The resilience of cities to COVID-19: A literature review and application to Dutch cities[1]

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Abstract

Urban agglomeration and accessibility advantages can quickly turn into disadvantages in a pandemic. In a globalized world of international trade and travel, a virus can spread at light speed, akin to the high rate of information and knowledge diffusion attributed to highly urbanized locations. In this chapter, we discuss how cities may be affected by the COVID-19 pandemic in the medium to long run from the perspective of urban economics, focusing on the transmission of knowledge. We provide an overview of recent thoughts on the impact of the pandemic on urban economies and add a case study of the four largest cities in the Netherlands (Amsterdam, Rotterdam, The Hague, and Utrecht) in which we assess how the sector composition in these cities affects the ability of the workforce to switch to working from home and moving away from the highly prized interaction environments.

We show that a likely outcome of the pandemic is an increase in the spikiness of the economic geography of innovation and that the impulse given to digitization further increases the spatially selective transmission of information. To a degree (tacit), knowledge can be transmitted, as new levels of digital communications are now accessible that foster more personal forms of communication, including dialog (Castaneda and Toulson 2021), reducing transmission costs. However, we also argue that this does not lead to a death of distance but quite the opposite: reduced transmission costs suggest, in line with what we know of previous waves of digitization, that 'truly' tacit knowledge that offers competitive advantage becomes scarcer and that urban locales that still offer efficiency advantages in the transmission of such knowledge are becoming scarcer as well. A key question for the future is whether the conditions that define where and how these spikes occur have remained the same or were altered in subtle ways.

Introduction[2]

Highly dense cities are an ideal environment for the spread of viruses. COVID-19 is not the first pathogen to spread quickly in cities. The plague, cholera, and Spanish flu are examples of pandemics that have had a major impact urban populations (Glaeser and Cutler 2021; Griffin and Denholm 2020). In some cases, these pandemics have also led to new and innovative urban planning (Florida et al. 2021). For example, sewage systems can be directly traced back to efforts to control pathogens (Johnson 2006). According to some, the advent of sewage has enhanced the benefits of urban agglomeration, as the advantages of living in high densities have been decoupled from hygiene and health drawbacks (Rosenthal and Strange 2004; Rosewell 2016). At the same time, the continued growth of cities that sanitation has enabled has resulted in other disadvantages such as congestion, crime, and poor air quality. COVID-19 may arguably be a driver for a new systemic leap in the organization of cities (Eltarabily and Elgheznawy 2020).

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[2] Parts of this chapter have been discussed (in Dutch) in: Economische Verkenning Rotterdam 2022, www.evr010.nl.

At the same time, the COVID-19 pandemic is affecting productivity, creating disruptions and driving the destruction of economic activity in cities (Kamal 2020). Glaeser and Cutler (2021) called the pandemic, and the weak underlying institutional structure of society, "demons of density," and argued that human interaction, which is responsible for most of the prosperity of cities in past decades (Glaeser 2011), is now associated with increased risk of contagion. To reduce the rate of contagion, many governments introduced social distancing measures, ranging from working from home, limiting transport capacity, closing schools so that children must be educated at home, to closing shops and personal services (Thissen et al. 2022). These measures were accompanied by a sharp downturn in economic activity. Interestingly, Sheridan et al. (2020) showed that the primary cause of the downturn in economic activity was the virus itself rather than social distancing measures.

Following a longer than expected pandemic and its resultant measures, a sense of urgency emerged for developing digital technology (Piroșcă et al. 2021), resulting in the rapid development of remote working solutions, as evidenced by shifting patent applications (Bloom et al. 2021) as well as strong price increases in stocks for remote working solutions. Solutions range from advanced videoconferencing to remote learning options to cloud computing. Services which were previously provided in-person were done virtually, such as telehealth (Hollander and Carr 2020; Golinelli et al. 2020). Many business processes were converted to digital equivalents, demonstrating the ability of firms and employees to adapt rapidly. As such, the pandemic has led to an accelerated "emergency" digitization of work in firms (de Lucas Ancillo et al. 2021; Kudyba 2020; Soto-Acosta 2020), public services (Gabryelczyk 2020; Agostino et al. 2020), education (Cone et al. 2021; Williamson and Hogan 2020; Crawford et al. 2020), and consumption patterns. Others argue that the pandemic has laid bare the limits of digitization with respect to organizing business processes (Faraj et al. 2021). Nevertheless, the degree and speed of digitization technology developed and adopted during the pandemic is unprecedented.

This chapter presents a literature review on the spatial-economic implications of COVID-19 measures during and after the pandemic. This review focuses on the potential revival of the death of distance debate, where in line with the above narrative, it is argued that working from home can fundamentally change the need for commuting, the demand for office space, and in-person interactions with workers. Arguments in favor of and against this process are discussed. We tested these arguments with an expert focus group comprising real estate agents, local and regional policy-makers, and specialized spatial-economic consultants and reported the findings of this discussion. The chapter then presents a crude analysis that links three concepts that are central to the discussion. These concepts link working from home opportunities to sectoral urban and regional structure in the context of COVID-19 prevalence to evaluate whether more spiky spatial economies are resilient during and after the pandemic. The chapter concludes with the presentation of a research agenda.

Reviving the death of distance discussion?

Does this revive the long-lasting "death of distance" discussion prevalent in the popular literature? With San Francisco (Schram 2022) and New York (Boyle and Rockeman 2022) not seeing the return of commuters to half of pre-pandemic capacity, this time, it seems different. Furthermore, the results of Mondragon and Wieland (2022) suggest a degree of permanency in this pattern of behavioral change, as they attributed half of the house price growth between December 2019 and November 2021 to the effect of remote working (see also Barrero et al. 2021). There have been many forecasts that the importance of distance has decreased (Cairncross 1997; Friedman 2005),

starting with Future Shock (1970) and The Third Wave (1980) by futurist Alvin Toffler, who had little confidence that cities would survive and instead saw a big future for working from so-called electronic cottages built for telecommuting. However, such forecasts were followed by periods of increased importance of agglomeration economies and a spikier economic geography (Florida 2005). According to Glaeser and Cutler (2021), this is because the working population grew more than the (limited) percentage of employed persons working from home, who must still overcome loneliness, lack of interaction, and coordination. Over the last decades, large technological leaps have coevolved with increased urbanization (Leamer and Storper 2001). An important question is whether this coevolution is causal. Most evidence suggests that technological progress creates additional jobs, as previously unexplored ideas become feasible due to new enabling technologies and the automation of more mundane (i.e., routine) tasks (Florida et al. 2021). Additionally, technology may complement labor as technologies augment the productivity of workers (Autor et al. 2022).

