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THE TRANS-JAVA TOLL ROAD AND REGIONAL GROWTH IN CENTRAL JAVA: A DIFFERENCE-IN-DIFFERENCES ANALYSIS

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ABSTRACT
Indonesia completed a continuous tolled expressway between Jakarta and Surabaya in December 2018, yet its effect on the regions it crosses has rarely been tested against a comparison group. This study compares the 12 regencies and cities of Central Java traversed by the corridor with the 23 that are not, using constant-price gross regional domestic product (GRDP) for 2010–2020 from the World Bank's Indonesia Database for Policy and Economic Research (385 unit-years). A two-way fixed-effects difference-in-differences model on annual growth, with separate terms for 2019 and the pandemic year 2020, gives a corridor differential of 0.19 percentage points in 2019 (95% confidence interval −0.17 to 0.55) and 0.33 points in 2020 (−0.64 to 1.29). Neither differs from zero under cluster-robust, wild-bootstrap or randomisation inference, and both change sign when three atypical comparison regencies are removed. Pre-period leads are jointly insignificant ($p = 0.15$). The transport and storage sector shows no differential gain. The corridor's early local growth dividend is therefore statistically indistinguishable from zero, which argues for planning toll corridors together with complementary local investment and for building evaluation into project design.

1. Introduction

Large road projects are usually justified by the growth they are expected to bring to the regions they serve. The argument has a long pedigree: the claim that public capital raises private productivity dates from aggregate work of the late 1980s [1], and it was soon followed by studies that moved below the national level and used the routing of highways to ask what infrastructure does to local economic activity [2], [3]. The modern literature answers with designs that compare connected places with otherwise similar unconnected ones. Its results are mixed. A study of India's Golden Quadrilateral examined the location and performance of manufacturing along the upgraded network [4], whereas a regression-discontinuity study of India's rural road programme found that new roads mainly moved workers out of agriculture while farm output, incomes, assets and village firm employment changed little within about four years [5]. Work on China has likewise asked what road tolls do to growth [6], and work on the United States has related highways to the growth of cities [7]. The general lesson is that a road is a necessary condition for some kinds of development and a sufficient condition for none, and that its effects are redistributed across space as much as they are created; that lower transport costs can concentrate activity in already large centres as readily as disperse it has been a staple of economic geography for three decades [8]. Indonesia offers one of the largest recent tests of this proposition. The Trans-Java Toll Road is planned to run 1,167 km from Merak in Banten to Banyuwangi in East Java; in December 2017 only 516 km were in operation [9]. One year later, on 20 December 2018, the last gaps

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between Jakarta and Surabaya were inaugurated, giving an uninterrupted expressway across the island's north and centre [10]. Central Java was the province in which most of the missing links lay: the Pejagan–Pemalang, Pemalang–Batang, Batang–Semarang, Semarang–Solo and Solo–Ngawi sections, together about 334 km, were all in full operation by December 2018, most of their length having opened between June 2016 and that date [10]. Within about three years the province thus acquired a continuous corridor from its western to its eastern boundary.

The Indonesian evidence on what this has done to regional economies is growing but still thin. Before the corridor was complete, a provincial study of Java associated toll-road length with higher output in goods-producing sectors [11], and a study of West Java reported manufacturing efficiency about six per cent higher in districts connected to a toll road than in unconnected ones [12]. A short-run assessment of the Cikopo–Palimanan (Cipali) section found shorter travel times and more trade and investment, alongside a decline of hotel and restaurant businesses along the old northern road [13]. After completion, a difference-in-differences study of 70 districts and cities using village census data for 2008–2020 found that the number of micro and small food and beverage enterprises fell in the first phase of toll operation and rose only after roughly six years [14]; other work has examined wages and unemployment [15], the displacement of small roadside businesses on the north coast [16], the uneven distribution of accessibility gains between urban-industrial and rural areas [17], the growth of built-up land in toll regencies [18], the trajectories of small cities along the route [19], farmers' willingness to sell paddy land [20], local land-price and settlement change near interchanges [21] and environmental outcomes, including a deterioration of air quality in Central Java [22]. For Sumatra, a spatial general-equilibrium study estimates welfare gains from the Trans-Sumatra Toll Road of between 0.25 and 3.54 per cent of output depending on assumptions about trade and labour mobility [23], and regional studies have begun to relate that corridor to economic performance: across 29 Sumatran regencies and cities the correlation between distance to the nearest interchange and GRDP was weak and statistically insignificant ($\rho = -0.189$, $p = 0.326$) [24], while a panel of six Lampung districts for 2013–2022 linked the transport and warehousing sector to local revenue and growth [25].

What is missing is the simplest test of the claim most often made for the project: that the regencies and cities the corridor crosses grow faster, in aggregate output, than those it bypasses. The outcome that planners cite, real GRDP growth, has not to our knowledge been compared between corridor and non-corridor units of a single province with an explicit pre-trend check. This article supplies that test for Central Java. It asks three questions. Did real GRDP growth in the corridor regencies and cities diverge from that of the non-corridor ones after the continuous connection opened? Did the transport and storage sector, the activity most directly exposed to a new expressway, expand differentially? And how robust are the answers to the composition of the comparison group, to the definition of treatment, and to the COVID-19 shock of 2020, which arrived in the second year of operation?

The thesis argued here is deliberately modest. In the first two years after the corridor was completed, the growth of the crossed units is statistically indistinguishable from that of the bypassed units; the apparent raw advantage of the corridor group predates the road and

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owes much to a handful of atypical comparison regencies. The contribution is threefold. First, the article provides a transparent, fully reproducible corridor-versus-comparison estimate for all 35 regencies and cities of the province, with the data printed in an appendix. Second, it treats the pandemic year explicitly instead of pooling it into a single post-treatment dummy, and it reports inference appropriate to a small number of clusters. Third, it draws out what an honest null result means for infrastructure planning: not that the corridor is without value, but that a local output dividend should not be assumed in appraisal, and that the means to detect one should be designed into projects from the start.

Beyond macroeconomic output metrics such as GRDP, the physical footprint of the Trans-Java Toll Road manifests as a powerful driver of landscape and environmental transformation. Recent spatial-temporal analyses utilizing planetary-scale cloud platforms like Google Earth Engine indicate that the broader Trans-Java infrastructure has systematically accelerated urbanization and land use conversion around major interchanges, converting thousands of hectares of green and open spaces into built-up areas. For instance, long-term spatial monitoring from 1990 to 2020 reveals massive built-up expansions—such as a 17,681 Ha increase in Surabaya and over 3,700 Ha in Semarang—resulting in significant environmental trade-offs, including decreased land capability and the Urban Heat Island (UHI) effect. Integrating these spatial dimensions into the evaluation of transport corridors provides a more comprehensive picture: while regency-level economic output may exhibit delayed or muted short-run divergence, the physical and spatial restructuring around interchanges occurs rapidly and demands proactive spatial planning.

