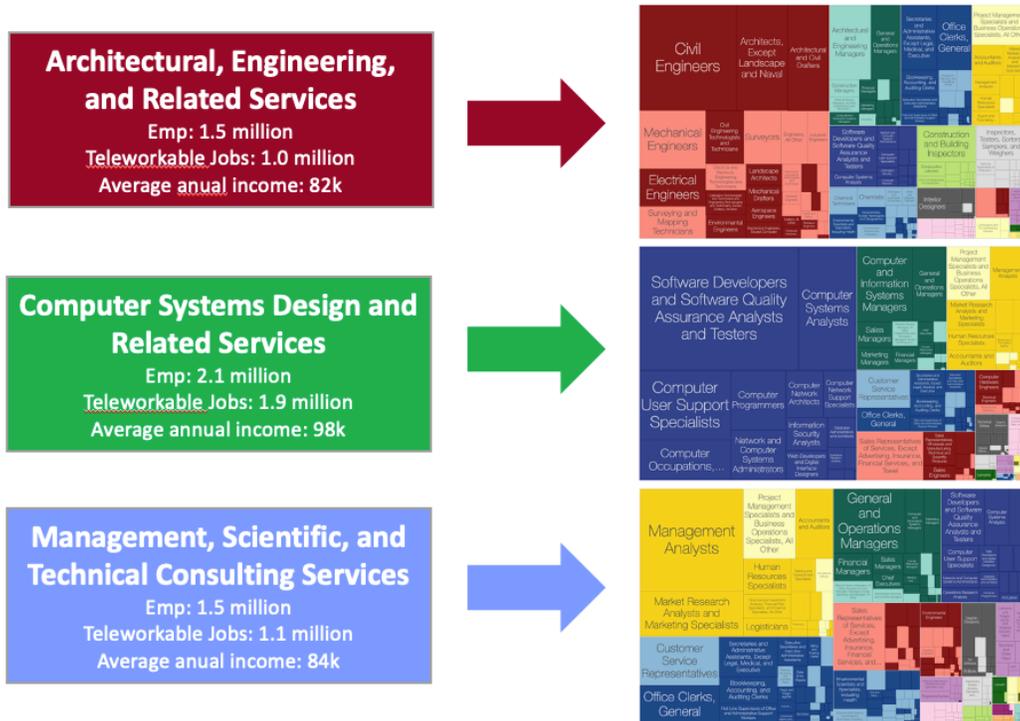
Note: US service imports by country of origin, excluding travel and transport (US\$ 310bn)

Figure A3: Share of Colombia in US service imports



Note: Calculations using data from the Bureau of Economic Analysis.

Figure A4: From occupations to industries, an example



Note: Calculations using data from O\*NET, and the US Bureau of Labor Statistics.

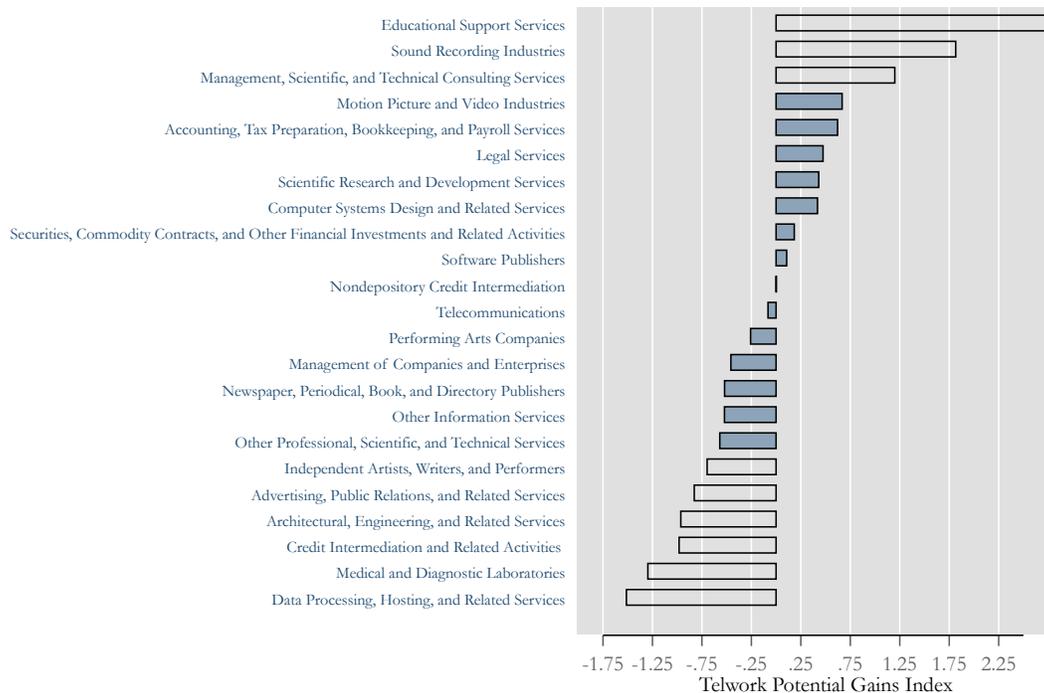
Table A.1 provides a list with the top 20 teleworkable industries in the US, its wage and share of total employment. The most teleworkable industry is legal services, followed from other industries related mostly to professional and technical services.