The lockdown during the recent pandemic and the resulting forced exploration, adoption, and innovation in tools for reducing physical proximity have led to rapid technological progress. These new tools are designed to substitute physical proximity, again potentially reducing its importance. New in the discussion on geographic proximity and the role mediating role of information technology is the technology-readiness level of new collaboration tools, especially videoconferencing. Current technologies allow for dialog, more frequent interactions, and conveying (limited) emotion and body language, more readily emulating personal interaction, and its "capacity for interruption, repair, feedback, and learning" (Nohria and Accles 1992, p. 292 in: Bernela et al. 2019). This is important as communication via these media satisfies more conditions for conveying tacit knowledge.

Most evidence on the transference of tacit knowledge dates prior to 2010, with lower technology levels and more one-dimensional communication, such as e-mail, chat or voice messaging. The work of Castaneda and Toulson (2021) suggests that a critical threshold has been passed whereby a higher degree of tacit knowledge can now be transferred through digital means. At the same time, Bernela et al. (2019) argued that face-to-face interaction, and by extension, colocation, are most important for the transference of highly tacit knowledge, as innovation requires frequent contact. Information technology now provides more opportunities for frequent contact while still maintaining a degree of the benefits of face-to-face interaction.

However, this seems to be not a disruption or reversal but an acceleration of an existing trend. The question remains how agglomeration benefits are affected. With new forms of infrastructure and digitization, academia and practitioners wonder whether the importance of physical proximity decreases. At the same time, experience shows that the importance of physical proximity increases with technological breakthroughs. This can be explained by the scarcity of agglomeration advantage: if the accessibility of all places is increased, it is those locations that can still distinguish themselves by offering a unique advantage that prosper (Breznitz 2021). In other words, the number of places that offer a significantly greater number of information and knowledge dissemination options than those offered by the recent technological advance, is decreasing. By extension, this makes places with an extraordinarily high rate of knowledge dissemination scarcer and at the same time more desirable from a firm perspective. In particular, highly dense cities are more conducive to more complex interactions (Balland et al. 2020). As a result, the most central, metropolitan living environments are arguably the most attractive locations for innovative activities, as they offer a scarce resource: the sharing of more tacit knowledge at lower transaction costs than other locales or using substituting technologies.

The benefits and costs of location-independent work

The COVID-19 pandemic also gave rise to a separate but highly related question. Given an unprecedented boost to digitization location independent work (in most cases working from home) has gained ground; see the developments in New York and San Francisco. How does this affect learning within and between organizations? The insight that digitization can boost productivity has been voiced before (Chan et al. 2018), but barriers to widespread adoption have prevented firms from capitalizing on these advantages. These barriers fall into four categories:

- Culture: Work is at the office.
- Trust: Will employees be productive?
- Risk: Will it work? Will our clients accept it?
- Collective action: It only works if everyone does it.

The conditions of the pandemic created a sense of urgency that forced firms to rapidly adapt or perish. This created a unique set of conditions that caused a paradigm shift in the way that work is organized. The initial results suggest positive experiences and persistent behavior. At the macro level, the numbers suggest that most employees choose to perpetuate some but not all of the modified behavior: employees return to the office, although not with the same frequency as before. The pandemic has led to a forced experiment with digitization and working from home in many organizations. Early experiences suggest that working from home results in various cost savings: 1) monetary cost savings (Beno 2021), 2) transaction cost savings, and 3) productivity gains (OECD 2020). Conversely, there are indications that working from home also increases 1) social costs, 2) health costs, and 3) innovation costs.

Working from home results in significant monetary cost savings, both for employers and employees. Accountancy firm PwC (2020) estimated that employers would save €1.7 billion per year if all Dutch employees work from home for one day. The popular press suggests that employers are also more positive about the role of working from home in their business processes compared to the situation before the pandemic (CNN 2022; Financial Times 2021). Office space is a potentially significant source of cost savings for employers, but savings also occur through minimized catering, energy, and travel expenses (in the Dutch case, the variable costs of company cars are an important source of cost savings). Research by DJV Insights (2021) showed that even after the pandemic, many employees desire to continue to carry out part of their work at home. Employees gain back the nonreimbursable financial costs of commuting and may save on the number of hours of childcare needed (due to travel time savings outside work hours) (Lupu 2017; in: Beno 2021). It seems that the increase in working from home, at least in part, is permanent (Barrero et al. 2020). The Netherlands Bureau for Economic Policy Analysis (CPB) (Jongen et al. 2021) predicted a doubling of working from home compared to the pre-COVID-19 situation. This is in line with the results of Hamersma et al. (2020), who found that many employees reported positive experiences of working from home as well as an increased preference to work from home in the future.

Beno and Hvorecky (2021) showed that working from home may be accompanied by a fall in productivity. Conversely, productivity gains are also plausible: the technology that we now use to work from home can be used post-COVID-19 to work at any desired location (Barrero et al. 2021). The time savings this creates can be an important reason to rearrange work patterns. Travel time also decreases during work, and appointments are handled digitally so that more conversations can be held in each time span. Even if digital conversations are less productive, overall productivity can still increase if the time savings outweigh the missed benefits of an in-person meeting. It is plausible that there is a decreasing marginal return on in-person meetings, which would imply an optimum

that is partly digital and partly in person. However, this does require specific infrastructure and adaptive capacity on the part of the office worker.

De Lucas Ancillo et al. (2021) argued that the digitalization response to the COVID-19 pandemic goes beyond simple digital substitution and requires "breaking with the past." While companies initially used technology to emulate existing business processes remotely, they subsequently redesigned business processes, the workplace, governance, and corporate culture to new conditions and opportunities arising from digitization. It is not yet clear whether the average company adapts to digital change or applies a digital transformation (Soto-Acosta 2020), the latter being transformational in the business process. However, there are also critical voices about this new way of working. The long-term effect of the pandemic is still unclear. Employees miss face-to-face interactions and social contact with colleagues and the substantive and social depth in the work (Glaeser and Cutler 2021). This is at the expense of work quality, happiness at work, and, in some cases, even the wellbeing of the employee (Josten and Merens 2021). Roper and Turner (2020) pointed out that innovation in firms is procyclical and that small and medium-sized enterprises (SMEs) face a varying degree of cash constraints to innovation because of the pandemic, resulting in uneven opportunities to invest in innovation and thus adapt to post-COVID-19 conditions. This view is further supported by Bartik et al. (2020), who showed that the median SME (in the U.S.) had about a two-week worth of cash reserves on hand.

