



# DETERMINANTS OF TRADE IN VALUE-ADDED: MARKET SIZE, GEOGRAPHY AND TECHNOLOGICAL GAPS

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*May 19-20, 2014  
The Third World KLEMS Conference  
Tokyo, Japan*



# What is TiVA

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- Alternative trade relationship using Inter-country I-O database
- Foreign VA embodied in domestic exports,  
Domestic VA embodied in foreign final demand
- Target
  - 57 economies (OECD 34 )
  - 18 industries
  - 1995-2009



## Motivation of this study

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- To examine the differences in participation on global value chains (GVCs).
- Three determinants of flows of Trade in Value-Added
  - (1) Market size (home market effect)
  - (2) Geographical location (distance and regional effects)
  - (3) Gaps of resources and technology between economies**



# Recent application of gravity model to bilateral trade of intermediates

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- Egger and Egger (2004), Baldone et al (2007) and Bergstrand and Egger (2010), etc.
- Baldwin and Taglioni (2011): Poor performance of the standard gravity equation for parts and components
- Miroudot, Lanz and Ragoussis (2009): Imports of intermediates
  - more sensitive to trade costs
  - less affected by bilateral market size



# Dependent variables

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(1) Value added exports (OECD-WTO TiVA)

Value-added embodied in foreign final demand

(2)-(5) Bilateral gross exports (OECD ICIO)

Total

Intermediates

Household consumption

Gross fixed capital formation



# Empirical methods: Gravity Equation

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- Important issues of gravity estimation consistent with theory:
  - (1) How to deal with multilateral resistance term
    - Head and Mayer (2013) recommend Least Squares with country Dummies (LSDV) basing on Monte Carlo experiment
  - (2) How to handle “zero’s”
    - Recent studies recommend to compare estimates with OLS and the Poisson Pseudo-Maximum Likelihood (PPML) for robustness.
- Our models classify independent variables into 3 categories (and time fixed effect)



# Variables for Gravity Equation

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- (i) Specific dummy factors: exporters and destinations
- (ii) Bilateral trade costs and relations
  - Distance, border, official language,
  - Intra-“Regional” dummy (Europe+Turkey, East Asia and NAFTA)
  - Bilateral tariff rates using detail trade statistics (Miroudot *et al.*, 2013)
- (iii) Economy specific factors (PWT8.0)
  - Population, price, capital, human capital and TFP



# Results from TiVA-based econometric results

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- (1) Gravity equations fit better to VA exports than to “gross” exports in general
- (2) More robust effects of production and market size on value added trade than on “gross” trade, while no robust evidences on home market effect
- (3) Weaker effects of geographical distances on value added trade than on “gross” trade

**(4) Capital ratios and technological differences have significant effects of TiVA flows**

**(5) Labour skills in terms of educational attainment are irrelevant to TiVA flows in majority of sectors**





# Regression Results: Effects of resources and technology gaps

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- Today we will focus on the results using PWT8.0 data based on KLEMS (Tables 5-7)



# Regression Results: Effects of resources and technology gaps

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- Table 5: Impact of log difference in capital / population ratio (Model B) on 56 TiVA economies
  - Effects on value added trade: Positive, statistically significant and robust coefficients with both OLS and PPML for:
    - three manufacturing (“metal, etc.”, “machinery, etc.” and “electrical, etc.”)
    - two services (electricity supply, etc.” and “financial”)

**Table 5. Effects of Log Difference in Capital Stock per Population: 56 TiVA economies (Model B)**

*(1) OLS: 2005, 2008 and 2009*

Code	Domestic VA in foreign FD	“Gross” trade: All end— use	“Gross” trade: Intermediates	“Gross” trade: Final cons.	“Gross” trade: Capital G&S
01T05	—				—
10T14			—	—	—
15T16			—	—	—
17T19		+			
20T22					—
23T26	+	+	+	+	—
27T28	+	+		—	+
29	+	+			+
30T33	+	+	+	+	+
34T35		+		+	+
36T37	+	+		+	+
40T41	+	+	+		+
45		—	—	—	—
50T55	—	—		—	+
60T64				—	—
65T67	+	—	—	—	—
70T74	+	+	+	+	
75T95		—	—	—	+
<b>TOTAL</b>					+

