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Editor's Comments

The 2018 edition of the *Western Undergraduate Economics Review* represents the quality of academic work produced by undergraduate economics students at Western University in the past year. We are proud to showcase four papers in this edition, each dealing with timely topics that are consistently being discussed in both the academic sphere and among the general public. These papers highlight the calibre and diversity of research being done in Western's undergraduate economics department.

The publication begins with an undergraduate thesis coauthored by Jairo Pinto and Hamza Mhadi, written for the Economics 4400E class. They utilize a combination of difference-in-difference (adjusted-OLS) and regression discontinuity design to assess the effect of the 2016 Vancouver foreign-buyer transfer tax on housing prices and volume. Their work is followed by Oscar Crawford Ritchie's undergraduate thesis about the determinants of economic environmental policy, for which he was awarded the Mark K. Inman Senior Essay Prize. He presents a public choice theory based model which examines the relationship between different country-level characteristics, such as macroeconomic conditions and demographic makeup, and a country's decision on whether to adopt a carbon tax or cap and trade system. The third paper is Liam Wicken's microeconomic policy essay, in which he discusses the United States' healthcare system, particularly the impact of the 2010 Affordable Care Act on both medical debt and access to healthcare. The publication concludes with another award-winning paper by Ryan Howson, for which he won the Alumni Essay Prize in Economics. In Howson's political economy essay he surveys literature surrounding the effects of electoral systems on corruption levels and finds that Plurality Rule systems are the most successful at reducing corruption levels.

We would like to congratulate the successful authors on their hard work and contribution to the culture of excellence in Western's economics department. We hope readers enjoy this year's edition of the *WUER* and that it encourages students to continue their exceptional research in years to come.

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Acknowledgments

Assessing the Effects of the Vancouver Foreign-Buyer Transfer Tax on Housing Prices and Volume

Hamza Mhadi and Jairo Pinto

Abstract

The purpose of this study is to assess the impact of the recent tax policy on the Greater Vancouver housing market. In an attempt to dampen rising housing prices, the BC government implemented a 15% foreign-buyer transfer tax on August 2nd, 2016. This policy was introduced in the context of continued speculation around the impact and severity of foreign real estate investments in the Greater Vancouver Region (GVR). This policy is identical to Hong Kong's 15% BSD tax that was implemented in 2012. As hypothesized, the resulting effects observed in this case study are comparable in direction and magnitude to those seen in Hong Kong. In estimating the impact on housing prices and demand, a combination of difference-in-difference (adjusted-OLS) and regression discontinuity design were utilized.

Our results indicate that average housing prices decreased by approximately 6-7% in GVR five months after the tax implementation. Average volume of transactions also declined by approximately 50-60%. Both these results are statistically and economically significant. This analysis contributes to the literature on the use of hedonic pricing models and the effects of taxation in the context of a natural experiment.

1.0 Background

The British Columbia provincial government enforced a foreign-buyer transfer tax (PTT), which places an additional 15% transfer tax on all properties purchased by non-Canadian citizens in 22 jurisdictions within the Greater Vancouver Region (GVR) (Keir 2016). Speculation about a policy restricting foreign purchases began in May; however, the tax was officially announced on July 26th and then enforced on August 2nd, 2016 (CBC 2016). The provincial government enforced the foreign-buyer transfer tax as a means to address housing affordability issues within GVR (Keir 2016).

Real estate in GVR is the most expensive and the most appreciating in Canada. The benchmark price for a typical Vancouver home was $844,800 in May 2016, up 25.4% from May 2015 (Tencer 2016). In comparison, the benchmark price for a typical Toronto home was $614,700 in May 2016, up 11.6% from a year earlier (Tencer 2016). Local residents cannot keep up with the appreciating housing market as their median family incomes are below the Canadian national average (Statistics Canada 2016). The sale price of an underlying property relative to a household's income is a common metric used by real estate practitioners to assess housing affordability within a region (Lee 2016). Between

1984 and 2000, the average price for a detached home in GVR averaged 7.3 times relative to the average household's income; that ratio increased to over 19 times between 2001 and 2016 (Lee 2016).

GVR's expensive and appreciating real estate market can be explained by supply and demand economics. Geographical constraints in the form of mountains, the Pacific Ocean, agricultural land reserves, and the U.S. border have limited the land available for real estate development (Lee 2016). GVR property developers, consequently, prefer to develop denser housing alternatives (i.e. attached housing and mid/high rise buildings) over more spacious units (i.e. detached housing and single family dwellings) (Lee 2016). In 1991, half of all the homes in GVR were detached; by 2011, that number fell to one-third (Lee 2016).

A number of mutually reinforcing factors are driving the domestic demand for housing in GVR. A low interest rate environment has increased the availability of mortgages. A Bank of Canada study found that the share of 'highly indebted' Canadian households, those with interest bearing liabilities of more than 350% relative to their income, doubled to 8% from 2004 to 2013 (D . Macdonald 2015). Furthermore, a steadily growing population has increased demand for real estate in GVR. Metropolitan Vancouver's population has grown to 2,500,000 in 2014, from 450,000 in 2001 (Lee 2016). During that time period, Vancouver saw an influx of immigration compared to the rest of Canada; between 2001 and 2014 more than 350,000 immigrants moved to Vancouver compared to less than 20,000 in other parts in Canada (Lee 2016). The recent population growth rate of 1.2% is anticipated to continue over the next few decades.

However, according to a growing number of studies, foreigners are contributing to GVR's recently appreciating and overpriced housing market. A study conducted by the Canada Mortgage and Housing Corporation (CMHC) found that 6% of condominiums built in Metropolitan Vancouver since 2010 were purchased by foreign-buyers (CHMC 2016). Another survey initiated by Society of Notaries Public of British Columbia reported that 7% of residential transactions within Metropolitan Vancouver in 2015 were represented by foreign-buyers (Society Notares 2016).

Foreign demand exacerbates the housing affordability issues within GVR. Overseas buyers are purchasing these residential units primarily for investment purposes, which means that the units are often not occupied after the transaction has taken place. Such investments destabilize the real estate market as they decrease the quantity of local residents who own property. A recent study released by the City of Vancouver estimated that a total of 10,800 residential units, or 5% of the total homes covered, were empty (Ecotogious 2016). These findings may be understated, as the aforementioned study did not account for units that were scarcely occupied or those constructed in 2014-2015 (Bula 2016).

Vancouver is not the first to impose taxes on foreign real estate investors in attempt to slow down a fast-growing housing market. In fact, Australia, Singapore, and Hong Kong have all imposed additional taxes that are directed exclusively at non-resident buyers. In Australia, several cities have enforced foreign-buyer transfer taxes, most recently in

Victoria increasing the tax from 3% to 7% in July of 2016 (Nicholls 2016). In 2011, Singapore introduced the Additional Buyer's Duty (ABSD), which included a 15% tax on foreign buyers (IRAS 2017). Hong Kong also implemented a series of government stamp-duty measures, including a 15% *Buyer's Stamp Tax (BSD)* in October of 2012 (IRDHK 2017).

2.0 Relevance to Past Studies in the Literature

There have been various modeling approaches used to estimate the impact of taxes on the housing market. In particular, Dachis et al. (2012) adopt a combination of difference-in-difference estimates (DID) and regression discontinuity design (RD) in estimating a land-transfer tax in Toronto. This approach builds off traditional hedonic pricing models when controlling for key variables that impact housing prices.

Alternatively Chan and Yuen (2014) construct a vector-autoregressive model (VAR) in estimating the effects of a range of policy changes, including a foreign-buyer transfer tax, on the Hong Kong housing market. We begin by surveying the approach undertaken by Chan and Yuen (2014).

2.1 VAR Model: Hong Kong Case Study

Chan and Yuen (2014) construct a vector auto-regressive (VAR) model to estimate the short-run impact of several government policies on housing prices, transaction volume, and outstanding mortgage loans in Hong Kong. More specifically, their model takes the following form:

$$X_t = A_0 + A_1 X_{t-1} + \boldsymbol{BP_{t-1}} + CZ_{t-1} + \epsilon_t$$

where X is a vector of endogenous variables (i.e. housing prices, transaction volume, and outstanding residential mortgage loans), Z comprised of several controlling economic and financial indicators (i.e. Hang Seng Index (HSI), HSI Volatility Index, the unemployment rate and the average mortgage interest rate), and P representing a vector of policy variables. There are two sets of policy variables of interest in the model, various prudential measures (i.e. DSR caps, stress tests, stringent LTV requirements etc.), as well as various stamp-duty measures. Among the stamp-duty measures, the authors assess the individual impacts of three distinct taxes –one of which was the 15% foreign-buyer tax (BSD).

These various policies are specified as step-function variables, equal to 0 when no measures are applied and increasing by 1 for each new "count of tightening", and remaining at that level until the policy is changed. The authors' sample covered the period between January 2009 and November 2013, thus having to deal with various alterations and additions to the measures being analyzed. Given that some of the measures may include more than one set of policy instruments, there may be several counts in each round of "tightening". Using this specification, the coefficients of interest estimate the marginal effect of each count of tightening for each policy variable.

The BSD tax had a significantly greater effect on housing prices and transaction volume than any of the other measures analyzed (including macroprudential measures), by nearly twofold. BSD was found to have dampened housing prices by a monthly pace of nearly 1% while lowering transaction volumes by 35% one year after the tax (Figure 1).

Figure 1: Price Indices for Hong Kong Property Market (1999 = 100)[1]

Source: Rating and Valuation Department (GovHK)
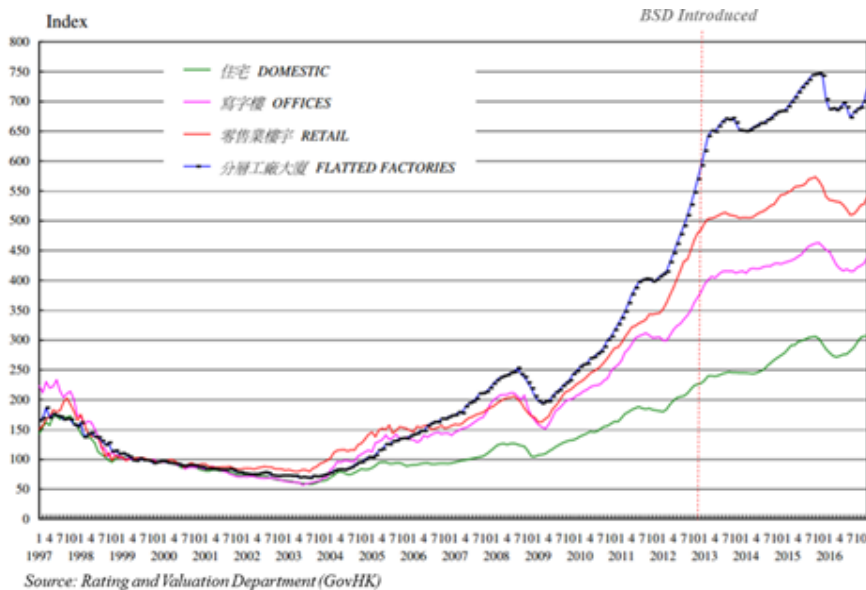
Model Assessment – Implications to Our Study

Overall the econometric model utilized by Chan and Yuen (2014) seems appropriate for their purposes, but unlikely to be as useful for our intended analysis of the Vancouver housing market. As the authors aim to also assess the impact of macroprudential measures in addition to stamp-duty measures, they include a range of macroeconomic and financial control variables which may not be relevant for our analysis. Mortgage interest rates and various stock indices may be important for controlling variation in debt levels and outstanding mortgage loans (one of the dependent variables used), but these control factors seem less directly relevant to estimating changes in individual housing prices. Additionally, as it pertains to estimating effects on housing prices, it is unspecified whether the authors utilized individual property transactions as the dependent variable or merely an average housing price index. If they utilized the former, the exclusion of any housing characteristic control variables may lead to imprecise estimates as literature on hedonic pricing models suggest (refer to *Hedonic Pricing Models* section).

Finally, we prefer an alternative model specification than the VAR used by the authors for modelling time series data that is highly persistent. Gil-Alana and Barros (2012) argue that shocks affecting the structure of house prices have clear persistent effects. Studies have

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[1] "Domestic" units are defined as independent dwellings with separate cooking facilities and bathroom (and/or lavatory). "Office premises" comprise premises situated in buildings designed for commercial/business purposes (Rating and Valuation Department, GovHK).

shown that the use of VAR in levels estimation models for data which are highly persistent may yield poorly sized tests (Ashley et. al 2009). Instead, it is recommended that testing should be done using differenced regressors (Ashely et. al 2009, p. 253). Nonetheless, given that the tax is identical, the results of this study are highly relevant for our analysis as they will provide a basis of comparison.

We find the approach adopted by Dachis et al. (2012) to be more intuitive, more parsimonious, and aligns well with the type of data we have access to. As such, we mirror our model specification similar to their analysis. However, several adjustments are made to better reflect the specifics of our Greater Vancouver case study. To lay the groundwork of the approach taken by Dachis et al (2012), it is useful to understand the fundamentals of hedonic pricing models.

2.2 Hedonic Pricing Models

There is a substantial amount of literature that has attempted to explain the value of a house by valuing its individual components through a method referred to as the *hedonic pricing model.* This method, largely developed by Rosen (1974), is motivated by the intuition that consumers generally derive utility from the various characteristics of a certain product, rather than the whole product itself (Chan 2014, p.9). Rosen's model, more specifically, asserts that the value of a house is equal to the aggregate value of all the individual physical characteristics or attributes (and relevant external factors) (i.e. square footage, bathrooms, bedrooms, age etc.). Expressing the price of a house (dependent variable) as a function of its various characteristics (independent variables) allows us to find regression estimates for each variable or characteristic.

Understanding the various components that determine the pricing of an individual housing observation is critical for the analysis adapted by Dachis et al (2012). By utilizing a *hedonic-pricing* design as the base-model, one can effectively control for the primary factors that explain differences in housing prices. Once controlling for such factors, we will be able to more effectively isolate the partial effect of the PTT on housing prices. Sirmans et al. (2005) examines over 125 empirical studies that utilized hedonic pricing models, recorded by a vast array of real estate and economics journals in the last decade. Noteworthy variables include: age, square footage, bedrooms, bathrooms, basement, and garage.

Although there are various characteristics that are consistently significant in explaining housing prices, the study found that both the magnitude and direction of many characteristics differ materially across locations in which the studies were conducted. Hedonic pricing models are location-specific and are utilized to gain insights about the valuation of housing for particular markets or regions (Sirmans 2005, p. 4). This finding stresses the importance of accounting for "spatial effects", especially if the sample size being studied spans multiple different regions or municipalities, as is the case for our particular dataset.

Several studies suggest that hedonic models using traditional OLS are unable to handle spatial effects that are inherently present in housing markets (Dubin 1992; 1998). More specifically, OLS does not account for spatial interaction effects between properties. Classical OLS, for example, is only able to model the price of a house dependent on its specified characteristics, and not the characteristics of other properties with varying geographical proximities. More specifically, it is argued that there is in fact a strong spill-over effects between properties, causing what is known as "spatial autocorrelation", and thus biasing the OLS estimates (Chan 2014, p.11). One such instance are endogenous interaction effects (i.e. where the dependent variable of observation i is related to a dependent variable of another observation j). In the case of hedonic models, the price (dependent variable) of one house will certainly impact the price of nearby houses as buyers consult nearby listing prices before making offers, often referred to as the *adjacency effect* (Can, 1992). Including location-specific dummy variables, such as neighbourhood or postal codes, should effectively account for such spatial effects (Chan 2014).

2.3 Toronto Case Study (LTT)

Dachis et al. (2012) examine the impact of the 1.1% Land-Transfer-Tax (LTT) on the volume and pricing of single-family homes. The LTT was introduced in early 2008 and applied to *all* residential purchases within the City of Toronto (with the exemption of first-time home buyers). This paper utilizes an amalgam of a differences-in-differences (DID) and a regression discontinuity design (RD) (please review *Model and Estimation Techniques* to view a parallel of the detailed model specifications utilized in this study). The results of the study estimate that the 1.1% LTT declined volume by 15% and reduced housing prices by approximately 1% eight months after implementation. Despite the policy difference between the LTT and PTT, the general model specification utilized by the author is applicable to our study in analyzing the *net effect* on the housing market, irrespective of the magnitude of the tax or to which particular buyers the tax is applicable.
In both instances, the tax is applied to a geographically defined boundary alongside other regions which did not experience the same treatment. Like differences-in-differences, the model compares the changes in prices (and volume) for houses in Toronto that are "treated" with the tax versus those that are "untreated" in nearby regions The validity of this approach relies on the assumptions that no other policy change differentially affected the control and treatment regions at the same time as the tax was imposed.

The Regression Discontinuity Design (RD) aims to evaluate the causal effects in the case of treatment assignment based on geographic borders. Spatial regression discontinuity is a particular case of RD that acknowledges geographic borders as *sharp cut-off points* where local effects can be estimated (Moore 2009). The key assumption is that, all else being equal (i.e. no differential treatments), the dependent variable would change continuously at the cut-off (Hahn et al., 2001). Doing so allows us to observe potential shifts in the dependent variable (i.e. housing prices and demand) from one side of the boundary to the other once the treatment has been applied. This methodology has been used in the past to investigate the effects of policies which vary over physical space that is clearly defined. For example, Duranton et al. (2011) observe the effects in municipal taxation across municipal borders and how it may impact a firm's behavior near the

boundaries. Black (1999) and Gibbons and Machin (2003) look at the effects on property value near particular school district boundaries.

