GREENER LAST-MILE DELIVERY TECHNOLOGIES AND REGIONAL DEVELOPMENT IN LATVIA: INPUT-OUTPUT APPROACH

Astra Auzina-Emsina
Riga Technical University, Latvia
astra.auzina-emsina@rtu.lv

Abstract. The European Green Deal targets to limit emissions by applying sustainable and greener technologies in transport, including last-mile delivery services. The aim is to estimate the potential impact of application of greener last-mile delivery technologies in the companies on sectoral and regional development in Latvia, using the input-output approach applying the latest data set of 2020 for Latvia. The economy is disaggregated according to the NACE 2-digit level into 64 economic activities and regional development additionally into 5 regions (Riga, Vidzeme, Kurzeme, Zemgale, and Latgale). The bottom-up approach is used. According to NACE, postal and courier services (H53) are selected as the main focus in the research reflecting last-mile delivery services. Sweden is used as a benchmark country as Sweden is already having one of the greenest transport sectors. Modelling results argue that if the postal and courier services in Latvia apply a greener technology that already exists (possible, achievable technology, not just in theory), then the total value added declines by -0.1% due to lower intermediate consumption for manufactured products. The most positive impact is on services (as warehouse services, employment services, wholesale trade services), however, the services auxiliary to financial services and insurance services, air transport services, paper and its products have the most negative impact. The modelled regional results claim that the major negative impact is in the metropolitan areas (Riga region), medium – Kurzeme and Latgale, minimal impact – Vidzeme and Zemgale. The findings are valuable to the companies in the industries that might be affected due to the shift towards other technologies and practices, as well as for the national government and EU institutions in policymaking.

Keywords: last-mile delivery, input-output analysis, technological change, greener transport, regional development, policymaking.

Introduction

Last-mile delivery has a growing scientific interest from various audiences. Greener transport involves studies on major trends as application of smart data and circular economy [1], sustainable mobility [2], also specific relatively innovative recent trends such as car sharing [3], e-scooter sharing [4], gender-specific influence on choices [5], age factor in greener choices [6]. Greener last-mile delivery frequently overlaps with technical, socio-economic aspects, and economic (costs-gains) factors, at the same time with personal and non-economic factors.

The European Green Deal has tight targets in the near future. Sweden has the second-best European Green Deal performance, following the Netherlands [7]. Concerning public transportation, revealing accessibility problems within the transport system and supporting the planning of smart and sustainable mobility networks, first-mile and last-mile issues are examined in urban areas (as in Stockholm, Sweden by [8]). Another study from Sweden argues that a company's size matters when retailers design last mile back-end fulfilment (LMBF) and last mile delivery (LMDe), while last mile consumer steering (LMCS) practice does not appear to differ based on size, in result, larger retailers have a more advanced LMDe and LMBF set-up than their SME counterparts [9]. At the same time, home delivery is the preferred method of last-mile delivery and exists the lack of provided home delivery services in Sweden [10]. Greener transport includes also lower emissions and reduced carbon dependency, policy steps are expected as much air travel is induced by its low cost [11]. The research on collection-delivery points argues that 22.5% reduction of vehicle kilometres travelled from collection-delivery trips by relocating 5% collection-delivery points from urban areas to suburban and rural areas is applied as greener last mile alternative in Sweden [12]. The literature review indicates that greener transport technologies involve various or even multiple activities at the same time, not limited to one or few steps required by policy measures.

The aim is to estimate the potential impact of application of greener last-mile delivery technologies in the companies on sectoral and regional development in Latvia, using the input-output approach. The focus of the study is to analyse existing technologies, hence a greener last-mile delivery country (Sweden) has been detected rather as theoretically greener, however not applied yet in any country in broad scale.

DOI: 10.22616/ERDev.2024.23.TF078

Definitely, many researches and assessments by scientists and companies had been implemented, and in near future, the shift towards greener technologies due to legislation and regulatory norms are going to continue in the EU caused by the European Green Deal targets.

Materials and methods

The data are extracted from the following databases: Eurostat [13] and Central Statistical Office of Latvia [14]. Potential development is modelled by applying an input-output approach using the latest data set of 2020 for Latvia. Sweden is used as a benchmark country as Sweden is already having one of the greenest transport sectors. The Netherlands had the best European Green Deal performance which was followed by Sweden [7], by reducing fossil fuel dependence and becoming a global climate transition leader [15].