2. Method

2.1 Design

The study is a causal-comparative analysis of secondary data using a difference-in-differences design. The treatment is the continuous tolled connection across Central Java that existed from the end of December 2018; the first full year of exposure is 2019. Because the corridor was built in sections, some units had a local tolled segment earlier (Section 2.3), and this staggered element is handled by a sensitivity analysis and not by a staggered-adoption estimator, for reasons given in Section 2.5.

2.2 Data and unit of analysis

The unit of analysis is the regency (*kabupaten*) or city (*kota*) of Central Java Province. All 35 units are included, so the data are a census of the province's second-tier regions and not a sample; a response rate is not applicable (administrative/aggregate data). The panel is balanced, with 11 annual observations per unit for 2010–2020 (385 unit-years) and, after differencing, 10 annual growth observations for 2011–2020 (350 unit-years).
Two series were retrieved from the World Bank's Indonesia Database for Policy and Economic Research (INDO-DAPOER), which compiles sub-national statistics of Statistics Indonesia (Badan Pusat Statistik, BPS) [26]: total GRDP including oil and gas at constant 2010 prices under the 2008 System of National Accounts (indicator NA.GDP.INC.OG.SNA08.KR), and gross value added of the transportation and storage sector on the same basis (NA.GDP.TRAN.STOR.SNA08.KR), both in million rupiah. The database

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was last updated on 11 August 2022 and its regency series end in 2020 [26]. Every value used is printed in Appendix Tables A1 and A2. As a consistency check, the sum of the 35 units was compared with the provincial GRDP reported in the same database; the ratio lies between 0.996 and 1.003 in every year from 2010 to 2019 (the database gives no provincial value for 2020).

Two features of the data bear on interpretation. First, most of the 2020 observations are reported to two decimal places whereas earlier ones are rounded to the nearest ten million rupiah, which suggests that they come from a different release; growth between 2019 and 2020 may therefore include revisions as well as real change. Second, the series stop in 2020. More recent regency accounts are disseminated through the BPS website, but its statistical tables could not be retrieved in machine-readable form for this study, and no figure that was not actually retrieved is used. The post-treatment window is consequently two years, of which one is the pandemic year. National growth was 5.0 per cent in 2019 and −2.1 per cent in 2020 [27].

2.3 Treated and comparison units

A unit is classified as a corridor (treated) unit if the main line of the Trans-Java Toll Road between Pejagan and Ngawi passes through its territory according to the published route descriptions of the sections [10]. Twelve units meet this criterion: the regencies of Brebes, Tegal, Pemalang, Pekalongan, Batang, Kendal, Semarang, Boyolali, Karanganyar and Sragen, and the cities of Semarang and Salatiga (Table 1). The remaining 23 units form the comparison group. The classification follows the published route alone and was not adjusted in the light of the results.

Three complications are acknowledged. Four units are, in the authors' judgement, not crossed by the main line but lie immediately beside it: the cities of Tegal, Pekalongan and Surakarta, and Sukoharjo Regency. They are in the comparison group in the main specification, which biases the estimate towards zero if they benefit; they are moved to the treated group, or dropped, in robustness checks. Secondly, four treated units had an operating tolled segment before 2018: Brebes (the Kanci–Pejagan road opened in January 2010 and Pejagan–East Brebes in June 2016), Semarang City and Semarang Regency (the first two sections of Semarang–Solo opened in 2011 and 2014) and Salatiga (reached in September 2017) [10]. For these the December 2018 event is the change from a local segment to a through corridor; a check restricted to the eight units first reached in 2018 is reported. Thirdly, the assignment of Salatiga rests on the route listing and on the location of the Salatiga gate, while one section description places the alignment in the adjoining Semarang Regency; the unit falls out of the restricted check in any case.

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Table 1. Trans-Java Toll Road sections in Central Java and classification of units

Section	Length (km)	Opening of sub-sections	Regencies/cities crossed (Central Java)
Kanci–Pejagan	33	26 January 2010	Brebes (and Cirebon, West Java)
Pejagan–Pemalang	57.5	Sections I–II 16 June 2016; III–IV 9 November 2018	Brebes, Tegal, Pemalang
Pemalang–Batang	39	Section I 9 November 2018; remainder with the 20 December 2018 inauguration	Pemalang, Pekalongan, Batang
Batang–Semarang	75	20 December 2018	Batang, Kendal, Semarang City
Semarang–Solo	72.64	12 November 2011; 4 April 2014; 15 September 2017; remainder by December 2018	Semarang City, Semarang, Salatiga, Boyolali, Karanganyar
Solo–Ngawi	90.1	Kartasura–Sragen 15 July 2018; Sragen–Ngawi 28 November 2018	Karanganyar, Sragen (and Ngawi, East Java)
Treated units (12)			
Brebes, Tegal, Pemalang, Pekalongan, Batang, Kendal, Semarang, Boyolali, Karanganyar and Sragen regencies; Semarang and Salatiga cities			
Adjacent units (4), comparison in main model			
Tegal, Pekalongan and Surakarta cities; Sukoharjo Regency			
Other comparison units (19)			

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Cilacap, Banyumas, Purbalingga, Banjarnegara, Kebumen, Purworejo, Wonosobo, Magelang, Klaten, Wonogiri, Grobogan, Blora, Rembang, Pati, Kudus, Jepara, Demak and Temanggung regencies; Magelang City
Source: Section lengths, opening dates and routes from [10] and its linked section entries; classification by the authors. The source does not date the final Semarang–Solo and Pemalang–Batang sub-sections individually; the network was declared connected on 20 December 2018.

2.4 Variables

The primary outcome is annual real GRDP growth, measured as the log difference multiplied by 100, , where is constant-price GRDP of unit in year . Growth is preferred to the level of log GRDP because the two groups were on different growth paths before the road: over 2011–2018 the corridor units grew by 5.53 per cent a year on average and the comparison units by 5.19 per cent. Parallel trends in levels therefore fail by construction, whereas parallel trends in growth rates, meaning a stable gap between the two groups' growth, is testable and, as shown below, not rejected. Results for the log level are reported for transparency. Secondary outcomes are the share of transportation and storage in GRDP (per cent), the log growth of that sector's value added, and the log growth of all other value added. GRDP per capita was not analysed because a consistent annual population series for the 35 units could not be retrieved from the same source.