Policies like Toronto's LTT and Greater Vancouver's PTT are implemented in geographically defined jurisdictions. In the LTT case, the tax was applied exclusively to the City of Toronto, and was not applied to surrounding municipalities. This allows the author to isolate the particular effects of the new tax on houses in Toronto along the Toronto-Suburban border for a more precise estimation (Dachis 2012, p.8). Although the author considers observations of varying distances to and from the Toronto border (on both sides of the border), the idealized situation is one in which one could isolate the effects precisely along the borderline.

Our particular case is unique as it pertains to applying the RD design. The tax is applied to an entire region that spans multiple municipalities (i.e. City of Vancouver, Maple Ridge etc.).

Many of the municipalities near the center of GVR do not have control groups *directly* bordering them which may provide some challenges according to the idealized RD design. However, the various municipalities where the tax applies are conveniently grouped together in one large geographical "cluster" (i.e. referred to as "Greater Vancouver Region"). We thus treat the entirety of GVR as one treatment group and select the surrounding control regions as those which directly border the outskirt municipalities of GVR (Exhibit 1), namely Abbotsford and Mission. We return to this potential issue later in our analysis and suggest alternative model alterations to more closely mirror the analysis conducted in our anchor paper.

3.0 Model and Estimation Techniques

Following the aforementioned model design, we construct two separate models in estimating the effect of the PTT on housing prices and volume of transactions. We will compare the change in prices and volume for houses in the Greater Vancouver Region (GVR) that are 'treated' with the PTT versus those 'untreated' in nearby regions.

As a difference-in-difference model specification, we look to estimate the following relation for change in housing prices (an analogous relation applies to change in volume of transactions):

*(GVR average prices **post**-PTT – GVR average prices **pre**-PTT)*
MINUS
*(Surrounding region avg. prices **post**-PTT – Surrounding region avg. prices **pre**-PTT)*

3.1 Estimating Change in Sale Price

The dataset we have manually constructed mirrors closely that which is used by Dachis et al. (2012). Each transaction contains the sale price, individual housing characteristics, location of the house (by neighborhood and jurisdiction), and the sale date.

We begin by constructing a basic hedonic pricing model where we express sale price as a function of the various key housing characteristics. These control variables include year built, number of bedrooms, number of bathrooms, and housing type (i.e. condo, duplex etc.). These control variables are represented by z_{it} in equation (1) and (2) – denoting a vector of the various housing characteristics for each transaction i, sold in month t.

As mentioned in our analysis of hedonic pricing models, it is critical to include a variable that accounts for "spatial effects". In our model, we define an indicator variable for each neighbourhood (i.e. "Cloverdale" within the City of Surrey). This variable attempts to control for any potential arbitrary correlation in housing prices or demand trends that may be found within each neighborhood in virtue of their spatial proximity. We define δ_i as an indicator variable for each unique neighborhood.

Additionally, as we are interested in observing changes in the housing market over time, it is important to control for potential seasonality effects. We can observe clear seasonality effects in our data as volume of transactions tends to peak in the summer months (Figure 2). A general model for monthly data that captures this phenomena is: $Y_t = \beta_0 + \beta_1 Feb_t + \beta_2 Mar_t + \beta_3 Apr_t + \beta_4 May_t + ... + \beta_{11} Dec_t + \beta_k X_{tk} + u_t$ where $Feb_t, Mar_t, ..., Dec_t$ are dummy variables indicating whether time period t corresponds to the given month. For example, if a transaction falls in the month of February, the dummy variable Feb_t will be equal to 1, and 0 otherwise. For simplicity, these 11 indicator variables are represented by M_t in equation (1) and (2) below. [1]

We proceed to add the difference-in-difference (DID) term. Let D^{GVR} be equal to 1 if the observation is within GVR and 0 otherwise. Let D^{PTT} be equal to 1 if the observation falls after the imposition of the tax (after August 2nd, 2016), and 0 if the transaction occurred before the imposition of the tax. We interact the variables and include it in our hedonic model as an additional term: $\lambda D^{PTT} * D^{GVR}$. The coefficient λ on our interaction term is in fact our DID estimator of interest. This coefficient informs us of the ceteris paribus impact of the PTT on housing prices. As is common in DID models, we include the separate terms in the model in addition to the interaction term, but only the interaction term provides a useful interpretation. If our interaction term is equal to 1 (i.e. GVR=1 and PTT=1), we restrict attention to the Greater Vancouver Region after the imposition of the tax.

The unit of observation utilized in our pricing equation is a particular transaction i, sold in a given month, t. We also take a logarithmic transformation of the dependent variable,

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[1] Our model thus effectively utilizes neighbourhood fixed effects, δ_i, and monthly fixed effects, M_t. This is line with the approach taken by Dachis et. al. (2012: 12).

sale price, to control for variations in price ranges. Finally, we let ε_{it} denote the mean zero component determined by unobserved factors.

Thus our regression equation looks as follows:

$$(1) \quad \log(P_{it}) = \beta_0 + \beta_1\delta_i + \beta_2 M_t + \beta_3 z_{it} + \beta_4(D_{it}{}^{PTT}) + \beta_6(D_{it}{}^{GVR}) + \lambda(D_{it}{}^{PTT}D_{it}{}^{GVR}) + \varepsilon_{it}$$

3.2 Estimating Volume Change

Our volume estimation equation is very similar to the pricing equation. However, our unit of observation changes. Let $v(x,t)$ refer to the volume of real estate transactions at a particular time and location. Let j index a unit of observation per neighbourhood and t index months. Thus let V_{jt} denote count of sales in neighbourhood j and month t. Our volume equation looks as follows:

$$(2) \quad V_{jt} = \beta_0 + \beta_1\delta_j + \beta_2 M_t + \beta_3 z_{jt} + \beta_4(D_{jt}{}^{PTT}) + \beta_5(D_{jt}{}^{GVR}) + \lambda(D_{jt}{}^{PTT}D_{jt}{}^{GVR}) + \varepsilon_{jt}$$

Additionally, we want to address any concerns around potential anticipation of the tax. The tax was formally announced by the BC Government on July 26th, 2016 and was implemented on August 2nd. However, we're concerned that there may have been material speculation or anticipation of the tax prior to the announcement. In fact, several media outlets covered the possibility of such a tax as early as May (Marr 2016). Controlling for a run-up in sales in anticipation of the tax is particularly important for estimating changes in volume before and after the tax.

Dachis et al. (2012) also considers the effects of the potential anticipation of the Land Transfer Tax in Toronto. They define 6 monthly dummy variables for Toronto for the months immediately before and after the imposition of the tax. Specifically, they define an indicator variable equal to 1 if the observation is in Toronto and the transaction falls within three months before or after the implementation of the tax – and 0 otherwise. The three months prior to the tax covers the anticipation period, and the three months after the tax covers the "adjustment period".

The authors account for an adjustment period to prevent immediate or short-term market reactions to the tax announcement from driving their estimates of the net effect of the tax. Accordingly, by defining these indicator variables, the authors no longer use those six months to identify the effect of the LTT (Dachis et al. 2012: 12).

We consider a similar model specification. Let T equal to 1 if the transaction occurs in GVR and the sale date falls between April 15th and September 15th. This time frame covers observations that occurred within 3.5 months prior to the tax announcement, and 1.5 months after.[1]

To test the robustness of this approach, we utilized an alternate strategy whereby we drop all observations from our sample that fall within the aforementioned time frame. We

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[1] Our adjustment period is shorter than that of our anchor paper given that we only have 5 months of observations post-tax implementation.

observe that the results of dropping the observations produces nearly identical results as utilizing the indicator variables. We find the latter approach more intuitive and thus utilized in our regression estimates. This adjustment is applied to both our price and volume estimations.

4.0 Description of Data

The dataset we have built tracks individual residential property transactions within GVR and various surrounding regions for 2015 and 2016. The data has been manually exported from a database managed by Landcor Data Corporation which hosts a range of real estate information provided by the real estate boards of BC.

We ensured that our sampling systematically did not leave out any particular type of observation (all prices ranges, neighbourhoods, and housing characteristics were extensively sampled). This was done for both 2015 and 2016 to arrive at total of nearly 100,000 observations. The control regions include Mission, Abbotsford, Central Vancouver Island, and the Capital region (Victoria). Each observation has transaction date, sale price, number of bedrooms and bathrooms, year the property was built, housing type (i.e. duplex, condo, etc.), jurisdiction, neighbourhood, and unique address.

The independent variable, transaction date, reflects the date the contract was *closed.* It does not reflect the day the contract was signed. It is important to note that the foreign-buyer tax impacts the transactions that closed after the tax implementation date (August 2nd, 2016), irrespective of the contract signing date. For example, if a foreign buyer signs a real estate contract on July 18th, 2016 (pre-PTT) and subsequently closed that transaction on August 5th, 2016 (post-PTT), then that buyer would be subject to the 15% tax. Accordingly, any potential ramp up in sales volume in our data leading up to the tax may be due to foreign buyers accelerating the closing date in order to avoid paying the 15% tax. If so, it becomes difficult to specify what portion of transactions leading up to the tax implementation date are attributable to newer contract signings versus previously signed contracts. Such an analysis is beyond the scope of this study. Additionally, we later drop several months of observations leading up to the tax to account for anticipation effects – and therefore this concern should not have any material effect on our results. The following provides a statistical summary of our dataset:

Table 1: Sample Size Breakdown

Number of Observations in Data Set			
	GVR	*Surrounding Regions*	*Total*
Pre- Tax	55,526	23,819	79,345
Post- Tax	9,232	7,774	17,006
Total	**64,758**	**31,593**	96,351

Data Source: Landcor Data Corporation 2017

Table 2: Descriptive Statistics

Data Summary				
Variable	*Mean*	*Std. Dev.*	*Min*	*Max*
SalePrice	$774,894	$757,355	$22,500	$24,500,000
Bedrooms	3.0	1.3	1	6
Bathrooms	2.6	1.2	1	6
Year (Built)	1986.493	18	1930	2010+

Data Source: Landcor Data Corporation 2017

Table 3: Average Price Percentiles GVR/ Control and Select Sub-Regions

	5th %	25th %	50th %	75th %	95th%	Observations
All Regions	$250,000	$415,000	$638,000	$1,050,000	$2,450,000	67,279
GVR	$263,000	$419,900	$656,450	$1,100,000	$2,500,000	64,758
Vancouver	$302,500	$439,900	$718,000	$1,432,500	$3,650,000	13.547
Richmond	$257,900	$414,900	$736,000	$1,320,000	$2,350,000	7,696
West Vanc.	$670,000	$1,600,000	$2,422,500	$3,400,000	$5,500,000	1,724
Control	$137,000	$370,500	$515,000	$633,000	$892,500	4,521
Abbotsford	$124,900	$348,950	$517,925	$645,500	$892,500	3,408
Mission	$265,000	$414,920	$509,424	$615,000	$895,000	1,113

Data Source: Landcor Data Corporation 2017

Table 4: Average Sale Price – Before and After Tax

		GVR	Surrounding Regions
Before Tax	Avg Sale Price	$ 894,015	$ 495,242
After Tax	Avg Sale Price	$ 1,063,055	$ 564,021
All	Avg Sale Price	$ 918,114	$ 516,130

Data Source: Landcor Data Corporation 2017

Table 5: Average Volume per Neighbourhood per Month – Before and After Tax

		Before Tax	After Tax
GVR	Avg. Volume/Month	**8**	**5**
	Max	241	127
Surrounding Regions	Avg. Volume/Month	**4**	**7**
	Max	54	42
All	Avg. Volume/Month	8	5

Data Source: Landcor Data Corporation 2017

When graphing the moving average change in sales volume over time, we can observe a clear decline in GVR vis-à-vis controlling regions after the implementation of the tax (Figure 2). In particular, we can observe the sales volume of GVR and surrounding regions to begin to converge after the tax announcement date. Our difference-in-difference regression attempts to estimate whether such a differential change between both curves is statistically significant following the introduction of the tax.

Figure 2 shows a moderate increase in sales volume for the control group over time. It should be noted that it is plausible the introduction of the tax in GVR led to an increase in demand for surrounding regions if, for example, foreign-buyers shifted their purchases to where the tax does not apply. If this the case, then the DID regression estimates would effectively be understated. That is, the control group is supposed to behave in such a way as to be indifferent to the tax in order to estimate the ceteris paribus tax impact on the treatment group. Accordingly, if the control group's volume of transactions is positively impacted by the tax, then it conceals what would have been a larger difference between the control group and treatment group.

**Figure 2: Sales Volume – GVR & Surrounding Regions**
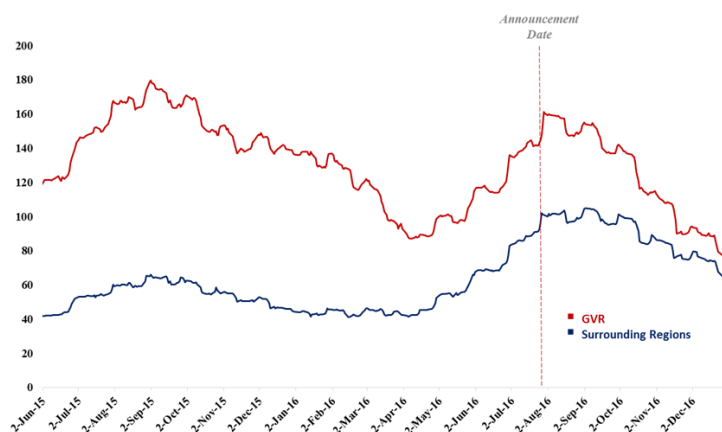
Data Source: Landcor Data Corporation 2017

Interestingly, the changes in sales volume seem to be dependant on varying prices ranges. For example, when isolating for transactions over the $1 million threshold, we observe a dramatic increase in volume in anticipation of the tax, followed by a sharp decline (Figure 3). By contrast, sales volume for transactions below the $1 million threshold did not demonstrate the same degree of volatility before and after the tax (Figure 4). We later consider potential hypotheses as to why a differential effect is seen among varying price ranges. In order to understand this phenomena further, we ran multiple regressions for volume conditional on varying price ranges.[1] Finally, observing the run-up in sales prior to the tax (at least for properties over $1 million) further confirms the need to exclude observations within the anticipation period.
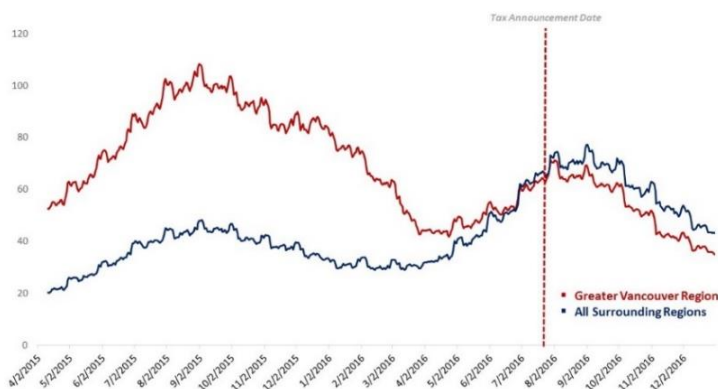
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[1] Conditional price regressions could not be run for our pricing equation due to endogeneity concerns.

Figure 3: Transaction Volume for Properties *over* $1MN
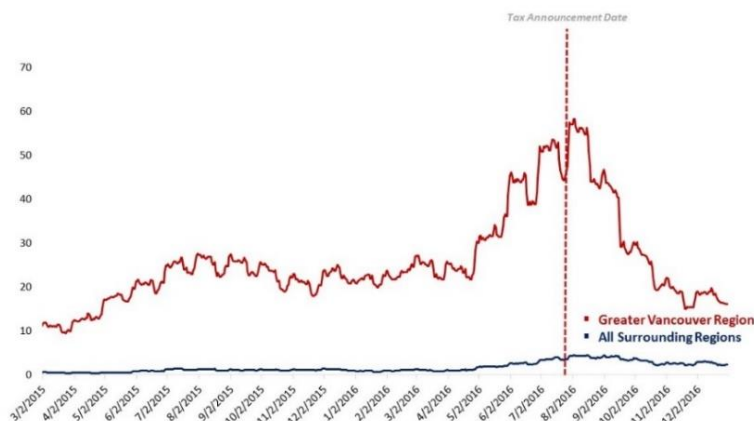
Data Source: Landcor Data Corporation 2017

Figure 4: Transaction Volume for Properties *under* $1MN

Data Source: Landcor Data Corporation 2017

When observing average price levels, it appears that prices also began to decline in GVR after the introduction of the tax (Figure 5). By contrast, the price levels in surrounding regions appears to be mostly stabilized, with a moderate growth rate. Our pricing regression equation attempts to identify whether this difference is statistically significant. Also, it should be noted the below graph highlights the tax announcement date (in red dotted line), but it is clear the market reacted more sharply following the actual implementation date (August 2nd, 2016). This is consistent with the fact that the tax only applied to properties that closed after August 2nd (and the data reflects contract closing dates).