Symmetric input-output tables (*product-by-product* approach) in current prices in 2020 (exception is Sweden, the latest available on 2019 is used) by 64 CPA/NACE elements form the core dataset representing technologies and intersectoral linkages. However, regional economic activity by value added (NACE 20 aggregated groups) by 5 planning regions in 2020 [14] is used as the data by 64 CPA/NACE in the applied regional disaggregation was not available. As Latvia applies the *product-by-product* approach to input-output statistics then countries that apply the same are analysed: Czechia, Germany, Estonia, Ireland, Spain, France, Croatia, Italy, Cyprus, Latvia, Lithuania, Hungary, Austria, Portugal, Slovenia, Slovakia, Sweden. Other EU countries apply the *industry-by-industry* approach.

Last-mile delivery is a concept outside traditional economic activity and product classifications applied in statistics, hence courier and postal services (H53) are selected as representative economic activity. Definitely, courier and postal services cover partially all aspects that in the literature had been assigned and analysed concerning last-mile delivery technologies, development, applications, social acceptance etc. aspects. These elements are outside the scope of this modelling.

Modelling the impacts of global consumption trends [16], policy measures during COVID-19 [17] and greener technologies [18] on transportation in Latvia were also based on the input-output approach and its adaptations. There is a long-standing expertise in the application of input-output based models or models including input-output linkages in Latvia and other countries, as estimation of carbon footprint [19], pollution by transport (in France [20], Spain [21]), new technologies on road transport (as CGE model for road transport electrification in the EU [22]).

The sequence of modelling:

1. Latvia's input-output model (demand-driven approach) elaboration and calibration for 2020 data.
2. International analysis of H53 input coefficients (17 EU countries), justification of selected benchmark country for greener already existing last-mile delivery technologies.
3. Modelling applying these selected greener last-mile delivery technologies in H53, other input coefficients of 63 products are hold constant (only H53 is changed), resulting in sectoral impact on 64 economic activities output, value added and final demand. The main focus is paid to the value added indicator. Results are computed in euros and relative changes in percentage are computed.
4. The bottom-up approach is used, aggregating values of 64 into 20 groups of economic activity as a regional (regions) bridge matrix is not available for 64 economic activities.
5. Computations of absolute values and the relative impact on regional economic activity by 5 planning regions.
6. Modelling results and findings comparison to the existing studies.

Input-output model is based on classic identities that total supply is identical to total use. Any product supplied is domestically produced (X_j) or imported (IM_i), meanwhile any demanded (or used product) is consumed in intermediate consumption (X_{ij}) or final demand (Y_i) domestically or exported minus imported value (in other words, net final demand). Each input structure of a product (good or service) consists of costs for products of other industries (intermediate consumption expenses X_{ij}) and added value (see Formula (1)):

$$X_j = \quad X_{ij} + VA_j, \tag{1}$$

where X_j – j industry's output,
X_{ij} – intermediate consumption of i products in j industry,

VA_j – added value of j industry.

Direct input coefficients illustrate the input vector of a specific economic sector, i.e. what and how many products of other sub-sectors and payments for labor, capital and other production resources are required to produce one unit of the specific sub-sector's products, representing the technological requirements (A_{ij}) (see Formula (2)):

$$A_{ij} = \frac{X_{ij}}{X_j} \quad . \tag{2}$$

By comparing direct input coefficients in two or more time periods, the changes in technologies and technological requirements are identified. Additionally, the coefficients of the added value v_j can be computed (see Formula (3)).

$$v_j = \frac{VA_j}{X_j} \ . \tag{3}$$

On the other hand, any product produced in the economy, depending on various factors, may be used in the production of other products (as an intermediate product), consumed (as a final product), invested, exported (as an export product) (see Formula (4)):

$$X_i = \quad X_{ij} + FD_i + I_i + EX_i - IM_i, \tag{4}$$

where FD_i – final consumption of households and government (including changes in stocks),
I_i – investments (or gross capital formation),
EX_i – export,
IM_i – import.

Regardless of the aspect in which economic activity is viewed, the output of industries is the same:

$$X_i = X_j \ . \tag{5}$$

The impact of the application of the greener last-mile delivery technology has been modelled by replacing the existing Ai vector for postal and courier activities with benchmark technology.