2.5 Estimating equations and inference

The main model is a two-way fixed-effects regression with separate treatment terms for the two post-connection years:

where are unit effects, year effects, equals one for corridor units, and and are indicators for 2019 and 2020. The coefficient is the differential growth of corridor units in the first full year of continuous operation relative to their own 2011–2018 average and to the contemporaneous change in comparison units; is the same quantity for the pandemic year. Splitting the post period matters because the year effect removes only the common part of the pandemic shock. If the shock hit corridor and non-corridor economies differently for reasons unrelated to the road (for example, through their exposure to tourism, export manufacturing or passenger transport), absorbs that difference. It is therefore read as a description of relative resilience and not as a clean treatment effect; is the estimate on which the causal reading rests. A pooled version with a single post-2018 term is also reported.
The identifying assumption is that, in the absence of the continuous connection, the gap between the growth rates of corridor and comparison units would have stayed at its 2011–2018 level. It is examined in three ways with pre-period data. First, an event-study version of the model replaces the two treatment terms with a full set of interactions between and year indicators, omitting 2018:

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and the seven lead coefficients are tested jointly. Second, a linear differential trend in growth is estimated on 2011–2018 only. Third, a placebo treatment is assigned to 2016–2018 within the pre-period sample.
Standard errors are clustered by unit (35 clusters, 12 treated) with the usual finite-sample correction, and confidence intervals use the distribution with 34 degrees of freedom [28]. Because cluster-robust inference can be unreliable with few clusters, two further -values are reported for the main coefficients: a wild cluster bootstrap- with Rademacher weights and the null hypothesis imposed, using 1,999 replications [29], and a randomisation -value obtained by reassigning corridor status to 1,999 random sets of units of the same size and re-estimating the model, in the spirit of inference procedures designed for a small number of policy changes [30]. All three are two-sided.

The recent econometric literature shows that two-way fixed-effects estimators can be misleading when treatment timing varies and effects are heterogeneous [31], [32], [33], [34]. The main model avoids the problem by defining a single treatment date for all treated units, so that no already-treated unit serves as a control for a later-treated one. The cost is that earlier local openings are ignored; the restricted-sample check in Section 3.4 addresses this. With only two post-treatment years and four early-segment units, a staggered-adoption estimator would add complexity without adding usable information.

All computations were carried out in Python with a script that reads the appendix data and reproduces every figure reported below.

2.6 Ethics

The study uses only publicly available aggregate statistics and involves no human participants; ethical approval was therefore not required.

3. Results

3.1 Descriptive comparison

At the 2018 baseline the two groups differ in ways that matter for interpretation (Table 2). Corridor units are larger on average (mean GRDP of Rp 31.4 trillion against Rp 24.5 trillion) and have a smaller transport and storage share (3.08 per cent against 4.34 per cent). The comparison group is also more heterogeneous: the standard deviation of its growth rate exceeds that of the corridor group in every year, largely because it contains three regencies whose growth paths are visibly atypical in the data (Appendix Table A1). Cilacap, the second-largest economy in the province, grew by between 1.6 and 5.8 per cent a year before 2020 and then contracted by 11 per cent; Kudus was the steadiest slow grower, at 2.5 to 4.3 per cent; and the GRDP of Blora rose by 21 per cent (in log terms) in 2016 alone.

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Table 2. Mean annual real GRDP growth (log per cent) of corridor and comparison units, 2011–2020

Year	Corridor mean (n = 12)	Corridor SD	Comparison mean (n = 23)	Comparison SD	Difference
2011	5.96	0.57	5.30	0.93	0.66
2012	5.24	0.51	4.92	0.86	0.32
2013	5.91	0.34	5.11		

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0.99
0.80
2014
5.29
0.36
4.81
0.62
0.49
2015
5.36
0.38
5.29
0.49
0.07
2016
5.26
0.29
5.67
3.43
−0.41
2017
5.32
0.16
4.93
0.92
0.39
2018
5.91
0.51
5.51
0.81
0.40
2011–2018
5.53
–
5.19
–
0.34
2019
5.65
0.37
5.12
0.88
0.53
2020
−1.58
0.61
−2.25
2.11
0.67

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Source: Authors' calculations from INDO-DAPOER data [26]; unweighted means across units. SD = standard deviation across units.

The raw comparison flatters the corridor. In 2019 corridor units grew 0.53 points faster than comparison units and in 2020 they contracted 0.67 points less. But they had also grown faster in seven of the eight preceding years, by 0.34 points on average. The simple difference-in-differences, the post-period gap minus the pre-period gap, is 0.19 points for 2019 and 0.33 points for 2020. In aggregate terms the pattern is the same: the summed GRDP of the 12 corridor units rose by 6.12 per cent in 2019 and that of the 23 comparison units by 4.70 per cent, but the corresponding figures for 2018, before the corridor was continuous, were 6.51 and 5.12 per cent.

3.2 Main estimates

Table 3 reports the estimates of equation (1). The corridor differential in 2019 is 0.19 percentage points with a cluster-robust standard error of 0.18; the 95 per cent confidence interval runs from −0.17 to 0.55. The three -values agree that it cannot be distinguished from zero (0.30, 0.31 and 0.46). The 2020 coefficient is larger, 0.33 points, but far less precise (standard error 0.47, interval −0.64 to 1.29). Pooling the two years gives 0.26 points (standard error 0.30).

Table 3. Difference-in-differences estimates of the

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corridor effect on real GRDP

Model and outcome
Term
Estimate
SE
95% CI
p (cluster)
p (wild bootstrap)
p (randomisation)
N
M1: growth, log %
Corridor × 2019
0.190
0.178
−0.173 to 0.552
0.295
0.305
0.463
350

Corridor × 2020
0.327
0.474
−0.636 to 1.289
0.495
0.509
0.643
350
M1b: growth, log %
Corridor × post-2018
0.258
0.301
−0.355 to 0.871
0.398
0.395
0.552
350
M2: ln GRDP (level)

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Corridor × 2019
0.016
0.009
−0.002 to 0.034
0.084
0.071
0.173
385

Corridor × 2020
0.023
0.012
−0.001 to 0.047
0.065
0.035
0.114
385
Source: Authors' estimates from INDO-DAPOER data [26]. All models include unit and year fixed effects; 35 clusters, 12 treated. SE = cluster-robust standard error; CI = confidence interval.

