

# Uso de Google Maps API para la evaluación de los efectos socio-espaciales de las autopistas urbanas en Santiago, Chile

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Ceremonia de Incorporación a la Sociedad Chilena de Ingeniería de  
Transporte  
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CE X- eqpsC^z- S ^ C^ ~^ z.00z

/c



El uso de GMaps permite calcular los tiempos de viaje ahorrados por las autopistas. Las zonas que son a la vez ricas y periféricas son las más beneficiadas.

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c Bszq<z~q @CY eqfsc^z- <S ^

//

© R^zdp@~<<S ^

● KC^Cqf <S ^ @CY 4-sC @C @ zbs

● pCs~Yz- @bs

● J ; b^<Y-sb^Cs

c r-^zSLb %s~s -~zbeSz-s

/}

| ; --zdp -~zbeSz-s S^-~L~q@ s C^ | CEE Q CEE >cl CEW >cJCEE\ SYb^Cs  
@C@ YqSi

c r-^zSLb %s~s -~zbeSz-s

/f

- | ; --zdp -~zbeSz-s S'-~L~q@s C^ | CEEQ CEE>cl CEW >cJCEE\ SYb^Cs @C@ YqSi
- | B^ e-q YCb>yq ^s ^zSLb sCY ^x- C^ | CEE>| CEE\ SYb^Cs @C@ YqSi

c r-^zSLb %s~s -~zbeSz-s

/E

- | ; --zcp -~zbeSz-s S'-~L~q@s C^ | CEEQ CEE>cl CEW >cJCEE\ SYb^Cs @C@ YqSi
- | B^ e-q YCb>yq ^s ^zSLb sCY ^x- C^ | CEE>| CEE\ SYb^Cs @C@ YqSi
- | X-s -~zbeSz-s HOp^ <~CzS^@s ebqq<b^Cs Cb^ \ S-s>ebqs- S e-<z b ~q4 ^ szSb %ebqs- S^ ~C^S C^ CY-sb @CY-~zb\ fSY fe-q@bU ? b..^y Pb\ sb^j

c r-^zSLb %s~s -~zbeSz-s

/E

- | ; --zcp -~zbeSz-s S'-~L~q@s C^ | CEEQ CEE>cl CEW >cJCEE\ SYb^Cs @C@ YqSi
- | B^ e-q YCb>yq ^s ^zSLb sCY ^x- C^ | CEE>| CEE\ SYb^Cs @C@ YqSi
- | X-s -~zbeSz-s H Cp^ <~CsS^~@s ebqq<b^Cs Cb^ \ S->ebqs- S e-<z b ~q4 ^ szSb %ebqs- S^ ~C^S C^ CY~sb @CY-~zb\ fSY fe-q@bU ? b..^Qy Pb\ sb^j
- | cl - bs @Cse~ s>\ C@qj s- S e-<z b C^ Ybs zS\ ebs @CfS UC Cs @HkSY ebqY CfbY-S ^ @CY S@@%Y HZ- @C@zbs eqfSsi

c [ -e- @CYs -~zbeSz-s

/J



rb~qC=GS~Cp->ai f|CE|g X-s -~zbeSz-s>Ys @CseY<- \ SC^zbs %Y  
\ bfS@ @-r-^zSLb @C; PSG pCfSz- dY^Cb fJg



| Bszq- < z- q @CY eqfsc^z- S ^

/1

© R^zqp@- < S ^

● KC^Cq S ^ @CY 4-sC @C @zbs

} sb @CKbbLYC[ -es, dR

^@SCs e-q Cf-Y-qCYS e- <zb @CYs - ~zbeSz-s

● pCs- Y- @bs

● ; b^ < Y- sb ^Cs



| yqfs \ 0@0 s @C zS\ eb @C fS U

/v

KbbLYQ -es C^zqL- b^S^C Ybs zS\ ebs @C fS U e-q S q @C S- U~s- ^@b  
@SzS zbs \ b@bsi ] bsbzqps=