Figure 5: Average Sale Price
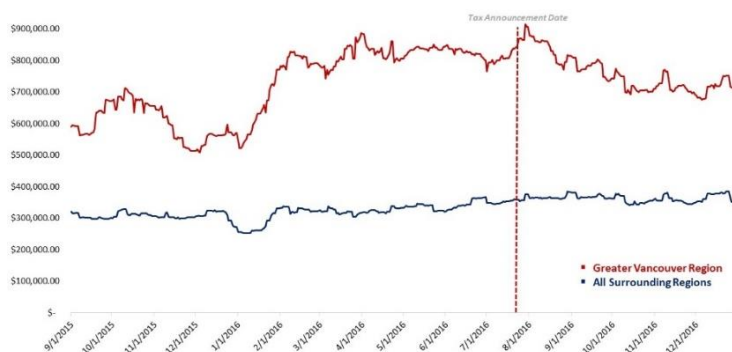
Data Source: Landcor Data Corporation 2017

We ultimately decide to exclude observations of the control groups that do not directly border GVR in order to more appropriately follow a traditional RD design. This entailed dropping the control observations in the Central Vancouver Island as well as Capital region (Victoria). The below regressions thus utilize Abbotsford and Mission as the control groups.

5.0 Results and Findings

5.1 Pricing Results

Utilizing the aforementioned pricing equation, our regression results indicate that the PTT decreased average housing prices in GVR by approximately 6-7% (Models 1-3). Housing characteristics, neighborhood indicator variables, housing type, and monthly seasonality controls were all significant. In order to account for potential anticipation of the tax, a series of regressions were performed omitting property transactions that fall within a specified date range. For example, in Table 6 Model 1, all property transactions that occurred between April 15th, 2016 and August 31st, 2016 were omitted from that specific regression. As aforementioned, this time frame also includes a period shortly after the introduction of the tax in order to account for a potential short-term "adjustment effect" (August 2nd – August 31st, 2016).

We observed that as the anticipation period was widened, the impact of the PTT on average housing prices increased in magnitude up until April 2016. When removing further observations prior to April 2016, there was a negligible change to our estimates. This suggests that any potential effects from anticipation of the tax began to be seen from April onwards.

Additionally, we are interested in analyzing the effects of the tax on different segments of the housing market (i.e. condos, duplex, single family dwellings etc.). The most notable change was observed among single family dwellings – the most expensive housing type. The average housing price for single family dwellings in our sample was $1.3 million compared to an average of approximately $700,000 for all other property types. Model 6

below shows a pricing regression including only transactions of single family homes. The results suggest the tax decreased the average price of this segment of the market by approximately 4.43% compared to 6.95% when excluding single family homes (Model 6 and 7).

There may be several explanations for this differential effect among property types. A simple explanation may be that all property types observed a relatively similar decrease in prices in absolute terms – thus when converting to percentages, such a change makes up a relatively smaller impact on more expensive property types. Alternatively, it is plausible wealthier individuals who purchase single family homes may be less concerned around potential short-term market fluctuations than less wealthy buyers (i.e. have a greater financial cushion to withstand any potential losses). If this is the case, then wealthier (local) buyers may be less likely to change their purchasing behaviors as a result of the new policy. Indeed, our volume results covered in the next section suggest that the tax decreased sales volume significantly more in the less expensive end of the market (thus placing greater downward pressure on price levels). Nonetheless, fully elaborating a potential difference in demand elasticity among property types is beyond the scope of this study.

Table 6: Impact of PTT Tax on Property Prices (all of GVR and Mission/ Abbotsford)

Price Impact (All GVR and Mission/Abbotsford)							
	1	2	3	4	5	6	7
PTT (%)	-7.61%	-6.58%	-5.74%	-4.56%	-2.93%	-4.43%	-6.95%
Housing charachteristics (Y/N)	Y	Y	Y	Y	Y	Y	Y
Seasonality	Y	Y	Y	Y	Y	Y	Y
Dates omitted	Apr 15- Aug 31	May 15-Aug 31	Jun 15- Aug 31	Jul 15- Aug 31	None	Jun-15-Aug 31	Jun 15- Aug 31
Type of Home	All	All	All	All	All	Single Family	All Except Single Family
Observations	51,727	54,943	58,608	62,728	69,279	16,729	41,879
T-Test	-6.15	-5.64	-5.1	-4.23	-3.25	-2.8	-4.35
R squared	0.8361	0.8351	0.8349	0.8341	0.8350	0.8074	0.737
Robust standard error	0.0124	0.0117	0.0113	0.0108	0.0090	0.0158	0.0160
Statistically significant @ 5%	Y	Y	Y	Y	Y	Y	Y

All 22 jurisdictions that are impacted by the foreign-buyer transfer tax are defined as the treatment group (GVR); the control group is defined as the Mission and Abbotsford. Housing characteristics include count of bedrooms, count of bathrooms, property type, and age the underlying property was built. All these variables were found to be statistically significant at the 10% level. Dates omitted refers to the time frames for which observations were dropped from our sample in order to remove potential anticipation and adjustment effects. For models 6 and 7, Single Family refers to housing type category: "Single Family Dwellings". Seasonality refers to including the monthly control variables M_t.

Data Source: Landcor Data Corporation 2017

So far, the net effect on average housing prices in GVR seems to have had a very similar effect to that which was observed by Chan and Yuen (2014) in Hong Kong after the introduction of the same tax. As aforementioned, it was assessed that the Hong Kong tax led to a decrease in prices by a monthly pace of approximately 1% every month – suggesting that by the five-month mark, prices would have declined by a comparable margin (~5%).

5.2 Volume Results

Recall that our unit of observation for our volume equation tracks count of sales per neighborhood per month. Table 7 suggests that PTT decreased the average number of sales per neighbourhood per month by approximately 4-5 transactions – which translates to a decrease in volume of approximately 50-60%. We provide five variations of the model, each of which omits transactions that occurred over certain dates in order to account for the aforementioned anticipation effect.

Additionally, following a similar model adjustment by our anchor paper, we conduct two separate regressions conditional on varying price ranges – for property transactions above and below a $500,000 threshold. We observe that the less expensive properties experienced a greater decline in sales volume as a result of the tax (Table 7 Model 6). This is consistent with our previous hypothesis that buyers in the lower end of the housing market are more sensitive and risk-averse to potential market fluctuations – leading them to hold off on potential purchases.

The effects of the tax on sales demand in GVR are greater than those observed in the Hong Kong case study (approximately 35% volume decline). However, it should be noted the Hong Kong case study conducted the analysis utilizing 6 more months of post-tax data than was included in our study. It is possible the effects of the tax on sales volume will subside over time.

Table 7: Impact of PTT on Sales Volume (including all of GVR and Mission/ Abbotsford)

Volume impact (all GVR and Mission/ Abbotsford)							
	1	2	3	4	5	6	7
Volume	-64.63%	-60.92%	-56.41%	-54.10%	-54.02%	-77.98%	-51.26%
Monthly transactions prior to tax	8.07	8.01	8.07	8.21	8.33	5.33	5.09
Monthly transaction decline	-5.22	-4.88	-4.55	-4.44	-4.50	-4.16	-2.61
Housing characteristics (Y/N)	Y	Y	Y	Y	Y	Y	Y
Statistically singificant @ 10%(Y/N)	Y	Y	Y	Y	Y	Y	Y
Dates omitted	Apr 1 -Aug 31	May 1 -Aug 31	Jun 1 - Aug 31	Jul 1 - Aug 31	None	Jun 1 - Aug 31	Jun 1 - Aug 31
Price Range	All	All	All	All	All	<$500k	>$500k
Observation	11,856	12,480	13,104	13,728	14,976	4,114	7,770
T-Test	-8.83	-12.1	-12.04	-12.06	-13.2	-7.51	-8.17
R Squared	0.57	0.58	0.58	0.57	0.57	0.70	0.42
Robust standard error	0.59	0.33	0.32	0.31	0.27	0.36	0.48

To calculate for the volume % change we divided the monthly volume *decline* per neighbourhood (coefficient of interest within our volume equation (2)) by the average number of *monthly transactions per neighbourhood within the GVR prior to the implementation of the tax*. The variable was found to be statistically and economically significant at the 5% level through most of the regressions. Housing characteristics and seasonality were also included and were statistically significant. The variables for housing characteristics and seasonality are the same variables utilized in our pricing regressions

Data Source: Landcor Data Corporation 2017

Supplementary Analysis: *Restricted* Regression Discontinuity Design

Following the econometric approach of Dachis et al. (2012), a more restricted regression-discontinuity design was applied focusing on property transactions that are between 10-15km from both sides of the GVR border. Such an analysis yields the purest effects of the PTT on property prices. The jurisdictions found within this restricted space are the District of Maple Ridge (GVR), Township of Langley (GVR), Mission (non-GVR),

and Abbotsford (non-GVR). In order to figure out which observations belong in this subset, we spatially mapped each neighbourhood of the aforementioned regions and excluded any that fell outside of the specified range – this left us with approximately 4,697 observations. Table 8 shows the results of this restricted analysis.

When focusing the analysis on property transactions that occurred 10-15km of the GVR border, the effects of the PTT are noticeably greater. The tax decreased the pricing level of GVR homes within this restricted range by approximately 9-10%. All pricing results were deemed significant at the 5% level, and further confirms the findings of our more broad analysis.

One possible explanation for why there was a greater effect in the restricted analysis may have to do with differences in demand elasticity in the various specified regions. That is, regions within 15km of the border will tend to be cheaper than those found in other regions of GVR that have higher demand levels (i.e. Richmond, City of Vancouver etc.). As aforementioned, the tax seems to have differential effects on different pricing ranges.

Table 8: Impact of PTT on Property Prices within a 10-15km Range of the GVR Border

Price impact within a 10-15KM of the GVR border							
	1	2	3	4	5	6	7
PTT (%)	-9.36%	-10.07%	-9.51%	-9.26%	-7.75%	-8.75%	-8.37%
Housing charachteristics (Y/N)	Y	Y	Y	Y	Y	Y	Y
Seasonality	Y	Y	Y	Y	Y	Y	Y
Dates omitted	Apr 15- Aug 31	May 1 –Aug 31	Jun 1 - Aug 31	Jul 1 - Aug 31	None	Jun 15- Aug 31	Jun 15- Aug 31
Type of Home	All	All	All	All	All	Single Family	All Except Single Family
Observations	2,417	2,832	3,265	3,816	4,697	1,628	1,637
T-Test	-4.19	-5.02	-5.14	-5.33	-5.38	-3.55	-2.99
R squared	0.6980	0.6862	0.6815	0.6798	0.6881	0.5391	0.7741
Robust standard error	0.0223	0.0201	0.0185	0.0174	0.0144	0.0315	0.0280
Statistically significant @ 5%	Y	Y	Y	Y	Y	Y	Y

Property transactions that occurred exclusively in Mission, Abbotsford, Langley Township, and Maple Ridge and that reside within a 10-15km limit were included. Housing characteristics include count of bedrooms and bathrooms; property type; and age the underlying property was built. All these variables were found to be statistically significant at the 10% level. Seasonality was also included in the aforementioned regressions in the form of monthly dummy variables; most of them were also found to be statistically significant at the 10% level.

Data Source: Landcor Data Corporation 2017

Similar to the RDD analysis on price, a series of regressions were conducted to estimate the impact of the tax on transaction volume for properties that fall within a 10-15km range from the GVR border. The results from Table 9 indicate that the tax did not have a statistically significant effect on property volumes. One possible explanation for the negligible effect on volume may have to do with the insufficient sample size.
As noted in Table 9 below, "monthly transactions prior to tax" within this restricted regions was on average 1-2 transactions per neighbourhood, compared to an average of approximately 8 transactions per neighbourhood per month in the broader analysis (Table 7). Given that sales volume per neighbourhood per month was already very low prior to the tax, any further decrease was relatively negligible. Exhibit 2 and 3 highlight variations of the restricted RDD design. Overall, due to the significantly smaller sample side utilized in our restricted RDD design, we prefer the broader analysis presented in Tables 6 and 7.

Table 9: Impact of PTT on Sales Volume within 10-15km of the GVR

Volume impact within a 10KM-15KM of the GVR border				
	1	*2*	*3*	*4*
Volume	-50.66%	-26.83%	-11.39%	2.89%
Monthly transactions prior to tax	1.17	1.48	1.96	2.59
Monthly transaction decline	-0.59	-0.40	-0.22	0.07
Housing characteristics (Y/N)	Y	Y	Y	Y
Statistically significant @ 10%(Y/N)	N	N	N	N
Dates omitted	**May 1 -Aug 31**	**Jun 1 - Aug 31**	**Jul 1 - Aug 31**	**None**
Observation	900	945	990	1,080
T-Test	-0.98	-0.66	-0.38	0.13
R Squared	0.5270	0.5269	0.5148	0.5197
Robust standard error	0.6041	0.6015	0.5893	0.5748

Property transactions that occurred exclusively in Mission, Abbotsford, Langley, and Maple Ridge and that reside within a 10km-15km limit were included. To calculate for the volume % change we divided the monthly transaction decline per neighbourhood by the average number of *monthly transaction per neighbourhood within GVR prior to the implementation of the tax*. The monthly transaction per neighbourhood decline was our coefficient of interest in this variable, labeled as PTTGVR, in our model specification. The variable was found to be statistically and economically significant at the 5% level through most of the regressions. Housing characteristics and seasonality were also included and were statistically and economically significant. The variables for housing characteristics and seasonality are the same variables utilized in our pricing regressions

Data Source: Landcor Data Corporation 2017

6.0 Conclusions

In summary, the purpose of this study was to assess the impact of the recent GVR tax policy on the housing market. In attempt to dampen rising housing prices, the BC government implemented a 15% foreign-buyer transfer tax. This policy was introduced in the context of continued speculation around the impact and severity of foreign real estate investments in the Greater Vancouver Region, particularly in the higher priced housing segment. This policy followed directly in the footsteps of Hong Kong, which implemented the identical tax several years ago. The resulting effects observed in this case study are comparable to our results for pricing yet diverge from our results on volume. One possible explanation for the discrepancy is that the Hong Kong case study conducted the analysis utilizing 6 more months of post-tax data than was included in our study. It is possible the effects of the tax on sales volume will subside over time. In estimating the impact on housing prices and demand, we utilized a combination of difference-in-difference and regression discontinuity design – modelled after the analysis conducted by Dachis et al. (2012).

Our results showed that average housing prices decreased by approximately 6-7% in GVR five months after the tax implementation. Average volume of transactions also declined by approximately 50-60%. This analysis furthers the literature on the use of hedonic pricing models and effects of taxation in the context of a natural experiment.

Exhibit 1: Map of GVR

Source: 2006 Census Statistics Canada

Exhibit 2: Price Impact including all observations in Mission, Abbotsford, Maple Ridge District, Langley Township

Price impact including all observations in Mission, Abbotsford, Maple Ridge District, Langley Township					
	1	2	3	4	5
PTT (%)	-8.27%	-8.60%	-8.54%	-8.96%	-7.66%
Housing charachteristics (Y/N)	Y	Y	Y	Y	Y
Seasonality	Y	Y	Y	Y	Y
Dates omitted	Apr 15- Aug 31	May 15-Aug 31	Jun 15- Aug 31	Jul 15- Aug 31	None
Observations	3,732	4,344	5,007	5,842	7,203
T-Test	-4.42	-5.25	-5.74	-6.49	-6.57
R squared	0.8065	0.8066	0.8017	0.8032	0.8072
Stadnard error	0.0187	0.0164	0.0149	0.0138	0.0117
Statistically significant @ 5%	Y	Y	Y	Y	Y

Observations included all transactions within Mission, Abbotsford, Maple Ridge, and Langley Township – not just within 15km of the GVR border. Previous model specifications apply.
Source: Landcor Data Corporation 2017

Exhibit 3: Volume Impact including all observations in Mission, Abbotsford, Maple Ridge District, Langley Township

Volume impact including all observations in Mission, Abbotsford, Maple Ridge District, Langley Township				
	1	2	3	4
Volume	-78.82%	-53.54%	-35.74%	-18.99%
Monthly transactions prior to tax	1.10	1.40	1.83	2.40
Monthly transaction decline	-0.87	-0.75	-0.65	-0.46
Housing characteristics (Y/N)	Y	Y	Y	Y
Statistically significant @ 10%(Y/N)	N	N	N	N
Dates omitted	**May 1 -Aug 31**	**Jun 1 - Aug 31**	**Jul 1 - Aug 31**	**None**
Observation	1,420	1,491	1,562	1,704
T-Test	-1.57	-1.37	-1.2	-0.86
R Squared	0.5347	0.5285	0.5141	0.5181
Robust standard error	0.5545	0.5452	0.5445	0.5281

Observations included all transactions within Mission, Abbotsford, Maple Ridge, and Langley Township – not just within 15km of the GVR border. Previous model specifications apply.
Source: Landcor Data Corporation 2017

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The Determinants of Economic Environmental Policy

Oscar Crawford-Ritchie

Abstract

Although there is a large selection of literature focusing on environmental economic policies, there is a lack of any form of public choice theory based model that explains and predicts government behaviour in this field. This paper puts forward a probit model that uses data from the World Bank and the OECD from 1989 to 2015 in order to predict a given government's choice between a carbon tax and a cap and trade system. It also intends to provide some predictive ability on the scope and price of the chosen policy using fixed effects OLS regressions. The results of this study indicate that there appears to be some ability of the model to predict the likely policy choice given a jurisdiction's economic and demographic makeup. The author hopes that this work will open up the possibility for more in depth public choice models in the environmental field as more data and policy examples become available in the coming years.

