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# A timely estimation of local investment trends using administrative data[1]

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# A timely estimation of local investment trends using administrative data

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## Abstract

Investments in transport equipment are one of the most volatile components of the Italian National Accounts, and they are highly correlated with overall business investments in capital goods. By aggregating selected components of motor vehicle registrations coming from administrative sources, it is possible to approximate national trends in quarterly investments in transport equipment very well. Based on this evidence, we build provincial-level quarterly indicators of business investments based on granular data on motor vehicle registrations, disaggregated by vehicle and owner type. We report significant heterogeneity in investment trends across provinces.

Keywords: business investments, vehicle registrations, administrative data.

JEL classification: E01, E22.

## Contents

# 1. Introduction[1]

Central banks need timely information about the state of the economy to calibrate monetary policy decisions. Indeed, it is difficult to make sound quantitative assessments of the impact of macroeconomic shocks when only aggregate, low-frequency data are available. Moreover, the importance of having high-frequency macroeconomic data available has undoubtedly become much more evident since the outbreak of the Covid-19 pandemic.

In this paper, we exploit a new dataset of granular administrative data for 2019-2021 to nowcast business investments in Italy. In particular, we use data on motor vehicle registrations to track the evolution of investments in transport equipment, which are one of the most volatile components of the Italian National Account and strongly correlate with overall business investments in capital goods.

So far, car registrations have been widely used to assess household expenditure trends on durable goods. Here, we show that aggregating selected components of motor vehicle registrations makes it possible to obtain precise estimates of national trends in quarterly investments in transport equipment as well. In particular, we exploit the information on the type of owner, i.e., whether it is a private individual or a company. This information is crucial to identify and remove the component of car registrations that should be accounted for as households' expenditure on durable goods, as they may show different trends compared to registrations by companies. Moreover, cars account for the largest and most volatile share of commercial vehicles, and keeping track of cars is key to obtaining a good estimate of investment trends.

Based on this evidence, we exploit the spatial granularity of motor vehicle registrations to build quarterly indicators of business investments at the provincial (NUTS-3) level. These indicators fill a severe statistical gap in terms of spatial granularity of Italian National Accounts. In Italy, business investment estimates are available only up to the NUTS-2 level and with a three-year lag.

We report significant heterogeneity in investment trends across provinces. Looking at the overall evolution of registrations during the pandemic, the percentage variation in vehicle registrations ranges from -37.0 percent to +10.4 percent. In addition, we find that the evolution of investments has been weaker in the provinces most affected by the epidemic, as measured by Covid-19-related hospitalizations. In particular, a 10 percent increase in hospitalizations is associated with a 0.32 percent reduction in the number of vehicle registrations. Therefore, given the significant variance of hospitalization rates across provinces, epidemiological conditions account for a significant fraction of the observed heterogeneity in commercial vehicle registrations.

This paper is organized as follows. Section 2 describes the administrative dataset. Section 3 assesses the correlation between our indicators of commercial vehicle registrations and business investments, and we analyze trends at the provincial level. Section 4 investigates the correlation between investment trends and epidemiological conditions. Section 5 concludes.

## 2. Data

We use granular data on motor vehicles registrations in Italy provided by the Ministry of Sustainable Infrastructures and Mobility. Our dataset includes the monthly number of registrations by vehicle type at the municipal level, from January 2019 to June 2021. The vehicle types are as follows: i) cars, ii) buses, iii) light commercial vehicles, and iv) trucks.[2] Registrations are assigned to municipalities based on the primary address of the owner.

Figure 1. Car registrations by owner

(indices 2019=100)
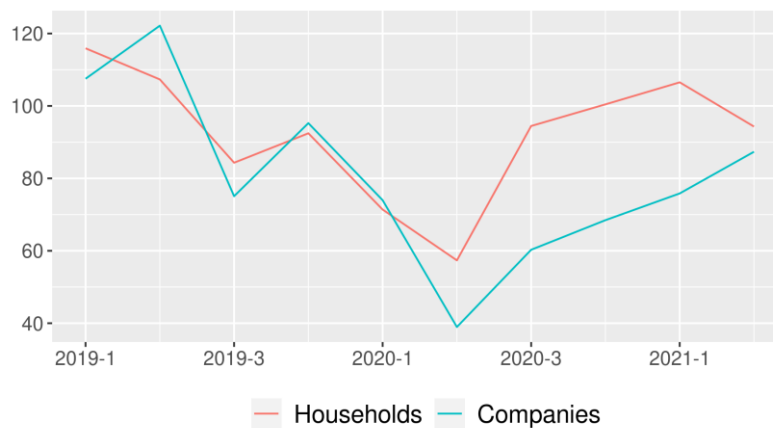


Source: Ministry of Sustainable Infrastructures and Mobility.

Regarding cars, we know the type of owner, i.e., whether it is a private individual or a company. This information is crucial to identify and remove the component of car registrations that should be accounted as households' expenditure in durable goods, as they may show different trends compared to registrations by companies (see Figure 1).[3] In our definition *commercial vehicles* include buses, light commercial vehicles, trucks and cars owned by companies.

Cars account for the largest and most volatile share of commercial vehicles (Figure 2).[4] In 2019, cars accounted for 79 percent of commercial vehicle registrations. The second most important category is light commercial vehicles (18 percent).