| yqfs \ 0@0 s @C zS\ eb @C fS U

/v

KbbLYQ -es C^zqL- b^S^C Ybs zS\ ebs @C fS U e-q S q @C S- U~s- ^@b  
@SzS zbs \ b@bsi ] bsbzps=

| yb\ -\ bs <b\ b bqLC^Cs %@CzS^bs Ybs <C^zqS@Cs @C Y s <b^-s @C Y  
C^<-Csz- a? fDvgj

| yqfs \ 0@0 s @C zS\ eb @C fS U

/v

KbbLYQ -es C^zqL- b^S^C Ybs zS\ ebs @C fS U e-q S q @C S- U-s- ^@b  
@SzS zbs \ b@bsi ] bsbzps=

| yb\ -\ bs <b\ b bqLC^Cs %@CzS^bs Ybs <C^zps@Cs @CY s <b^-s @CY  
C^<-Csz- a? fDvvgj

| d-q <-@ S U <-K-Y\ bs zI (S U <b^s@Cq ^@b zqfs \ b@bs=  
yq ^sebzCe 4S b fydg, ~zb\ fS fOg %o-zb\ fS Ct <Y-%@b  
-~zbeSz-s frgj



| yqfs \ 0@0 s @C zS\ eb @C fS UC

/v

KbbLYQ -es C^zqL- b^S^C Ybs zS\ ebs @C fS UC e-q S q @C S- U-s- ^@b  
@SzS^zbs \ b@bsi ] bsbzqps=

- | yb\ -\ bs <b\ b bqLC^Cs %@CzS^bs Ybs <C^zqps@Cs @CYs <b^-s @CY  
C^<-Csz- a? fDvvgj
- | d-q <-@ S U <-K-Y\ bs z\_l (S U <b^s@Cq ^@b zqfs \ b@bs=  
yq ^sebzCe 4S b fydg, ~zb\ fSYfOg %o-zb\ fSYCt<Y-%^@b  
-~zbeSz-s frgj
- | ? C' ^S bs Ybs ^@sCs

$$l(SU) = \frac{z_l(SU)}{z_r(SU)}, [ = yd, O$$

y S\ eb -Pbq q @b fCt zq g ebq ~s-q -~zbeSz-s fzq ^sebzCe 4S bgj

| yqfs \ C@S@s @CzS\ eb @CfSUC

/v

KbbLYQ -es C^zqL- b^S^C^Ybs zS\ ebs @CfSUC e-q S@C S- U-s- ^@b  
@SzS^zbs \ b@bsi ] bsbzqps=

| yb\ -\ bs <b\ b bqLC^Cs %@CzS^bs Ybs <^zqps@Cs @CYs <b^-s @CY  
C^<-Csz- a? fDvvgj

| d-q <-@ S U<-K-Y\ bs z\_l (S U <b^S@Cq ^@b zqfs \ b@bs=  
yq ^sebzCe 4Sdb fydg, ~zb\ fSYfOg%o-zb\ fSYCt<Y-%^@b  
-~zbeSz-s frgj

| ? C' ^S bs Ybs ^@S^Cs

$$l(SU) = \frac{z_l(SU)}{z_r(SU)}, [ = yd, O$$

yS\ eb -Pbqf @b fCtqzq g ebq ~s-q- ~zbeSz-s fzq ^sebzCe 4Sdbgj

| Bt<Y-%^@b <b^-s H^Cq @CYq ^s- ^zSLb>l ~C@ \ bs <b^ u| CE, edpti |  
\ SYb^Cs @C <-K- Ybs H^Cq^ PC<Pbs C^ | CED>S\ -Y ^@b @- @C s\ - ^-  
H^Cq @Ce~^z-i

| , C^z-U s % @ C s f C^z-U s

/u

BY ~sb @CKbbLYQI -es eCq\ S zC^Cq S^Hbd\ - <S ^ @Cs-Lq@ @ >Ct LC^ - %o  
C^ @szS zbs \ b@bsi d~C@C ~s-qpC C^ @szS z-s <S-@ @Si

| , C^z-U s % @ C s f C^z-U s

/u

BY ~sb @C K bbLYQ -es eCq \ S C z C^Cq S^Hbq - <S ^ @C s- Lq @ @ > C t LC^ - %  
C^ @S z S zbs \ b @bsi d ~C @C ~s- q s C C^ @S z S z- s <S - @ @C si