1.0 Introduction

Climate change poses an extreme threat to the entire globe. Human-made pollution has severely damaged the planet's climates, and many scientists believe that if the current trends continue, the raising water levels, increased frequency of tropical storms and rising heat will damage property, harm agricultural production, kill many animal species and make particular regions uninhabitable (United Nations 2014). To prevent, or at least mitigate, the impacts of global warming, many governments have begun to implement policies to combat the leading cause of climate change: carbon and greenhouse gas emissions. International agreements such as the Kyoto Protocol, and the United Nations' Framework Convention on Climate Change (2016b) resulted in a pledge by a large number of nations to reduce carbon emissions by a significant degree over the next few decades. Two of the most widespread policy tools used by governments to achieve their set emissions targets are a tax on carbon emissions, or a carbon tax, and an emission trading scheme, or a cap and trade system.

Figure 1: Global Carbon Emission Per Capita

Figure 1 displays CO_2 emissions per capita world-wide. It is the first time in the last two decades that carbon output per capita has decreased in a non-recession. This is in no small part thanks to the increased use of environmental economic policy.

I will explore why different governments with the same goal of carbon emission reduction, select different policies in order to reach that goal. Furthermore, I will propose a potential explanation for the factors that cause the implementation of relatively stronger or weaker environmental economic policies. The primary goal of this paper is to suggest a model using potential explanatory factors within a jurisdiction that can predict which policy is more likely to be implemented. I will also attempt to predict how these factors impact both the price of carbon and how much of a jurisdiction's emissions are covered by the implemented policy.

Data Source: The World Bank 2016b
  i)   Carbon Tax
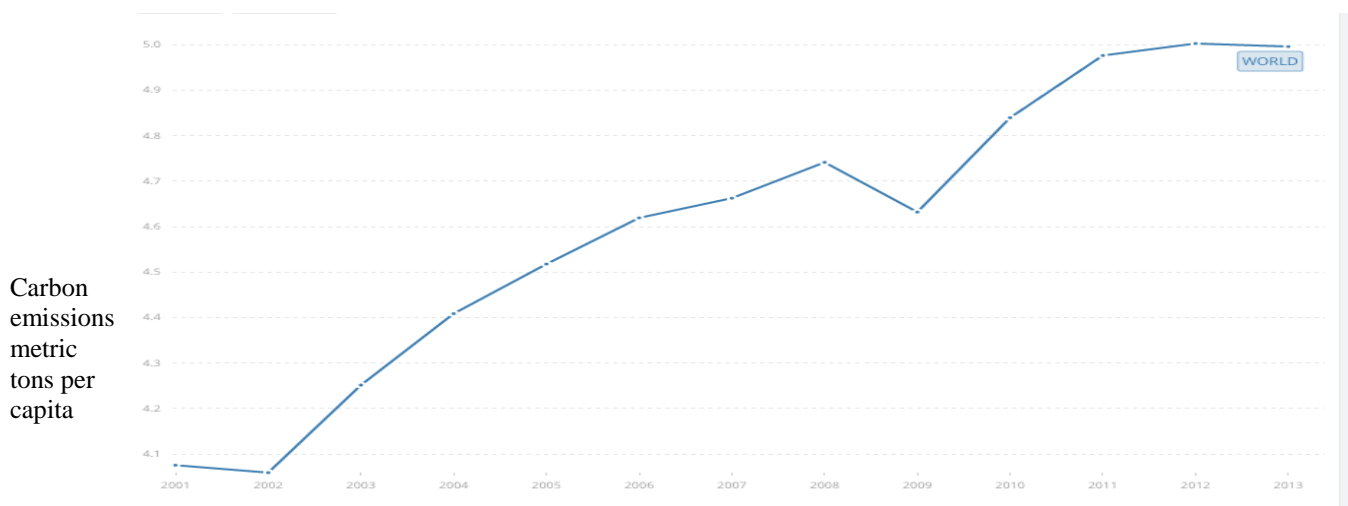
A carbon tax is a fee placed on units of emissions of CO_2 equivalents by particular industries or production of a certain product or type of product. The legal burden of the tax is usually placed on business which would then pass down some of the cost to consumers. Finland was the first nation to impose this policy in 1990, followed by the rest of the Scandinavian countries in the early 1990s.

  ii)   Cap and Trade

A cap and trade system, or sometimes called an emission trading scheme, is a policy where a government, or collection of governments, provides a set number of emissions permits to businesses that allow for emissions of carbon up to a certain level. These permits are sometimes given for free or through an auction. If a business is able to produce under its allocated amount, it is allowed to sell at market price its leftover emissions allowance

to another enterprise. If a business produces more emissions than is allocated or is purchased, then the firm is subject to heavy fines. This system incentivizes businesses to reduce emissions as a means of generating additional revenue and ensures that a given government's pollution emissions targets are met (The World Bank 2015a).

In this paper, I will not focus on which of the two policies are better, more efficient or more effective in different situations or jurisdictions. Rather, evidence is put forward suggesting in which economic and demographic atmospheres are each policy more likely to be present or implemented and how strong or weak these policies once implemented will be. The model will be in the public choice theory tradition meaning that it will try to provide an explanation using independent variables as to why a particular decision is made. The model presented in this paper will be a public choice model in the sense that it will not examine the effectiveness or efficiency of the policy or contain any prescriptive implications but it will be an observation about the likely policies selected for a given type of jurisdiction.

The primary question of interest is: *can the traits of a jurisdiction's economy and demographic conditions help predict the type of environmental economic policy that is in place or will be put in place?* The answer to this question may provide some value since many additional jurisdictions are in the process of implementing or creating new environmental policies in the upcoming years. It may also provide some insight into predicting the type of policies chosen based on patterns of similar jurisdictions. China, South Africa, the Canadian provinces, many American states and various other nations are in the early stages of policy creation or implementation and the findings of this study may help outside observers to predict the type of policies that will be put in place.

2.0 Relevant Economic Literature

While there is much reliable literature that discusses environmental economic policies, they tend to focus primarily on the efficiencies or cost effectiveness of the policies. There is not a wide availability of public choice models dealing with environmental economic policies. As such, I draw on the previous research in both public choice theory and environmental economics. One piece of literature that is of particular interest is Blais, Cousineau, and McRoberts' work, *The Determinants of Minimum Wage Rates* (1989). This article gave the general inspiration or the framework for the establishment of a model that uses factors of a jurisdiction that can explain, or at least predict, a government's policy in particular circumstances. Blais et al. (1989) focuses on a minimum wage, rather than environmental policy and their work answers the question on a much smaller scope than this thesis as it only deals with Canadian provinces rather than global nations. Also, the variables that were relevant to Blais et al. (1989), such as gender, employment and union coverage are less relevant to the model that will be presented in this paper. With that being said, Blais' model itself still provides a basis to explain a government's policy choices. The major difference between the determinate of minimum wage and the research found here is that minimum wage is a single choice: *what will the minimum wage be?* Therefore, an OLS regression is sufficient for that model. However, in climate policy there are at least two choices: *which, if any, policy?* and *what is the scope of the policy?* This is why my

paper will build on Blais et al's (1989) basic model by including a probit probability model to answer the first question as it is a binary response between policy or no policy.

Much of the relevant available literature dealing with environmental economics provides arguments for the inclusion of variables that may impact a given government's policy choices. A piece of literature that touches on some of the ideas presented in my thesis is found in a report created by the European Bank for Reconstruction and Development (2011) (the "EBRD") that discusses climate change policy in transitioning democracies in Eastern Europe. The report puts forward the idea that the strength of carbon intensive industry within an economy, the power of the voice of its lobbyists, the awareness of climate change as an issue and the level of legitimate democracy in the country all play at least some role in determining the strength of climate change policies. The EBRD report deals with a smaller data sample than the data put forward in this paper and focuses more on the level of democracy present in each country rather than other economic considerations. My model does take into consideration the level of democracy in that nation but focuses more on which industries are the most prevalent in the economy and the characteristics of the jurisdictions' populations. Regardless, the EBRD report is a useful analysis that provides some basis for my choice of variables used in the model.

A number of other articles and reports have played a role in establishing significant variables that contribute to the creation of the model used in this paper. For example, in their article *Does Effective Climate Policy Require Well-Informed Citizen Support?*, John Axsen, Ekaterina Rhodes, and Mark Jaccard, (2014) make the argument that in British Columbia the more informed and educated the electorate is, the more likely it is to support stricter, or stronger, environmental policies. This suggests that a determining factor of a given government's policy choice is the education level of the population of the jurisdiction in question. This does seem to hold at least on a surface level. Similarly, in Grainger and Kolstad's (2009), *Who Pays a Price on Carbon,* as well as Begin et al.'s (2016) paper, *Provincial Carbon Pricing and Household Fairness*, the issue of the impact of environmental economic policies on households and business are addressed. These papers both address the practical effect of these policies. One of the significant results of both works, that a carbon tax has the potential to be largely regressive, suggests that a nation with a poorer population should, in theory, oppose a carbon tax more so than a cap and trade system. These findings indicate that a measure of the population's wealth, in the form of GDP per capita, should be included in order to see if this hypothesis holds. Other research done by organizations such as the World Bank provide some basis for determining which variables should be used in my model such as oil production which seems to decrease the amount of carbon tax and cap and trade systems frequency. While a significant amount of literature on the topic of environmental economic policy and public choice theory is available, there is not enough substantial work on the intersection of these two fields to give a coherent argument for why these policies aimed at the same end goal differ so much. My thesis strives to add this perspective to the economic literature.

3.0 Variables and Data

The most significant portion of the data presented in this paper comes from the World Bank's data base (The World Bank 2016a). The World Bank's database has a large amount of economic and social indicators from a variety of nations. I gathered panel data from 1989 to 2015 from 37 jurisdictions, including 36 counties and the European Union. I selected the nations and jurisdictions that have some form of environmental policy in place as well as those that are significant economic players such as China and Russia to act as controls. I also made sure to select nations that are implementing policies in the next few years such as South Africa, or those who have been activity debating in recent years such as the Czech Republic, to account for differences between those who have already implemented a policy and those who are near to it. Although I collected data for 1989-2015, I only made use of data from every third year. This is in order to account for governments making choices on a regular but not necessarily an annual basis. The logic behind this is more fully realized in section VI. I used 2015 data as that was the most recent available and went backwards to include data from every third year.

The World Bank collects information on almost every country in categories such as the percentage of GDP that comes from imports, exports, oil rents, agricultural production, coal rents and manufacturing. In addition, I used the World Bank data for GDP per capita, and the percentage of the population that lives in rural regions. The rationale behind the inclusions of some of these variables is found in part in the literature previously reviewed. The model is trying to best capture, in the simplest manner possible, the economic and social makeup of a jurisdiction. The variables for trade's importance in the economy, i.e. imports and exports as a percentage of GDP, were included as metrics for how much that economy relies on other nations and producing things at lower costs. The oil, agriculture, coal and manufacturing rents as a fraction of GDP indicate which industries are the most important in an economy in an attempt to determine how reliance on different carbon intensive industries impacts a government's willingness to implant particular policies. The percentage of population is included because, generally, the larger share of a population living in rural areas, the greater the cost of goods and services that use carbon intensively. These include the cost for electricity, transportation, food costs and is mainly due to transportation cost to get from point of production to consumer or from one's home to educational, health care, entertainment, and other commonly used facilities. This will cover how much a change in policy a rural population is willing to accept. GDP per capita indicates how much a nation is able to bear an increase in carbon cost and higher GDP per capita countries should be more willing to accept a policy that raises that cost.

The Organization for Economic Development's (OECD) database is used to obtain education data, namely the percentage of 35-44 year-olds in the population who have some post-secondary or equivalent education. This variable is a simple indicator of general education level, as it covers how educated the population in the jurisdiction is. From the Economist Intelligence Unit (2016) I gathered their index rankings of how 'democratic' nations are. The Economist gives each nation a number on a continuous scale of 1 to 10 indicating how democratic a country based on a wide number of factors. This paper uses the Economist's ranking of nations and made a dummy variable where Dem= 0 when the

Economist ranks the country in the most 'democratic group', or 9-10 on the scale, Dem=1 when it was in the second most democratic group, 8-8.99 on the scale, and so on. In this paper the lower the value of 'Dem' the more 'democratic' it is. While not a perfect one, this metric should serve as an effective dummy variable to account for differences in general political leanings on the world stage. Generally, those that rank as more democratic have less industry influence on policy and more direct democracy. So, the lower the variable is, the smaller the impact a particular industry will have on a policy. It should also be an adequate instrument for political and ideological tendencies. This factor is an important thing to control for as nations with more liberal tendencies will be more likely to implement these policies, all other factors being equal. This is by no means a perfect substitute for government access and ideological leanings, but it should be an effective one nonetheless as those ranked higher on the index tend to be more economically and socially liberal.

The dependent variables are as follows: a dummy variable where tax=1 if there is a carbon tax and =0 otherwise, a dummy variable where cap=1 if there is a cap and trade scheme and =0 otherwise, the strength of the carbon tax and strength of a cap and trade system. The strength of a policy was obtained by multiplying the average price of carbon output and the approximate percentage of total emissions covered by the policy (percent coverage*average price of carbon). The data for these variables has been gathered from the World Bank's report, *State and Trends of Carbon Pricing* (2015b; 2016b)*,* as well as the OECD's publication of environmental tax profiles (2015). In order to get the relative strength of a particular policy dependent variable I used the data from the World Bank reports concerning the average carbon price as well as the percentage of emissions covered by the given policy and multiplied the two to create a new variable. As the question being answered in this paper concerns government policy, all independent variables have a three-year time lag. The reason for this is that it takes time for government to form and implement policy and such policy is usually based on the state of the economy and demographics at an earlier stage. This means that if the political and economic situation in a given jurisdiction does play a role in this type of policy formation it will most likely be the situation in the past. The reason for a three-year time lag rather than a two or four-year lag is more fully explained in section VI. Some important descriptive statistics can be found in Table 1.

Table 1: Variables Used and Descriptive Statistics

Variable	Observations	Mean	Standard Deviation	Min	Max
tax	507	0.1420118	0.349407	0	1
cap	507	0.394477	0.1948499	0	1
taxstr	506	1.8587	8.176219	0	64
capstr	507	0.0682976	0.5052	0	7.182
lagag	404	5.63383	6.1399	0.6284	32.94
lagcoal	476	0.220516	0.5994759	0	3.7547
lagco2	436	7.9836	4.238285	0.2186904	20.07577
lagex	473	34.42978	17.95	7.030571	123.9946
laggdp	477	26942	19016.57	635.4946	91593
lagman	392	18.8044	6.864116	6.832177	75.3
lagim	472	33.67542	17.32	5.461268	92.24
lagpop	507	28.76278	14.13347	5.863	83.71
lagoil	477	29741	2.695704	0	18.12375
laged	166	32.78089	10.98134	8.73956	62.26
Dem	455	1.914286	1.843943	0	7

Data Source: The World Bank 2016a; The World Bank 2016b: The World Bank 2015b; The Economist Intelligence Unit 2016; OECD 2015; OECD 2017; United Nations Framework Convention on Climate Change 2016a

The formal definitions of all the variables used can be found in the appendix.

4.0 Considerations for the Model

There are some significant factors to keep in mind while examining the model presented in this paper and the results that follow:

i) The 'Strength' of a given policy has no economic meaning outside of its relative position to the same policy types in other countries and regions. It is comparing the policy with a baseline of no policy, i.e. either no emissions is covered by the policy or its price rate is 0, or both. This means that if a factor tends to make a policy 1 unit stronger, then that means that it is correlated with some combination of the average price of carbon and the percentage of carbon covered by the policy. Another way to conceptualize it is the average additional amount of monetary cost that a unit of carbon produced would be if it was produced equally across all industries and production methods.

ii) The percentage of emissions covered by the particular policy as well as the price of carbon in that policy are based on estimated averages on an annual basis. Many governments tax particular industries or types of carbon production methods at different rates and provide exemptions to certain firms and industries. The price of carbon for all policies has also been converted to US dollars so the price may be slightly distorted due to conversion rates in a given year. This means that the estimates will not be precise but they

will still provide reasonable and sufficient estimations. All estimations on policy and currency for tax rate conversions were done by the World Bank and the OECD from the sources mentioned in section III.

iii) Federations and overlapping jurisdictions created an additional consideration when establishing the model and gathering the necessary data. Environmental policy at this level has as of yet been left to the Canadian provinces and US state governments rather than to each of the federal governments. Similarly, the European Union as a whole and some municipalities around the world, for example Tokyo, have also implemented policies independent of federal legislation. The model incorporates the sub nations' policies in place as part of the entire federal policy as the economic policy and uses the European Union as a separate policy making body that is influenced by the population as a whole rather than the policies of individual member nations. While not perfect, as there are undoubtedly cross influences of policies at different levels, given the available data and resources available this was the most practical manner in which to avoid this issue. A similar issue is whether the policies of the EU influences the policy choice of member nation. For the sake of this model the assumption is that they are made independently. Although in practice they most likely influence each other, the variation in policy inside the EU and outside are approximately the same, in fact, because of the Scandinavian nations early adoption it is most likely the case that individual European countries have stricter policies even if the EU also had its own policy.

v) This model assumes that a government makes a choice between the two polices separately, meaning that it does not look at implementing both policies. The assumption is that the policy choice is two separate binary choices, to put in place that given policy or not to. It also assumes that government, or more philosophically accurate the people, actively make the decision each time there is an election. In this model I assumed on average a government was up for reelection every three years. Three years was chosen both because three years would be a balance between the more traditional every 4 years elections and the more volatile coalition parliamentarian systems which can sometimes have elections every 18 months or so. It also ensures that I have sufficient data.