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[2] Commercial vehicles are classified according to their mass in tons. The mass of light commercial vehicles should be less than 3.5 tons.

[3] In 2019, the share of cars registered by private individuals was about 57 percent.

[4] Unfortunately, we do not have data about the monetary value of different type of vehicles. It is very plausible that the share of cars over total expenditure would be lower, and that of other segments (e.g. trucks) higher.

Figure 2. Commercial vehicles registrations by type

(thousands)
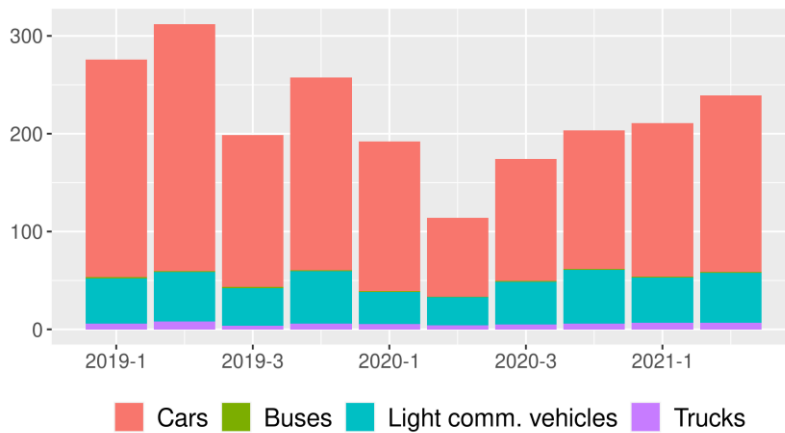


Source: Ministry of Sustainable Infrastructures and Mobility.

# 3. Commercial vehicle registrations and business investments

Our goal is to use commercial vehicle registrations to timely track trends in business investments at a granular level. Similar to Chetty et al. (2020), we test the representativeness of these statistics through a comparison with a publicly available benchmark, possibly at the aggregate level. Unfortunately, official statistics on investment at a geographical level are scarce and very lagging.[5]

Gross fixed investments in transport equipment in the National Accounts – which include depreciation – are the most appropriate benchmark for this comparison.[6] Investments in transport equipment are also one of the most volatile components of the National Accounts, and therefore they are a challenging benchmark. Moreover, investments in transport equipment are highly correlated with overall business investments in machinery, equipment and weapons (Figure 3).[7] Therefore, they provide timely and valuable information on trends in business investment.

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[5] ISTAT disseminates annual investment estimates only up to the regional level and with a three-year lag. Last available data refer to 2018. Moreover, the breakdown for asset type is not available.

[6] New vehicle registrations are the main input used by ISTAT to estimate investments in transport equipment. Differently from us, they retrieve data from UNRAE (Unione Nazionale Rappresentanti Autoveicoli Esteri), and there may by minor misalignments compared to the data disseminated by the Ministry of Sustainable Infrastructures and Mobility. Moreover, ISTAT exploits information on transactions of used cars, production and external trade of transport equipments. See ISTAT (2015a) and ISTAT (2015b).

[7] Investments in transport equipment are a subcomponent of investments in machinery, equipment and weapons (their share was about 18 percent during 2015-2020).

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## Figure 3. Investments in machinery, equipment and weapons and in transport equipment
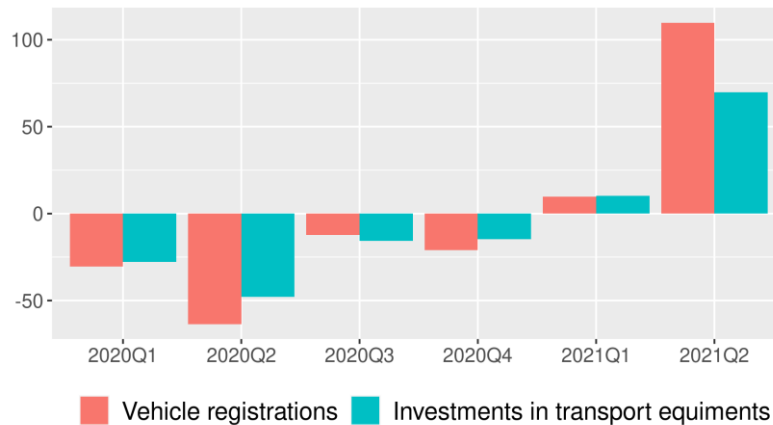
(millions of euro; chain linked seasonally adjusted)
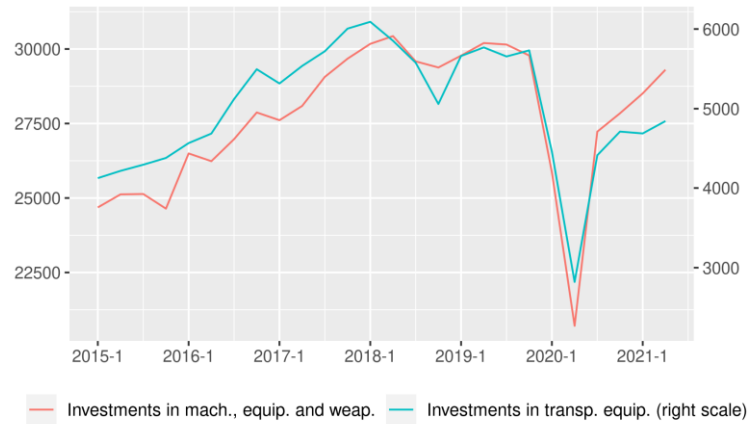


Source: ISTAT and Ministry of Sustainable Infrastructures and Mobility.