Furthermore, it is conceivable that frequent working from home has negative consequences for learning and innovation not only within but especially between organizations (Glaeser and Cutler, 2021). Working from home does not fit well with the ideal image of innovation ecosystems, with nonlinear process planning, many personal interactions, and implicit knowledge transfer. Conversely, if we view the technology leap in digitization not as solely enabling working from home but as an enabler for location-independent work, interaction between people and organizations can become more frequent.

Incidentally, the impact of COVID-19 on different organizations and groups of employees is certainly not uniform. There are major differences between large companies and small and medium-sized enterprises and between younger or new employees and experienced employees. In SMEs, working in person "in the office" is more so the norm. Recently hired or young employees seem to experience the strongest benefits from interaction by learning how to work in the business (Kahn, 2022; Glaeser and Cutler, 2021). More experienced employees, who may have more familial obligations, experience more benefits from working from home, although this is strongly dependent on the family situation (e.g., having children who attend school), home characteristics, and personal preferences. However, the heterogeneous impact is of importance for the knowledge transfer between these groups, as differing preferences and benefits limit interactions (Thissen et al. 2022, Grabner and Tsvetkova 2022) and therefore limit a source for learning within organizations.

Furthermore, the workplace is not just a place to attain productivity, learn about business processes, and share knowledge. It is also a place where "learning the ropes" and adopting a broader skillset in the form of competency development takes place. The workplace can be viewed as a meaningful place for development that aids in providing purpose and belonging and helps shape identity (Michaelson et al. 2014). It is a place for personal development, as employees are also inspired by colleagues through mentoring and strategic leadership. The results of Younas and Bari (2020) even suggest that talent retention depends, in part, on these activities rather than knowledge sharing.

Consequences for the urban and regional economy

However, it seems that location-independent work finally has carved out a more permanent place in the knowledge economy, which has consequences for the urban economy. In the office market, this mainly leads to a change in the use of space. The value of the office will be assessed in a different way. The employee comes to the office for the possibility that the building offers to engage in valuable interactions with others people such as colleagues, customers, suppliers, and partners. This leads to a different set of requirements regarding the office and therefore also has consequences for the design, whereby common areas for consultation and informal spaces such as coffee bars and sports facilities are more central (Florida et al. 2021). At the same time, separate units are important for digital meetings and concentration rooms. In consulting a group of Dutch experts[3], respondents doubted whether more location-independent work leads to an increased or decreased demand for office space. The experts state that the firms they advise have not yet made firm decisions on future leases. For the time being, companies are closely monitoring new developments and try to optimize within existing leases. It appears that parties vested in keeping offices have limited short run options for adjustment.

Relative radical behavioral changes offer room to accelerate developments that were initiated before COVID-19 (Van Oort and Thissen 2021). For example, the pandemic has led to an increased focus on health in the city and a healthy life balance. Attention to greening the city and space for slow traffic (e.g., cycling and walking) is also increasing. Here, too, the pandemic has an accelerating effect. Resilience is increasingly associated with innovation: Challenges such as the COVID-19 pandemic create opportunities for improvement. However, the pandemic also accelerates inequality in the city. Knowledge workers (Drucker 1999; Autor et al. 2003) in business services appear to be less affected by the pandemic than employees in personal services and production (Glaeser and Cutler, 2021). For people with freedom of choice, the palette of possibilities increases. On the other hand, the options for people in a profession in which working elsewhere is not possible, or for people with a more limited budget, are decreasing, and as such a digital divide may be occurring (Beno 2021; Miladinovic 2020). In their book *Survival of the City*, Glaeser and Cutler (2021) showed the other side of economies of scale and high densities in cities. They argue that the pandemic had a profound impact on cities because of their underlying problems. These problems center around the provision of universal access to the city and how “insiders have rigged the game.” Their argument revolves around the universal but unequally distributed benefits of cities and the lack of openness toward talent and new business. They argue that cities are at risk of demise because institutions hinder entrepreneurship and the entry of new residents, as well as perpetuate pockets of poverty by restricting new development. Of particular interest to this chapter is their argument that the services industry provides mass employment for those without a college degree as well as for high-paying talent. Glaeser and Cutler reason that in an age of digitization, humans retain an edge position in personal interaction and creativity. Their anecdotes show that many personal services in cities are more about experience rather than function and luxuries rather than necessities.

We conducted a focus group interview with policy-makers and industry experts in December 2021, the results of which provide additional insight into the role of the city as a nexus for human interaction (reference: EVR, see also footnote 3). The experts agreed that the hypothesis of i.a. Glaeser and Cutler (2021) that the pandemic had a very disruptive effect on existing behavior that does not seem correct; rather, there is limited adjustment and especially even acceleration. This is

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related to the ability of people to resist and bounce back; as soon as an obstacle has been removed, we often return to established behavioral patterns. Our exploration shows that locations are increasingly evaluated on multiple criteria, which increases the complexity of the city. Before COVID-19, a preference seemed to arise for metropolitan, mixed-use interaction environments, with rich facilities and preferably sufficient green space. The pandemic has accelerated the reaffirmation of this preference. Another trend that has been reaffirmed is the rise of the services industry, particularly regarding the integration of digital and physical services, such as grocery shopping and online food delivery – (Gavilan et al. 2021). The widespread adoption of these technologies at an unprecedented rate has supplanted traditional services. However, this adoption process was in part forced and does not serve the human desire for human interaction that is so inherently ingrained in the service economy. Many services we consume are not necessities but luxuries, which we can do without if they are deemed too risky (Glaeser and Cutler 2021). During the pandemic, digitization has created complements for many necessary services, but not the luxuries that are delivered face-to-face and whose primary value is human interaction and experience (Weltevreden et al. 2008, Farag et al. 2006). It is that part of the service economy which we forego during lockdown, and which we quickly readopt when restrictions are relaxed. This point of view is further strengthened by the insights of Correia et al. (2020), who showed that it is the health-related effects of pandemics that depress the economy rather than government intervention.

At the same time, this also means that locations that were perceived as less attractive before the pandemic will face tougher challenges after the pandemic. Monofunctional and decentralized locations and outdated real estate will especially face challenges in competing for business. As the urgency to commute to work has been reduced for many office workers, the requirements that work locations need to meet to still attract workers have increased.

The pandemic and Dutch regions: Indications for spikier economies?

In this section, we preliminarily evaluate several issues raised in the previous sections. Preliminary, as up-to-date data on economic behavior are scarce, the pandemic is not fully over. We work with hypotheses posted by Glaeser and Cutler (2021), linking density to the association between sector structure (with respect to knowledge intensive business services and hospitality), COVID-19 prevalence, and the ability to work from home just prior to the COVID-19 pandemic. We assess bivariate relations between these three indicators in the 40 NUTS-3[4] urban regions of the Netherlands and relate each of these to density to evaluate whether more spiky economies fare better or worse in and after the pandemic.