The level model (M2) appears to tell a more favourable story: log GRDP in corridor units is 1.6 per cent higher in 2019 and 2.3 per cent higher in 2020 than the model predicts, with conventional -values below 0.10 and one bootstrap -value below 0.05. This is the result a less careful analysis would report, and it should not be believed. A level specification attributes to the treatment any pre-existing difference in growth, and the corridor units had been pulling away from the comparison units by about a third of a percentage point a year since 2011. Because the pre-period is centred on 2014, a drift of 0.34 points a year continued to 2019 and 2020 implies level gaps of about 1.7 and 2.0 per cent relative to the pre-period mean, which is almost exactly what the model returns. The randomisation -values for the level model (0.17 and 0.11) do not support rejection either.

3.3 Pre-trend checks

The event-study coefficients from equation (2) are given in Table 4. None of the seven lead coefficients is individually significant, and their joint test does not reject equality with zero ($F = 1.68$, $p = 0.15$). The leads are nonetheless not a flat line: they are mostly positive up to 2014 and negative in 2015 and 2016, and the 2016 coefficient (−0.81) is large because of the Blora surge in the comparison group. The linear differential trend in growth over 2011–2018 is −0.065 points per year (standard error 0.042, $p = 0.12$), and the placebo treatment assigned to 2016–2018 yields −0.34 points (standard error 0.29, $p = 0.24$). The parallel-trends assumption in growth rates is thus not rejected, but with 35 clusters these tests have limited power, and the point estimates hint that the corridor's growth advantage was, if anything, narrowing before 2018. Because a failure to reject does not establish parallel trends, and because recent work recommends asking how conclusions change if the post-period deviation is allowed to resemble the pre-period one [35], a further sensitivity model adds a corridor-specific linear trend in growth to equation (1), so that the counterfactual gap continues to narrow at its pre-2019 pace. The estimates rise to 0.48 points for 2019 (standard error 0.30, 95 per cent interval −0.13 to 1.09, $p = 0.12$) and 0.68 points for 2020 (standard

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error 0.58, p = 0.25) in the full sample, and to 0.17 points (standard error 0.13, interval −0.09 to 0.42) and 0.01 points (standard error 0.26) when the three atypical comparison regencies described in Section 3.1 are excluded. Allowing for the pre-trend thus moves the point estimates upwards but never to statistical significance. The two post-period coefficients in the event study, 0.13 for 2019 and 0.26 for 2020, are smaller than those of equation (1) because the reference is the single year 2018 instead of the eight-year pre-period average.

Table 4. Event-study estimates: corridor × year interactions on real GRDP growth (reference

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year
2018
)

Year
Estimate
SE
95% CI
p
2011
0.254
0.305
−0.344 to 0.852
0.405
2012
−0.084
0.217
−0.509 to 0.341
0.697
2013
0.394
0.255
−0.105 to 0.893
0.122
2014
0.080
0.177
−0.267 to 0.428
0.650
2015
−0.334
0.265
−0.854 to 0.186
0.208
2016
−0.813
0.834
−2.447 to 0.821
0.330
2017
−0.013
0.216
−0.436 to 0.410
0.952
2018
0 (reference)
–
–
–

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2019
0.125
0.120
−0.110 to 0.360
0.298
2020
0.262
0.443
−0.606 to 1.130
0.554
Joint test of 2011–2017 leads
F = 1.68

0.148
Source: Authors' estimates from INDO-DAPOER data [26]. Unit and year fixed effects; standard errors clustered by unit (35 clusters); N = 350.

3.4 Robustness

Table 5 varies the sample and the treatment definition. The most consequential change is the removal of the three atypical comparison regencies identified in Section 3.1. Without Cilacap, Blora and Kudus the 2019 estimate falls to −0.03 points (standard error 0.10) and the 2020 estimate turns negative, −0.23 points (standard error 0.26). The positive point estimates of the main model are therefore produced by these three units and, in 2020, almost entirely by Cilacap, whose GRDP fell by 11 per cent in log terms. The trimmed sample was defined after inspecting the data and is offered as a sensitivity check, not as a preferred specification. In it the confidence interval for 2019 is also much tighter, −0.23 to 0.17: differential effects larger than about a fifth of a percentage point in either direction are excluded by the interval.

The other checks leave the conclusion unchanged. Reclassifying the four adjacent units as treated gives 0.23 points for 2019; dropping them from the comparison group gives the same. Restricting the treated group to the eight units first reached by a toll road in 2018 gives 0.15 points for 2019 and 0.49 for 2020, neither significant. Using simple percentage growth in place of log growth, or shortening the pre-period to 2014–2018, changes nothing of substance, although the shorter window raises the 2019 estimate to 0.34 points ($p = 0.15$), an indication of how sensitive the estimate is to which pre-period years define the counterfactual gap.

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Table 5. Robustness of the growth estimates (log per cent)

Specification			
Units (treated)			
Corridor × 2019: estimate (SE) [95% CI]			
p (cluster)			
Corridor × 2020: estimate (SE) [95% CI]			
p (cluster)			
R1: excluding Cilacap, Blora, Kudus			
32 (12)			
−0.030 (0.099) [−0.231, 0.171]			
0.764			
−0.226 (0.259) [−0.754, 0.303]			
0.390			
R2: adjacent units treated			
35 (16)			
0.228 (0.203) [−0.185, 0.641]			
0.269			
0.276 (0.535) [−0.812, 1.364]			
0.610			
R3: adjacent units dropped			
31 (12)			
0.229 (0.209) [−0.199, 0.656]			
0.283			
0.341 (0.556) [−0.794, 1.476]			
0.544			
R4: units first reached in 2018 only			
31 (8)			
0.150 (0.180) [−0.218, 0.517]			
0.413			
0.493 (0.459) [−0.445, 1.430]			
0.292			
R5: simple percentage growth			
35 (12)			
0.207 (0.194) [−0.187, 0.601]			
0.294			
0.286 (0.456) [−0.641, 1.214]			
0.534			

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R6: pre-period 2014–2018
35 (12)
0.341 (0.234) [−0.134, 0.816]
0.154
0.478 (0.524) [−0.587, 1.544]
0.368
R7: R1 and R3 combined
28 (12)
−0.038 (0.110) [−0.264, 0.188]
0.732
−0.347 (0.270) [−0.900, 0.206]
0.209
Source: Authors' estimates from INDO-DAPOER data [26]. Unit and year fixed effects; standard errors clustered by unit. Wild-bootstrap and randomisation p-values for R1–R4 lie between 0.27 and 0.76 for every coefficient and lead to the same conclusions.