## Investments in transport equipment and commercial vehicles registrations

(year-on-year percentage change)



Source: ISTAT and Ministry of Sustainable Infrastructures and Mobility.

Vehicle registrations have a strong seasonal component. Unfortunately, our time series starts in January 2019 and is too short for applying any seasonal adjustment procedure. Therefore, we compare the year-on-year percentage changes of quarterly commercial vehicle registrations and investment in transport equipment since the first quarter of 2020 (Figure 4).[8] Although this period features unprecedented volatility in macroeconomic variables, changes in commercial vehicle registrations

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[8] The comparison is based on Quarterly National Accounts released by ISTAT on August, 31, 2021.
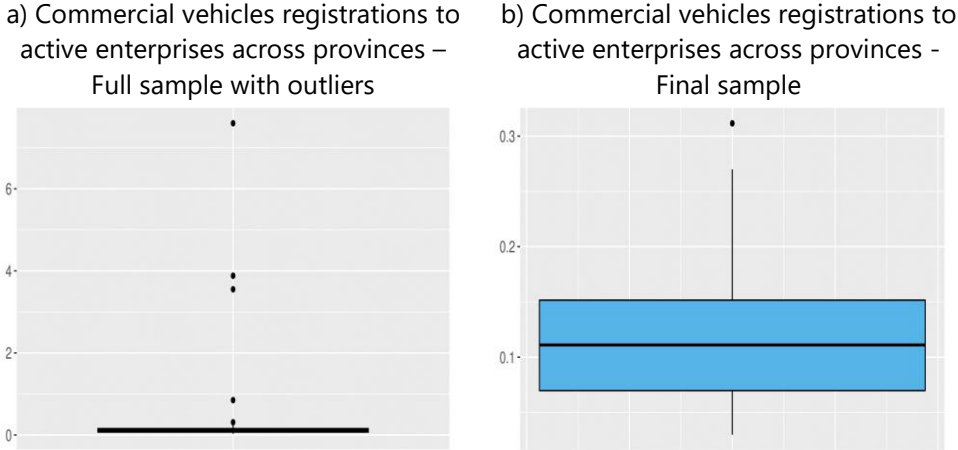
approximate quite well those of National accounts investments.[9] We detect significant differences only in the second quarter of both 2020 and 2021: in the second quarter of 2020, registrations fell more than investment; as a result, they grew more on an annual basis in the corresponding period of 2021.

A more robust validation would require the availability of longer time series. However, the ability of commercial vehicle registrations to capture the large swings in investment in transport equipment indicates that these statistics are very useful in tracking investment patterns.

## Exploring provincial developments in commercial vehicle registrations

Based on the evidence from the previous section, we use commercial vehicle registrations to assess the heterogeneity in investment across provinces. Turning from national to provincial trends, we must point out two potential pitfalls. First, we observe new vehicles registrations but have no information on transactions of existing vehicles. This introduces a measurement error, because a sale of an existing vehicle between two provinces should be accounted as an investment for the destination province and a divestment of the province of origin.[10] Second, registrations are assigned to municipalities based on the primary address of the owner. Instead, it would be ideal if they were assigned based on the location of the production unit that uses the asset in its production process.

Figure 5. Distribution of commercial vehicle registrations across provinces

a) Commercial vehicles registrations to active enterprises across provinces – Full sample with outliers

b) Commercial vehicles registrations to active enterprises across provinces - Final sample



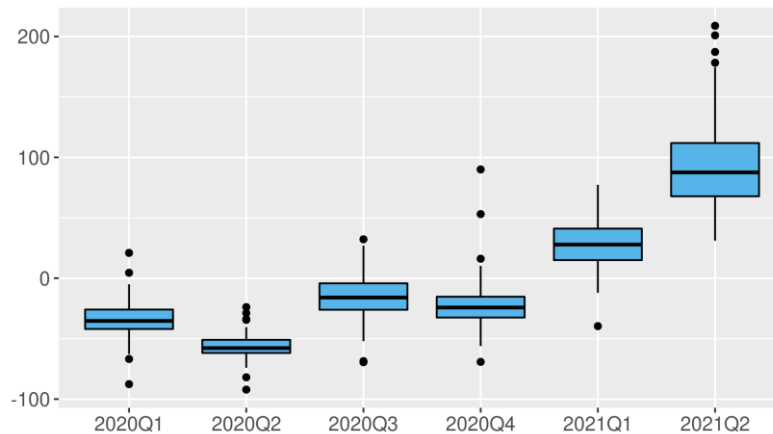Source: Ministry of Sustainable Infrastructures and Mobility.

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[9] Investment in transport equipment also includes lumpy large expenditures on other goods (ships, planes, and trains). The dynamics of these expenditures can explain the differences between the trends in investment and registrations in specific quarters.

[10] Up to our knowledge, there is no estimate of trading volumes in the market for existing commercial vehicles in Italy.