In baseline modelling, the technology is believed to be changed but the final demand elements are hold constant to assess the impact of greener technologies. Next, the value added is the calculation quantity of the value added coefficient and the product of the calculation output:

$$VA_j = v_j \times X_j \ . \tag{1}$$

Therefore, it is also possible to model changes in industry technologies (changes in the values of direct cost coefficients *Aij*) or changes in the part of added value, thus using the corresponding values of added value coefficients in the calculations. If regional allocation of economic activity is introduced, then also regional effect is being computed. At present, five planning regions (close to NUTS-3) are being used, determined by data availability.

Computed direct input coefficients for postal and economic activity for 17 countries (see Table 1) lead to the finding that value added share in one unit produced (ratio of value added to output) (v_j) varies significantly and at three subgroups:

- *high* value added to output (Croatia, Hungary, France, Ireland, Cyprus, Slovenia, Sweden),
- *medium* (Austria, Portugal, Lithuania, Czechia, Slovakia, Spain) and
- *low* (Latvia, Germany, Italy, Estonia).

In Latvia, to produce one euro worth of postal and economic activity, 0.59 euro is spent on other products and services and 0.02 on product taxes; the value added is relatively low – 0.38 euro and this is below the national average in 2020 (0.49).

It leads to the necessity to model the economic effect if a greener (according to industry and consumer perspective) technology that is possible in real conditions (already existing in alike benchmark country) is applied in Latvia, hence Sweden is selected as the benchmark country.

Table 1

Direct input coefficients of postal and courier economic activity (H53) in the EU* countries in 2020

Country	A_B	C_E	F	G	H	I_U	IC	Taxes**	Value added	Output
Croatia	0.00	0.01	0.00	0.00	0.09	0.02	0.14	0.000	0.855	1.000
Hungary	0.00	0.05	0.00	0.03	0.07	0.14	0.31	0.058	0.630	1.000
France	0.00	0.06	0.00	0.01	0.07	0.20	0.35	0.045	0.597	1.000
Ireland	0.00	0.03	0.00	0.01	0.16	0.13	0.41	0.022	0.567	1.000
Cyprus	0.00	0.08	0.00	0.02	0.10	0.20	0.43	0.028	0.541	1.000
Slovenia	0.00	0.03	0.00	0.01	0.27	0.10	0.43	0.039	0.523	1.000
Sweden* **	**0.00**	**0.02**	**0.00**	**0.03**	**0.17**	**0.23**	**0.47**	**0.011**	**0.512**	**1.000**
Austria	0.00	0.02	0.01	0.00	0.40	0.09	0.55	0.010	0.439	1.000
Portugal	0.00	0.02	0.00	0.00	0.39	0.11	0.54	0.020	0.438	1.000
Lithuania	0.00	0.06	0.00	0.01	0.26	0.14	0.50	0.062	0.435	1.000
Czechia	0.00	0.05	0.01	0.02	0.30	0.13	0.53	0.033	0.432	1.000
Slovakia	0.00	0.03	0.00	0.01	0.42	0.09	0.57	0.008	0.418	1.000
Spain	0.00	0.03	0.00	0.00	0.39	0.12	0.56	0.018	0.417	1.000
Latvia	**0.00**	**0.03**	**0.00**	**0.00**	**0.33**	**0.20**	**0.58**	**0.021**	**0.391**	**1.000**
Germany	0.00	0.03	0.01	0.09	0.30	0.15	0.60	0.021	0.376	1.000
Italy	0.00	0.06	0.00	0.01	0.40	0.13	0.62	0.024	0.356	1.000
Estonia	0.00	0.04	0.00	0.03	0.42	0.14	0.65	0.006	0.337	1.000

* EU countries that publish input-output table set in *product-by-product* approach (in Eurostat)

** Taxes less subsidies on products (D21_D31)

***data on 2019

Source: the author's calculations, on the basis of [13]

Results and discussion

The modelling results argue that if the postal and courier services in Latvia apply a greener technology that already exists (possible, achievable technology, not just in theory), then the total value added declines by -0.1% due to lower intermediate consumption for manufactured products. The greener technology demands fewer manufactured products.

The findings claim that the largest positive impact is on services (as warehouse services, employment services, wholesale trade services) (see Table 2), however, the services auxiliary to financial services and insurance services, air transport services, paper and its products have the most negative impact (see Table 3).