The ability to work independently of location differs by occupation and sector. It is mainly the service and business professions in the knowledge economy that offer opportunities for location-independent work. This poses an important dilemma. It is precisely in this knowledge-based economy that proximity plays a crucial role in knowledge exchange and therefore in fostering innovations from which firms, cities, and regions can derive competitive advantages. Therefore, we may expect that working from home is more prevalent in regions with higher shares of knowledge-intensive business services and in regions where face-to-face meetings may lead to more spiky economies. Figure 1 suggests a clear correlation between the ability to work from home and the share of knowledge-intensive business services in urban regions in the Netherlands. Although this does not prove causality, it is plausible that *knowledge-based economies allow for more location independent work* (in line with Glaeser and Cutler 2021, Chapter 7) as Figure 1 further confirms that

[4] For more information on the Nomenclature of Territorial Units for Statistics (NUTS), see https://ec.europa.eu/eurostat/web/nuts/background

density is positively related to both the share of knowledge intensive business services and the ability to work from home.

In knowledge-based economies, hospitality services (e.g., hotels, restaurants, meeting places) are often identified as key facilitators of interaction between employees of different firms (Glaeser and Cutler 2021, Thissen et al. 2022). Therefore, although the hospitality industry itself cannot work well from home, we would expect a correlation between high shares of the hospitality industry and the ability to work from home in regions if hospitality industries function as facilitators of knowledge-based economies. However, Figure 2 shows that there is little to no correlation between hospitality industry shares and the ability to work from home prior to the pandemic. Although this result is surprising, it does not exclude the possibility of more complex conditional correlations resulting from counterbalancing forces[5]. On the one hand, the hospitality industry may facilitate services that allow for more working from home, while on the other hand, working from home is rare in most occupations within the hospitality sector and other sectors that are strong drivers of the hospitality industry such as tourism, culture, the arts, and the events industry. However, for now, we conclude that *regional economies with large shares of hospitality industries are unrelated to economic structures that enable working from home* (contrary to the suggestion in Glaeser and Cutler 2021, Chapter 6). Furthermore, Figure 2 provides another surprising result: the share of hospitality services is not strongly correlated with density in Dutch regions, which is contrary to what was expected.

As Glaeser and Cutler (2021) argued, the artistry, care, and effort of a barista making a latte for the enjoyment of the customer is hard to digitize; at the same time, this interaction is seen as a risk of contagion during a pandemic. We can derive two insights from this. First, in a service-based knowledge economy, direct interaction may be required to experience the benefits of personal attention, as is also argued in the case of knowledge exchange. Therefore, if the transmission of knowledge and personal experience follows the same mechanism of viral transmission, namely, frequent personal interaction, then we would expect the two to coincide. Second, this would result in higher COVID-19 prevalence in knowledge-based economies.

Figure 3 suggests that COVID-19 incidence and knowledge-intensive business services coincide in urban regions in the Netherlands. *Regions with larger shares of knowledge-intensive business services also carry a higher risk of COVID-19 infection* (Glaeser and Cutler 2021, Chapter 5). We do not claim that this is a causal connection but simply point out that the conditions for knowledge transfer are likely the same conditions relevant for mass contagion. The results with respect to density in this figure are also compelling, as all dense regions have high COVID-19 incidence, but not all low-density regions have low incidence. This suggests that while density may nearly guarantee contagion, low density does not necessarily protect against contagion.

Additionally, and by extension of the earlier argument, we also assessed the association with hospitality services. Hospitality services, such as consumer amenities, are often argued to be important facilitators of the knowledge economy (Glaeser et al. 2001). They offer workspaces to gig workers and facilitate meetings and knowledge exchange. As such, they could be enablers of contagion, as well as knowledge exchange. Figure 4 suggests an absence of correlation between COVID-19 incidence and hospitality services. The figure can easily be interpreted as suggestive of a

[5] One may argue that this argument only holds if the hospitality industry serves the knowledge economy. To address this concern, we also tested the conditional correlation in the setting of a parsimonious OLS model. This estimate yields similar (insignificant) results.

negative correlation in specific subgroups. The effects of national lockdowns on these results should be acknowledged, as hospitality services were closed or highly regulated for a long time.

To relate whether regions in which working from home was easier prior to the pandemic and were also better protected from COVID-19 contagion, we examined Figure 5. This figure suggests a weak positive association, indicating that the ability to work from home at higher frequencies did not protect these regions from contagion and that other factors related to human interaction may better explain COVID-19 incidence. We see a positive association between density and both the COVID-19 incidence and the ability to work from home.

To sum up the results and assess whether Glaeser and Cutler's "demons of density" are also at work in the Netherlands, we found that denser urban regions have higher COVID-19 incidences and have a sector structure favoring knowledge-intensive business services that simultaneously offer more opportunities to work from home. However, the ability to work from home did not protect these regions from contagion. We found that in the Netherlands, density and COVID-19 incidence did not strongly correlate with the share of hospitality services in the region but note that the hospitality services industry was among the most tightly regulated sectors during the pandemic. Furthermore, our analysis shows that while density coincides with COVID-19 incidence, low density does not insure against contagion. This all points toward more vulnerable and spiky economic development during and after COVID-19. To shed additional light on the dynamics between sector structure, the ability to work from home, and COVID-19 incidence, we focused on the four largest and densest cities in the Netherlands.

The pandemic in the four largest cities in the Netherlands

In this section, we briefly explore the impact of the pandemic in the four largest Dutch metropolitan regions: Amsterdam, Rotterdam, Utrecht, and The Hague. Based on secondary data on these regions (at the NUTS3 level), we assessed their economic structure in more detail, decomposed the ability to work from home prior to the pandemic, and monitored COVID-19 incidence and employment dynamics. A priori, we would expect economies with a large share of business services to have better potential to switch to remote work and subsequently have a lower COVID-19 incidence. However, the results in the previous section suggest that the reverse is true: COVID-19 incidence and working from home go hand-in-hand. Based on insights from the literature review, we explored whether we can observe a stronger impact of the pandemic in cities with a stronger specialization in the service industry compared to cities with other specializations based again on the premise that the mechanisms for the spread of knowledge are similar to the mechanisms for the spread of contagion.