Keeping these issues in mind, we analyze the distribution of vehicle registrations across provinces. Taking into account the ratio of number of registrations to the number of active enterprises,[11] we find that the provinces of Aosta, Bolzano and Trento are outliers, as in these provinces many car rental companies have their headquarters (Figure 5.a).[12] Based on National Accounts rules, vehicle registrations by rental companies must be recorded as in investments in the provinces where these companies are located. However, in the following analysis we will remove these provinces from our sample, as their vehicle registrations would reflect mostly national rather than local factors (Figure 5.b).[13]

We find large heterogeneity in quarterly year-on-year growth rates across provinces; the dispersion increased in the first half of 2021 (Figure 6), although the median year-on-year percentage change was similar across NUTS-1 regions (Figure 7).

## Figure 6. Heterogeneity in quarterly trends

(year-on-year percentage change)



Source: Ministry of Sustainable Infrastructures and Mobility

In 2020, commercial vehicle registrations declined in all provinces (Figure 8.a). The steepest declines occurred in South Sardinia, Gorizia, Lecce and Trieste, where the fall was larger than -50 percent. On the other side, registrations were most resilient in Avellino, Enna and Verbania, where the variation was smaller than -15 percent. The median decline was -34.4 percent.

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[11] Data on active enterprises are available from the Statistical register of active enterprises (ASIA - Enterprises) maintained by ISTAT.

[12] In Aosta, Bolzano and Trento registration taxes are the lowest among all provinces, and for this reason they account for a very large share of rental car registrations (about 75 percent in 2019).

[13] The province of Florence also has a high ratio of vehicle registrations to population, which is explained by the presence of a large rental company in Scandicci. To eliminate this bias, we removed all observations related to Scandicci from the sample.

## Figure 7. Heterogeneity in half-yearly trends

(year-on-year percentage change)
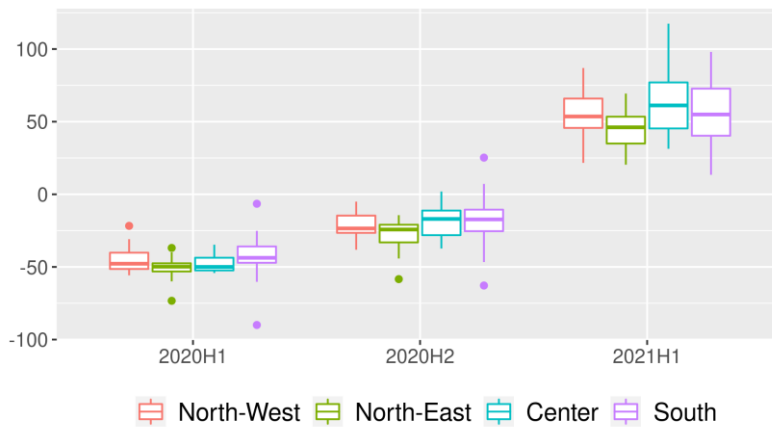


Source: Ministry of Sustainable Infrastructures and Mobility.

The overall evolution of registrations during the pandemic was also very mixed (Figure 8.b). We computed the percentage variation in the first half of 2021 compared to the same period in 2019 to avoid the 2020 base effect. Considering the 5th and the 95th percentiles of the distribution, the percentage variation ranges from -37.0 percent to +10.4 percent. The median change is -18.3 percent.

## Figure 8. Heterogeneity of the recovery across provinces

a) Percentage change in 2020 compared to 2019

b) Cumulative change between 2021H1 and 2019H1



Source: Ministry of Sustainable Infrastructures and Mobility.

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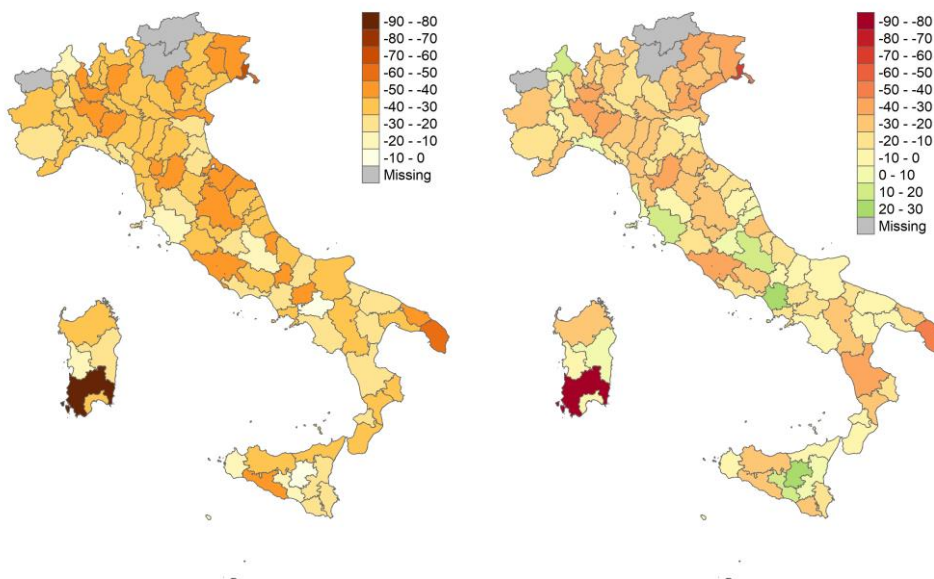
## 4. The impact of Covid-19 epidemics on commercial vehicle registrations

It is difficult to make a timely quantitative assessment of the impact of macroeconomic shocks when only aggregate, low-frequency data are available. For this reason, as discussed by Nakamura and Steinsson (2018), exploiting spatial heterogeneity may be a strategy to identify causal effects in empirical macroeconomics.[14] For example, Chetty et al. (2020) use a large and spatially granular dataset to identify in real-time how COVID-19 epidemics affected the economic activity in the US.