Table A.1: Teleworkable industries

Naics 4-digit code	Industry Title	Teleworkable share	wage	employment share
5411	Legal Services	92.9	37.0	0.79
5230	Securities, Commodity Contracts, and Other Financial Investments and Related Activities	92.5	44.3	0.65
7114	Agents and Managers for Artists, Athletes, Entertainers, and Other Public Figures	90.6	31.5	0.02
5112	Software Publishers	89.2	49.1	0.30
5251	Insurance and Employee Benefit Funds	89.2	33.4	0.00
5415	Computer Systems Design and Related Services	88.1	43.9	1.50
5242	Agencies, Brokerages, and Other Insurance Related Activities	87.4	27.3	0.82
5259	Other Investment Pools and Funds	86.6	29.8	0.01
5182	Data Processing, Hosting, and Related Services	84.5	38.4	0.23
5412	Accounting, Tax Preparation, Bookkeeping, and Payroll Services	83.2	32.1	0.67
5241	Insurance Carriers	82.3	33.6	0.82
6116	Other Schools and Instruction	80.6	13.0	0.32
6114	Business Schools and Computer and Management Training	79.3	28.8	0.05
5211	Monetary Authorities-Central Bank	78.6	44.3	0.01
6115	Technical and Trade Schools	77.7	21.9	0.09
5122	Sound Recording Industries	76.4	27.2	0.01
3341	Computer and Peripheral Equipment Manufacturing	75.0	46.4	0.10
5416	Management, Scientific, and Technical Consulting Services	74.9	36.3	1.02
5331	Lessors of Nonfinancial Intangible Assets (except Copyrighted Works)	74.6	35.1	0.01
5414	Specialized Design Services	74.5	29.4	0.10

Note: Calculations using data from O\*NET, and US Bureau of Labor Statistics.

Figure A.5: Teleworkable Services Attractiveness Index



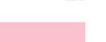
Note: Calculations using data from O\*NET, US Bureau of Labor Statistics, US Bureau of Economic Analysis, and Dunn and Bradstreet data for Colombia.

Figure A.6: Current presence in Colombia and global players

Colombia		Global				
<b>Computer Systems Design and Related Services (5415)</b>						
Name	Employment	Name	GU country	Total Emp.	NAICS GU	Group NAICS
IBM DE COLOMBIA Y CIA S C A	2,082	International Business Machines Corporation	USA	26,715	5415	3341
RAPPI S A S	1,556	Sap SE	GERMANY	18,559	5415	5415
ENERGIA INTEGRAL ANDINA S A	1,500	China Electronics Technology Group Corporation	china	17,998	5415	5415
TCS SOLUTION CENTER SUCURSAL COLOMBIA	1,363	Fujitsu Limited	JAPAN	16,562	5415	5415
INCUBARE S A S	1,324	SERVICE STREAM LIMITED	australia	15,866	5415	2371
<b>Management, Scientific, and Technical Consulting Services (5416)</b>						
Name	Employment	Name	GU country	Total Emp.	NAICS GU	Group NAICS
COOMEVA SERVICIOS ADMINISTRATIVOS S A	1,598	Worleyparsons Limited	AUSTRALIA	57,600	5413	5416
APPLUS NORCONTROL COLOMBIA LIMITADA	1,469	Cardno Limited	AUSTRALIA	40,084	5413	5416
PRICEWATERHOUSECOOPERS ASESORES GERENCIALES LTDA	678	Aecom	USA	24,609	5413	5416
FUNDACION SOCYA	555	Clariant AG	SWITZERLANI	55,156	5614	5416
Norte Networks	450	WOJEWA&DZTWO LUBELSKIE	poland	35,319	9991	5416