5.0 Methodology and Model

As the topic in question for this paper is dealing with a discrete choice made by governments, it would seem that some kind of selection correction factor model would be appropriate. Since the subject of this paper has a small sample size, particularly with the cap and trade choice which would only have six observations with a once and for all choice, the selection correction factor is ineffective. As such, a new model that still allows the question to be answered must be used using a different assumption. In this model it is assumed that governments do not make a once and for all decision. They have the power to repeal taxes that are unpopular and become non-viable. While governments do not make the binary choice every year they do make it each new election. This is a reasonable assumption as the Australian carbon tax was repealed as part of the opposition party's election campaign in 2013 and Ontario's opposition party has pledged to get rid of cap and trade if elected in 2018. The model also includes a dummy variable for the presence of a

tax or a trading scheme in the previous period, i.e. three years prior, to help control for it as it is certainly true the presence of it in the past makes it more likely.

This study will be focused on four major regressions. First, I will run two probit regressions, one for a dummy variable for the existence of a carbon tax on the independent variables listed below and a second probit regression for the dummy variable for the presence of a cap and trade system on the same independent variables. Once those two probit regressions are run, which factors within the listed explanatory variables make each policy more or less likely to be implemented can be established. Afterwards, using fixed effects to ensure there is no collinearity between the same countries across time, I will run two regressions for the strength of the policy, one for each policy, on the same independent variables as used before. I will eliminate in each regression those observations from jurisdictions that do not have that policy as to not place a downward bias on the result. This second set of regressions will determine once a particular policy is chosen by a government what factors tend to be signals of a relatively weaker or stronger policy. The following is the econometric model to be used in the paper to achieve the final results.

i) $P(tax_i = 1) = \emptyset(\beta_0 + \beta_1(lagag_i) + \beta_2(lagCO2_i) + \beta_3(lagex_i) + \beta_4(lagGDP_i) + \beta_5(lagman_i) + \beta_6(lagpop_i) + \beta_7(lagoil_i) + \beta_8(lagcoal_i) + \beta_9(lagedu_i) + \beta_{10}(lagim_i) + \beta_{11}(Dem_i) + \beta_{12}(lagtax_i) + \varepsilon_{it})$

ii) $P(cap_i = 1) = \emptyset(\beta_0 + \beta_1(lagag_i) + \beta_2(lagCO2_i) + \beta_3(lagex_i) + \beta_4(lagGDP_i) + \beta_5(lagman_i) + \beta_6(lagpop_i) + \beta_7(lagoil_i) + \beta_8(lagcoal_i) + \beta_9(lagedu_i) + \beta_{10}(lagim_i) + \beta_{11}(Dem_i) + \beta_{12}(lagcap_i) + \varepsilon_{it})$

iii) If tax=1, using fixed effects: $(tax\ddot{s}tr_{ii}) = (\beta_0 + \beta_1(lag\ddot{a}g_{it}) + \beta_2(lag\ddot{e}x_{it}) + \beta_3(lag\ddot{G}DP_{it}) + \beta_4(lag\ddot{m}an_{it}) + \beta_5(lag\ddot{c}oal_{it}) + \beta_6(lag\ddot{p}op_{it}) + \beta_7(lag\ddot{o}il_{it}) + \beta_8(lag\ddot{i}m_{it}) + \beta_9(lag\ddot{e}du_{it}) + \beta_{10}(lag\ddot{o}il_{it}) + \beta_{11}(De\ddot{m}_{it}) + \beta_{12}(lag\ddot{t}ax_{it}) + \varepsilon_{it})$

iv) If cap=1, using fixed effects: $(cap\ddot{s}tr_{ii}) = (\beta_0 + \beta_1(lag\ddot{a}g_{it}) + \beta_2(lag\ddot{e}x_{it}) + \beta_3(lag\ddot{G}DP_{it}) + \beta_4(lag\ddot{m}an_{it}) + \beta_5(lag\ddot{c}oal_{it}) + \beta_6(lag\ddot{p}op_{it}) + \beta_7(lag\ddot{o}il_{it}) + \beta_8(lag\ddot{i}m_{it}) + \beta_9(lag\ddot{e}du_{it}) + \beta_{10}(lag\ddot{o}il_{it}) + \beta_{11}(De\ddot{m}_{it}) + \beta_{12}(lag\ddot{c}ap_{it}) + \varepsilon_{it})$

6.0 Empirical Results

This study has come up with some interesting results warranting discussion and examination.

<u>Regression i: Probit regression for carbon tax on independent variables</u>

$P(tax_i = 1) = \emptyset(\beta_0 + \beta_1(lagag_i) + \beta_2(lagCO2_i) + \beta_3(lagex_i) + \beta_4(lagGDP_i) + \beta_5(lagman_i) + \beta_6(lagpop_i) + \beta_7(lagoil_i) + \beta_8(lagcoal_i) + \beta_9(lagedu_i) + \beta_{10}(lagim_i) + \beta_{11}(Dem_i) + \beta_{12}(lagtax_i) + \varepsilon_{it})$

Table 2: Regression i Results

Variable	Coefficients
Lagged value added from agriculture	-0.5742209 (0.100)
Lagged CO_2 per capita emissions	-0.4363429 (0.031)
Lagged exports	-0.292587 (0.071)
Lagged GDP per capita	0.0000163 (0.681)
Lagged Imports	0.3770326 (0.011)
Lagged oil rents	0.9176093 (0.011)
Lagged Education level	0.0644593 (0.0001)
Lagged manufacturing value added	-0.2054805 (0.000)
Lagged percentage of the population living in rural areas	-0.0056742 (0.807)
Lagged coal rents	1.306537 (0.160)
Lagged tax	3.218791 (0.0001)
Democracy Index	-1.490631 (0.043)
Constant	-1.771779 (0.711)
( )- p-value	Pseudo R2=0.6831 Prob > chi2= 0.001 N=131

Data Source: The World Bank 2016a; The World Bank 2016b: The World Bank 2015b; The Economist Intelligence Unit 2016; OECD 2015; OECD 2017; United Nations Framework Convention on Climate Change 2016a

When running the probit regression for carbon taxes on the independent variables, it appears as though some of the basic assumptions that were held are supported by the available data. A higher education rate among the public, in the form of completion of some post-secondary education, indicates a higher likelihood of the presence of a carbon tax. The lagged variable for education rates indicated, to a 10 percent significance level, that a better educated electoral base has a positive relationship with a higher chance of

carbon output taxation. This is consistent with previous findings in the related literature. Additionally, the model suggests that a high level of CO_2 emissions per capita for the jurisdiction in the recent past lowers the chances to a large amount that a carbon tax will be in place. Again, this finding is statistically significant. These results imply that a particularly high CO_2 output level relative to other nations does not likely play a significant role in inspiring policy in an attempt to change emission levels, but that policy formation comes from other factors. Based on the results of this regression the larger the amount of exports compared to the rest of the economy, the less likely a carbon tax will be present in that same economy at the 7 percent significance level. There could be many reasons for this, but one possible explanation is that the larger the exports sector is, the more influence and power the firms in that industry have on policy formation and implementation. This is because a main way that exporters can seem attractive to the rest of the world is lower prices. Those that export will want to keep production costs low and put significant effort into preventing a carbon tax, which increases the cost of production. Alternatively, the more a country imports the more likely it seems to be to accept a tax. This may be for the same reason. As the jurisdiction relies less on its own production, those in it may be more willing to accept the tax as it impacts them in a less direct way than exporters. The size of agriculture in the economy also has a significant correlation with the likelihood function, at the 10 percent level. Agriculture has the potential to produce a large amount of carbon and thus participants in that industry would have an interest in stopping any attempt to create that policy.

A final, and perhaps surprising, result from this model is the fact that it predicts that the larger the oil industry is in comparison to the rest of the economy the higher likelihood of a carbon tax, to a 1 percent significance level. One possible explanation is that large oil producers within the OECD are both significant oil producers and have in place a high tax on carbon, for example Norway. Another explanation is that oil producers prefer a tax on carbon over a cap and trade given the choice and have thus been lobbying government to implement such a policy when it becomes clear that some climate change action will occur. This is because a carbon tax will allow for oil producers to produce any amount so long as their marginal benefit exceeds their cost plus any tax, while a cap and trade may stop production if the market or permits are limited. Finally, and not surprisingly, a tax in the previous period makes it more likely for the implementation of a tax in the current period.

Regression ii: Probit regression for cap and trade on the variables

$P(cap_i = 1) = \emptyset(\beta_0 + \beta_1(lagag_i) + \beta_2(lagCO2_i) + \beta_3(lagex_i) + \beta_4(lagGDP_i) + \beta_5(lagman_i) + \beta_6(lagpop_i) + \beta_7(lagoil_i) + \beta_8(lagcoal_i) + \beta_9(lagedu_i) + \beta_{10}(lagim_i) + \beta_{11}(Dem_i) + \beta_{12}(lagcap_i) + \varepsilon_{it})$

Table 3: Regression ii Results

Variable	Coefficient
Lagged value added from agriculture	0.4286397 (0.139)
Lagged CO_2 per capita emissions	0.4135132 (0.139)
Lagged exports	-0.1974881 (0.058)
Lagged GDP per capita	-0.0003958 (0.037)
Lagged Imports	N/A
Lagged oil rents	-1.200423 (0.294)
Lagged Education level	0.6380895 (0.017)
Lagged manufacturing value added	0.2084106 (0.201)
Lagged percentage of the population living in rural areas	-0.5829024 (0.021)
Lagged coal rents	N/A
Lagged cap	N/A
Democracy Index	N/A
Constant	-5.13783 (0.042)
( )- p-value	Pseudo R2=0.8380 Prob > chi2= 0.000 N=119

As in the previous regression a few interesting results can be found when a probit regression is run for presence of a cap and trade system on the independent variables. Unsurprisingly, post-secondary education achievement rate seems to have a strong positive relationship. At less than a 0.02 p-value education has a large positive coefficient relative to the other coefficients in the model. As in the previous regression, this makes conceptual sense; the more highly educated the population, the more likely they are to be willing to accept policies put in place to combat climate change, even if that means slightly higher prices. A factor that seems to make a cap and trade system less likely is the percentage of the population living in rural areas. With a p-value of about 0.02 the model indicates that as the percentage of the total population living in rural areas increases the implementation of a cap and trade system is less likely to occur. The result may be, in part, that those living in rural areas have higher transportation costs than those living in urban areas, which is one of the most sustainable costs to a rise in carbon prices. As such, the more people who would be negatively impacted by a policy the less likely the policy is to be put in place. Interestingly, the higher the GDP the less likely it is for a cap and trade system to be present even though conceptually a higher income nation should be more willing to accept any type of policy. The marginal results do appear very small though, so the impact either way is likely limited. Because there is less variation between cap and trade systems than there was with carbon taxes, the variable for a policy present in the previous period is not included as it predicted present current cap and trade presence perfectly. Those coefficients whose results are N/A where dropped due to collinearity and may be due to the relatively small sample.

Regression iii: Fixed effects regression of the strength of a carbon tax on the independent variables, if a carbon tax is present in that jurisdiction.

If tax=1, using fixed effects: $(tax\ddot{s}tr_{ii}) = \left(\beta_0 + \beta_1\left(lag\ddot{a}g_{it}\right) + \beta_2\left(lag\ddot{e}x_{it}\right) + \beta_3\left(lag\ddot{G}DP_{it}\right) + \beta_4\left(lag\ddot{m}an_{it}\right) + \beta_5\left(lag\ddot{c}oal_{it}\right) + \beta_6(lag\ddot{p}op_{it}) + \beta_7\left(lag\ddot{o}il_{it}\right) + \beta_8\left(lag\ddot{i}m_{it}\right) + \beta_9\left(lag\ddot{e}du_{it}\right) + \beta_{10}(lag\ddot{o}il_{it}) + \beta_{11}(De\ddot{m}_{it}) + \beta_{12}(lagt\ddot{a}x_{it}) + \varepsilon_{it}\right)$

Table 4: Regression iii Results

Variable	Equation iii
Lagged value added from agriculture	-5.300772 (0.076)
Lagged CO_2 per capita emissions	-1.725862 (0.008)
Lagged exports	0.1404694 (0.721)
Lagged GDP per capita	0.0001355 (0.619)
Lagged Imports	0.8793408 (0.0800
Lagged oil rents	-0.4719745 (0.707)
Lagged Education level	-0.7273278 (0.002)
Lagged manufacturing value added	-0.6181162 (0.245)
Lagged percentage of the population living in rural areas	-2.832426 (0.000)
Lagged coal rents	2.220207 (0.776)
Lagged tax	N/A
Democracy Index	N/A
Constant	-89.50168 (0.000)
( )- p-value	Overall R2=0.8307 F score= 0.000 N=40

Data Source: The World Bank 2016a; The World Bank 2016b: The World Bank 2015b; The Economist Intelligence Unit 2016; OECD 2015; OECD 2017; United Nations Framework Convention on Climate Change 2016a

This regression was run using fixed effects and only used data points that had a carbon tax, in other words this answers the question: given a carbon tax is chosen, what factors are indicators of the strength or weakness of the tax? As it was a fixed effects model, both democracy level and lagged tax were dropped because they rarely change period to period. Interestingly, the regression found that for every one percentile point increase in the size

of the agriculture industry within an economy holding the other variables constant, there was a 5.3 decrease in 'strength', or a 5.3 decrease in the percentage of total emissions covered by the tax multiplied by the average tax rate. Another way to view this is for every 1 percentile point increase in agriculture industry as a share of the total GDP the price of carbon averaged out for all industries and production sources fell by \$5.30 USD. This result was found at the 10 percent significance level.

A very interesting and counterintuitive result is that while countries with a higher education rate are more likely to have a tax, as the education rate increases the strength of the tax decreases. Less surprising is the fact that heavy carbon emitters tend to bring the strength of the tax down. If a larger section of the population is living in rural areas, the tax is going to tend to be weaker by about 2.8 units for every percentile point increase rural population at less than the 1 percent significance level. This may be because carbon taxes are more significantly felt in transportation industries which those in rural environments need more of, and therefore will bear a larger percentage of the cost. The larger the fraction of GDP going towards imports, the stronger the tax will tend to be, by about 0.9 units for every 1 percent in share of GDP increase at the 8 percent significance level. This could be because those in an economy which imports a larger amount are paying less for domestic production costs which are impacted significantly by a carbon tax and so are more willing to accept it as they bear less of the cost than if they did not import. Those coefficients whose results are N/A were dropped due to collinearity and may be due to the relatively small sample size.

<u>Regression iv: Fixed effects regression of the strength of a cap and trade policy on the independent variables, if a cap and trade system was present in that jurisdiction.</u>

If cap=1, using fixed effects: $(cap\ddot{s}tr_{ii}) = (\beta_0 + \beta_1(lag\ddot{a}g_{it}) + \beta_2(lag\ddot{e}x_{it}) + \beta_3(lag\ddot{G}DP_{it}) + \beta_4(lag\ddot{m}an_{it}) + \beta_5(lag\ddot{c}oal_{it}) + \beta_6(lag\ddot{p}op_{it}) + \beta_7(lag\ddot{o}il_{it}) + \beta_8(lag\ddot{i}m_{it}) + \beta_9(lag\ddot{e}du_{it}) + \beta_{10}(lag\ddot{o}il_{it}) + \beta_{11}(De\ddot{m}_{it}) + \beta_{12}(lag\ddot{c}ap_{it}) + \varepsilon_{it})$

Table 5: Regression iv Results

Variable	Coefficient
Lagged value added from agriculture	0.254757 (0.435)
Lagged CO_2 per capita emissions	0.0039249 (0.981)
Lagged exports	0.0006496 (0.968)
Lagged GDP per capita	-0.000005 (0.572)
Lagged Imports	0.0016648 (0.925)
Lagged oil rents	0.217232 (0.673)
Lagged Education level	0.0138214 (0.075)
Lagged manufacturing value added	0.034909 (0.115)
Lagged percentage of the population living in rural areas	-0.121479 (0.388)
Lagged coal rents	0.0036378 (0.981)
Lagged cap	N/A
Democracy Index	N/A
Constant	-0.0091064 0.191
( )- p-value	Overall R2=0.0914 F score= 0.6211 N=20

Data Source: The World Bank 2016a; The World Bank 2016b: The World Bank 2015b; The Economist Intelligence Unit 2016; OECD 2015; OECD 2017; United Nations Framework Convention on Climate Change 2016a

This regression was run using fixed effects and only used data points that had a cap and trade system, in other words this answers the question that given a cap and trade scheme is chosen what factors are indicators of the strength or weakness of the tax? The results of this regression are inconclusive. It suggests that it may be possible that the higher the education level, the strong the policy to the 8 percent significance level. However, the

regression's F-score indicated that the null of not having any real statistical significance cannot be rejected. This may be, in part, due to the fact that the number of jurisdictions with a cap and trade system is significantly less than those with a carbon tax in place. Also, as cap and trade systems are newer relative to carbon tax systems, there are even fewer data points available to examine. Specifically, only 20 reliable observations were available compared to 40 observations for the carbon tax. This means that no meaningful conclusion about the indicators of a strong cap and trade policy can be made using the data in this paper.