*Notes: "+" means coefficient is significantly greater than zero at 10% level (5% for one-tailed).*

*"-" means coefficient is significantly smaller than zero at 10% level (5% for one-tailed).*

*Coloured cell means PPML demonstrate significantly positive coefficient at least 90% level (95% for one-tailed).*



# Regression Results: Effects of resources and technology gaps

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- Table 6: Impact of human capital index of employment (Model B) on TiVA economies
  - All robust and significant signs with value added trade are negative except one sector (15T16: Food products, beverages and tobacco)
  - The case of manufacturing sector such as “Machinery and equipment, nec”:
    - explained by the rise of emerging economies represented by China in the global value chains.

**Table 6. Effects of Log Difference in Human Capital Index: 56 TiVA economies (Model B)**

*(1) OLS: 2005, 2008 and 2009*

Code	Domestic VA in foreign FD	“Gross” trade: All end— use	“Gross” trade: Intermediates	“Gross” trade: Final cons.	“Gross” trade: Capital G&S
01T05			+	+	
10T14					
15T16	+	+		+	
17T19		—			—
20T22	+	+	+	+	—
23T26		—		—	—
27T28	—	—		—	—
29	—	—	+		—
30T33	—	—	+	—	—
34T35		—	+	—	
36T37		—		—	—
40T41	—	—	—		
45	—		+	+	
50T55	—		—		
60T64			+	+	+
65T67			+	+	+
70T74	—	+	+	+	+
75T95		+	+	+	+
<b>TOTAL</b>	—	—		—	—

*Notes: "+" means coefficient is significantly greater than zero at 10% level (5% for one-tailed).*

*"-" means coefficient is significantly smaller than zero at 10% level (5% for one-tailed).*

*Coloured cell means PPML demonstrate significantly positive coefficient at least 90% level (95% for one-tailed).*



# Regression Results: Effects of resources and technology gaps

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- Table 7: Impact of technological differences measure by TFP levels (Model B)
  - Origin's superiority in terms of technology contributes positively to bilateral value added trade
  - The OECD sample lists seven goods sectors out of eleven and five services out of seven as well as total industry as those with robust, significant and positive coefficients

**Table 7a. Effects of Log Difference in TFP Level: 56 TiVA economies (Model B)**

*(1) OLS: 2005, 2008 and 2009*

<b>Code</b>	<b>Domestic VA in foreign FD</b>	<b>“Gross” trade: All end— use</b>	<b>“Gross” trade: Intermediates</b>	<b>“Gross” trade: Final cons.</b>	<b>“Gross” trade: Capital G&amp;S</b>
<b>01T05</b>	+				—
<b>10T14</b>		+	+		
<b>15T16</b>	+	+	+		—
<b>17T19</b>	+	+	+	+	
<b>20T22</b>	+	+			—
<b>23T26</b>	+				—
<b>27T28</b>	+		+		
<b>29</b>	+	+		—	
<b>30T33</b>	+	+	+	+	
<b>34T35</b>	+	+		+	
<b>36T37</b>					
<b>40T41</b>		+	+		
<b>45</b>	+				+
<b>50T55</b>	+		—		—
<b>60T64</b>	+	+		+	
<b>65T67</b>	+	+	+	+	—
<b>70T74</b>	+	+	+	+	+
<b>75T95</b>	+				
<b>TOTAL</b>	+	+		+	

*Notes: "+" means coefficient is significantly greater than zero at 10% level (5% for one-tailed).*

*"-" means coefficient is significantly smaller than zero at 10% level (5% for one-tailed).*

*Coloured cell means PPML demonstrate significantly positive coefficient at least 90% level (95% for one-tailed).*