3.5 Transport and storage

If the corridor had an early local effect anywhere, the sector that sells transport and warehousing services is where one would look first. Table 6 gives no sign of it. The growth of transport and storage value added in corridor units was indistinguishable from that in comparison units in 2019 (0.01 points, standard error 0.44). In 2020 the sector contracted by about 35 per cent in log terms in both groups, and the estimated differential, 0.65 points with a standard error of 4.35, is uninformative. One data point drives much of that imprecision: the database records a fall of 63 per cent in Surakarta's transport value added in 2020, against 42 per cent for the next most affected unit. The value was re-read from the source and is reported as found, but it may be a revision artefact; excluding Surakarta gives −2.21 points (standard error 3.14).

The sector's share of GRDP fell in corridor units relative to comparison units in 2019 by 0.18 percentage points, an estimate that is statistically significant under all three inference procedures. It should not be interpreted as an effect of the road. The share had been rising more slowly in corridor units throughout the pre-period (differential trend −0.029 points per year, standard error 0.014, $p = 0.03$), so the parallel-trends assumption fails for this outcome, and the 2019 coefficient largely continues that divergence. Growth of value added outside transport and storage shows the same pattern as total GRDP: 0.23 points in 2019 (standard error 0.18) and essentially zero in 2020.

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Table 6. Difference-in-differences estimates for the transport and storage sector

Outcome	Term	Estimate	SE	95% CI	p (cluster)	p (wild bootstrap)	p (randomisation)
Sector share of GRDP (percentage points)							
	Corridor × 2019	−0.175	0.066	−0.308 to −0.042	0.012	0.007	0.027
	Corridor × 2020	0.140	0.143	−0.151 to 0.431	0.334	0.313	0.332
Sector value-added growth (log %)							
	Corridor × 2019	0.006	0.438	−0.885 to 0.897	0.989	0.993	0.989
	Corridor × 2020	0.647	4.350	−8.193 to 9.487	0.883	0.884	0.922

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Same, excluding Surakarta
Corridor × 2019
−0.021
0.443
−0.923 to 0.882
0.963
–
–

Corridor × 2020
−2.206
3.136
−8.585 to 4.173
0.487
–
–
Non-transport value-added growth (log %)
Corridor × 2019
0.228
0.182
−0.143 to 0.598
0.220
–
–

Corridor × 2020
−0.045
0.561
−1.186 to 1.096
0.937
–
–
Source: Authors' estimates from INDO-DAPOER data [26]. Unit and year fixed effects; standard errors clustered by unit; 35 units (34 where Surakarta is excluded). The share outcome fails the pre-trend check (see text).

3.6 Spatial transformation and land cover dynamics

While the difference-in-differences estimates show no immediate short-run divergence in aggregate regional GRDP growth among crossed units, evidence from broader corridor-level spatial analyses demonstrates that the Trans-Java infrastructure triggers profound localized physical transformations. Geospatial evaluations using high-resolution satellite imagery and Google Earth Engine across key Trans-Java interchanges (such as Semarang and Surabaya) indicate that built-up areas expanded universally between 1990 and 2020, driven by the pursuit of higher economic land values near interchanges. In Semarang and Surabaya specifically, the rapid growth of built-up land (+3,708.07 Ha and +17,681.09 Ha respectively) occurred largely at the expense of productive

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green and open spaces. This spatial reality complements the economic null result: the primary immediate impact of the toll road is redistributive and physical—restructuring local land cover and accelerating urbanization around access nodes—long before aggregate regency-level economic accounts capture a measurable output dividend.

4. Discussion

4.1 What the estimates show

The answer to the first research question is that no divergence can be detected. In the first full year of continuous operation the regencies and cities crossed by the Trans-Java corridor grew about 0.2 percentage points faster, relative to their own past and to the rest of the province, than they would have under an unchanged gap, and the uncertainty around that figure comfortably includes zero and modest negative values. When three atypical comparison regencies are set aside the estimate is zero to the first decimal place and fairly tightly bounded. The answer to the second question is also negative: transport and storage did not expand faster in corridor units, and its share of their output continued a relative decline that began years before. On the third question, the conclusion survives every change of sample and definition tried, and the one configuration that would have produced a "significant" corridor effect, the level specification, is the one that the pre-period data show to be invalid.

The pandemic year deserves a separate remark. The corridor group contracted less than the comparison group in 2020 in the raw data, and it would be easy to read this as resilience conferred by connectivity. The estimates do not support that reading. The 2020 differential is imprecise in the full sample and negative once Cilacap is excluded, which means that the raw gap reflects the composition of the comparison group, in particular the sharp contraction of a single large regency, and not a property of corridor units. This is the reason the year was modelled separately: a pooled post-treatment coefficient of 0.26 would have blended a near-zero clean-year estimate with a composition effect.

4.2 Relation to earlier findings

A null local effect on aggregate output in the short run is consistent with much of what is known. The rural-roads evidence from India is that connection reallocates labour without raising local production or incomes within four years [5]. For the Trans-Java corridor itself, the one earlier study with a comparison group and a long panel found that small food and beverage enterprises declined at first and recovered only after about six years [14], and the Cipali assessment recorded gains in trade and investment alongside losses for businesses on the bypassed road [13]. Along the Trans-Sumatra corridor, proximity to an interchange was found to be unrelated to regency GRDP, the authors concluding that benefits depend on each region's economic structure and its capacity to use the new connectivity [24]. Qualitative and spatial studies describe the same redistribution: activity moving from the old north-coast highway towards interchanges and favoured locations [16], benefits concentrating in urban and industrial areas [17], and built-up land expanding fastest in already industrial regencies [18]. If the corridor mainly relocates activity within and between regencies, and if its largest benefits accrue to through traffic whose origins and destinations lie in Jakarta, Semarang, Surabaya and their industrial belts, then regency-level GRDP in the crossed territory is not where the gains will first appear.

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The finding does not contradict the studies that report positive associations between toll roads and output in Java [11], [12]. Those compare places with and without toll access in cross-section or relate output to network length, and they capture the long-run sorting of industry towards accessible locations as well as any causal effect of the road. The present design removes time-invariant differences between places and asks only whether growth changed when the corridor became continuous. Nor does the result bear on aggregate welfare. The general-equilibrium estimates for Sumatra put the gains from a trunk toll road at between a quarter of one per cent and three and a half per cent of output, depending on how mobile labour is assumed to be, and they locate those gains mainly in Sumatra as a whole and not specifically along the alignment [23]. A difference-in-differences between crossed and uncrossed regencies of one province cannot see benefits that both groups share.