Bs <bszbsb C^ z S \ eb % @ S C pi X- S^Hbq - <S ^ @C y d @C e C^ @C @C Y  
- ~zbq @ @ Y b < Y R^Hbq - <S ^ C t LC^ - i r C b ^ b <C^ z S \ ebs zbz- Y C s > eCq p ^ b  
s- @C s b \ ebs S S ^ f C se C q > <- \ S^ - z - > f S U ^ @ b j





|  $\hat{a}_{SCS} \text{ ebq} < b^{\wedge}$

/D

d-q  $< @ < b^{\wedge} - S < q - \backslash bs @bs \hat{a}_{SCS} s^{\wedge} z zSbs =$

|  $\hat{a}_{SCS} < C^{\wedge} zq YCs = yb \backslash - \hat{a} @ b < Y < b^{\wedge} - | - C \text{ b}^{\wedge} z S^{\wedge} C O Y d - Y < S @ C X -$   
[  $b^{\wedge} @ > < , l (S = l (S <$

|  $\hat{a}_{SCS} \backslash \sim Y S b^{\wedge} - YCs = \backslash < , l \quad u \frac{l(SU)}{uc_}$

|  $\hat{a}_{SCS} \text{ ebq} < b^{\wedge}$

/D

d-q < @ < b^{\wedge} S < q \ bs @bs ^@SCS sS'z zSbs=

|  $\hat{a}_{SCS} < C^{\wedge} zq \ YS = yb \ - \ ^{\wedge} @b < Y < b^{\wedge} \ | \ -C \ b^{\wedge} zS^{\wedge} C \ OYd - Y < S @CX -$   
[  $b^{\wedge} @ > < , [ (\$ = [ (\$ <$

|  $\hat{a}_{SCS} \ \sim YS b^{\wedge} \ YS = \ \backslash < , [ \quad U \frac{f(SU)}{uc_}$

Bszbs ^@SCS sb^ ebzC^ < S YS = ;  $\sim \text{---}^{\wedge} z b zS \ \backslash \ \text{eb eb} @q - \ -Pbq p q \sim^{\wedge} \ - \ \text{eCpb}^{\wedge} -$   
 $\ | \ -C \ fS U \ @s @C SsCL \ ^{\wedge} \ CY \ \backslash \ b @ \ | \ -C \ S < bU m$

| ^@SCs <b^s@Cq ^@b Y e-qSS ^ \ b@Y

/-

rG syCyebqC^z-UC @C ~s-- qbs f\ bzbp - @bsg @CYbz-YI ~Cs-YC @C S-I ~C  
fSU^ - U%G^ yd> syI ~CfSU^ - U%G^ --zb\ fSY BYzSA eb  
CH-zf- \ C^zC -Pbqf @b ebqYs - ~zbeSz-s y(\$ Cs=

$$y(\$) = \frac{s(z_r(SU) - z_o(SU))}{u}$$

| ^@SCs <b^s@Cq ^@b Y e-qSS ^ \ b@Y

/-

rG syCyebqC^z-UC @C ~s-- qbs f\ bzbqS -@bsg>@CYzbz-YI ~Cs-YC@CSl ~C  
fSU^ - U%G^ yd> sy| ~CfSU^ - U%G^ --zb\ fSY BYzSA eb  
CHzSf-\ C^zC-Pbqj @b ebqYs - ~zbeSz-s y(\$ Cs=

