# An Assessment of Oil and Gas Royalty Rates in Alberta,

# 2007-2012

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**May 10, 2013**

## INTRODUCTION

This study builds on the work of nineteenth Century economist Henry George, who wrote extensively on the distribution of wealth and the importance of taxes on land and factors related to the value of land like natural resources. In particular in his book Progress and Poverty he proposed a single tax on land values, to impose the burden of taxes onto owners of land rather than on labour and capital; he believed that in this way wages and earnings of capital would rise, leading to the reduction in poverty, but also of economic crises.

Following Henry George's idea that taxes imposed on capital can be a disincentive to investment decisions we made an analysis to estimate the effects of the increase in royalty rates on bonus bids in Alberta for the period 2007 to 2012. A difference-in-difference approach is used to compare the pattern of winning bonus bids in Alberta, where higher royalty rates were introduced between 2007 and 2010, and British Columbia, which is a province without changes in royalty rates during the same period[1]. The results reinforce the argument made by Henry George, because royalties can potentially have the same effect of disincentive investment decisions, as they are imposing taxes on the production process. We found that during the period of higher royalty rates there was a negative effect in Alberta which reduced the value of the bonus bids in the province, implying that royalty rates have a distortionary effect on investment and exploration decisions in the oil and gas industry.

This study follows the methodology of Busby et al. (2011). However, this analysis differs from Busby essentially in the following: a) Busby considered for the difference-in difference estimation three provinces: Alberta, British Columbia and Saskatchewan, while this study just

[1] Also, note that British Columbia and Alberta are adjacent provinces, and this situation provides the suitable conditions to make the comparison feasible as we will explain in section 3.

focuses in the first two; b) the period of study for Busby is 2003 to 2010, whereas this analysis is from 2007 to 2012, and; c) our study use a different methodology to determine whether or not a parcel where a bonus bid is submitted is close to the border or not, since we are considering a closer area to the border, so that the pattern of investment that we are comparing in both provinces would be more evenly distributed, as it is explained is Section 3.

The Government of Alberta collects revenues from the oil and gas industry[2] through a rent-based Royalty system, bonus bids and rental fees. In addition, corporate income tax and local municipal taxes are paid by the energy firms. In particular, the main system for generating government revenues from the oil and gas sector consists of: a) the bonus bid system, which is the public offering of petroleum and natural gas resources owned by the people of Alberta, through government auctions of the right to explore, develop and extract the depleting resources, and; b) royalties levied based on the value of production.

The Government of Alberta has made changes to this Royalty system since the generic system was initially introduced in 1997[3], in an attempt to increase government revenues without distorting exploration and investment incentives. Currently, the Royalty system includes different categories and classifications, so that we can distinguish, among other aspects, among the Royalty rates imposed on conventional oil, natural gas and oil sands. The royalty rate for each one of these categories is determined by specific characteristics, such as the type and volume produced and a factor that reflects the average Alberta market price.

Assessment of the Royalty system has become an important issue recently, since continued fluctuations of the energy prices in recent years have caused losses in the amount of

[2] This is an important source of revenues since Canada is the third-largest producer of natural gas and sixth largest producer of crude oil in the world (Canadian Association of Petroleum Producers).
[3] Before 1997, each individual oil sands project negotiated the royalties with the Government of Alberta. (Plourde, 2009, p 115).

revenues collected by the province, compared to anticipated revenue. There are different factors that have contributed to lower the benchmark indexes that serves as references to calculate the royalties imposed, like the West Texas Intermediate (WTI). These factors also include, but are not limited to, pipeline shutdowns, refinery outages and pipeline constraints. These have affected the net corporate operating surplus, which is estimated to fall by 6.6.% in 2012[4]. The effects on the provincial budget are considerable, as the revenues related to the non-renewal resources account for 28% of the total revenue[5] (see Chart A-1 in Appendix A). Likewise, as a consequence of the decline in energy prices, 2012-13 resource revenues were forecast to be $4.1 billion lower than was initially expected. Similarly a decrease of $6.2 billion in 2013-14 revenue was estimated to occur, the changes in the collection of royalties revenues can be observed in Chart A-2 (Appendix A). [6]