4.3 Why a local dividend may be absent or undetectable

Four explanations are compatible with the evidence, and the data cannot separate them. The first is time. Two years, one of them a pandemic year in which transport value added fell by about a third in both groups, is short against the horizon over which firms relocate and land is converted; the study of small enterprises cited above suggests a lag of several years [14]. The second is spillover. The comparison regencies are not isolated from the corridor: Central Java is a compact province, and producers in uncrossed regencies can also use the road to reach Jakarta and Surabaya. To the extent that they benefit, the comparison is contaminated and the estimate understates the corridor's effect on the province as a whole, while still correctly describing the absence of a differential advantage for crossed units. The third is displacement within treated units: gains near interchanges may be offset by losses along the old arterial road in the same regency, leaving the regency total unchanged. The fourth is anticipation. Construction spending and land transactions may have raised activity in corridor regencies before opening, and some of the earlier sections were already in use, so part of any effect may be embedded in the pre-period average against which 2019 is compared. The narrowing of the corridor's growth advantage before 2018, visible in the lead coefficients, is at least not evidence of an anticipatory boom.

4.4 Implications for infrastructure planning

Three implications follow for the planning and appraisal of toll corridors, in Central Java and in the corridors now being built elsewhere in Indonesia.

The first concerns what is promised. Public justification for expressways commonly invokes growth in the regions crossed. The evidence here is that, for a project of this scale, a differential output gain in crossed regencies was not detectable in the first two years and, in the trimmed sample, is bounded at roughly a fifth of a percentage point of annual growth. Appraisal should therefore rest on the benefits that an expressway delivers with reasonable certainty, namely savings in travel time, vehicle operating cost and reliability for users, and should treat local output effects as uncertain, lagged and partly redistributive. Regional governments that budget on the expectation of an automatic revenue or growth dividend from an interchange are likely to be disappointed.

The second concerns complementary investment. A toll road lowers the cost of moving between interchanges; it does little for a firm that cannot reach the interchange cheaply, obtain serviced industrial land, or find power, water and labour nearby. The literature reviewed above shows activity concentrating where those conditions already exist [17], [18].

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For corridor regencies the planning question is therefore less whether the road exists than whether spatial plans, access roads, industrial estates and logistics facilities are aligned with it, and whether the costs it imposes, on bypassed roadside economies [16], on farmland [20] and on air quality [22], are managed. A toll operator's commercial interest lies in traffic volumes and not in local development, so the latter has to be pursued deliberately by provincial and regency governments.

The third concerns evaluation itself. This study could be carried out only with regency accounts published years after the event, on a design fixed after the fact, and its precision is limited by the 35 units available. Large projects should be accompanied from the outset by an evaluation plan that names the outcomes expected to change, the comparison areas, and the data to be collected at a finer spatial scale than the regency: traffic counts by origin and destination, firm registrations and land-use change by distance from interchanges, and sub-district accounts where they exist. Indonesian researchers have already shown, with village census data and satellite imagery, that such designs are feasible [14], [18]. Making them a routine requirement of the project cycle would turn each new corridor into evidence for the next.

5. Limitations

The limitations of the study are substantial and should temper every conclusion drawn from it. The post-treatment window is two years, because the public database from which regency accounts could be retrieved ends in 2020; more recent regency accounts on the BPS website could not be retrieved in a form that allowed every figure to be verified, and they were therefore not used. One of the two years is dominated by the pandemic. The analysis cannot speak to medium-run effects, which one enterprise-level study suggests may differ in sign from short-run ones [14].

Inference rests on 35 clusters, 12 of them treated. The confidence intervals are wide in the full sample, and the study is not powered to detect differential effects of a few tenths of a percentage point. A null result under these conditions means that an effect was not detected, not that none exists; only in the trimmed sample is the interval narrow enough to exclude moderate effects, and that sample was defined after inspecting the data.

Identification is imperfect. Treatment was not randomly assigned: an expressway alignment is chosen for engineering and economic reasons, and the corridor units differ from the others in size, sectoral structure and pre-period growth. The parallel-trends assumption in growth rates is not rejected, but the pre-period tests have low power, and the assumption fails for the transport share. Spillovers to comparison units violate the stable-unit assumption and bias the estimate towards zero. Earlier local openings and construction activity blur the treatment date. Treatment is a binary indicator of being crossed, which ignores the number and location of interchanges and the distance of each unit's economic centre from them. The classification of units relies on published route descriptions and not on an official alignment map, and the opening dates in Table 1 are taken from a secondary compilation that could not be checked against the regulator's records in this study.

The data have their own weaknesses. The 2020 values appear to come from a different release than earlier years. GRDP per capita, employment, wages and land values, all of which

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might respond differently, were not analysed. Finally, the study covers one province; Central Java's corridor units may not be representative of those in West or East Java.

6. Conclusion

When the last gaps in the Trans-Java Toll Road were closed in December 2018, Central Java acquired a continuous expressway across twelve of its thirty-five regencies and cities. Comparing those twelve with the other twenty-three before and after that date, this study finds no detectable divergence in real GRDP growth in 2019 (0.19 percentage points, 95% confidence interval −0.17 to 0.55) or in the pandemic year 2020, and none in the growth of the transport and storage sector. However, when viewed alongside broader spatial evidence from the Trans-Java corridor, these economic findings reveal a crucial duality: whereas short-run aggregate output growth in crossed regencies remains statistically indistinguishable from comparison units, physical land cover transformations—such as intensive urban expansion and the conversion of green spaces near interchanges—occur rapidly and systematically.

Within those bounds, the study supports a sober view of what a trunk toll road does: it changes transport costs instantly, restructures local land cover and accelerates urbanization near access points over time, but it does not by itself instantly make crossed regencies grow faster in aggregate output than their neighbours. Planning must proceed on that basis, pairing corridors with local access, localized environmental mitigation (addressing UHI and hydrological degradation), and operational spatial planning instruments such as Detailed Spatial Plans (Rencana Detail Tata Ruang / RDTR). Extending the present panel with regency accounts from 2021 onwards, and integrating high-resolution remote sensing of land-use change at the sub-district scale, represent the logical next steps for future research.

Declarations

Data availability. All data analysed in this article are drawn from publicly available documents and datasets, which are cited in the text and listed in the references. No new primary data were generated. The complete dataset is printed in Appendix Tables A1 and A2.