7.0 Prediction Check

As policies are usually announced in advance of being put into place, we have the opportunity to observe if the policy choice planned to be implemented in the near future made by those who are not yet included in the dataset are consistent with the model's predictions. Due to the fact that the paper used a likelihood model it is by no means perfect, it just shows which policy choice is should be more likely.

a) Chile: Chile has recently started to implement a carbon tax. This means the model would suggest a likelihood of a larger than average oil industry, education rates and imports as well as smaller than average exports, agriculture production, and initial CO_2 per capita output and that the country is more democratic than the average observed nation. It does have above average imports and below average exports which is consistent with the model but it also has a smaller oil industry, larger agricultural industry and higher initial carbon per capita output. It seems that the prediction would have been wrong in this case.

b) Ontario: Ontario is in the early stages of a putting in place a cap and trade system. According to the model, we would predict this outcome if Ontario has a lower amount of exports than average, higher education rates and a smaller population living outside of cities. Ontario does in fact have a lower percentage of the population not living in cities than the average in the dataset and a higher education rate than average. However, it also has more exports than the average in the dataset. Overall based on two out of three predictive factors it seems like a safe assumption that someone using the model would have predicted that the likely result for Ontario is a cap and trade. This is especially true since the two factors that most closely line up with Ontario traits – high level of urbanization and high education levels – are also the most statistically significant of the coefficients and have the largest magnitude in that probit regression.

c) South Africa: South Africa has begun putting in place a carbon tax. The country has a relatively small agriculture industry, smaller exports, and higher education obtainment which all would imply higher likelihood of carbon taxes but also has a smaller oil industry, democracy rating, and imports. However, because of various significance and magnitude levels, it is reasonable to have assumed that the someone using this model could have predicted that South Africa would implement a carbon tax. Therefore, it is reasonable to say that this was neither a failure nor successful prediction.

Based on the small sample of jurisdictions, the model presented in this paper does a reasonable job about half the time which indicates that it has some predictive validity.

8.0 Conclusion and considerations on the findings

Although the final regression (iv) did not produce any meaningful results, the first three regression models did. The model presented in this paper provides evidence that suggests that as the level of imports, education obtainment, democracy rating and oil production increases, the presence of a carbon tax becomes more likely. As does the presence of a tax in the previous period. Alternatively, the larger the size of the agriculture industry, exports and carbon emissions per capita, the smaller the likelihood of such a policy being in place. The results of the model also found that if a government had chosen a carbon tax then, holding all other factors constant, the greater the size of the agriculture industry, the more people who have obtained post-secondary degrees or greater the population living in rural areas, the 'weaker' the tax on carbon is likely to be. Additionally, the results found evidence to suggest that the smaller the amount of exports in the economy, the smaller the rural population relative to total population and the higher the education level in the population is, the more likely a cap and trade scheme would be in place.

While the model presented here is not perfect, it does provide a framework in which a prediction of policy direction can be made. The underlying model will undoubtedly benefit from more data in the next decade, particularly regarding cap and trade systems. With the benefit of more data the model can be altered and improved upon to focus on time dependent choices, i.e. a once and for all choice. The model created in this study could potentially be of great interest to political scientists and economic forecasters attempting to predict the long-term policy path of a given region or government. While not perfect, it does seem that it is possible to predict what policy will likely be put in place and how strong that policy is likely to be based on a given nation's economic and demographic makeup. While it is need of improvement, the model described in this paper puts forward a unique and potentially very useful model that at least provides a starting point for the application of public choice theory into mass government economic and environmental policy.

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Appendix
Table 6: Variable List

Variable name	Shorthand	Definition
Carbon Tax	tax	Dummy Variable that =1 if a carbon tax is presence and =0 otherwise
Cap and Trade	cap	Dummy Variable that =1 if a cap and trade system has been implemented and =0 otherwise
Carbon Tax Rate	tax rate	Average price in USD of carbon output in a carbon tax system per metric tons
Cap and Trade Rate	cap rate	Average price in USD of carbon output permit per metric ton
Carbon Tax Coverage	tax coverage	Approximate percentage of total carbon emissions covered by tax
Cap and Trade Coverage	cap coverage	Approximate percentage of total carbon emissions covered by cap and trade system
Carbon Tax Strength	taxstr	Carbon Tax Rate multiplied by Carbon tax coverage
Cap and Trade Strength	capstr	Cap and Trade Rate multiplied by Cap and Trade Coverage
Lagged value added from agriculture	lagag	Value added from agriculture as % of total GDP from three years prior

Variable name	Shorthand	Definition
Lagged CO_2 per capita emissions	lagco2	CO_2 emissions per capita in metric tones carbon equivalent from two year prior
Lagged exports	lagex	Exports as a % of GDP from three years prior
Lagged GDP per capita	laggdp	Gross domestic product per capita from three years prior
Lagged Imports	lagim	Imports as a % of GDP from three years prior
Lagged oil rents	lagoil	Oil rents as a % of GDP from two year prior
Lagged Education level	lagedu	% of population aged 35-44 that has completed post secondary education or equivalent from three years prior
Lagged manufacturing value added	lagman	Total value added by manufacturing as a % of GDP from three years prior
Lagged percentage of the population living in rural areas	lagpop	% of total population who live in rural regions three years prior
Lagged Tax	lagtax	Dummy Variable that=1 if tax was preset three years prior, =0 otherwise
Lagged Cap	lagcap	Dummy Variable that=1 if cap was preset three years prior, =0 otherwise
Democracy Index	Dem	Dummy variable =0 if democracy ranking =9-10, =1 if ranking = 8-8.99….
Lagged coal rents	lagcoal	Coal rents as a % of GDP from two year prior

Sources: The World Bank 2016a; The World Bank 2016b: The World Bank 2015b; The Economist Intelligence Unit 2016; OECD 2015; OECD 2017; United Nations Framework Convention on Climate Change 2016a

Obamacare and the Burden of Medical Debt – Are Americans Better Off?

Liam Wicken

Abstract

Despite the misconception that American healthcare is privately-funded, nearly a third of Americans receive publicly-funded healthcare. The Affordable Care Act of 2010 (ACA), also known as Obamacare, was introduced to reduce exclusionary non-group health insurance practices, reform existing non-group health insurance regulations, and improve existing Medicare and Medicaid policies to improve access to care for Americans. The evidence shows that, while rates of uninsured Americans decreased, many groups saw increased health insurance premiums and a new health coverage gap emerged as state-level Medicaid regulations clashed with federal-level reforms. Overall, however, Obamacare did improve the financial health of Americans as related to medical costs, and will perhaps lower the likelihood of American citizens going into medically related bankruptcy in the future.

1.0 Background

The healthcare system in the United States is funded through a mix of private and publicly funded health insurance schemes. The *Dependent Medical Care Act of 1956* was the first large publicly funded health insurance program created, spurred by the need for comprehensive health insurance support for veterans and their families after World War II. Prior to Congress enacting Title XVII of the *Social Security Act* (also known as Medicare[1]) in 1965, it was found that only 56 percent of people aged 65 or older had health insurance, largely due to increased private insurance premiums as a result of poor health (Gornick et. al. 1996, 179-237). By 2010, publicly funded programs like Medicare and Medicaid[2] had grown to provide fully-funded or subsidized health insurance to 93.2 million Americans, around one third of the total population, with the bulk of health insurance still being provided privately through employer coverage and the individual ("non-group") insurance market (*see figure 1*) (Gruber 2011, 895).

Despite the efforts of these public programs, prior to the Affordable Care Act of 2010 (ACA), over 50 million Americans were left uninsured across the country (Gruber 2011, 895). In 2009, the US ranked third among Organisation of Economic Co-operation and Development (OECD) countries by proportion of uninsured individuals, and suffered the

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[1] *See Appendix 1*

[2] *See Appendix 2*

highest rates of 'significant' out of pocket healthcare costs among highly developed OECD countries (OECD, 2009). Including the high cost of insurance premiums for those with pre-existing conditions and the existence of practices such as lifetime coverage maximums in the private insurance industry, Americans suffer from high rates of medical bankruptcy and crippling debt from medically necessary procedures, something that is foreign to those living in single-payer health systems like that of Canada and the United Kingdom. Despite the increase in publicly provided insurance in the decades preceding the ACA, the financial burden on Americans related to medical debt had worsened in years leading up to it, with 62 percent of personal bankruptcies citing health expenses as the chief cause in 2007, up from 8 percent in 1981 (Himmelstein et. al. 2009, 741-746).

On a similar time scale, the magnitude of personal medical debt grew in the United States. From 2003 to 2007, the proportion of Americans experiencing difficulties paying medical debt rose to 19 percent from 15 percent (Herman, Rissi, and Woolhandler 2011). This increase reflected the prevalence of private insurance policies with excessively high deductibles and co-pays. Additionally, the nature of medical expenses as unexpected emergency events has led to medical debt in the US being pervasive regardless of insurance status. In fact, a 2011 study published in the American Journal of Public Health found no significant correlation between medical debt and insured/uninsured status among those surveyed in Arizona, after controlling for income level and health status (Herman, Rissi, and Woolhandler 2011).

While income level and health status are the largest determinants of medical debt, women and minorities are more likely to experience difficulty paying medical debt, according to a Kaiser Family Foundation survey and report (Liz Hamel et. al 2016). Thus, the current American health system falls short on equity in addition to general financial health. In reflection of these systemic problems, and with further exacerbation in the wake of the Great Recession, it was clear that significant health reform was needed in the US.

2.0 Obamacare

In 2006, Massachusetts introduced significant state-level healthcare reform after identifying affordability and access problems in healthcare. Dubbed "Romneycare" after then-governor Mitt Romney, the foundation of the Massachusetts reforms focused on the individual healthcare market, decreasing the level of uninsured individuals, and reducing overall healthcare costs (Gruber 2011, 897-898). Several years later, this model would be adapted and reapplied at the federal level as "Obamacare."

Obamacare, a commonly used term collectively for the Patient Protection and Affordable Care Act (ACA) of 2010 and the Healthcare Reconciliation and Education Act of 2010, is considered the largest overhaul of the American healthcare system since the introduction of Medicare and Medicaid in 1965 (Blumenthal, Abrams, and Nuzum 2015). While provisions of the acts focus mainly on the individual health insurance market, the Medicare, Medicaid and extensive employer-provided insurance frameworks were affected as well (Gruber 2011, 893). The "three-legged stool" framework of the ACA has the

following components, with the bulk of the changes coming into effect by 2014 (*see figure 2 for detail*):

I. Reform to the individual ("non-group") insurance market. This is also referred to as "marketplace" insurance.

II. Mandating that individuals not covered by Medicaid buy marketplace insurance, lest they pay a fine.[1]

III. Implementing subsidies for individuals with marketplace insurance to help cope with increased premiums, co-pays, and deductibles. These subsidies are funded in part by an expansion of Medicaid coverage and by new tax credits for low-income individuals.

In the individual insurance market, the ACA outlawed the practices of lifetime maximums on insurance coverage and coverage exclusions based on pre-existing conditions, with the hopes that these would allow greater insurance inclusion (Gruber 2011, 893). In the interest of equity, another ACA provision mandated that private insurers take only a patient's age and smoking status into account when calculating premiums, in contrast to the high cost variance and excessive segmentation of the existing individual insurance market (Gruber 2011, 893). To combat the existence of adverse selection, the individual shared responsibility provision in the ACA mandated individuals to purchase a certain amount of health insurance based on their household income, or else pay a fine (Gruber 2011, 896).

With the risk pool increasing as a result of this new mandated health insurance, and sicker and older individuals requiring coverage through the non-group insurance market reforms, it was abundantly clear that premiums would rise across the board. To offset these, Obamacare introduced expanded Medicaid coverage for those earning up to 138 percent of the federal poverty level[2], and subsidies through tax credits for individuals and families earning up to 400 percent of the federal poverty level (Gruber 2011, 896).

To fund these large expansions of coverage and premium subsidies, new Medicare payroll taxes were introduced, and a new capital gains tax introduced for those earning above $200,000 per year. In addition to this, reimbursements in "Medicare Advantage" programs that offered seemingly excessive coverage for seniors were cut back (Gruber 2011, 897).

Measures to address rising healthcare costs were also introduced. One such provision aimed at reducing excess demand for healthcare was the introduction of the "Cadillac Tax," an excise tax on insurance policies costing customers more than a certain amount per year.

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[1] *This leg of ACA was repealed in November 2017 by the **Tax Cuts and Jobs Act**, a move the CBO estimates will decrease federal deficits by $338 billion by 2027 but result in 13 million additional Americans without health insurance by 2027 and 10% increases in non-group insurance premiums over current projections. See* https://www.cbo.gov/system/files/115th-congress-2017-2018/costestimate/reconciliationrecommendationssfc.pdf *for more information.*

[2] *The 2017 Department of Health and Human Services poverty guidelines start at $12,060 for a one-person household, adding $4,180 per person. Hawaii and Alaska have different poverty guidelines. See* https://aspe.hhs.gov/poverty-guidelines *for further information.*

This worked to deter the consumption of excessively generous insurance policies, lowering overall demand for healthcare and thus lessening upward pressure on healthcare prices. In addition to this tax, health insurance markets or exchanges were encouraged by states to increase competition and the ability for consumers to 'shop around' for coverage. In contrast to this, the existing non-group insurance market suffered from high rates of segmentation and low availability, with small, diversified risk pools. To this end, Jonathan Gruber, one of the chief architects of both Romneycare and Obamacare, argued that the pre-ACA non-group insurance market didn't act as an insurance market due to excessive out-of-pocket costs (Gruber 2011, 895). To further reduce healthcare costs, Obamacare introduced measures to establish Independent Payment Advisory Boards to monitor and redesign Medicare reimbursement models (Obama 2016, 528).

Beyond these three main components of Obamacare, other provisions were made to address certain equity and healthcare access goals. For instance, coverage for services that provide contraception and screen for domestic or intrapersonal violence was increased for over 55 million women (Obama 2016, 528). It would seem that, at face value, Obamacare was a good start at tackling the affordability and access issues in American healthcare. Below, I will assess the outcomes and criticisms of Obamacare on these problems.

3.0 Results

Before generalizing the effects of Obamacare, it is important to look into the results of the state-level 2006 Massachusetts reforms. As a model for Obamacare, Gruber and others looked keenly into how premiums, rates of insured individuals, and healthcare costs would change post-Romneycare. It was found that the rates of uninsured individuals in the state dropped by 60 percent from 2006-2010, and that privately-provided insurance (both through employer coverage and the non-group market) as a proportion of insurance coverage actually increased to 76 percent from 70 percent over the same time span (Gruber 2011, 898). Although seemingly counterintuitive, the effects of significant private insurance reforms appear to have prevailed over increased Medicaid coverage, leading to increased usage of private insurance policies. The Congressional Budget Office notes that this may be due to increases in Medicaid coverage (up to 400 percent of the poverty line) still being far below the median income for those with employer coverage, thus the expansion doesn't eat into employer coverage in a significant way (Gruber 2011, 901). In addition to this, non-group insurance premiums decreased by 40 percent from 2006-9, while the same premiums increased by 16 percent over the same time period in the rest of the country (Gruber 2011, 899). Overall, the results of the Massachusetts experiment were promising enough that Gruber was brought on board to help adapt Romneycare to the national scale.

Generally, since the introduction of Obamacare, the US has seen a reduction in the number of uninsured people (CBO 2016). Estimates of that reduction range from 7 to 20 million people, with 2.3 million additional young people (younger than 26 years old) covered (Council of Economic Advisors 2016). Of those newly covered, roughly half benefit from increased Medicaid coverage, with the other half benefitting from favourable

non-group insurance market reforms (Blumenthal et. al. 2015, 2452). Additionally, uninsured rates dropped across all races, age groups, and income groups, *(see figures 3-5)* with women and minorities making the largest gains in coverage (CEA 2016, Carrasquillo and Mueller 2018, 8.3). Additionally, the ACA is responsible for a positive change in after-tax income of 25% for those in the bottom 10 percent of earners, and a net income change of 5 percent across the second quintile of earners, indicating its use as a social welfare policy in addition to a social insurance policy (Carraquillo and Mueller 2018, 8.3).

Despite this, opposition has been raised about increased premiums across all but the lowest payment plans, in addition to co-payment and deductible costs that have risen quite sharply since the ACA was enacted (Johnson 2016). This was partially anticipated, especially considering that states that adopted ACA-style non-group insurance market reforms in the 1990s comprised some of the highest premiums in the country pre-ACA. However, in the Massachusetts example, premiums actually *decreased* due to higher government subsidies and more robust non-group and employer-provided insurance regulation. The opposite effect seems to have taken place post-ACA. Gruber (2011) suggests that small reductions in non-group policy premiums post-ACA (14-20 percent) were offset by consumers purchasing more generous individual policies, leading to higher average premiums. In this sense, while premiums increased, individuals obtained greater coverage and consequently greater healthcare utilization, and thus the effects of these premiums on the general financial stability of Americans may be unclear, since they are receiving greater healthcare coverage for higher price.