Table 2

Modelling results on the most positively affected economic activities in the case of a greener last-mile delivery technology in Latvia

NACE economic activities	Change, in % (compared to pre-scenario situation)
H52 Warehousing and support services for transportation	1.2%
N78 Employment services	0.9%
L68A Imputed rents of owner-occupied dwellings	0.5%
G45 Wholesale and retail trade of motor vehicles	0.5%
S95 Repair services	0.5%
K65 Insurance	0.4%
J62_J63 Computer programming, consultancy and related	0.4%
E36 Natural water; water treatment and supply services	0.4%

Table 2 (continued)

NACE economic activities	Change, in % (compared to pre-scenario situation)
M71 Architectural and engineering services	0.3%
N80-N82 Security and investigation services; etc. support	0.2%

Source: the author's calculations

The most negative impact is detected in the same postal and courier services as the postal and courier services consumes less the same services from other companies in this economic activity, also less air transport is used, less land transport, but more warehouses, leading to more optimised solutions in route planning.

Table 3

Modelling results on the most negatively affected economic activities in the case of a greener last-mile delivery technology in Latvia

NACE economic activities	Change, in % (compared to the pre-scenario situation)
H53 Postal and courier services	-20.5%
K66 Services auxiliary to financial services and insurance	-10.8%
H51 Air transport services	-5.3%
N77 Rental and leasing services	-1.5%
C17 Paper and paper products	-1.4%
N79 Travel agency, tour operator and other reservation services	-0.6%
C20 Chemicals and chemical products	-0.6%
C33 Repair and installation services of machinery and	-0.5%
C13-C15 Textiles, wearing apparel and leather products	-0.4%
H49 Land transport services	-0.3%

Source: the author's calculations

The bottom-up approach is used, aggregating values of 64 into NACE 20 groups of economic activity for further regional impact modelling, however, the absolute values computed compared to the pre-scenario state result in growth rate per aggregated group (see Table 4). Many economic activities in this level of disaggregation show no affect from the greener technology applied in last-mile delivery. However, the companies in financial and insurance activities (K) and administrative and support service activities must have in strategic plans activities to limit this negative impact by diversifying or other strategies considered. Greener technologies results are more responsible attitude and actions concerning waste, effective digital and ICT application and real estate services.

Table 4

Modelling results on aggregated impact in the case of a greener last-mile delivery technology in Latvia

NACE aggregated groups	Change, in % (compared to the pre-scenario situation)
A Agriculture, forestry and fishing	0.0%
B Mining and quarrying	0.0%
C Manufacturing	-0.1%
D Electricity, gas, steam and air conditioning supply	-0.1%
E Water supply, sewerage, waste management	**0.2%**
F Construction	0.0%
G Wholesale and retail trade, repair of motor vehicles	0.0%
H Transportation and storage	-0.3%
I Accommodation and food service activities	0.0%
J Information and communication	**0.2%**

Table 4 (continued)

NACE aggregated groups	Change, in % (compared to the pre-scenario situation)
K Financial and insurance activities	**-2.1%**
L Real estate activities	0.3%
M Professional, scientific and technical activities	0.0%
N Administrative and support service activities	**-0.5%**
O Public administration and defence, social security	0.0%
P Education	0.0%
Q Human health and social work activities	0.0%
R Arts, entertainment and recreation	0.0%
S Other service activities	0.1%
T Activities of households as employers	0.0%
TOTAL	**-0.1%**

Source: the author's calculations

The modelled regional results claim that the major negative impact is in the metropolitan areas (Riga region), medium – Kurzeme and Latgale, but the minimal impact – Vidzeme and Zemgale.

Table 5

Modelling results on regional impact in the case of a greener last-mile delivery technology (change, in % (compared to pre-scenario situation)) in Latvia

Planning regions	Latvia	Riga planning region	Vidzeme planning region	Kurzeme planning region	Zemgale planning region	Latgale planning region
TOTAL	-0.06%	-0.08%	-0.01%	-0.02%	-0.01%	-0.02%

Source: the author's calculations

Regional development in multi-country studies in the EU mainly applies NUTS-2 level of disaggregation (as [23] for 272 regions in the EU), the applied statistical regional disaggregation for Latvia is closer to NUTS-3 level, as Latvia is one region in NUTS-2 level. The study on faster delivery services in busy metropolitan areas if a specially-developed algorithm applied claims that the overall cost savings to the carrier were estimated to be in the range 34-39% [24]; highlighting the potential for improvements even in intensive areas that are believed to be used most intensively with minor ineffectiveness compared to less intensive urban or even rural areas. The policymaking process is linked to the territorial reform in Latvia and expected urban-rural cohesion [25].