Use of AI. The initial draft of this manuscript was prepared with generative-AI assistance (Claude, Anthropic) by Research Center Progresif from publicly available data and documents; data, calculations and references were verified against their sources (verification log available from the editorial office). The authors substantially revised and extended the draft and take full responsibility for its content.

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Appendix

Table A1. GRDP at constant 2010 prices by regency/city, Central Java, 2010–2020 (billion rupiah)

Unit Group	2010	2011	2012

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2013
2014
2015
2016
2017
2018
2019
2020
Batang
T
9,447.33
10,025.04
10,488.46
11,104.70
11,693.90
12,328.24
12,942.69
13,627.28
14,448.63
15,226.89
15,030.58
Boyolali
T
13,721.70
14,592.03
15,369.97
16,266.50
17,148.35
18,170.38
19,132.56
20,188.70
21,406.27
22,681.10
22,399.52
Brebes
T
20,158.11
21,498.42
22,482.26
23,812.06
25,074.17
26,572.83
27,921.99
29,450.23
31,050.89
32,869.15
32,640.97
Karanganyar
T
16,393.79

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17,205.06
18,219.46
19,256.52
20,262.44
21,286.29
22,428.79
23,665.95
25,150.28
26,641.19
26,137.00
Kendal
T
18,798.28
20,032.43
21,075.72
22,386.12
23,536.83
24,762.33
26,131.14
27,586.10
29,245.66
30,908.49
30,443.69
Pekalongan
T
10,254.32
10,834.20
11,354.85
12,034.81
12,630.37
13,234.56
13,917.70
14,652.18
15,525.05
16,356.35
16,047.51
Pemalang
T
11,282.20
11,847.20
12,477.24
13,172.06
13,898.67
14,673.70
15,463.80
16,297.65
17,268.89
18,270.19
18,146.61
Salatiga City

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T
5,845.48
6,230.22
6,574.91
6,989.05
7,378.04
7,759.18
8,163.94
8,589.01
9,127.75
9,664.50
9,503.16
Semarang
T
21,572.14
22,925.46
24,306.72
25,758.12
27,264.11
28,768.33
30,283.03
31,939.25
33,855.68
35,747.01
34,687.62
Semarang City
T
80,824.10
86,142.97
91,282.03
96,985.40
103,109.87
109,110.69
115,485.43
122,000.44
131,317.63
140,326.26
137,951.30
Sragen
T
15,832.56
16,870.23
17,902.10
19,102.18
20,169.82
21,390.87
22,618.32
23,933.25
25,356.46
26,853.06

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26,367.26
Tegal
T
15,106.51
16,071.82
16,912.25
18,050.29
18,958.84
19,999.48
21,182.92
22,322.10
23,552.55
24,866.73
24,502.62
Pekalongan City
A
4,624.26
4,878.33
5,151.81
5,456.20
5,755.28
6,043.10
6,367.27
6,706.28
7,087.92
7,477.43
7,337.83
Sukoharjo
A
16,357.22
17,319.64
18,342.25
19,401.89
20,449.01
21,612.08
22,845.98
24,152.94
25,564.07
27,076.44
26,616.94
Surakarta City
A
21,469.55
22,848.44
24,123.78
25,631.68
26,984.36
28,453.49
29,966.37
31,562.98

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33,506.22
35,443.18
34,827.19
Tegal City
A
6,895.71
7,341.54
7,650.48
8,084.18
8,491.33
8,953.88
9,440.53
9,955.59
10,594.34
11,205.32
10,953.33
Banjarnegara
C
9,439.36
9,952.40
10,473.36
11,043.08
11,629.85
12,266.05
12,929.66
13,630.39
14,438.15
15,246.87
15,045.88
Banyumas
C
23,016.94
24,538.60
25,982.16
27,793.14
29,367.69
31,164.88
33,051.05
35,147.31
37,414.50
39,779.32
39,121.62
Blora
C
10,149.08
10,597.72
11,116.87
11,712.50
12,227.20
12,882.59

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15,913.43
16,843.36
17,609.72
18,322.13
17,464.95
Cilacap
C
75,099.09
78,156.82
79,702.24
81,022.67
83,391.50
88,357.61
92,830.36
95,103.85
98,159.05
100,445.73
89,934.72
Demak
C
11,647.74
12,275.70
12,823.23
13,499.23
14,078.42
14,913.00
15,666.35
16,537.58
17,479.88
18,417.01
18,374.56
Grobogan
C
12,766.02
13,172.71
13,842.05
14,474.73
15,064.46
15,962.62
16,674.63
17,617.25
18,688.57
19,692.61
19,379.68
Jepara
C
13,347.32
14,004.33
14,825.00
15,623.74

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16,374.72
17,210.37
18,074.13
19,001.04
20,170.26
21,384.28
20,969.88
Kebumen
C
12,311.42
13,068.99
13,707.06
14,333.33
15,163.09
16,115.55
16,916.22
17,743.92
18,777.05
19,825.06
19,526.36
Klaten
C
17,002.05
18,071.35
19,102.40
20,241.43
21,424.52
22,558.98
23,717.93
24,920.30
26,360.65
27,829.65
27,482.91
Kudus
C
52,933.50
55,175.79
57,440.81
59,944.56
62,600.68
65,029.94
66,669.09
68,649.05
71,048.11
73,249.69
70,662.04
Magelang
C
14,363.23
15,323.04

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16,071.14
17,020.76
17,936.29
18,864.65
19,876.74
20,882.80
22,082.80
23,253.15
22,861.47
Magelang City
C
4,010.72
4,255.66
4,484.27
4,755.09
4,992.11
5,247.34
5,518.68
5,804.31
6,138.62
6,472.54
6,314.05
Pati
C
18,782.55
19,893.33
21,072.33
22,329.69
23,365.21
24,770.33
26,121.96
27,532.17
29,192.48
30,902.90
30,545.61
Purbalingga
C
10,858.63
11,474.22
12,138.45
12,778.31
13,397.71
14,130.61
14,806.55
15,564.28
16,458.71
17,387.94
17,174.55
Purworejo
C

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8,513.49
8,993.81
9,406.24
9,870.97
10,312.94
10,862.65
11,418.36
12,005.10
12,670.38
13,360.77
13,132.49
Rembang
C
8,373.55
8,808.30
9,277.16
9,780.75
10,284.27
10,850.27
11,418.01
12,123.47
12,939.88
13,612.55
13,409.63
Temanggung
C
9,710.20
10,301.57
10,740.98
11,299.34
11,867.68
12,489.39
13,110.75
13,724.46
14,483.26
15,214.06
14,890.75
Wonogiri
C
13,310.57
13,786.71
14,605.09
15,303.28
16,107.80
16,977.20
17,865.35
18,788.40
19,837.02
20,856.21
20,561.60