$$y(\$) = \frac{s(z_r(SU) - z_o(SU))}{u} + \frac{su \cdot \epsilon}{u}$$

| ^@SCs <b^s@Cq ^@b Y e-qSS ^ \ b@Y

/\_

rG syCyebqC^z-UC @C ~s-- qbs f\ bzbqS -@bsg>@CYzbz-YI ~Cs-YC@CSl ~C  
fSU^ - U%G^ yd> syI ~CfSU^ - U%G^ --zb\ fSY BYzS\ eb  
C^zSf- \ C^zC- Pbbq @b ebqYs - ~zbeSz-s y(\$ Cs=

$$y(\$) = \int_U s(z_r(SU) - z_o(SU)) + \int_U su \cdot C$$

X- fC^z-U @C <- \ 4SqC - --zb>e-q V = r, O Cs=

$$.. v(\$) = \int_U s(z_{yd}(SU) - z_v(SU))$$

| ^@S@S <b^s@Cq ^@b Y e-qSS ^ \ b@Y

/\_

rG syCyebqC^z-UC @C ~s-- qps f\ bzbqS -@bsg>@CYzbz-YI ~Cs-YC@CSl ~C  
fSU^ - U%G^ yd> syI ~CfSU^ - U%G^ --zb\ fSY BYzS\ eb  
C^zSf- \ C^zC- Pbbq @b ebqYs - ~zbeSz-s y(\$ Cs=

$$y(\$ = \frac{s(z_r(SU) - z_o(SU))}{U} + \frac{sU \cdot CE}{U}$$

X- fC^z-U @C <- \ 4SqC - --zb>e-q V = r, O Cs=

$$.. v(\$ = \frac{s(z_{yd}(SU) - z_v(SU))}{U} + \frac{sU \cdot CE}{U}$$

| ^@SCs <b^s@Cq ^@b Y e-qSS ^ \ b@Y

/-

rG syCyebqC^z-UC @C ~s-- qbs fl bzbqS -@bsq>@CYzbz-YI ~Cs-YC@CSl ~C  
fSU^ - U%G^ yd> sy| ~CfSU^ - U%G^ --zb\ fSY BYzS\ eb  
C^zSf- \ C^zC- Pbbq @b ebqYs - ~zbeSz-s y(\$ Cs=

$$y(\$ = \int_U s(z_r(SU) - z_o(SU)) + \int_U su \cdot C$$

X- fC^z-U @C <- \ 4SqC - --zb>e-q V = r, O Cs=

$$.. v(\$ = \int_U s(z_{yd}(SU) - z_v(SU)) + \int_U su \cdot C$$

BY-- \ C^zb C^zSf @CY fC^z-U @C <- \ 4SqC - --zb Cs .. 0 - .. r=

$$.. (\$ = \int_U s(z_r(SU) - z_o(SU))$$

{ Bszq~z~q @CY eqfsc^z- S ^

/cCE

© R^zqp@~<S ^

● KC^Cqf <S ^ @CY 4-sC@C@zbs

① pCs~Y~-@bs

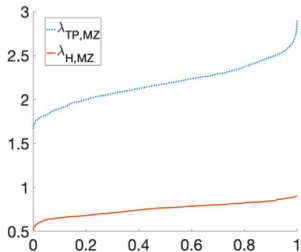
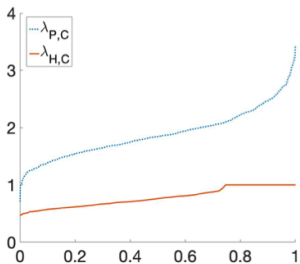
pCs~Y~-@bs -LqL-@bs