In this section, we use our dataset to find preliminary insights about the relation between local epidemiological conditions and business investments in Italy.

Figure 9. Vehicle registrations (cumulative percentage change between 2019H1 and 2021H1) and hospitalizations
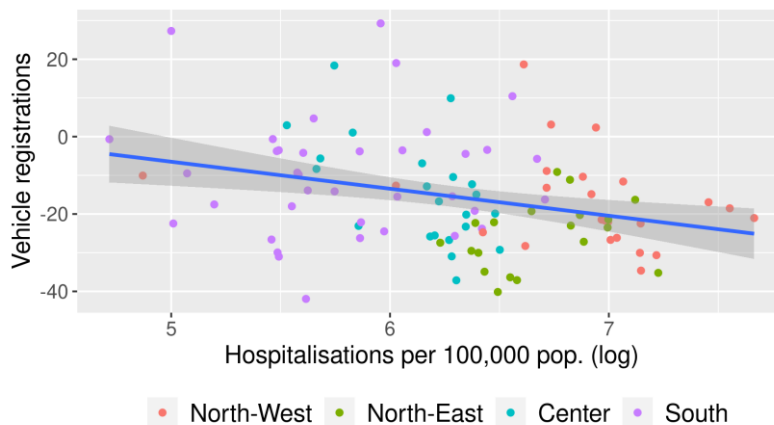


Source: ISTAT, Ministry of Sustainable Infrastructures and Mobility and Italian National Institute of Health.

Although an identification of the transmission channels would be key to assess the causal link, the preliminary evidence is that the evolution of commercial vehicle registrations has been weaker in the provinces most affected by the epidemic, as measured by Covid-19 related hospitalizations (Figure 9). To provide a quantitative assessment of the impact, we estimate the following panel regression model on quarterly data between the first quarter of 2019 and the second quarter of 2021:[15]

$$Y_{i,t} = \alpha_i + \gamma_t + \beta Hosp_{i,t} + \varepsilon_{i,t}$$

[14] Quoting Nakamura and Steinsson (2018): "The use of regional data typically multiplies the number of data points available by an order of magnitude or more. It also allows for difference-in-difference identification and makes possible the use of a powerful class of instrumental variables: differential regional exposure to aggregate shocks."

[15] We remove from the sample Gorizia and South Sardinia, as they are outliers (Figure 8.b). Our results would hold also including these small provinces, although the magnitude of the estimated effect of the pandemic on commercial vehicle registrations would slightly decrease.

In this regression, $Y_{i,t}$ is the logarithm of commercial vehicle registrations in province $i$ during quarter $t$, and $Hosp_{i,t}$ is the logarithm of the number of Covid-19 related hospitalizations per 100,000 inhabitants.[16] We control for structural differences between provinces by including fixed effects $\alpha_i$, while the time dummies $\gamma_t$ absorb common trends across provinces. The parameter $\beta$ measures the elasticity of commercial vehicle registrations to hospitalizations.

Figure 10. Quarterly hospitalizations across provinces
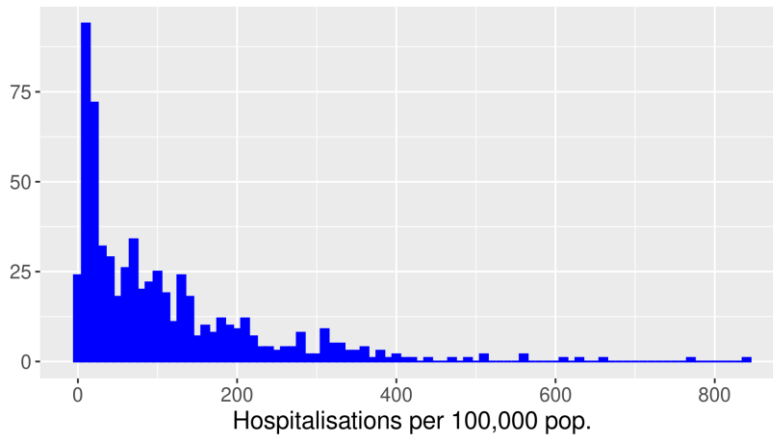


Source: ISTAT, Ministry of Sustainable Infrastructures and Mobility and Italian National Institute of Health.

We find that the estimate of parameter $\beta$ is both statistically and quantitatively significant: a 10 percent increase in the number of hospitalizations is associated with a 0.32 percent reduction of the number of vehicle registrations.[17] Therefore, given the significant variance of the empirical distributions of the quarterly hospitalization rates across provinces (Figure 10),[18] epidemiological conditions account for a significant fraction of the observed heterogeneity in commercial vehicle registrations.

Although this result is robust to different specifications of the regression model, further work is needed to better understand the causal link between the epidemic and investments in transport equipment.