This situation appeared to be more striking when the provincial government increased royalties on oil and gas production in 2007, making them more sensitive to energy price movements. Nonetheless, in 2010, the government decided to decrease the higher royalties that have been imposed, due to declining prices of oil in the previous years (2009 and 2008, see chart A-3 in Appendix A), and also because of the concern that companies were relocating to other provinces and shutting down local operations due to the higher royalties.[7]

It is interesting to note that the Royalty system is rent-based, and under this structure current operating and capital costs can be deductible from revenues; most oil-producing countries have adopted this type of regime. In contrast, a revenue-based regime for royalties is levied on gross production or revenue, and does not allow deduction for costs; this system will

[4] Alberta Treasury Board and Finance, Economic Outlook, Fiscal Plan, 2013-16, p 84-85.
[5] Alberta Treasury Board and Finance, Economic Outlook, Fiscal Plan 2012-15, p 52.
[6] Overview. Fiscal Plan 2013-16 p 4.
[7] Busby et al. (2011) p 1.

be suitable whenever a government does not have enough information about costs. However, the latter system is distortionary and can reduce investment and production.[8] Governments usually have available information regarding costs, since they can audit the financial data of the oil companies, hence a rent-based royalty system can be implemented, as is the case of Alberta.

In Section 1 we briefly review some of the literature regarding this topic and the previous results that were obtained in similar analyses; in Section 2 we describe the characteristics of the data that was used for the estimation, as well as its sources; the third section explain the methodology of the estimation method, the tests and corrections that were undertaken; Section 4 contains the results and the related economic analysis; finally we present our conclusions, which essentially support those of Busby et al.

## 1. LITERATURE REVIEW

In his book Progress and Poverty, Henry George considers that the wealth of a society is obtained from wages, which are the product of labour, interests, which are the returns for the use of capital, and rents, that are the return for the use of land. A government collects revenues when imposing taxes to the accumulated wealth (wages, interests and rent). However, George argued that this taxation system was not optimal for the society. George considered that landowners speculated with the value of the land and accumulate wealth without providing any service to the community, while at the same time they were an obstacle for those who did not have access to land and this situation lead to poverty.

[8] Mintz, Jack, Chen, Duanjie (2012) p 3 and 6.

Then, George proposed a single tax on land, but just on its unimproved value, because he argued that taxes falling on land improvements will discourage the use of that land for production, implying a disincentive to investment. In contrast a land tax, as he proposed, will be absorbed by the landowner, without causing that the amount of land diminish, and since land is immobile the landowner cannot take it to another region, therefore this tax will not distort incentives nor reduce the efficiency use of land. He also believed that this single tax will increase wages and earnings of capital; while at the same time will avoid economic crises by a more equitable redistribution of wealth.

For the methodology of this study we followed the analysis of Busby et al. (2011) that used a difference-in-difference approach to evaluate the effect of changes in oil and gas royalty rates on winning bonus bids that are, in theory, a function of the expected net present value of oil and gas deposits estimated by companies. They assume that "bonus bids reflect the net present value, over and above profits at a minimum rate of return and royalties paid, that producers expect to earn from the property"[9]. Increased royalties decrease firm's profit by reducing the net price that the firm get from an extra unit of production. In their model royalties will decrease the quantity of resource that is produced, and the decrement in bonus bid will be higher than the increment in the revenue collected from the royalty rate increase; they refer this as the "overcompensation" effect. [10]

For their analysis they compared resources bonus bids in Alberta, British Columbia and Saskatchewan to isolate Alberta's royalty rate increase from other factors that could have affected companies' bonus-bid decisions. They assume that even though, the three provinces have different types of natural resources and tax structures, most of these differences stay fixed

[9] Busby et al. (2011) p 8.
[10] Ibid.

over time. For the estimation, they used data on oil and gas licences and leases auctioned in Alberta, British Columbia and Saskatchewan from the period: January 1, 2003 to September 2010. The conclusion of the paper was that higher royalty rates distort investment decisions, and will lead to a decrease in the bonus bids from new developments.[11]

Another study on this topic is Plourde (2010), where he estimated the effects of changes in royalties and taxes on the distribution of cost and price risk between developers/producers and governments/owners. In this analysis, Plourde used simulation models to estimate the level and distribution of the net present value, and then he combined these results with a series of changes in revenue and expenditure factors to estimate the distribution of those changes. This analysis was done separately for the Governments of Canada and Alberta.