We calculated relative specializations for the four metropolitan regions based on firm establishment data (see Table 1). The data used are publicly available from Statistics Netherlands and include all firm establishments excluding the public sector (i.e., government, health care, and education). The four cities differ in their relative specializations. In all four cases, services are more prevalent in the metropolitan regional economy compared to the national economy. The metropolitan region of The Hague has a modest specialization in services (1.09) and, as expected, is less specialized in agriculture (0.82), industry (0.83), and trade and logistics (0.86) compared to the national economic structure. However, compared to the other three cities, these relatively space-intensive activities are most strongly represented. Specifically, for the region of The Hague, the location of public sector establishments affects the results, as this city houses the seat of parliament as well as different branches of national government. The region of Amsterdam is strongly specialized in commercial services, both knowledge intensive (KIBS – 1.18) and other commercial services (1.16), while

agriculture (0.15) and industry (0.18) are underrepresented both compared to the national level as well as the other cities. The Rotterdam region specializes in trade and logistics (1.13), as the region houses the largest port in Europe. The region of Utrecht has the strongest specialization in knowledge intensive business services (0.13). As such, based on these data (as well as city characteristics), we can derive a distinct profile for each of the four cities: The Hague as a center for public services, Amsterdam as a services economy, Rotterdam as a major trade hub and Utrecht as a knowledge economy.

Figure 6 provides insight into the impact of sector structure on the degree to which working from home was common before the pandemic in these city regions. We estimated the proportion of employment in which working from home is a common versus uncommon occurrence. We combined two secondary data sources at the national level from Statistics Netherlands on the propensities to work from home in different occupations with data on the frequency of occupation within sectors. The results were multiplied by sector structures in the respective regions to yield the results in the figure. Two key assumptions underlie the validity of these results: 1) sorting of occupations over sectors in regions mimics national patterns of sorting, and 2) propensities to work from home in specific regions are similar for specific occupations.

The results of this exercise confirm that in the regions with the strongest services specializations, the ability to work from home is highest. Even before the pandemic, working from home was more prevalent in the occupations most dominantly represented in these regions. Interestingly, the region with the strongest specialization in knowledge intensive business services (Utrecht) is not the region in which working from home is most common. Rather, the region of Amsterdam, which specializes in other commercial services, had the highest incidence of working from home. Although tentative, this would suggest that working from home may more strongly be related to the services aspect of these jobs rather than their knowledge intensity.

In

Figure 7, we plotted the cumulative number of COVID-19 infections over the total population for the four largest Dutch cities (at the municipal level), ordered from largest to smallest city by population. In the first one-and-a-half year of the pandemic, Rotterdam had the highest COVID-19 incidence. Under the social distancing measures and lockdown restrictions imposed, the sector structure of Rotterdam did not contribute to the ability to contain contagion (Thissen et al. 2022). Simply put, the city of Rotterdam housed an outsized number of jobs in which working from home was impossible or difficult. In the last three months of observations, we found the opposite result. Aside from the observation that COVID-19 incidence surges in the most recent three-month period under the relaxed restrictions as well as the emergence of the omicron variant, we see another interesting result. Under these relaxed restrictions, the surge in cases is strongest in Utrecht. While the city had the lowest cumulative incidence of the four cities up until December first, 2021, it now has the highest incidence. Although anecdotical, this reversal coincides with the end of government intervention. It would be interesting to study whether this reenabled the high levels of interaction in a knowledge economy and assess whether these interactions are conductive to contagion.

As a last step, the changes in gross regional product are presented in Table 2 for different stages of the pandemic. In the early pandemic, the city-region of Amsterdam was most affected. The industry mix in the capital favors both financial institutions and tourism, sectors which were strongly affected by the pandemic. The city of the Hague was relatively protected from adverse effects by its relatively large public sector. At the same time, sector structure explains the pattern of recovery. The strongest recovery occurred in Amsterdam, but to a level prior to the pandemic. The city of Rotterdam experienced the strongest growth between 2019 (prior to the pandemic) and 2021. Within the context of the four largest cities, the pandemic seems to have favored the development of cities with lower services-oriented agglomeration and more knowledge-intensive economies (e.g., Utrecht), allowing these cities to catch up with Amsterdam. These results suggest a slowdown of economic activity in services that require in-person interactions in Amsterdam, while the sector structures in Rotterdam and The Hague ensured continued activity and Utrecht's knowledge economy enabled an easier than expected switch to remote work compared to prior to the pandemic.

The Netherlands as a special case?

Our results are preliminary in the sense that the full effects of the COVID-19 pandemic can only be analyzed in hindsight. However, our results provide a first indication for the direction of such a development in the Netherlands. Our results suggest that density does not have a strong effect on contagion, but low density in the context of the Netherlands is distinct from low density in other larger, less urbanized countries. Therefore, it is valuable to replicate the analysis with data from other countries with stronger variation between NUTS-3 areas. A similar argument can be made with respect to our case study on the four largest cities in the Netherlands. These cities are almost connected into one single urban agglomeration, locally called the "Randstad," a polycentric urban region with a green area at its center surrounded by four large and many smaller agglomerations (Van Oort et al. 2010). Therefore, our results should be considered within this context. We preliminarily tested whether results from U.S. oriented literature hold in the distinct context of the Netherlands. The similarities and differences we identify may be instructive for identifying the underlying mechanisms of the processes discussed in the literature review to our chapter.

Conclusion and research agenda

This chapter lists what is known about (post) pandemic impacts in urban regions. The chapter investigates how urban agglomeration and accessibility advantages affect the spread of COVID--19 and how similar these conditions are to the rapid spread of information. We discussed how cities may be affected by the COVID-19 pandemic in the medium to long run from the perspective of urban economics, focusing on the transmission of knowledge. An overview of recent thoughts on the impact of the pandemic on urban economies is provided. We then tentatively assessed whether a knowledge-based sector structure, COVID-19 incidence, and the ability to work remotely coincide at regional levels in the Netherlands, as argued by Glaeser and Cutler (2021). A special focus is on the four largest cities in the Netherlands (Amsterdam, Rotterdam, The Hague, and Utrecht), in which we studied how the sector composition in these cities affects the ability of the workforce to switch to working from home (moving away from the highly prized interaction environments), whether this enables people to avoid infection, and how regional domestic products developed during the pandemic.

Our results suggest that although density, a sector structure favoring knowledge-intensive business services, and the ability to work from home go hand in hand in urban regions in the Netherlands, this does not ensure against contagion in a pandemic. While we found no link to hospitality services in our analysis, we recognize that these were highly regulated over the past two years. We did find that low density is no guarantee for low contagion in the context of the Netherlands.