## 5. Conclusions

This paper uses vehicle registrations data to analyze the heterogeneity in local investment patterns. In addition, by exploiting spatial granularity and heterogeneity

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[16] We consider hospitalizations because they are less sensitive to differences in testing capacity across time and regions. Since all variables are in logs, we must add 1 to the number of hospitalizations.

[17] This estimate is statically significant at the 1 percent level (the standard error is 0.007). The $R^2$ of the regression is 0.98.

[18] Considering the empirical distributions of the quarterly hospitalization per 100,000 population across provinces, the 75th percentile is about seven times the 25th percentile (145.3 and 19.6, respectively).

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in the spread of the Covid-19 epidemic, it presents quantitative evidence of its potential impact on business investments.

As further developments of this preliminary evaluation, we will analyze longer time series to better assess how commercial vehicle registrations fit the investments in transport equipment from national accounts. Moreover, we will apply seasonal adjustment algorithms to better interpret local patterns. Subsequently, we will investigate the feasibility to analyze trends in vehicle registrations at a lower level of granularity than the province, e.g., the labor market areas (Sistemi locali del lavoro).

A further research avenue will be the analysis of data on car registrations by private individuals. These data will allow a timely analysis of the propensity of households to purchase durable goods up to the municipal level and on a monthly basis.

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# A timely estimation of local investment trends using administrative data

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11th IFC Biennial Conference, August 26, 2022

# Introduction

- Investments in transport equipment are very volatile and they are highly correlated with overall business investments in capital goods.

- This paper:
    - Nowcasting business investments in transport equipment in Italy
    - Building timely quarterly indicators of business investments at the NUTS-3 level

- We exploit timely granular administrative data on motor vehicles

- We find that:
    - By aggregating selected components of motor vehicle registrations, we can approximate trends in investments in transport equipment very well
    - There is significant heterogeneity in investment trends across NUTS-3 regions
    - The evolution of investments has been weaker in the provinces most affected by the Covid-19 pandemic

# Data

- Monthly number of registrations by vehicle type and owner at the municipal level, from January 2019 to June 2021, provided by the Ministry of Sustainable Infrastructures and Mobility

- We exploit the information about the owner to filter out car registrations from natural persons