Some interesting results from that study were that the producers bear a higher share of risk related to the changes in revenue and expenditure factors compared to the share of net returns; while, the opposite is true for the government, at both the federal and provincial levels: each bear a lower share of risk.[12]

On the other hand, Mintz and Chen (2012)[13] undertook an analysis to search for the optimal tax regime in the oil and gas industry by making an international comparison of the different regimes in six oil-producing countries[14]. They analyzed the effect of taxes and royalties on the investment decisions of the oil and gas industry and how the former can distort the latter. For this purpose they calculated the marginal effective tax and royalty rate (METRR)[15] "as the amount of taxes and royalties paid as a percentage of the pre-tax-and-royalty return on capital

[11] Idem, p 24.
[12] Plourde (2010) p 4661.
[13] Mintz (2012), p. 1.
[14] Australia, Brazil, Canada (five provinces), Norway, the United Kingdom and the United States (four states).
[15] This method is based on J. Mintz and D. Chen (2010).

that would be required to cover taxes, royalties and the financing of capital, debt and equity"[16] . This METRR is an indicator of the impact of the fiscal regime on the investment decisions.

In this study, Mintz and Chen attempt to demonstrate that a rent-based royalty regime is neutral, and hence has no distorting impact on investment decisions as it allows for full deductions of current and capital costs, thus only revenues that exceed economic costs are subject to the royalty. One of their final conclusions was that the METRR analysis showed that a rent-based regime provides the optimal tax system since it does not apply a tax burden at the margin. In this sense, they argued that the Alberta royalty system that is implemented for the oil sands is optimal, because it is similar to a rent-based regime. The only caveat with this regime is the price-sensitivity associated with it.[17]

There is a study from Watkins (1975) on the bidding process, where he found that, although the government of Alberta can obtain a high proportion of the foreseeable economic rent through the bidding process when the competition is strong, it cannot achieve potential rents due to unanticipated changes in economic conditions, such as changes in oil prices.[18] Watkins included in his analysis bids within the Rainbow area located in the northwest part of the territory of Alberta, for the period 1966 to 1971. Since information on economic rent was not available, he used other estimates of rent by taking the difference between the present worth of the future revenues expected from the lease and the associated costs.[19]

It is also important to consider that in the bidding process some companies may hide their identity, and therefore their corporate information, by hiring a broker. With this they are able to obtain a competitive advantage. This situation was analyzed by Winter (2011), for the petroleum

[16] Mintz (2012), p 8.
[17] Idem p. 29.
[18] Watkins (1975) p. 309.
[19] Idem p. 305.

and natural gas lease auctions in Alberta during the period 1996 to 1999. In this study, she found that the "the probability of a broker winning is positively correlated with a broker previously winning and the winning firm previously using a broker to win adjacent leases"[20], which reinforces the argument that firms use brokers to generate asymmetric information. This is particularly interesting since we use for our estimation data related to the size of the companies, therefore, if some of the firms use brokers, it will be a biased in terms of the real size of these firms, which will not be observable. As we explain later to address this problem we decided to attempt to determine the size of the firms in terms of the amount of the bids that were submitted during the period of study.

## 2. DATA

When the generic royalty system was imposed in 1997, the maximum royalty rate was 30 percent of natural gas gross production revenues, and that was also the maximum rate for the gross value of oil produced. However, in October 2007, it was announced that the maximum royalty rate was to be adjusted to 50 percent of gross revenues for oil and gas; this was to be effective on January 2009. In less than three years, precisely in March 2010, the Alberta government stepped back and declared a reduction of the maximum royalty rate to 36 percent for natural gas and 40 percent for conventional oil; this was to be effective on January 2011[21]. For the purpose of estimation, we consider the period of higher royalty rates to start from October 2007 up to March 2010, beginning and ending in the dates when the announcements were made, since it is at these points that the markets started reacting to the new levels of royalties.

[20] Winter (2010) p 35.
[21] Busby et al. (2011) p 5.