One negative consequence of higher out-of-pocket costs however is the exacerbation of the so-called "coverage gap" in uninsured Americans post-ACA. Some segment of the population eligible for non-group insurance assistance (estimated as high as 50 percent) remains uninsured in 2017 due to excessive and prohibitive out of pocket costs (Carrasquillo and Mueller 2018, 8.5). These people earn too much to be eligible for Medicaid (or live in states that have opted not to expand Medicaid to higher income levels) but earn too little to afford even subsidized non-group insurance with high out-of-pocket costs and thus choose to pay the fine rather than buy coverage. This phenomenon results in an uninsured segment of the population that even Obamacare will fail to allow coverage for, something that was noticed in the Massachusetts example, where uninsured rates steadied around 5.5 percent post-Romneycare (Himmelstein et. al. 2009, 224). Another factor in rates of uninsured individuals is the difficulty Obamacare has had in implementing the Medicaid expansion nationwide. For political reasons, 19 states currently have yet to adopt the increase in Medicaid coverage mandated by Obamacare, leaving significant groups without coverage in states with some of the highest populations of poverty or near-poverty level individuals (Obama 2016, 528). This opposition is twofold: those who believe mandating increases in state-level healthcare spending is an overreach of the federal government's power, and those who ideologically oppose raising taxes on wealthy people (such as the increase in payroll tax or the implementation of the "Cadillac Tax") to increase coverage for the poor (Carrasquillo and Mueller 2018, 8.3-8.4). Whether or not the 19 states without the coverage expansion will adopt it in the future remains to be seen.

With regards to the general financial health of the American public, Obamacare seems to have had positive effects. Inequality of insurance coverage, both among income and racial groups has decreased, although gaps do still exist (CEA 2016). Furthermore, medical-related financial well-being among low and middle-income Americans has improved through improved access to care, financial security, and health outcomes (CEA 2016). Despite these improvements, the existence of an insurance coverage gap among not the lowest earners but those in lower-middle income brackets has had an unclear effect on medical bankruptcies. While the number of medically-related bankruptcies decreased in the short-run following Obamacare's introduction, the effect on long-run medical bankruptcy rates is inconclusive. One reason for this is the time lag between increased insurance coverage and the creation of the "coverage gap" explained above (Himmelstein et. al. 2009, 228). While rates of medical bankruptcy have not changed significantly in Massachusetts post-Romneycare (Himmelstein et. al. 2009, 228), several factors may lead to lower medical bankruptcy rates in the long-run across the country.

First, the rate of increases in healthcare costs and insurance premiums has decreased to its lowest point in 40 years (Obama 2016, 528). This has led to slowdowns both in out-of-pocket and Medicare healthcare expense increases, slowing expense increases for both the federal government and individuals (Obama 2016, 528). As a result, the Congressional Budget Office estimates total deficit reductions of $253 billion for the period of 2016-2025, and further reductions estimated at $3.5 trillion for the period of 2026-2035. With slowing healthcare expense growth, individuals will be burdened with lower growth rates of healthcare-related debt, possibly leading to lower rates of medical bankruptcy.

Second, improvements in healthcare delivery systems and reimbursement schemes mean that American hospitals are incentivized to hold physicians and other healthcare providers more accountable for efficiency and outcomes (Obama 2016, 529). This is projected to result in more efficient hospital spending, lowering the likelihood that patients are over-treated and overbilled for their conditions.

While significant progress has been made to address systemic issues in the American health system, there still exist serious and widespread equity problems. One widespread criticism of Obamacare, particularly from progressive critics, is the lack of coverage for almost 9 million undocumented immigrants, a compromise Democrats had to make in order to pass Obamacare through the Republican-majority house (Carrasquillo and Mueller 2018, 8.6). In addition to this, Medicaid remains unpopular and disliked among both the American public and healthcare providers, where Medicaid claimants are more likely to be turned away and refused service (Carrasquillo and Mueller 2018, 8.6). This leads to a lower quality of healthcare for those with Medicaid than those with private insurance or Medicare. If one assumes that a universal, cost-contained, and equitable health system is the goal of health policy, then it is clear that Obamacare was a band-aid solution to deep systemic problems, and in this sense it did not go far enough to ensure quality care to every American, regardless of their ability to pay.

In addition to this, difficulties repaying medical debt are still pervasive in the US. More than a quarter of Americans have said they or someone in their household are still having difficulties managing medical debt, according to a study from the Kaiser Family Foundation in 2016 (Hamel et. al. 2016). While low income and uninsured individuals are most susceptible to catastrophic medical expenditures, middle income and insured respondents also showed that they are struggling to repay medical debt (Hamel et. al. 2016).

However, overall, Obamacare did improve access to care through decreased rates of uninsured individuals across all demographic segments, improved the financial health of Americans as related to medical costs, and will perhaps lower the likelihood of American citizens going into medically related bankruptcy in the future. There is still a long way to go in establishing a health system in the US on par with the universal, single-payer systems of the United Kingdom or even Canada, but Obamacare is a step in the right direction.

4.0 Figures

Sources of Health Insurance Coverage in the United States, 2009

	People (Millions)	Percentage of Population
Total Population	304.3	100
Private	194.5	63.9
Employment-based	169.7	55.8
Direct purchase	27.2	8.9
Public	93.2	30.6
Medicare	43.4	14.3
Medicaid	47.8	15.7
Uninsured	50.6	16.7

Figure 1: Sources of Health Insurance Coverage in the United States, 2009. Retrieved from Gruber, Jonathan. "The Impacts of the Affordable Care Act: How Reasonable are the Projections?" National Tax Journal 64, no. 3 (2011). 895

Key Provisions of ACA Coverage Expansions Taking Effect in 2014.		
Provision and Policy Details	**Policy Questions**	**Estimated Effects in 2014**
Medicaid expansion		
Expanded eligibility to adults 19–64 yr of age with incomes below 138% of federal poverty level (FPL) — in states choosing to expand Streamlined application process and increased public awareness for adults and children eligible for Medicaid under pre-ACA standards	What percentage of newly eligible adults will sign up? Will enrollment among previously eligible adults and children also increase ("woodwork," or "welcome mat," effect)? Will Medicaid replace private insurance coverage for many beneficiaries?	44% of coverage gains due to enrollment of previously eligible adults and children, including the 2011–2013 early Medicaid expansions 19% of coverage gains due to enrollment of adults who became newly eligible in 2014 Enhanced enrollment in six early-expansion states No significant reduction in private coverage as a result of Medicaid expansion
Premium subsidies for exchange coverage		
Tax credits to subsidize the purchase of private insurance from state or federal health insurance exchanges Subsidy amount is tied to income and available to persons who aren't Medicaid-eligible and have income between 100% and 400% of FPL	How effective will premium subsidies be at inducing enrollment? Will participation vary with state policies regarding the exchanges?	37% of coverage gains due to premium subsidies Subsidies nearly twice as effective at increasing coverage in states with state insurance exchanges as in those using federal exchange
Individual mandate		
Individuals lacking health insurance must pay a tax penalty when filing federal income taxes In 2014, the penalty was equal to $95 per person or 1% of taxable income, whichever was greater, but this increased to $695 or 2.5% of taxable income by 2016 Some individuals are exempt because they have very low incomes, their state hasn't expanded Medicaid, they belong to a federally recognized Native American tribe, or they have no affordable coverage options	Will individuals and families be aware of the mandate details in a way that affects their insurance behavior? Will there be a more general effect of the mandate on insurance coverage rates? Will the effect of the mandate increase over time as the financial penalty for lacking coverage grows?	No significant effect of mandate details on coverage in 2014 A more general effect of the mandate to boost enrollment is still possible

Figure 2: Detailed Key Provisions of ACA Taking Effect in 2014. Retrieved from Molly Frean, B.A., Jonathan Gruber, Ph.D., and Benjamin D. Sommers, M.D., Ph.D.
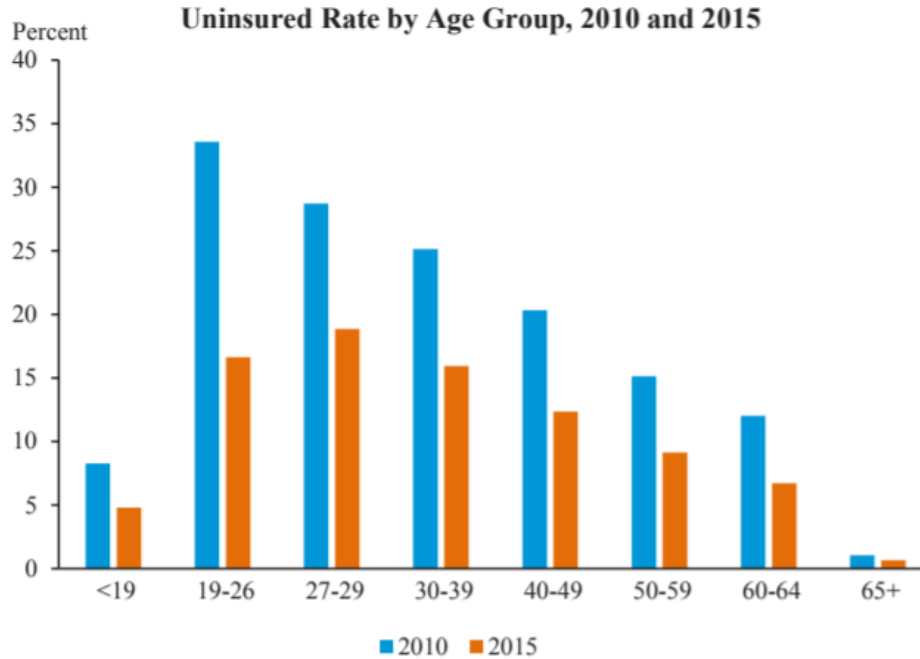N Engl J Med 2016; 375:1605-1608. DOI: 10.1056/NEJMp1609016

Uninsured Rate by Age Group, 2010 and 2015

Percent

■ 2010　■ 2015

Figure 3: Uninsured rates among age groups, 2010-2015. Retrieved from the 2017 Economic Report to the President, 167.

Uninsured Rate by Race, 2010 and 2015
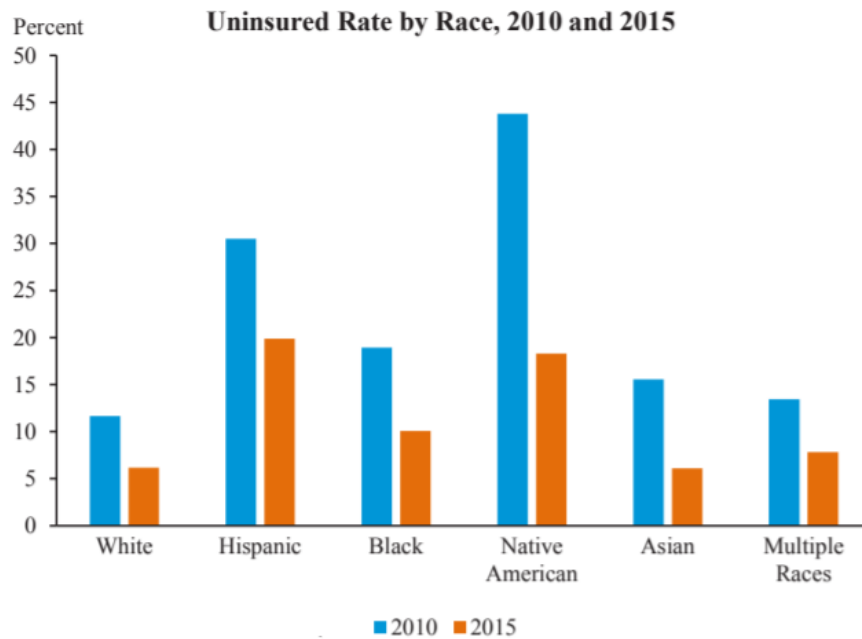
Percent

■ 2010　■ 2015

Figure 4: Uninsured rates among racial groups, 2010-2015. Retrieved from the 2017 Economic Report to the President, 168.
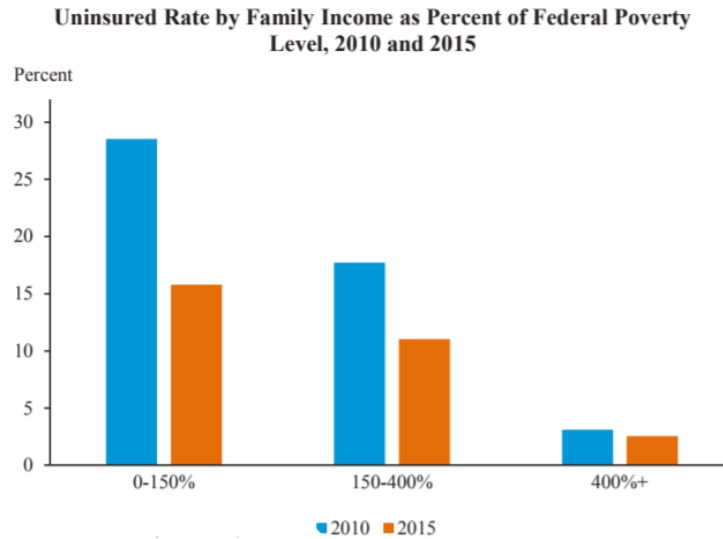
Figure 5: Uninsured rates across income groups, 2010-2015. Retrieved from the 2017 Economic Report to the President, 168.

Appendices

Appendix 1: Medicare Definition

Medicare is a US single-payer federal government-funded health insurance program created in 1965 for people aged 65 or older, people aged under 65 with disability status as determined by the Social Security administration, and people with end-stage renal disease (kidney failure).[1] Unlike Medicaid, Medicare is entirely federally funded through the Centers for Medicaid and Medicare Services (CMS), an agency of the US Department of Health and Human Services. The program consists of three components: Part A, hospital insurance that is generally covered by workers' payroll taxes; Part B, general medical insurance which is covered by monthly insurance premiums; and prescription drug coverage that is covered by monthly insurance premiums similarly to Part B.[2]

Appendix 2: Medicaid definition.

Medicaid is a US social healthcare program created in 1965 that provides government-funded health insurance to low-income individuals and families.[3] Medicaid is partially administered through CMS, working in tandem with state-level administrators.[4] Unlike Medicare which is considered a social insurance program, Medicaid is considered a social welfare program.

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[1] https://www.cms.gov/Medicare/Medicare-General-Information/MedicareGenInfo/index.html

[2] Ibid.

[3] https://www.medicaid.gov/affordable-care-act/index.html

[4] https://www.cms.gov/Medicare/Medicare-General-Information/MedicareGenInfo/index.html

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The Effects of Electoral Systems on Corruption: Why Plurality Rule Produces Less Corruption than Proportional Representation

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Abstract

This paper contributes to the literature analyzing the determinants of corruption by investigating the linkages between a country's corruption level and its electoral system. Specifically, countries with Plurality Rule and Proportional Representation voting systems are compared, seeking to analyze how features of both affect measured rates of corruption. It is concluded that, on balance, Plurality Rule systems tend to outperform Proportional Representation systems at reducing corruption. Drawing from the relevant literature, three reasons for this are suggested: first, electing representatives directly rather than by party list increases a candidate's accountability to voters; second, Plurality Rule systems are structurally associated with fewer political parties leading opposition parties acting as more effective checks and balances against incumbents; and third, Plurality Rule increases incentives for party self-discipline. Despite this, one feature of Proportional Representation systems - namely, the tendency to feature multi-member districts - does contribute to reducing corruption, all else equal. Policy recommendations are investigated following from the conclusions of the study.

1.0 Introduction

Many studies over the past two decades (Mauro 1995; Svensson 2005) have suggested that corruption has substantial negative economic and political effects on countries. Consequently, a growing body of literature within political economy has attempted to narrow down its determinants. At the same time, many researchers have also attempted to analyze the effect that a democracy's electoral system has on the country. This paper is situated at the intersection of these two areas of research: examining the effects that electoral systems – Plurality Rule or Proportional Representation (PR) being the two main variations – have on corruption levels. There are many intuitive reasons to believe that a country's election system could influence its levels of political corruption; voting is a mechanism by which citizens hold corrupt politicians accountable, and electoral systems affect the incentives of politicians as well as of voters and opposition parties. In this paper, relevant theoretical and empirical research seeking to specify how this occurs is investigated.

With this motivation in mind, this paper argues that on balance, Plurality Rule systems outperform Proportional Representation systems at reducing corruption for three reasons: electing representatives directly rather than by party list increases politicians' accountability to voters; fewer political parties in Plurality Rule systems facilitate

opposition parties acting as further checks and balances on incumbents; and Plurality Rule increases incentives for party self-discipline. Despite this, it is concluded that one particular attribute of PR systems – namely, the tendency to feature multi-member districts – does have corruption-reducing properties despite the fact that PR is more corrupt on the whole.

In making this argument, the paper will proceed as follows: first, the definition of corruption and the resolution of several key issues concerning its measurement will be discussed. Second, the theoretical reasons why a link between electoral systems and corruption might exist will be examined. Next, relevant contributions to the empirical literature on the subject will be studied, arguing that on balance Plurality Rule tends to be less associated with corruption than PR. Specific focus will be on initial papers by Myerson (1993) and Lederman et al. (2005) who suggest that PR is less corrupt, followed by subsequent work by Persson and Tabellini (2003) and Kunikova and Rose-Ackerman (2005) who come to the opposite (and better-supported) conclusion. Finally, what policy recommendations might follow from such a conclusion will be reviewed, as will several important caveats to these findings.