**Table 7b. Effects of Log Difference in TFP Level: 34 OECD members (Model B)**

*(1) OLS: 2005, 2008 and 2009*

Code	Domestic VA in foreign FD	“Gross” trade: All end— use	“Gross” trade: Intermediates	“Gross” trade: Final cons.	“Gross” trade: Capital G&S
01T05	+		+		—
10T14	+			—	—
15T16	+	+		+	
17T19	+	+	+	+	+
20T22	+	+			—
23T26	+			+	—
27T28	+			+	+
29	+	+		—	+
30T33	+	+	+	+	
34T35	+	+		+	
36T37		—			
40T41	+		+	—	
45	+				+
50T55		—	—		
60T64	+			+	
65T67	+	+	+	+	
70T74	+	+	+	+	+
75T95	+	+	+		+
<b>TOTAL</b>	+	+		+	+

*Notes: "+" means coefficient is significantly greater than zero at 10% level (5% for one-tailed).*

*"-" means coefficient is significantly smaller than zero at 10% level (5% for one-tailed).*

*Coloured cell means PPML demonstrate significantly positive coefficient at least 90% level (95% for one-tailed).*





# Regression Results: Effects of resources and technology gaps

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- Table 7: Impact of technological differences measure by TFP levels (Model B)
  - These good performances of technological differences
    - consistent with previous empirical studies concluding relatively good results of models based on Ricardian Model compared to Heckscher-Ohlin model.



## Conclusion

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- Confirmation of weak gravity estimates for gross exports of final, intermediates and total flows
- Strong gravity relationship confirmed using value-added export flows
- Value added trade flow reflects bilateral technological gap in terms of TFP level better than “gross” trade flow
- Bilateral differences in factor endowment does not explain trade patterns similarly to previous studies based on Heckscher-Ohlin model.



## Suggestions for future studies

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- Alternative variables for distance, multilateral resistance and regional definitions
- Different methodology  
(Knowledge Capital Model explaining the patterns of horizontal and vertical FDI, identification of headquarter and factory economies)
- Completely new theoretical framework required !



# APPENDIX



# Covered Economies

57 economies (+ RoW);  
1995, 2000, 2005 2008 and 2009

OECD	All OECD 34 countries
BRIICS	Brazil, China, India, Indonesia, Russian Federation, South Africa
Other EU27	Bulgaria, (Cyprus), Latvia, Lithuania, Malta, Romania
Other G20	Argentina, Saudi Arabia
Other South Eastern Asia	Brunei Darussalam, Cambodia, Malaysia, Philippines, Singapore, Thailand, Viet Nam
Other Eastern Asia	Chinese Taipei, Hong Kong China
Other	(Rest of the World)



# Covered Industries

	ISIC Rev 3	Industry
1	01-05	Agriculture, hunting, forestry and fishing
2	10-14	Mining and quarrying
3	15-16	Food products, beverages and tobacco
4	17-19	Textiles, textile products, leather and footwear
5	20-22	Wood, paper, paper products, printing and publishing
6	23-26	Chemicals and non-metallic mineral products
7	27-28	Basic metals and fabricated metal products
8	29	Machinery and equipment, nec
9	30-33	Electrical and optical equipment
10	34-35	Transport equipment
11	36-37	Manufacturing nec; recycling
12	40-41	Electricity, gas and water supply
13	45	Construction
14	50-55	Wholesale and retail trade; Hotels and restaurants
15	60-64	Transport and storage, post and telecommunication
16	65-67	Financial intermediation
17	70-74	Real estate, renting and business activities
18	75-95	Community, social and personal services

**Table A3. Model B: 56 TiVA economies (OLS)****(1) Origin's value added embodied in destination's final demand: 2005, 2008 and 2009**