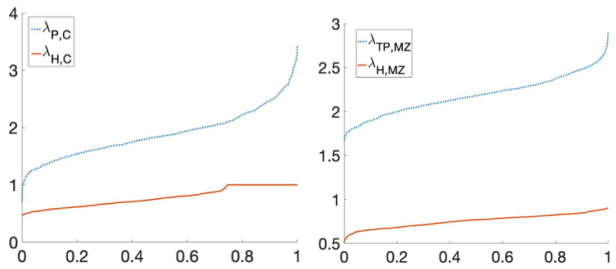
pCs~Y~-@bs Cse- <SYCs

; bopCY <S ^ <b^ ^fCYsb<SbC<b^ \ Sb

① ; b^<Y-sb^Cs



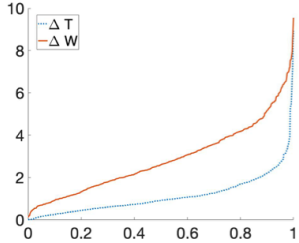




- | } s-q-~zbeSz-s e~@C sCq\ ~%b^fC^SC^zD yd C^ @CsfC^z-Ui
- | yd,, e~@C YD-q- {, Ji ; Cq- @CY<C^zdp Cs \ C^bq- ci
- | dbq@C^SS^ o,. ci X- \$~Y@@sC-Yk- ^k- <~ ^@b Ys-~zbeSz-s  
^b sC ~s ^i
- | } ^-s eb<-s <b^s Cs-^ e-qS~Yq C^zC\ -YsCqfs@-s ebqy di

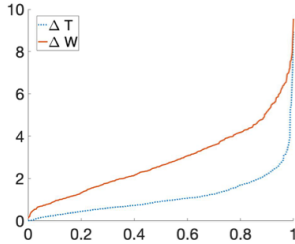
{ ^@SGs y, „

/c|



{ ^@SCs y, „

/c|



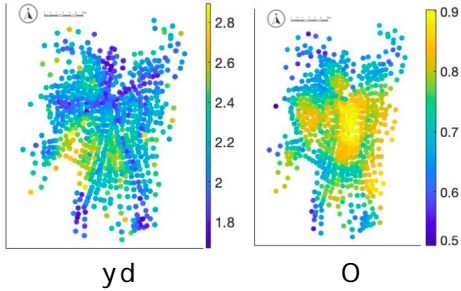
| y Csz—b^<C^zq @b C^ eb<-s <b^ -s=C^ Y \ -%bq->b 4C^ Ybs  
fS Uops ^b ~s ^ --zb>b Ys --zbeSz-s ^b sC^ \ ~<Pbi

| „ -Y- ^<- f- YbqS \ -s -Ybs=CYS e-<zb C^ Y e-qSS ^ \ b@Y  
e~@C sCq Yb \ -s S ebq- ^zQ

{ ^@SCs \ , C^ CYCse- \$b

/c{

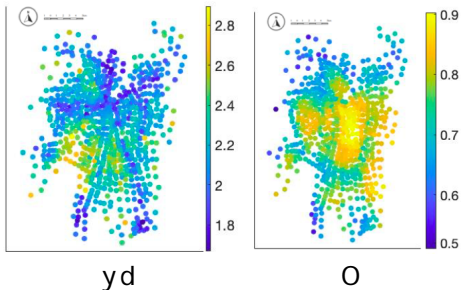
[ bszq \ bs sbY \ C^zC Ybs ^@SCs \ ~Ysb^- YCs



{ ^@Scs \ , C^ CYCse- \$b

/cl

[ bszq \ bs sbY \ C^zC Ybs ^@Scs \ ~Ysb^- YCs



| X-s <b^-s - Yp@abq @CY \ Czdp eqfSc^z- ^ Ybs \ ClbqCs ^@Scs @C  
zq ^sebzCe 4Sbi X- <b^- s- qeb^Sc^zC> Ybs eCbqfsi

| Xbs bqLC^Cs @CY <C^zdp @CY <S@@ - edpfC-P- ^ eb<b Ys - ~zbeSz- si  
} ^-s eb<-s <b^-s feq\$ <S- Y C^zC - Y^bqCg sb^ Ys \ -s 4C^C' <S@ si