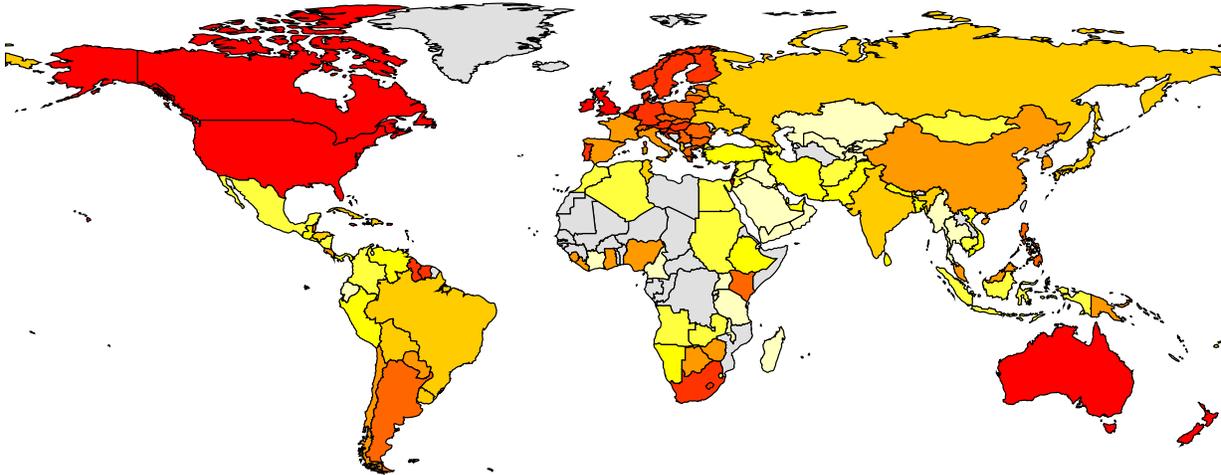
Note: Calculations using the Dunn and Bradstreet dataset

Figure A.7: Global players

<p><b>Educational Support Services</b></p> <p>Educational Testing Service Inc </p> <p>IDP Education Ltd </p> <p>Pearsons Education </p>	<p><b>Accounting, Tax Preparation, Bookkeeping, and Payroll Services</b></p> <p>Deloitte LLP </p> <p>KPMG LLP </p> <p>Ernst &amp; Young LLP </p>	<p><b>Software Publishers</b></p> <p>Microsoft Corporation </p> <p>Oracle Corporation </p> <p>Black Knight, Inc. </p>
<p><b>Sound Recording Industries</b></p> <p>Mood Media Corporation </p> <p>Kobalt Music Group Limited </p> <p>GMM Grammy Public Company </p>	<p><b>Legal Services</b></p> <p>Insurance Australia Group </p> <p>Shine Corporate </p> <p>NEXITY </p>	<p><b>Telecommunications</b></p> <p>China Telecommunications Corporation </p> <p>AT&amp;T Inc. </p> <p>Singtel Australia Investment </p>
<p><b>Management, Scientific, and Technical Consulting Services</b></p> <p>Worleyparsons Limited </p> <p>Aecom </p> <p>Clariant AG </p>	<p><b>Scientific Research and Development Services</b></p> <p>Roche Holding AG </p> <p>Syneos Health, Inc. </p> <p>Wuxi AppTec Co., Ltd. </p>	<p><b>Other Professional, Scientific, and Technical Services</b></p> <p>BHP Group Limited </p> <p>Origin Energy Limited </p> <p>Greencross Limited </p>
<p><b>Motion Picture and Video Industries</b></p> <p>Comcast Corporation </p> <p>Village Roadshow Limited </p> <p>Event Hospitality and Entertainment </p>	<p><b>Computer Systems Design and Related Services</b></p> <p>Sap SE </p> <p>TPG TELECOM LIMITED </p> <p>China United Network Communications </p>	<p><b>Medical and Diagnostic Laboratories</b></p> <p>Quest Diagnostics Incorporated </p> <p>Diagnostics da America </p> <p>Laboratory Corporation of America </p>