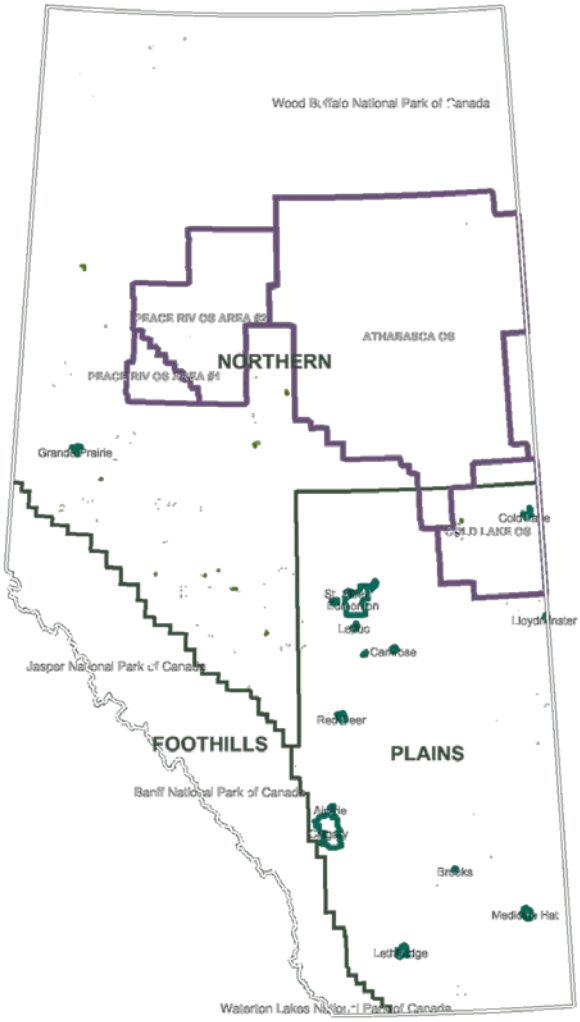
In contrast, British Columbia has applied the same royalty rate since 1998 for natural gas at a maximum rate of 27 percent of the value of production; and in the case of oil, the royalty system started in 2000 with a maximum rate of 24 per cent.[22]

Bonus bids, auctions are conducted monthly in British Columbia and every two weeks in Alberta. For the analysis we convert the data, when it was necessary, to a monthly frequency starting in January 2007 up to December 2012, for both provinces. In the case of British Columbia, there exist three types of tenure rights: a) permits for the right to explore; b) drilling licenses which allow firms to drill to a determined depth, and last between three and five years, and; c) leases that concede to companies the exclusive right to produce oil and gas in a specific geographic area, and have a duration of 10 years, but can be extended in perpetuity if production continues. For Alberta, there are just licenses and leases, the former are given for a period of five years in the Foothill region, four years in the Northern area and two years in the Plains; leases last five years in all the areas, but can prolonged if the production continues.[23] We do not distinguish between different types of tenure rights and therefore all types of bonus bids are included in the analysis.

Note that, Alberta's territory is divided into three different regions by the Government of Alberta in order to determine the type of license term[24]: Foothills, Northern and Plains. Thus, we set a different dummy variable for each region to differentiate between the regions considered in our study. For clarification we present in Figure 1 a map with these regions:

[22] Idem p 4.
[23] Idem p 7-8.
[24] The term of the license will vary depending on the geology, climatic conditions, topography and access conditions, and the terms are, as it was mentioned before: five years for Foothills, four years for the Northern area and two years for the Plains.