	15T16	17T19	20T22	23T26	27T28	29	30T33	34T35
	<i>Ln_dva_ffd</i>	<i>Ln_dva_ffd</i>	<i>Ln_dva_ffd</i>	<i>Ln_dva_ffd</i>	<i>Ln_dva_ffd</i>	<i>Ln_dva_ffd</i>	<i>Ln_dva_ffd</i>	<i>Ln_dva_ffd</i>
<i>Ln_dist</i>	-0.943*** (0.050)	-0.748*** (0.046)	-0.850*** (0.039)	-0.797*** (0.036)	-0.709*** (0.034)	-0.733*** (0.042)	-0.572*** (0.042)	-0.829*** (0.052)
<i>regional</i>	0.120 (0.088)	0.177** (0.082)	-0.005 (0.065)	-0.008 (0.058)	0.157*** (0.058)	0.109 (0.072)	0.103 (0.070)	0.045 (0.096)
<i>DL_N</i>	-1.300*** (0.487)	-0.897** (0.358)	-1.616*** (0.336)	-1.092*** (0.259)	0.420 (0.282)	-0.843** (0.364)	-0.823** (0.361)	-1.861*** (0.593)
<i>DL_p</i>	-0.315*** (0.080)	-0.320*** (0.064)	-0.469*** (0.057)	-0.199*** (0.048)	-0.325*** (0.054)	-0.336*** (0.063)	-0.260*** (0.056)	-0.159 (0.098)
<i>DL_l</i>	-0.880*** (0.252)	-0.509** (0.205)	0.111 (0.195)	-0.502*** (0.142)	-0.822*** (0.163)	-0.266 (0.199)	-0.393** (0.190)	-0.051 (0.335)
<i>DL_h</i>	1.473** (0.716)	0.649 (0.596)	2.613*** (0.543)	-0.607 (0.424)	-1.661*** (0.494)	-4.078*** (0.669)	-1.258* (0.646)	0.587 (1.024)
<i>DL_k</i>	0.107 (0.084)	0.024 (0.069)	-0.009 (0.057)	0.207*** (0.048)	0.284*** (0.057)	0.414*** (0.067)	0.321*** (0.066)	0.032 (0.104)
<i>DL_tfp</i>	0.444*** (0.130)	0.468*** (0.110)	0.485*** (0.087)	0.200*** (0.073)	0.280*** (0.091)	0.276*** (0.100)	0.943*** (0.106)	0.367** (0.161)
<i>(Bilateral tariff related variables; dummies for contiguity, etc.; year fixed effects)</i>								
<i>R-sq</i>	0.855	0.889	0.922	0.940	0.944	0.922	0.924	0.858
<i>adj. R-sq</i>	0.853	0.887	0.920	0.940	0.943	0.921	0.923	0.856
<i>obs.</i>	7195	7710	7863	8110	7123	7647	8060	6735

Notes: Heteroskedasticity consistent standard errors in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$  and \*\*\*  $p < 0.01$ .

**Table A4. Model B: 56 TiVA economies (PPML)*****(1) Origin's value added embodied in destination's final demand: 2005, 2008 and 2009***

	15T16	17T19	20T22	23T26	27T28	29	30T33	34T35
	<i>dva_ffd</i>	<i>dva_ffd</i>	<i>dva_ffd</i>	<i>dva_ffd</i>	<i>dva_ffd</i>	<i>dva_ffd</i>	<i>dva_ffd</i>	<i>dva_ffd</i>
<i>Ln_dist</i>	-0.665*** █(0.075)	-0.522*** █(0.087)	-0.553*** █(0.058)	-0.599*** █(0.048)	-0.511*** █(0.053)	-0.418*** █(0.061)	-0.234*** █(0.053)	-0.565*** █(0.072)
<i>regional</i>	0.341*** █(0.120)	0.256* █(0.145)	0.360*** █(0.092)	0.152* █(0.087)	0.326*** █(0.085)	0.274*** █(0.101)	0.525*** █(0.099)	0.480*** █(0.123)
<i>DL_N</i>	-1.092 █(0.711)	-1.421 █(0.938)	-0.523 █(0.732)	1.343*** █(0.396)	1.249* █(0.672)	1.291* █(0.769)	0.350 █(0.890)	1.649 █(1.282)
<i>DL_p</i>	-0.125 █(0.098)	0.343** █(0.138)	-0.266* █(0.159)	0.079 █(0.057)	-0.095 █(0.082)	-0.250** █(0.100)	-0.027 █(0.092)	-0.264* █(0.151)
<i>DL_l</i>	-2.423*** █(0.287)	-1.525** █(0.637)	-1.495*** █(0.435)	-2.237*** █(0.196)	-1.763*** █(0.317)	-0.924** █(0.371)	-0.473 █(0.347)	-1.369** █(0.620)
<i>DL_h</i>	3.629*** █(0.992)	2.812 █(1.939)	1.384 █(1.308)	-1.918*** █(0.691)	-1.831* █(1.057)	-3.347*** █(1.242)	1.591 █(1.411)	-1.368 █(2.214)
<i>DL_k</i>	-0.036 █(0.106)	0.222 █(0.138)	-0.087 █(0.085)	0.043 █(0.062)	0.205** █(0.086)	0.266** █(0.105)	0.306*** █(0.112)	0.056 █(0.156)
<i>DL_tfp</i>	0.371** █(0.183)	0.270 █(0.338)	1.015*** █(0.273)	0.572*** █(0.116)	0.272* █(0.164)	0.186 █(0.201)	0.595*** █(0.226)	-0.113 █(0.344)
<i>(Bilateral tariff related variables; dummies for contiguity, etc.; year fixed effects)</i>								
<i>R-sq</i>	0.853	0.958	0.923	0.940	0.937	0.927	0.936	0.920
<i>adj. R-sq</i>								
<i>obs.</i>	7336	7896	7895	8118	7163	7874	8101	6879