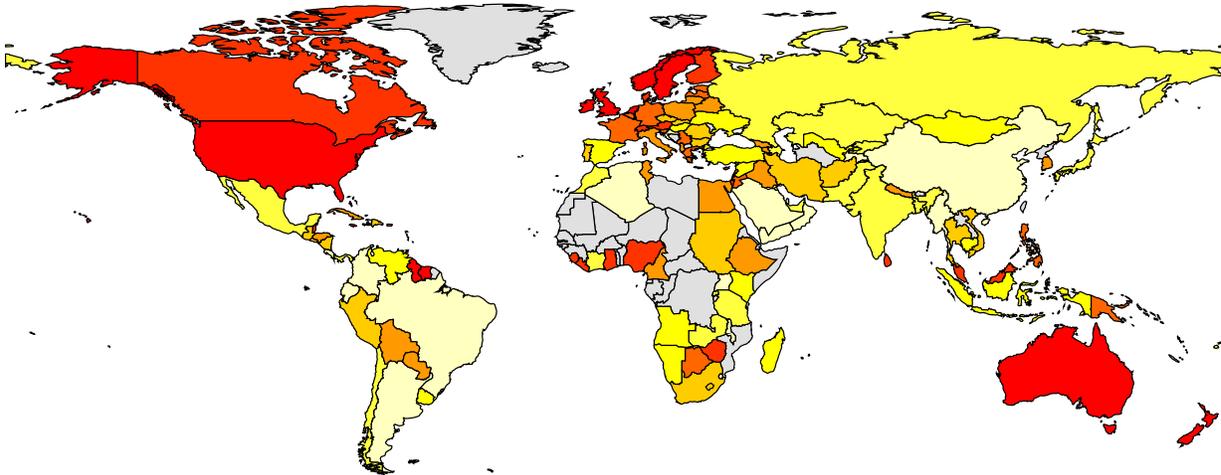
Note: Calculations using the Dunn and Bradstreet dataset

Figure A.8. English Proficiency Index 2020



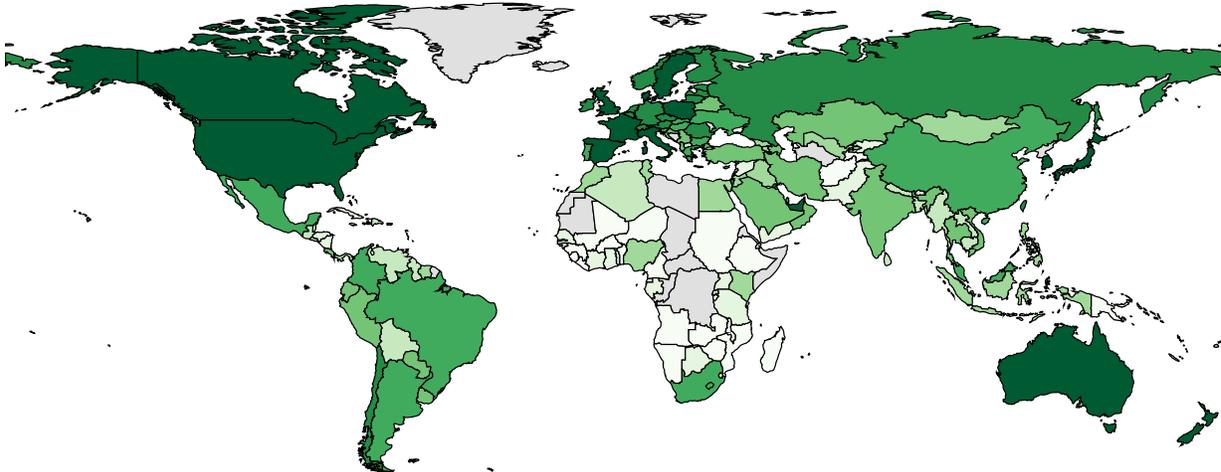
Note: English Proficiency Index, constructed by Education First. Countries with English as its official language (e.g., AUS, USA, GBR) were assigned the maximum score of the index for visualization purposes.

Figure A.9. English Speaking Proportion of the population



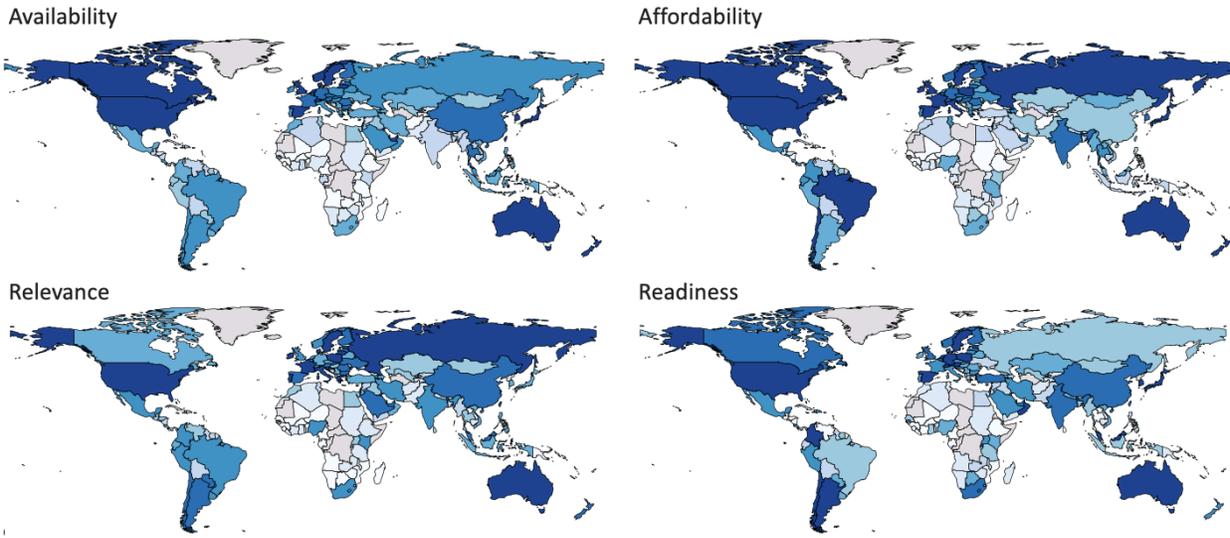
Note: various sources.