**Figure 1.**
**Alberta Regions**

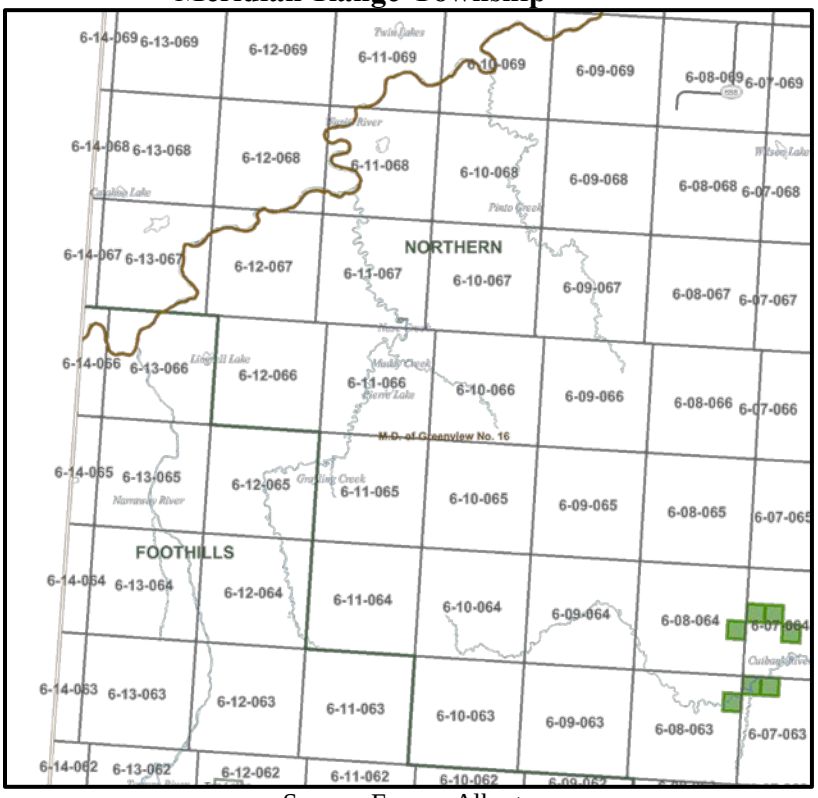



Source: Alberta Energy

In our analysis we considered only the winning bonus bids for the areas that are close to the border between Alberta and British Columbia. For this reason, the Plains region of Alberta is not included since it lies in the east part of the province, close to the province of Saskatchewan. Conversely, the region of Foothills is on the west side of Alberta and due to its particular shape is it possible to include almost all the bonus bids on parcels in this region.

To determine whether or not a parcel of Alberta subject to a bid is near to the border we use the Meridian-Range-Township (MRT) measure; we decided to include the adjacent eight MRTs to the border. As an illustration of this methodology we present the map in Figure2, in which appears the notation that corresponds to each MRT; once we know this information is it possible to sort the parcels closer to the border; for instance, we select the bonus bids from the parcels corresponding to the MRT 6-14-065 up to the MRT 6-07-065, and so forth.

**Figure 2**
**Meridian-Range-Township**



Source: Energy Alberta

All the information regarding the value of the bonus bids, the name of the firms that won the auctions, the MRT that identifies the location of the parcel, the number of hectares and the date were obtained from the web site of Alberta Energy.[25]

[25] http://www.energy.gov.ab.ca/Tenure/1314.asp, April 10, 2013.

Likewise, the web site of the Ministry of Energy in British Columbia provides information regarding bonus bids, including the value, the location, the name of the firm, the number of hectares and the date of each one of the winning bids.[26] The methodology to decide whether or not a bonus bid would be included in the sample was the same as explained above for the province of Alberta, the only difference is that British Columbia assign different numbers to each area, instead of MRT there is a parcel number that can be tracked on a map to find its exact location. We combined the information of both provinces to construct a data base that was used for the estimation, resulting in 447 different firms, and 11,098 observations.

As a characteristic of each firm we calculate the participation of each firm in the bonus bids process by estimating the total value of the winning bids within the period of this analysis (January 2007 to December 2012), then we classified the firms as follows: a) small, for those with a value of bids less than 1,000,000; b) medium, for companies for which the value of bids were between 1,000,000 and 100,000,000, and; c) large, for firms with values larger than 100,000,000. In this regards, it is interesting to notice that British Columbia has more larger firms than Alberta, considering this classification. This could imply that there was an adverse effect for Alberta due to the increase in royalty rates, as we will explain in more detail later.

It is interesting to note that for the period when royalty rates were high, the average value of bonus bids in Alberta decreased from $320,653 to $257,852, as well as the number of bids (from 4,788 to 3,283); whereas, the opposite is true for British Columbia, where the average value of bonus bids went from $1,274,206 to $2,500,077 and the number of bids increased as well from 1,367 to 1,660 (See Table B-2 and Table B-3 in Appendix B). This implies that for the

[26] http://www.empr.gov.bc.ca/Titles/OGTitles/SaleResults/Pages/default.aspx, April 10, 2013

period with high royalty rates the revenues collected by the Government of Alberta should have decreased.