*Notes: Heteroskedasticity consistent standard errors in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$  and \*\*\*  $p < 0.01$ .*



**Table A3. Model B: 56 TiVA economies (OLS) - continued*****(1) Origin's value added embodied in destination's final demand: 2005, 2008 and 2009***

	40T41	45	50T55	60T64	65T67	70T74	75T95	TOTAL
	<i>Ln_dva_ffd</i>	<i>Ln_dva_ffd</i>	<i>Ln_dva_ffd</i>	<i>Ln_dva_ffd</i>	<i>Ln_dva_ffd</i>	<i>Ln_dva_ffd</i>	<i>Ln_dva_ffd</i>	<i>Ln_dva_ffd</i>
<i>Ln_dist</i>	-0.771*** █(0.034)	-0.747*** █(0.040)	-0.680*** █(0.034)	-0.677*** █(0.036)	-0.764*** █(0.036)	-0.651*** █(0.034)	-0.733*** █(0.037)	<b>-0.710***</b> █(0.034)
<i>regional</i>	0.034 █(0.055)	-0.116* █(0.070)	-0.084 █(0.059)	-0.080 █(0.059)	-0.132** █(0.058)	-0.084 █(0.058)	-0.145** █(0.062)	<b>-0.029</b> █(0.057)
<i>DL_N</i>	0.471* █(0.256)	-1.626*** █(0.396)	-0.391 █(0.331)	-1.348*** █(0.308)	-0.858*** █(0.279)	-0.654** █(0.280)	-0.121 █(0.383)	<b>-0.639***</b> █(0.220)
<i>DL_p</i>	-0.482*** █(0.044)	-0.052 █(0.056)	-0.283*** █(0.052)	-0.238*** █(0.047)	-0.201*** █(0.049)	-0.115** █(0.046)	0.199*** █(0.063)	<b>-0.214***</b> █(0.036)
<i>DL_l</i>	-0.759*** █(0.142)	-0.616*** █(0.202)	-0.784*** █(0.164)	-0.441*** █(0.159)	-0.127 █(0.153)	-0.778*** █(0.148)	-1.248*** █(0.218)	<b>-0.612***</b> █(0.114)
<i>DL_h</i>	-4.684*** █(0.420)	-4.089*** █(0.639)	-2.485*** █(0.554)	0.209 █(0.460)	0.161 █(0.457)	-1.351*** █(0.446)	0.896 █(0.686)	<b>-0.638*</b> █(0.330)
<i>DL_k</i>	0.434*** █(0.044)	0.016 █(0.066)	-0.141** █(0.061)	-0.034 █(0.053)	0.111** █(0.048)	0.199*** █(0.050)	-0.037 █(0.069)	<b>0.019</b> █(0.038)
<i>DL_tfp</i>	0.006 █(0.069)	0.252** █(0.111)	0.152* █(0.090)	0.432*** █(0.080)	0.493*** █(0.075)	0.220*** █(0.076)	0.192* █(0.101)	<b>0.199***</b> █(0.060)
<i>(Bilateral tariff related variables; dummies for contiguity, etc.; year fixed effects)</i>								
<i>R-sq</i>	0.934	0.899	0.930	0.929	0.933	0.944	0.925	<b>0.942</b>
<i>adj. R-sq</i>	0.933	0.898	0.929	0.928	0.932	0.943	0.923	<b>0.941</b>
<i>obs.</i>	8112	7938	8257	8260	8251	8261	8107	<b>8261</b>