A further study could assess the long-term effects of greener technologies as, definitely, demand pattern changes over time, including last-mile services for households (B2C) (as private consumption) and B2B solutions, and any hybrid or alternative form that might occur in future. The findings suggest several courses of action for policymakers and have a number of practical implications. More frequently updated input-output data set is required due to its importance for monitoring and proactive and on-time policy measures elaboration for targeted and notable results towards the EU Green Deal targets; if only available on every five years, then proactive actions are limited or suitable.

Conclusions

1. Greener technologies in transport result in lower demand for intermediate consumption for other transport services (less air transport, less land transport), lower demand for manufactured items and financial service. The companies operating in these economic activities can foresee the future development and take steps to diversify the business or gradually switch to other.
2. Less land transport leads to larger demand for storage places and warehouses and hence an increased demand is modelled.

3. The modelled greener technologies lead to larger demand for repair services and insurance. Use the same equipment, tools and vehicles longer.
4. The findings are valuable to the companies in the industries that might be affected due to the shift towards other technologies and practices, as well as for the national government and EU institutions in policymaking ensuring balanced economic development.

Acknowledgements

This research was funded by the Latvian Science Council's fundamental and applied research programme, project "Development of Model for Implementation of Sustainable and Environmentally Friendly Last Mile Distribution Transportation Services in Latvia" (TRANS4ECO), project No. lzp-2022/1-0306, 01.01.2023.- 31.12.2025.

References

[1] Vacchi M., Siligardi C., Cedillo-González E. I., Ferrari A. M., Settembre-Blundo D. Industry 4.0 and smart data as enablers of the circular economy in manufacturing: Product re-engineering with circular eco-design. Sustainability (Switzerland), vol. 13 (18), 2021, DOI: 10.3390/su131810366.
[2] Tammaru T., A., Witlox F.Towards an equity-centred model of sustainable mobility: Integrating inequality and segregation challenges in the green mobility transition. Journal of Transport Geography, vol. 112, 2023, DOI: 10.1016/j.jtrangeo.2023.103686.
[3] Vélez,A. M. A. , Plepys A. Car sharing as a strategy to address ghg emissions in the transport system: Evaluation of effects of car sharing in Amsterdam. Sustainability (Switzerland), vol. 13(4), 2021, pp. 1-15, DOI: 10.3390/su13042418.
[4] Krauss K., Gnann T., Burgert T., Axhausen K. W. Faster, greener, scooter? An assessment of shared e-scooter usage based on real-world driving data. Transportation Research Part A: Policy and Practice, vol. 181, 2024, DOI: 10.1016/j.tra.2024.103997.
[5] Kawgan-Kagan I. Are women greener than men? A preference analysis of women and men from major German cities over sustainable urban mobility. Transportation Research Interdisciplinary Perspectives, vol. 8, 2020, DOI: 10.1016/j.trip.2020.100236.
[6] Ágoston C., Balázs B., Mónus F., Varga A. Age differences and profiles in pro-environmental behavior and eco-emotions. International Journal of Behavioral Development, vol. 48, no. 2, 2024, pp. 132-144, DOI: 10.1177/01650254231222436.
[7] Ozdemir S., Demirel N., Zaralı F., Çelik T. Multi-criteria assessment framework for evaluation of Green Deal performance. Environmental Science and Pollution Research, vol. 31 (3), 2024, pp. 4686-4704, DOI: 10.1007/s11356-023-31370-2.
[8] Kåresdotter E., Page J., Mörtberg U., Näsström H., Kalantari Z. First Mile/Last Mile Problems in Smart and Sustainable Cities: A Case Study in Stockholm County. Journal of Urban Technology, vol. 29 (2), 2022, pp. 115-137, DOI: 10.1080/10630732.2022.2033949.
[9] Risberg A., Jafari H. Last mile practices in e-commerce: framework development and empirical analysis of Swedish firms. International Journal of Retail and Distribution Management, vol. 50 (8–9), 2022, pp. 942-961, DOI: 10.1108/IJRDM-10-2021-0513.
[10] Patowary M. M. I., Peulers D., Richter T., Melovic A., Nilsson D., Söilen K. S. Improving last-mile delivery for e-commerce: the case of Sweden. International Journal of Logistics Research and Applications, vol. 26 (7), 2023, pp. 872-893, DOI: 10.1080/13675567.2021.1998396.
[11] Gössling S., Hanna P., Higham J., Cohen S., Hopkins D. Can we fly less? Evaluating the 'necessity' of air travel. Journal of Air Transport Management, vol. 81, 2019, DOI: 10.1016/j.jairtraman.2019.101722.
[12] Liu C., Wang Q., Susilo Y. O. Assessing the impacts of collection-delivery points to individual's activity-travel patterns: A greener last mile alternative? Transportation Research Part E: Logistics and Transportation Review, vol. 121, 2019, pp. 84-99, DOI: 10.1016/j.tre.2017.08.007.
[13] Eurostat, Symmetric input-output table at basic prices (product by product). [online] [24.01.2024.]. Available at: https://ec.europa.eu/eurostat/databrowser/view/naio_10_cp1700__custom_9683175/default/table
[14] Official Statistics Portal of Latvia. [online] [02.02.2024.]. Available at: https://data.stat.gov.lv