Our indicative analysis shows that the conditions for a spiky economic geography (e.g., density, knowledge intensity, and interaction) are not necessarily at odds with a post-COVID urban economy. We suggest that a likely outcome of the pandemic is an increase in the spikiness of the economic geography of innovation and that the impulse given to digitization further increases the spatially selective transmission of information. To a tacit degree, knowledge can be transmitted, as new levels of digital communications that foster more personal forms of communication, including dialog (Castaneda and Toulson 2021), are now accessible, thereby reducing transmission costs. However, despite early signs in San Francisco and New York, this does not lead to a structural death of distance, but quite the opposite: reduced transmission costs suggest, in line with what we know of previous waves of digitization, that “truly” tacit knowledge that offers competitive advantage becomes scarcer and that urban locales that still offer efficiency advantages in the transmission of such knowledge are becoming scarcer as well. A key question for the future is whether the conditions that define where these spikes occur have remained the same or were altered in subtle ways. In addition, the question is put forth that as “truly tacit” knowledge becomes scarcer, it may also become relevant for a smaller subset of sectors in the economy. This requires further research.

In terms of urban and regional resilience, the pandemic seems to demonstrate that an overspecialization in the services industry poses significant risks if there are forces at work that limit human interaction and mobility. Cities with more diverse economic structures, including manufacturing, logistics, health care, and government, were apparently more resilient during the pandemic. Perhaps analogous to the risks faced by highly specialized industrial cities of the 20th century, a narrow specialization in specific sectors of the services economy may prove economically risky in the 21st century (Frenken et al. 2007).

Conceptualization about COVID-19 incidence, working from home, knowledge intensity, and regional productivity is not readily available and is difficult to assess in practice. Therefore, a research agenda is needed to better study economic resilience in the future. Our literature review and our empirical exercise show that sector and occupational structure dictate the ability to work remotely. As such,

we expect the largest changes to occur in those cities that have the largest shares of knowledge intensive business services. We suggest that further study is needed to assess how remote work affects knowledge-intensive business services, particularly in the form of the transmission of various degrees of tacit knowledge.

Lockdown conditions may have disrupted both the transmission of disease and knowledge, but human interaction is not limited to the workplace or to the sharing of tacit knowledge. The identification of the resilience of workers and firms requires detailed study into the question of whether workers in knowledge-intensive business services are at a higher risk of contagion now that restrictions have been relaxed. Conversely, our overview also suggests that study is warranted into the question of whether the transmission of tacit knowledge in firms that have adopted more intense remote work regimes is lower compared to those firms that have worked more on premise. This is a long-term undertaking, as it requires assessing microlevel innovation and productivity outcomes of the next years in counterfactual regimes of firms. Complementarily, the reliance of local economies on global value chain relations also needs to be accounted for when determining regional economic resilience (Thissen et al. 2022).

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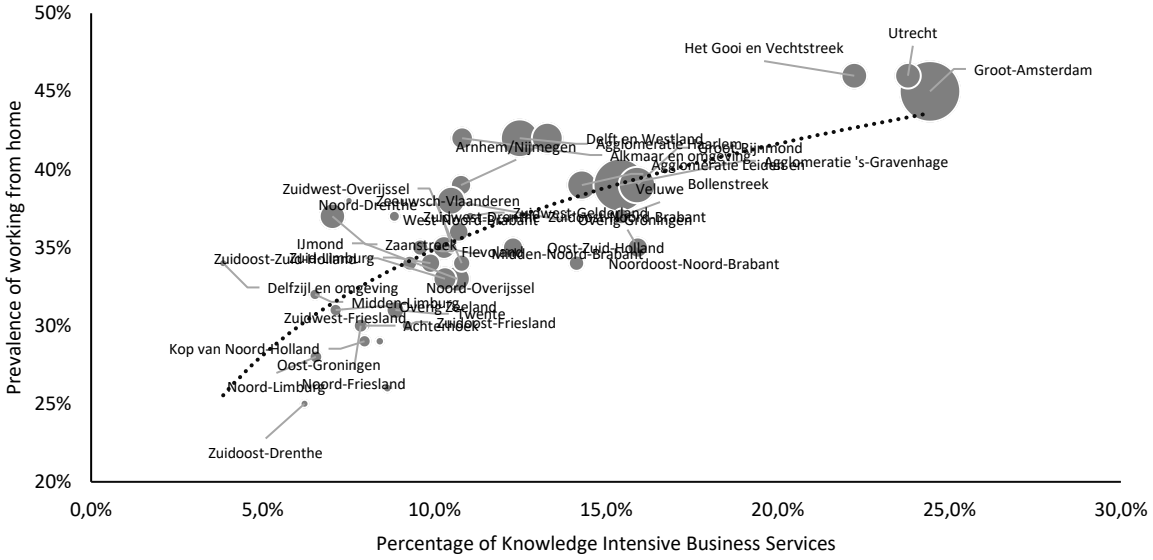
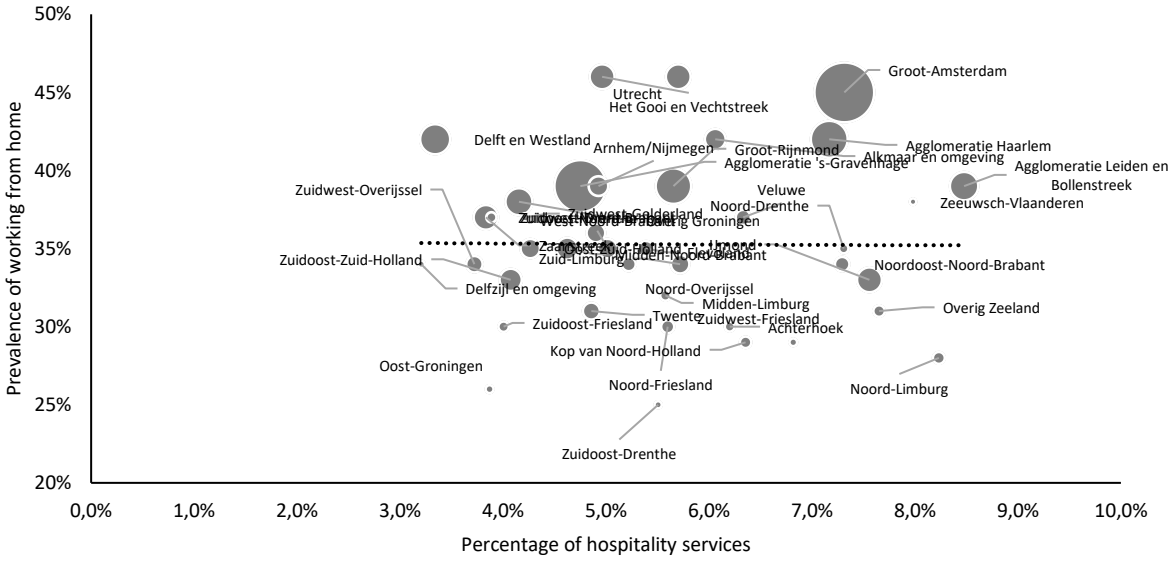
Figures