Notes: Heteroskedasticity consistent standard errors in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$  and \*\*\*  $p < 0.01$ .

**Table A4. Model B: 56 TiVA economies (PPML) - continued*****(1) Origin's value added embodied in destination's final demand: 2005, 2008 and 2009***

	40T41	45	50T55	60T64	65T67	70T74	75T95	TOTAL
	<i>dva_ffd</i>	<i>dva_ffd</i>	<i>dva_ffd</i>	<i>dva_ffd</i>	<i>dva_ffd</i>	<i>dva_ffd</i>	<i>dva_ffd</i>	<i>dva_ffd</i>
<i>Ln_dist</i>	-0.672*** █(0.050)	-0.623*** █(0.065)	-0.470*** █(0.042)	-0.508*** █(0.041)	-0.403*** █(0.050)	-0.420*** █(0.040)	-0.466*** █(0.047)	<b>-0.486***</b> █(0.044)
<i>regional</i>	0.079 █(0.086)	0.037 █(0.121)	0.194** █(0.080)	0.111 █(0.074)	0.232** █(0.092)	0.222*** █(0.073)	0.162* █(0.086)	<b>0.242***</b> █(0.075)
<i>DL_N</i>	1.249** █(0.507)	0.354 █(0.882)	0.479 █(0.629)	-0.899* █(0.467)	-0.828 █(0.699)	0.535 █(0.383)	1.377* █(0.727)	<b>0.780</b> █(0.492)
<i>DL_p</i>	-0.248*** █(0.063)	-0.311*** █(0.092)	0.061 █(0.080)	-0.269*** █(0.062)	-0.133 █(0.086)	-0.168*** █(0.056)	0.308*** █(0.087)	<b>-0.012</b> █(0.050)
<i>DL_l</i>	-1.224*** █(0.259)	-0.086 █(0.297)	-0.910*** █(0.263)	-0.671*** █(0.213)	0.511 █(0.311)	-0.396** █(0.168)	-1.696*** █(0.355)	<b>-1.117***</b> █(0.184)
<i>DL_h</i>	-5.698*** █(0.815)	-5.040*** █(1.380)	-2.453** █(1.072)	-0.669 █(0.765)	-0.730 █(1.350)	-1.760** █(0.711)	-3.491*** █(1.119)	<b>-1.241</b> █(0.778)
<i>DL_k</i>	0.240*** █(0.063)	-0.291** █(0.120)	-0.041 █(0.077)	-0.157** █(0.061)	0.283*** █(0.095)	-0.004 █(0.063)	0.162* █(0.096)	<b>-0.001</b> █(0.054)
<i>DL_tfp</i>	0.207* █(0.112)	-0.016 █(0.178)	0.319** █(0.130)	0.178* █(0.108)	0.532*** █(0.171)	-0.151 █(0.106)	0.299* █(0.166)	<b>0.256**</b> █(0.109)
<i>(Bilateral tariff related variables; dummies for contiguity, etc.; year fixed effects)</i>								
<i>R-sq</i>	0.914	0.813	0.900	0.925	0.936	0.963	0.921	<b>0.934</b>
<i>adj. R-sq</i>								
<i>obs.</i>	8261	8261	8261	8261	8261	8261	8261	<b>8261</b>

Notes: Heteroskedasticity consistent standard errors in parentheses. \*  $p < 0.10$ , \*\*  $p < 0.05$  and \*\*\*  $p < 0.01$ .