[15] Niskanen J., Anshelm J., Haikola S. A new discourse coalition in the Swedish transport infrastructure debate 2016-2021. Transportation Research Part D: Transport and Environment, vol. 116, 2023, DOI: 10.1016/j.trd.2023.103611.

[16] Auzina-Emsina A., Ozolina V., Jurgelane-Kaldava I. Modeling Global Consumptions Trends Impact on Transport and Logistics: Scenario Analysis. Lecture Notes in Intelligent Transportation and Infrastructure, vol. Part F1382, 2020, pp. 1-8. DOI: 10.1007/978-3-030-39688-6_1.

[17] Auziņa-Emsiņa A., Ozoliņa V. Transportation, logistics and regional development in covid-19 era: Modelling sectoral shocks caused by policy and safety measures. Research for Rural Development, 2021, pp. 144-151. DOI: 10.22616/rrd.27.2021.021.

[18] Auzina-Emsina A. Modelling the Potential Impact of the Application of Environmentally Friendly Transport Applied in Last-Mile Delivery on the National Economy: The Case of Latvia. TRANSBALTICA XIV: Transportation Science and Technology, Cham: Springer Nature Switzerland, 2024, pp. 327-336.

[19] Steen-Olsen K., Wood R., Hertwich E.G. The Carbon Footprint of Norwegian Household Consumption 1999-2012. Journal of Industrial Ecology, vol. 20 (3), 2016, pp. 582-592, DOI: 10.1111/jiec.12405.

[20] Bagoulla C., Guillotreau P. Maritime transport in the French economy and its impact on air pollution: An input-output analysis. Marine Policy, vol. 116, 2020, DOI: 10.1016/j.marpol.2020.103818.

[21] Alcántara V., Padilla E. Input-output subsystems and pollution: An application to the service sector and CO2 emissions in Spain. Ecological Economics, vol. 68 (3), 2009, pp. 905-914, DOI: 10.1016/j.ecolecon.2008.07.010.

[22] Tamba M. et al. Economy-wide impacts of road transport electrification in the EU. Technological Forecasting and Social Change, vol. 182, 2022, DOI: 10.1016/j.techfore.2022.121803.

[23] Huang S., Koutroumpis P. European multi regional input output data for 2008–2018. Scientific Data, vol. 10 (1), 2023, DOI: 10.1038/s41597-023-02117-y.

[24] McLeod F.N., et al. Quantifying environmental and financial benefits of using porters and cycle couriers for last-mile parcel delivery. Transportation Research Part D: Transport and Environment, vol. 82, 2020, DOI: 10.1016/j.trd.2020.102311.

Markova M. Rural-urban interaction inclusion in ongoing Latvia regional reform. Landscape Architecture and Art, vol. 15 (15), 2019, pp. 83-89, DOI: 10.22616/J.LANDARCHART.2019.15.09.