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Wonosobo	C	9,005.93	9,489.55	9,935.91	10,333.76	10,828.17	11,334.08	11,916.00	12,292.80	13,065.84	13,798.84	13,569.63	**Sum of 35 units**	
														623,224.65
														658,003.63
														690,461.04
														726,652.12
														763,219.70
														805,107.54
														848,787.71
														890,541.77
														941,073.22
														990,664.60
														964,015.51

Source: World Bank INDO-DAPOER, indicator NA.GDP.INC.OG.SNA08.KR [26], converted from million to billion rupiah and shown to two decimals (the 2020 values carry further decimals in the source; the analysis uses the unrounded values). Group: T = corridor (treated), A = adjacent unit (comparison in main model), C = other comparison. Unnamed units are regencies.

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Table A2. Gross valu

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e added of transportation and storage at constant 2010 prices by regency/city, Central Java, 2010–2020 (billion rupiah)

Unit Group	2010	2011	2012	2013	2014

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2015
2016
2017
2018
2019
2020
Batang
T
233.69
245.96
259.34
286.34
315.16
339.28
357.20
373.77
391.36
424.20
310.47
Boyolali
T
570.25
609.92
651.09
710.86
777.72
838.21
895.33
966.12
1,042.71
1,102.21
638.17
Brebes
T
557.93
569.41
625.13
703.39
783.05
837.52
893.51
949.52
1,016.64
1,107.18
766.68
Karanganyar
T
443.55
462.08
494.06

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538.42
578.92
605.62
637.93
673.07
706.16
748.38
580.00
Kendal
T
413.74
430.01
441.90
463.31
488.41
530.03
561.76
601.40
642.62
694.46
470.83
Pekalongan
T
262.54
272.57
289.85
316.18
345.84
366.24
388.21
412.99
430.58
464.28
365.32
Pemalang
T
326.13
338.41
367.45
389.20
411.17
434.02
462.44
506.63
525.82
568.34
387.60
Salatiga City
T
182.21

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190.28
204.65
226.65
247.07
270.36
279.97
296.41
316.36
343.76
250.49
Semarang
T
457.15
473.74
503.60
543.77
590.70
644.14
670.91
717.68
774.26
842.43
652.50
Semarang City
T
2,739.45
2,877.54
3,099.05
3,411.48
3,757.98
3,946.35
4,188.31
4,452.11
4,847.43
5,338.39
3,233.55
Sragen
T
411.27
435.82
472.89
518.07
572.18
600.44
620.71
652.44
687.81
736.62
542.22
Tegal

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T
427.12
439.94
462.83
505.82
551.92
599.87
640.96
680.00
724.91
776.58
543.84
Pekalongan City
A
334.65
348.49
360.88
372.33
389.71
410.93
432.15
457.38
489.71
526.56
397.23
Sukoharjo
A
537.49
558.35
580.99
637.99
694.75
759.02
820.59
882.06
945.86
1,016.76
690.99
Surakarta City
A
566.18
591.90
630.02
695.07
753.35
816.51
859.86
908.89
960.62
1,030.90

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384.65
Tegal City
A
273.48
279.47
291.24
313.31
366.74
400.47
425.35
451.26
481.29
516.93
388.27
Banjarnegara
C
365.99
376.52
410.58
445.53
482.86
521.42
549.89
586.26
626.65
670.73
477.71
Banyumas
C
883.34
956.01
956.65
1,046.03
1,130.99
1,208.36
1,280.50
1,360.43
1,448.39
1,563.88
1,065.89
Blora
C
285.48
291.42
312.48
344.92
381.37
411.53
445.80
467.44

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502.17
546.11
425.28
Cilacap
C
1,450.98
1,523.89
1,649.79
1,844.47
2,028.56
2,228.32
2,329.63
2,448.04
2,644.32
2,855.20
2,008.26
Demak
C
328.20
342.10
362.24
388.41
418.49
451.16
476.28
504.27
540.08
577.44
416.35
Grobogan
C
571.90
615.53
660.22
709.69
764.29
813.08
874.14
935.33
1,003.06
1,101.54
786.28
Jepara
C
553.96
564.51
597.28
650.52
695.08
735.84

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784.58
832.67
890.36
966.64
684.27
Kebumen
C
465.70
488.77
502.52
559.65
615.62
683.06
768.25
824.44
871.46
939.30
726.25
Klaten
C
392.66
407.27
424.25
469.35
515.46
544.59
566.77
597.10
625.69
656.72
468.12
Kudus
C
511.76
552.66
593.83
646.98
700.32
760.45
806.94
856.92
913.42
986.66
754.88
Magelang
C
505.90
526.15
570.46
619.32

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672.28
729.69
777.89
825.56
876.76
951.71
694.83
Magelang City
C
284.07
295.25
312.54
344.42
373.23
399.52
418.76
443.25
472.09
511.37
369.82
Pati
C
507.84
545.82
586.05
642.77
706.54
761.83
816.95
874.48
950.64
1,022.82
712.67
Purbalingga
C
361.09
371.64
398.74
434.38
471.10
510.54
538.90
572.92
602.02
656.94
459.29
Purworejo
C
471.40
488.08

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531.73
576.14
616.01
662.14
690.44
721.21
761.24
821.83
597.86
Rembang
C
304.82
318.34
339.53
375.32
414.92
443.04
467.12
495.34
532.27
577.83
444.69
Temanggung
C
419.37
437.26
484.59
539.88
568.60
613.42
652.23
675.72
706.33
771.94
533.79
Wonogiri
C
793.00
823.88
882.10
956.59
1,060.92
1,146.26
1,214.44
1,332.01
1,466.96
1,622.12
1,070.56
Wonosobo
C

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449.96
472.70
506.98
553.53
599.05
642.64
689.60
731.10
782.39
846.32
594.50
Sum of 35 units

18,644.25
19,521.69
20,817.53
22,780.09
24,840.36
26,665.90
28,284.30
30,066.22
32,200.44
34,885.08
23,894.11

Source: World Bank INDO-DAPOER, indicator NA.GDP.TRAN.STOR.SNA08.KR [26], converted from million to billion rupiah and shown to two decimals (the 2020 values carry further decimals in the source; the analysis uses the unrounded values). Group codes as in Table A1.

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