Figure 1: Working from home and knowledge intensive office workers – a more knowledge intensive workforce is more adaptable



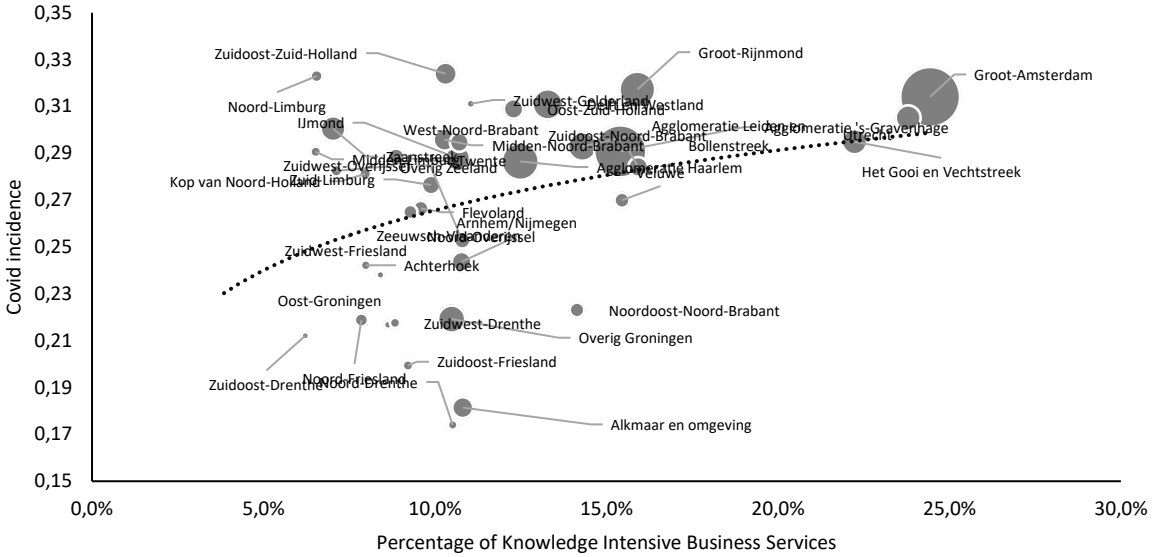
Source: Centraal Bureau voor de Statistiek (Statistics Netherlands) 2018

Figure 2: Working from home and hospitality services – no correlation



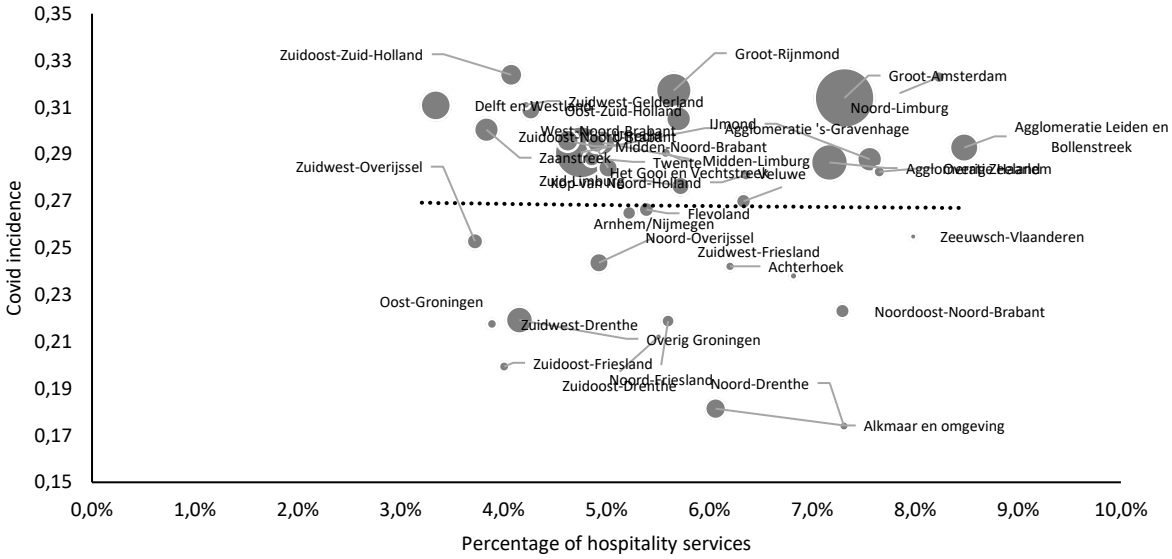
Source: Centraal Bureau voor de Statistiek (Statistics Netherlands) 2018

Figure 3: Risk of contagion and knowledge intensive office workers – places with more knowledge workers have a higher risk of contagion



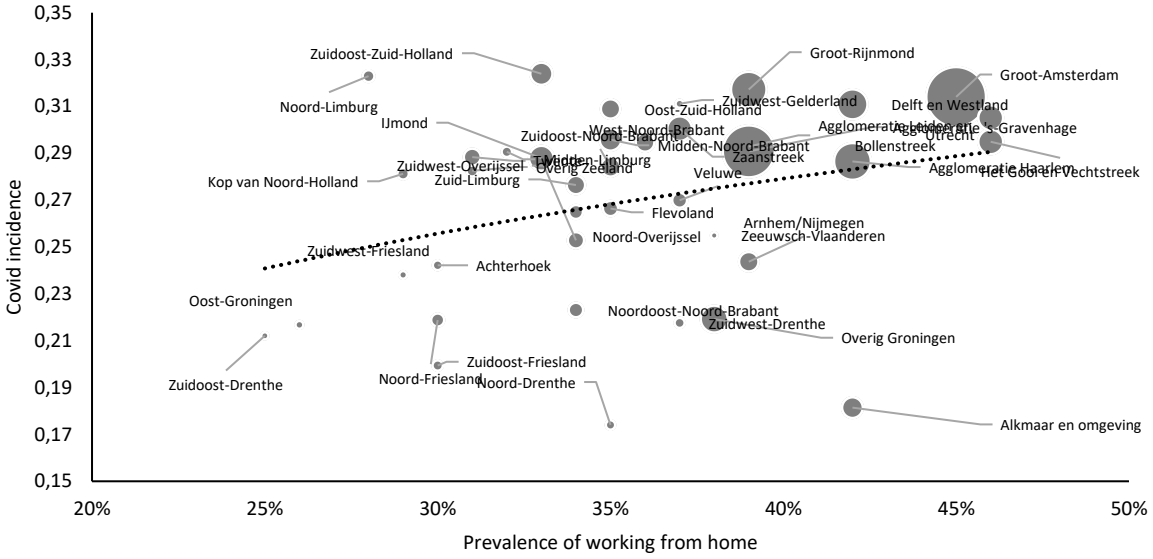
Source: Centraal Bureau voor de Statistiek (Statistics Netherlands) 2018, RIVM 2022