- Cars account for the largest and most volatile share of commercial vehicles

**Figure 1. Car registrations and total commercial vehicles registrations**
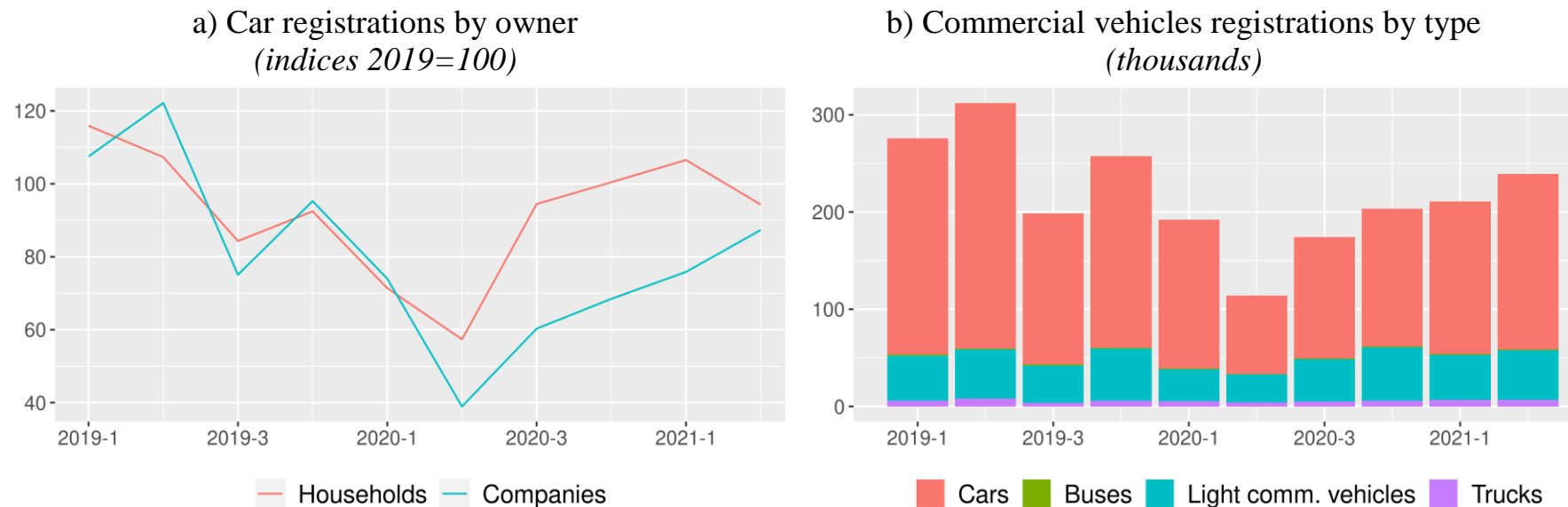


a) Car registrations by owner
*(indices 2019=100)*

b) Commercial vehicles registrations by type
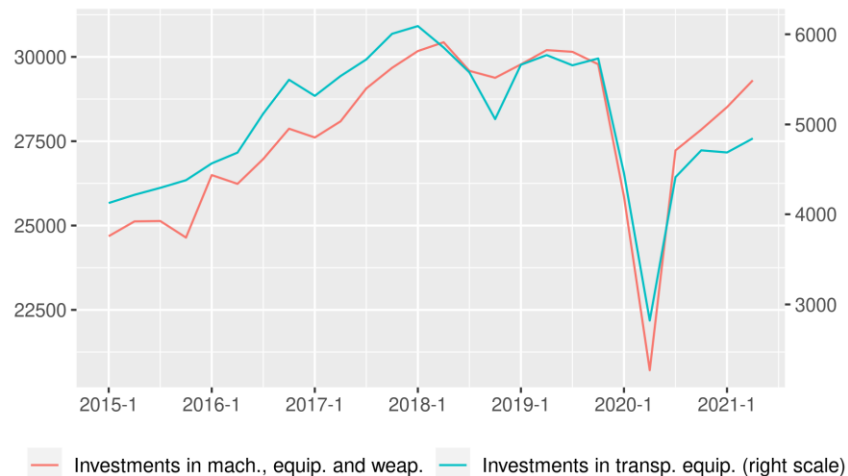*(thousands)*

Source: Ministry of Sustainable Infrastructures and Mobility.

# Vehicle registrations and business investments

- We define our indicator of commercial vehicle registrations as the sum of registrations of buses, light commercial vehicles, trucks and cars owned by companies

- We validate our indicator against gross fixed investments in transport equipment in the National Accounts

**Figure 2. Commercial vehicles registrations and investments**

a) Investments in machinery, equipment and weapons and in transport equipment
*(millions of euro; chain linked seasonally adjusted)*

b) Investments in transport equipment and commercial vehicles registrations
*(year-on-year percentage change)*



Source: ISTAT and Ministry of Sustainable Infrastructures and Mobility.

# Estimating regional trends in investments

- We compute NUTS-3-level indicators of commercial vehicle registrations to proxy investments

- We find large heterogeneity in quarterly year-on-year growth rates across provinces

- The dispersion increased in the first half of 2021. The median year-on-year percentage change was similar across NUTS-1 regions.

**Figure 4. Heterogeneity in trends across provinces**

a) Heterogeneity in quarterly trends
*(year-on-year percentage change)*

b) Heterogeneity in half-yearly trends
*(year-on-year percentage change)*
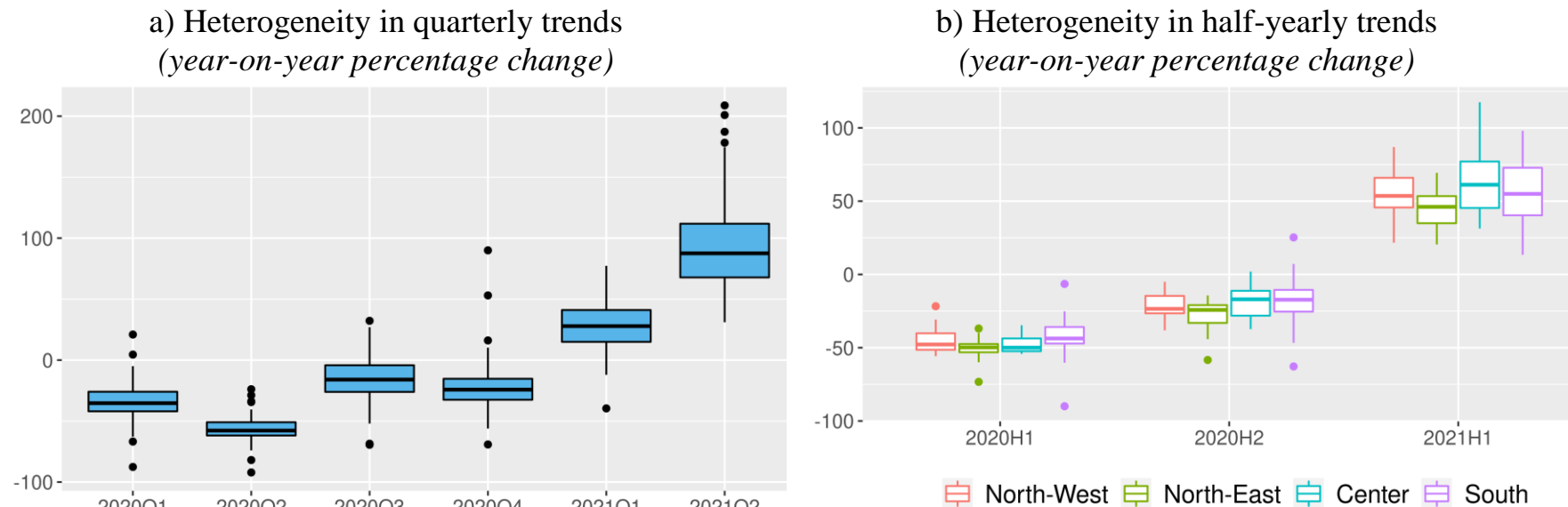
Source: Ministry of Sustainable Infrastructures and Mobility.