{ ^@SCs y, „ C^ CYCse- <\$

/cJ

y

„

{ ^@SCs y, „ C^ CYCse- <\$

/CJ

y „

- | X-s <b^-s q<-s sC 4C^C' <S ^ @CYs -~zbeSz-s=Y LC^zCfSU C^  
--zb\ fSY%Ys -~zbeSz-s YCL-^ -Yi O-%bzaq s eb<-s <b^-s @b^@C  
Ys -~zbeSz-s P-^ q@- <sb Ybs zCA ebs @CfSU
- | BYS<q\ C^zb C^ „ Cs \ -s Pb\ LC^Cbi



{ ; boppY <S ^ <b^ r BX

/cl

, <-@ <b^- sC YC -sL ^- CYr BX ep\ C@b @C s-s Pbl-qCs f; C^sb |CE| >  
 a; }; g-HCqC C^zC <boppY <S ^-@b <b^ ebsCsS ^ @C -~zb\ fSY%e-qSS ^  
 \ b@Y

Index\coeff	$\beta_{SEL}$	$\beta_{Distance\ Center}$	$\beta_{Distance\ Center-SEL}$
$\lambda_{P, C}$	-0.061	-0.013*	0.0035
$\lambda_{P, MZ}$	-0.13	-0.15	0.031
$\lambda_{H, C}$	0.1	0.26	-0.051
$\lambda_{H, MZ}$	0.048	0.052	-0.015
$\Delta T$	-0.33	-0.98	0.21
$\Delta W$	-0.36	0.23	-0.067*

\* Not significant at a 5% level.

- | BYzC\ eb -Pbop @b ebqYs -~zbeSz-s Cs \ -%bqC^ <b^-s l ~C sC ^  
 qS-s %eCqHqS-si o sC <b\ ebqz- sS SYq%oo yd @C \ -^Cq be~Cs-z-i
- | BYS^<qC C^zb C^ CY-zq <zSfb @CY -~zb Cs \ -%bqC^ <b^-s eb4qS %o  
 eCqHqS-si

J Bszq<z~q @CY eqfsc^z- S ^

/cv

© R^zqp@~<S ^

● KC^Cqf S ^ @CY 4-sC @C @ zbs

● pCs~Y-@bs

● J ; b^<Y-sb^Cs

J ; b^<Y-sb^Cs

/cu

- | R@C^zS <- \ bs | ~C <b^ -s zS^C^ \ - %qCs fC^z-U s ebzC^ <S YCs <b^ Ys  
- ~zbeSz- si
- | } ^-s eb<-s <b^ -s> qS- s %eCqHqS- s> sb^ Ys | ~C C^zSf- \ C^zCP- ^  
- Pbcq @b zS\ eb <b^ Ys - ~zbeSz- si
- | X-s - ~zbeSz- s P- ^ PC<Pb | ~C Ybs - ~zbs sG ^ \ -s -zq <zSfbs C^ zb@b  
r- ^zSLb> CseC<S Y C^zC e-q <b^ -s eb4qCs %eCqHqS- si
- | K[ , e~C@Csq ~^- PCq\ S^z- C^zSf- e-q Csz~@SqCYs e- <zb @C  
Ys - ~zbeSz- si a zqps ebsS YCs ~sbs <b\ b S@C^zS <-q <b^ -s <b^ \ -Yy di

J pCqC^S

/cD

GSA-\ >, i>. T-q Q S<>ri f| Cfcg , ssCssl C^z bHzPC sb<SDe-zSY  
C C<zs bH~qA ^ zq ^sebaq S'fCsz\ C^z ~sS'L KbbLYC[ -es, dR Tb~q^-YbH  
yq ^sebaq KCbLq eP%\_c>cCf\_\_i