2.0 Corruption: Definitional and Measurement Issues

Before examining the relationship between electoral systems and corruption, it is important to clarify what exactly is meant by corruption and how it is measured. While typically defined as the "misuse of public office for private financial gain by an elected official",[1] there are several issues which make it unclear what this definition refers to precisely. First, countries have different cultural and legal contexts which creates a problem in a universal definition of 'misuse'. For example, citizens across geographies may have divergent expectations of their politicians; an action considered corruption in one country could simply be called 'gift-giving' elsewhere. Second, because of its illegal nature, participants in corruption have incentives to keep it secret, making accurate measurement an ongoing challenge. Indeed, the only 'official' measurement of corruption available is the number of cases that are successfully reported, tried and convicted, but many argue that this statistic is a better measurement of the effectiveness of a country's judicial system than of its corruption levels (Chang and Golden 2007). As a result, current academic consensus suggests that the best available proxy for measuring corruption are surveys of perception of corruption, usually by business people, risk analysts, journalists and the general public (Persson, Tabellini and Trebbi 2003). In theory, perception surveys should account for country-specific cultural and legal contexts, since residents of a given country evaluate corruption levels based on local norms. Therefore, all studies subsequently referred to in this paper depend on this form of measurement, and generally focus on events such as kickbacks in public procurement, embezzlement of public funds and bribery of public officials.

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[1] Tanzi, V. (198). "Corruption Around the World: Causes, Consequences, Scope and Cures", *IMF Staff Papers*, 45(4), pp. 559-594.

3.0 The Relationship between Electoral System Type and Corruption

Thus far, much is known about the causes of corruption. Specifically, countries which are richer, more open to trade, located in the Organization for Economic Co-operation an Development (OECD), former British colonies and better educated are less likely to be corrupt (Treisman 2000). However, as Persson and Tabellini (2003) argue, even after accounting for those factors there remain examples of countries that exhibit similar characteristics but nonetheless differ wildly in corruption. For instance, Latvia and Estonia share common characteristics geographically, economically and historically, however Estonia is far less corrupt (Persson, Tabellini and Trebbi 2003). In many such cases, researchers have shown that one factor that may provide further insight is how these countries conduct elections – Estonia uses an Open-List Proportional Representation system while Latvia uses Closed-List PR. With this in mind, the following section examines the theoretical motivations for why there may be a link between such electoral systems and corruption levels.

One of the main functions of an electoral system is to allow voters to hold incumbent politicians accountable for their performance while in office. Kunikova and Rose-Ackerman (2005) conceive of the relationship between politicians and voters as a principal-agent problem. In this framework, politicians are elected to act as agents on behalf of citizens and are expected to consider principal interests when making decisions in office. It is often easy for politicians to deviate from this duty, but democratic mechanisms are expected to check and balance against this possibility. In this context, corruption is considered a deviation from a politician's duty as an agent, but is typically corrected for by an electorate's ability to vote a corrupt politician out of office. Therefore, there exists a clear link between an electoral system (the mechanism by which voting occurs) and corruption (a deviant action which rational voters punish). An ideal electoral system is one that causes corrupt politicians to be consistently and quickly voted out of office. It is then worth asking whether Plurality Rule systems or PR systems differ in their ability to meet this criteria.

Three important assumptions of this framework merit further discussion. First, it relies on voters being aware of corruption. Clearly, if corruption exists undetected, then voters are unable to factor it into their voting decision. However, most reputable studies of corruption rely on reporting by business people, journalists and the general public, which implies that on average, people know if corruption is going on – this will be a general assumption made in this paper. That being said, certain electoral systems may actually increase the probability that corruption is detected, a phenomenon that is discussed later. Secondly, this framework conceptualizes undetected corruption as an unambiguous material gain to a politician, as politicians who engage in corruption generally do not expect to be caught (Chang and Golden 2007). The relevant trade-off politicians face is choosing between the gains from corrupt actions and the potential harm to his/her re-election chances. Finally, it is assumed that the average voter does not like corruption, and would punish it accordingly at the polls. Even though it is clearly possible that certain citizens benefit from corrupt politicians (e.g. if a construction project is awarded corruptly to an individual's neighbourhood), it seems reasonable that in aggregate, the public is harmed by it and finds it distasteful.

4.0 Comparing the Effects of Plurality Rule and Proportional Representation

Having established the theoretical mechanism by which electoral systems affect corruption, it is now possible to freely refer to the two electoral systems most frequently employed in democracies throughout the world: Plurality Rule, where the sole winner of an election is simply the one who obtains a plurality of the votes, and Proportional Representation, where seats are allocated proportionately to the split within the district's electorate. To begin, Myerson (1993) was the first researcher to ask how a country's adoption of one of these two systems affects its level of corruption. His work, while purely theoretical and based on a game-theoretic voting model, finds that PR is more resistant to corruption than Plurality Rule. He notes that PR takes place within an entire country, and thus has high district magnitude,[1] whereas Plurality Rule features a winner-take-all system where only one representative is elected per district. For this reason, there tend to be more candidates to choose from in PR, and it is easier for a voter to switch their vote to another ideologically similar candidate if their preferred candidate is corrupted. Instead, in Plurality Rule, since there are generally fewer options, such a switch is more difficult while maintaining ideological alignment. In the event that many voters consider a candidate's policies more important than their history of corruption, voters would be less likely to vote out corrupt candidates than in PR. Plurality Rule often creates incentives to vote strategically so as not to waste one's vote, which in some cases could mean supporting a corrupt candidate. Thus, on the basis of district magnitude, Myerson argues that PR reduces corruption to a greater extent than Plurality Rule.

In addition, Lederman et al. (2005) hypothesizes that another feature of PR, namely the usage of closed party lists to send representatives to the legislature, is also useful in fighting corruption. Specifically, because the electoral fortunes of a political party depend on the public's perception of it rather than perceptions of individual candidates as in Plurality Rule, parties have an incentive to police their members closely. Otherwise put, a party would not include a candidate on it list if there were concerns about his/her corruption, leading to increased party discipline and less corruption overall. Thus, the ballot structure of PR also makes it more likely to reduce corruption.

Despite arguments that PR is more resilient to corruption than Plurality Rule, further examination of how both systems work in practice suggests otherwise. As mentioned above, electoral systems are meant to allow voters to hold politicians accountable for their actions, and there are several reasons why PR does not allow for this. Firstly, the usage of a party list in PR creates a free-rider problem (Persson, Tabellini and Trebbi 2003). Politicians care only about the electoral performance of the entire list, not their personal performance, and may thus engage in corruption for personal gain with minimal downside by riding on the party's reputation or the clean slates of fellow list-members. Although Lederman's argument is that parties take actions to stop such problematic politicians from being included on the list in the first place, in practice parties are not always aware of

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[1] District magnitude refers to the number of representatives elected from a particular district. For example, in British-style First-Past-the-Post, district magnitude is 1, whereas in Israel, which employs exclusively PR, district magnitude is equal to the total number of representatives in the single district, i.e. 120.

corruption, and also frequently include candidates on the list for reasons of party loyalty rather than individual appeal to voters (Persson, Tabellini and Trebbi 2003). In contrast, a Plurality Rule system creates a clear accountability link between a candidate's performance and their re-election, allowing voters to directly punish corrupt candidates. Second, Persson and Tabellini (2003) argue that party discipline in terms of candidate selection is actually greater in Plurality Rule, because of its focus on marginal 'Swing' districts where a tight race between two parties exists. Parties are particularly concerned with vetting and purging corrupt candidates from their ranks because getting (even slightly) fewer votes than the opposition in individual districts leads to the forfeiture of the entire seat. This provides strong refutation (or at least, cancelling out) of Lederman's argument that Proportional Representation leads to greater discipline. Third, while Myerson argues that the existence of many parties within PR lets voters switch away from a corrupt candidate without sacrificing ideological alignment, this does not necessarily allow a voter to directly 'punish' a corrupt politician, because it is unclear to whom one should switch their vote. There is usually a clear alternative option to a corrupt candidate because Plurality Rule generally features fewer parties. Thus, Plurality Rule is a better mechanism for allowing voters to hold corrupt politicians accountable.

Opposition parties also serve as important checks and balances on incumbent candidates, as it is often an opposition party that takes the initiative to unearth scandals in order to harm an opponent's chances (Kunicova and Rose-Ackerman 2005). Under PR, there are numerous reasons why opposition parties are less able to do so. First, because it is not winner-take-all, the benefits from unearthing corruption flow to all other parties rather than just the party who exposed the incumbent. In Plurality Rule, because individual districts often narrow to two-way races, there is typically a clearer alternative to the incumbent and this problem does not exist; the opposition party has an outsized incentive to unearth corruption, as they directly benefit from doing so. Second, PR is associated with a much higher probability of coalition governments. Consequently, opposition parties are faced with incentives to not harm the electoral chances of future coalition partners and to not induce other parties to have grudges against them. Thus, coalition incentives also decrease PR's ability to decrease corruption, but do not affect Plurality Rule systems as frequently.

On the basis that Plurality Rule makes it more likely that both voters and opposition parties hold incumbents accountable for corruption, Kunikova and Rose-Ackerman (2005) predict that PR systems tend to be more corrupt than Plurality Rule. Indeed, using a sample of 94 democracies from 1998, they find statistically significant evidence corroborating this theory. Interestingly, the magnitude of the effect of a dummy variable indicating Plurality Rule rather than PR is actually larger than other significant determinants of corruption as presented in previous studies, including level of economic development, suggesting that electoral systems are actually very important influences on corruption level. Overall, Kunikova and Rose-Ackerman's findings are more persuasive than Myerson's and Lederman's; they present theoretical refutation under the framework of voters and opposition parties acting as checks and balances on incumbents, and also provide actual empirical evidence rather than simply relying on theory as Myerson does. Thus, it seems clear that in practice, Plurality Rule is better at combatting corruption than PR.

To add nuance to this analysis, it is worth breaking down PR and Plurality Rule into two related but separate features: ballot structure, and district magnitude. Ballot structure refers to whether voters elect representatives directly or whether they elect politicians from party lists, whereas district magnitude refers to the number of politicians elected from an individual district. Clearly PR is typically associated with party lists and large district magnitude, whereas Plurality Rule is associated with direct elections and small district magnitude. Nevertheless, Persson and Tabellini (2003) hypothesize that when isolated, the two features may have opposite effects on corruption – namely, that using party lists tend to increase corruption (as Kunikova and Rose-Ackerman suggest) whereas higher district magnitude tends to decrease it (as Myerson suggests). Exploiting the fact that there exist some countries where the above relationship between ballot structure and district magnitude is not perfectly consistent (for example, pre-1994 Japan and Chile both use Plurality Rule with multi-member districts, and there are also many countries that combine different features of straight Plurality Rule and straight PR), they attempt to separately test these two effects. To do so, they collect measures of (1) the percentage of a country's legislators elected using party lists, and (2) a country's average district magnitude, and regress various measures of corruption on both variables separately. Using data from 1990-1998 from over 80 democracies, they find evidence corroborating both hypotheses: larger district magnitude is associated with lower corruption, while larger shares of candidates elected using party lists is associated with higher corruption. For this reason, while Persson and Tabellini (2003) corroborate Kunikova and Rose-Ackerman's findings that Plurality Rule systems as a whole generally decrease corruption better than PR, they find that this is in spite of the fact that Plurality Rule generally has very small district magnitude. Thus, their study reconciles the arguments presented by Myerson and those presented by Kunikova and Rose-Ackerman – district magnitude on its own does have a decreasing effect on corruption, but is overcome by the corruption-increasing effects of party lists in the real world when the entire systems is considered.

Persson's findings are particularly useful because they provide explanations for a number of real-world examples where otherwise similar countries differ in corruption levels. For example, Chile uses Plurality Rule whereas Argentina uses closed-list PR – this helps explain why Argentina exhibits significantly more corruption despite being historically and economically similar to Chile. Estonia also uses Open-List Proportional Representation, meaning that although the system is PR, voters are able to indicate their preference for certain candidates on the list over others, thus providing the accountability link that Closed-List PR lacks. This could explain why Estonia is significantly less corrupt then neighbouring Latvia which uses PR. In both the cases of Estonia and Chile, Persson's model explains a significant part of the corruption gap.

The unfortunate counterpart of Persson's findings is the limits on potential policy actions to reduce corruption. There exists an offsetting effect where Plurality Rule's benefits of direct accountability are balanced off by a reduction in average district magnitude because PR tends to combine large district magnitude with party lists, while plurality systems usually combine small districts with individual elections (Persson, Tabellini and Trebbi 2003). Indeed, it seems unlikely that any real-world democracy would consider moving to a multi-member district system with direct elections, which seems to be Persson's ideal. A country clearly considers many factors other than its level of

corruption when setting up electoral rules, and countries will rarely engage in the arduous process of electoral reform simply to reduce corruption (although this was a significant factor in Japan and Italy's electoral reforms in the 1990s) (Persson, Tabellini and Trebbi 2003). Nonetheless, it is still useful to recognize what particular features of both types of electoral system are allowing or preventing corruption from occurring.

A major additional caveat to this conclusion is necessary. In what has become known as Duverger's Law, Maurice Duverger (1972) argues that Plurality Rule systems tend towards having just two major political parties whereas PR tends to encourage a multiplicity of parties. Based on this, Charron (2011) points out that a number of the supposed benefits of Plurality Rule systems in reducing corruption may simply stem from the fact that they generally feature fewer parties. For example, when Kunikova and Rose-Ackerman argue that an opposition party with a credible chance of seizing power is likely to moderate its opponent's behaviour through the threat of unearthing corruption, this is a benefit stemming from a two-party system rather than from Plurality Rule in general. Indeed, by regressing corruption on the number of political parties in a subset of Plurality Rule democracies, Charron finds that the number of parties is positively associated with corruption (the number of political parties made no difference on the subset of only PR democracies). This is not to say that Plurality Rule on its own does not also play a role in reducing corruption, since other benefits, such as individual candidate accountability, exist in Plurality Rule irrespective of the number of political parties. It merely suggests that a significant part of the benefits of Plurality Rule, namely the ability of opposition parties to check and balance incumbents, is dependent on Plurality Rule's tendency to produce fewer parties as per Duverger's Law. For example, countries like Canada, Great Britain and India, which are Plurality Rule systems with more than two major political parties, may not be experiencing the full corruption-decreasing effects that hold in general for more typical two-party Plurality Rule systems. Overall, this caveat also demonstrates the importance of being attentive to whether observed changes in corruption actually result directly from the electoral system, or whether the change is simply being caused by other variables correlated with the electoral system such as the number of political parties.

The distinction between Open-List PR (OLPR) and Closed-List PR (CLPR) merits further analysis. From the above discussion, it would be easy to conclude that OLPR systems, in which voters get to express preferences between candidates within a list, are better at reducing corruption than CLPR because they provide the crucial direct accountability link between performance and re-election discussed above. Indeed, Persson and Tabellini (2003) test OLPR and CLPR systems against one another and find that in general, OLPR is better at reducing corruption than CLPR. However, as Chang and Golden (2007) point out, this link does not necessarily hold as district magnitude becomes large. They begin by acknowledging that corruption is a way for candidates to illegally amass resources which can be funneled back into their campaigns in order to increase their chances of winning. Additionally, in OLPR, there exists intraparty competition, as candidates are vying to be chosen by voters within their party, which requires more funds than CLPR in which one competes only against other parties. As district magnitude increases in an OLPR system, one competes against more candidates and thus has a greater incentive to amass resources, including doing so illegally through corruption. Specifically, Chang and Golden mention the importance of 'name recognition' in intraparty races; large

fields provides an incentive to distinguish oneself from other candidates, which is a costly endeavour. On this basis, they hypothesize that contrary to Persson and Tabellini (2003), OLPR systems may actually be worse than CLPR at corruption reduction in cases of large district magnitude. Indeed, upon an examination of data from over 40 democracies with PR, they conclude that in cases of OLPR, greater district magnitude makes it more likely that corruption will occur. Specifically, when the number of representatives elected from a particular district is greater than 15, OLPR becomes statistically significantly more corrupt than CLPR.

This finding adds to an understanding of the interplay between electoral systems and corruption in two ways. First, the corruption-reducing effect of large district magnitude found by Persson and Tabellini (2003) is shown to work only in cases of CLPR, not OLPR. Second, an actual policy recommendation follows: for countries which plan to use OLPR, corruption can be significantly reduced by keeping district small in order to discourage aggressive intraparty competition.

5.0 Conclusion

In summary, it has been argued that Plurality Rule systems are on balance more likely to decrease corruption than PR systems. Plurality Rule provides direct electoral accountability links for voters to oust corrupt candidates whereas party lists do not; Plurality Rule creates substantial incentives for party self-discipline because of the prominence of 'Swing' Districts; and Plurality Rule tends to be associated with a smaller number of political parties, which encourages opposition parties to provide crucial checks and balances on incumbents. Despite this result, district magnitude, which is high in PR and low in Plurality Rule, tends to reduce corruption, and is thus the one feature for which PR performs better than Plurality Rule. Overall, it has been demonstrated that a country's electoral system is a variable worth consideration as a significant determinant of political corruption.

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