# Heterogeneity in regional trends

- The overall evolution of registrations during the pandemic was very mixed

**Figure 5. Heterogeneity of the recovery across provinces**

a) Percentage change in 2020 compared to 2019      b) Cumulative change between 2021H1 and 2019H1



Source: Ministry of Sustainable Infrastructures and Mobility.
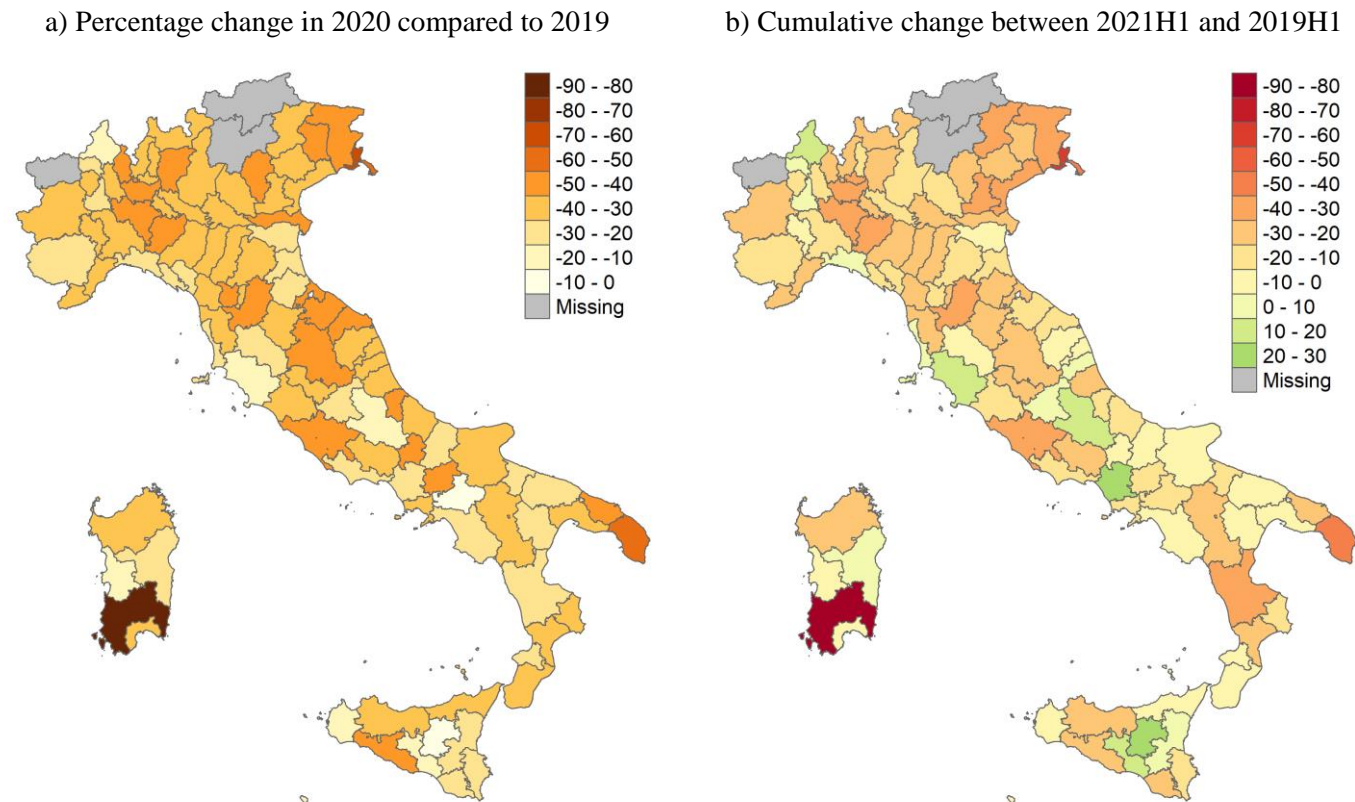
# The impact of the pandemic on vehicle registrations

- To provide an assessment of the impact of the pandemic on vehicle registrations, we estimate the following panel regression model on quarterly data between the first quarter of 2019 and the second quarter of 2021:

$$Y_{i,t} = \alpha_i + \gamma_t + \beta Hosp_{i,t} + \varepsilon_{i,t}$$

- In this regression, $Y_{i,t}$ is the logarithm of commercial vehicle registrations in province $i$ during quarter $t$, and $Hosp_{i,t}$ is the logarithm of the number of Covid-19 related hospitalizations per 100,000 inhabitants.

- We find that the estimate of parameter $\beta$ is both statistically and quantitatively significant: a 10 percent increase in the number of hospitalizations is associated with a 0.32 percent reduction of the number of vehicle registrations.

- Given the significant variance of the empirical distributions of the quarterly hospitalization rates across provinces, epidemiological conditions account for a significant fraction of the observed heterogeneity in commercial vehicle registrations.

# Conclusions

- This paper shows that administrative data on motor vehicles allow:
    - Nowcasting business investments in transport equipment
    - Building timely quarterly indicators of business investments at the NUTS-3 level

- We find that:
    - By aggregating selected components of motor vehicle registrations, we can approximate trends in investments in transport equipment very well
    - There is significant heterogeneity in investment trends across NUTS-3 regions
    - The evolution of investments has been weaker in the provinces most affected by the Covid-19 pandemic

- Next steps:
    - analyze longer time series and apply seasonal adjustment algorithms to better interpret local patterns
    - analyze trends in vehicle registrations at a lower level of spatial granularity