Figure 4: Risk of contagion and hospitality services – no clear correlation



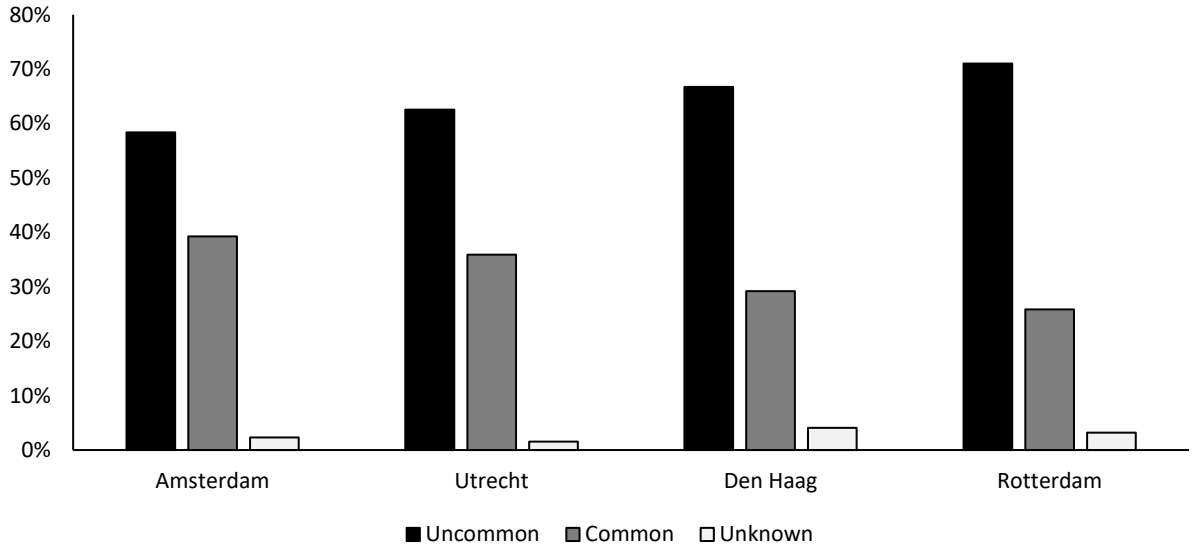
Source: Centraal Bureau voor de Statistiek (Statistics Netherlands) 2018, RIVM 2022

Figure 5: Working from home and contagion - prevalence of working from home and COVID-19 incidence show no correlation



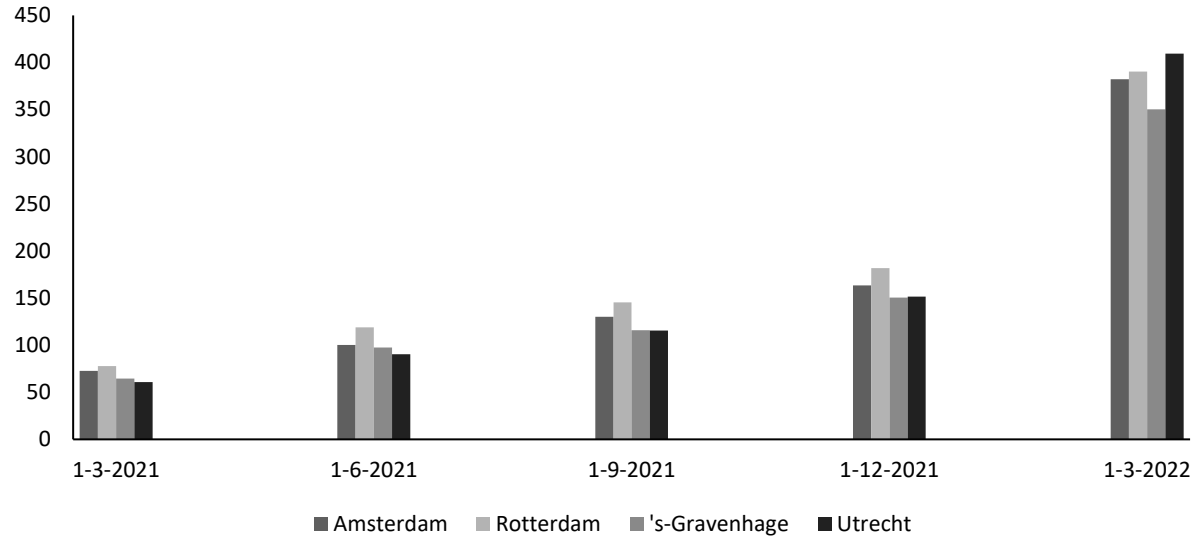
Source: Centraal Bureau voor de Statistiek (Statistics Netherlands) 2018, RIVM 2022

Figure 6: Distribution of employment in which working from home is common or uncommon by region



Source: LISA 2017, Statistics Netherlands 2019, author's elaboration.

Figure 7: Cumulative COVID-19 incidence per 1000 inhabitants in the four largest Dutch cities



Source: RIVM 2022; Statistics Netherlands 2020-2021, aggregated by the authors.

Tables

Table 1: Relative specialization by firm establishments in major Dutch cities as measured by a location quotient

		NUTS-3 region			
Codes	Activity	The Hague	Amsterdam	Rotterdam	Utrecht
A	Agriculture	0,822	0,148	0,475	0,497
BCDE	Industry	0,828	0,178	0,518	0,505
GH	Trade and logistics	0,859	0,865	1,133	0,847
ILNRS	Commercial services (excl. KIBS)	1,089	1,160	1,029	0,973
JKM	Knowledge intensive business services	1,060	1,179	1,038	1,229

Source: Statistics Netherlands 2020-2021, author's elaboration

Table 2: Changes in GRP for the four cities in various stages of the pandemic

Region	Early pandemic 2019-2020	Control and Recovery 2020-2021	Net effect 2019-2021
Rotterdam	-2,40%	6,00%	4,00%
Amsterdam	-6,70%	7,00%	0,00%
The Hague	-2,00%	4,00%	3,00%
Utrecht	-2,60%	5,00%	3,00%

Source: Statistics Netherlands, 2021