Figure A.10. Inclusive Internet Index – Economist Intelligence Unit



Note: Colombia is ranked 44 out of 120 in the Inclusive Internet Index overall index. Source: EIU

Figure A.11. Components of the Inclusive Internet Index (EIU)



Note: Colombia ranks 64, 33, 41 and 14 in the Availability, Affordability, Relevance and Readiness components of the index.

Table A.2: Determinants of US imports of services

VARIABLES	All services (excl. transp. & travel)		Finance & insurance services		ICT and R&D services		Professional and business services	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Distance to the US, log	-0.250** (0.107)	-0.224** (0.103)	-0.245** (0.111)	-0.209* (0.105)	-0.306*** (0.092)	-0.275*** (0.095)	-0.208** (0.083)	-0.159* (0.084)
Income per capita, log	0.614*** (0.124)	0.607*** (0.136)	0.618*** (0.124)	0.558*** (0.148)	0.851*** (0.143)	0.822*** (0.163)	0.591*** (0.166)	0.551*** (0.200)
Population, log	-0.115 (0.118)	-0.142 (0.117)	-0.127 (0.115)	-0.152 (0.114)	0.092 (0.102)	0.064 (0.104)	0.108 (0.089)	0.063 (0.089)
Individuals using the Internet (% of population)	-0.089 (0.148)	-0.123 (0.139)	-0.114 (0.123)	-0.128 (0.120)	-0.285 (0.173)	-0.312* (0.169)	0.000 (0.155)	-0.039 (0.155)
English speaking (% of population)	0.008*** (0.003)		0.008*** (0.003)		0.008** (0.003)		0.011*** (0.003)	
English Proficiency Index, log		0.221** (0.096)		0.295*** (0.092)		0.262** (0.100)		0.369*** (0.076)
Observations	69	69	69	69	69	69	68	68
R-squared	0.642	0.633	0.645	0.655	0.639	0.637	0.638	0.636

Robust standard errors in parentheses  
\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Note: Calculations using data from the US Bureau of Economic Analysis. Dependent variable is the value of imports per capita from each source country (in logs).

Table A.2: Determinants of US imports of services, Inclusive Internet Index components

VARIABLES	All services excl. Transp. and Travel				
	(1)	(2)	(3)	(4)	(5)
Distance, log	-0.263** (0.114)	-0.271** (0.126)	-0.240** (0.105)	-0.243** (0.119)	-0.262** (0.112)
Income per capita, log	0.417** (0.202)	0.429** (0.189)	0.457*** (0.121)	0.563*** (0.096)	0.476*** (0.121)
Population, log	-0.139 (0.141)	-0.117 (0.125)	-0.147 (0.134)	-0.102 (0.125)	-0.129 (0.130)
English speaking (% of population)	0.007*** (0.003)	0.008*** (0.003)	0.007** (0.003)	0.008*** (0.003)	0.008*** (0.003)
Inclusive Internet Index: Overall	0.129 (0.199)				
Inclusive Internet Index: Availability		0.118 (0.195)			
Inclusive Internet Index: Afordability			0.107 (0.116)		
Inclusive Internet Index: Relevancescore				-0.054 (0.096)	
Inclusive Internet Index: Readiness					0.076 (0.106)
Observations	69	69	69	69	69
R-squared	0.644	0.643	0.645	0.642	0.643
Robust standard errors in parentheses					
*** p<0.01, ** p<0.05, * p<0.1					

Note: Calculations using data from the US Bureau of Economic Analysis. Dependent variable is the value of imports per capita from each source country (in logs).