## 3. ESTIMATION METHOD

For the analysis of the effects of the changes in the royalty rates on the bonus bids we use the difference in difference method to isolate the effects of these changes in Alberta for conventional oil relative to no royalty increase in British Columbia. This method can be applied in this analysis since the geographic border that separates Alberta from British Columbia does not affect the characteristics of the oil and gas resources in either side and therefore the pattern of exploration and investment is distributed uniformly in this region. For these reasons is possible to isolate the effects of the royalty rates changes in Alberta by comparing the pattern of bonus bids across both provinces.

The estimated equation includes the natural logarithm of each winning bid as the dependent variable and a set of characteristics and dummy variables, as control variables; however, the variable of interest is the one that captures the effect of being in the period of high royalties and in the province of Alberta. The equation used is the following:

$$lnBid_{it}=\beta_0+\beta_1 small_t+\beta_2 large_t+\delta_1 province_t+\delta_2 ABnorth_t+\delta_4 royalty_t+\delta_3(province_t \; x \; royalty_t)+\mu_{it}$$

where

$lnBid_{it}$ is the natural logarithm of the bonus bids.

$small_t$ is a dummy variable that takes the value of 1 if the firm is small (according to the classification outlined in the previous section) and 0 otherwise.

$large_t$ is a dummy variable that takes the value of 1 if the firm is large and 0 otherwise.

$province_t$ is the dummy variable that takes the value of 1 if the province is Alberta and 0 otherwise.

$ABnorth_t$ is a dummy variable that takes the value of 1 if the region is the Northern Alberta and 0 otherwise.

$royalty_t$ is the dummy variable that denotes the period for which the royalties were higher.

$province_t \; x \; royalty_t$ a multiplicative dummy variable to capture the effect of the province of Alberta during the time of the higher royalties.

$\mu_{it}$ is the error term that will include all the other factors that are not considered in the variables of the regression.

Since we use data related to firms whose operations share the same location, we may have an issue related to clustered errors, i.e. high correlation among the observations for the same location; in this case the Ordinary Least Square Estimation will result to be unbiased, but with standard errors that will be wrong and conducive to misleading inferences.

For this reason we decided to use Cluster-Robust Standard Errors for our regression, with the dummy variable of the region of Alberta (ABnorth) as the cluster variable, since this dummy involves the information related to the location of the firms within Alberta, but also captures the information related to the observations that belong to British Columbia.

In a first approach, the dependent variable was in a linear form; however, the estimated coefficients were too high, for this reason we decided to transform the dependant variable using the natural logarithm to scale the results.

When testing for heteroskedasticity for each one of the variables included in the model, we decided to use the Breusch-Pagan-Koenker (BPK) test, which is better than the Breusch-Pagan test because the later assumes that the normality of the residuals and this property may be violated if there exists heteroskedasticity. For the case of the BPK test the null hypothesis is no heteroskedasticity ($H_0$: *no heteroskedasticity*;$H_1$: $H_0$ *is false*), and from the results we conclude that all the variables, except *royalty* are related to the problem of heteroskedasticity. To correct this we use a Heteroskedasticity Robust Estimation together with the Cluster-Robust Standard Error Regression.

## 4. ANALYSIS AND INTERPRETATION

After correcting for the clustered errors and the heteroskedasticity of the model, we obtained finally the estimated coefficients that are presented in the next table:

**Table 1.**

**Difference-in-Difference Results**

**Cluster-Robust Standard Error Regression.**

| Variable | Coefficient |
|---|---|
| **Small firms (relative to medium firms)** | -1.4865** (0.1934) |
| **Large firms (relative to medium firms)** | 0.6354 (0.1122) |
| **Province (=1 if Alberta)** | -0.7985* (0.0171) |
| **In Northern Alberta (relative to Foothills)** | -0.1872* (0.0029) |

| Variable | Coefficient |
|---|---|
| **During the period of high royalty rates** | 0.0360* (0.0027) |
| **Effect of change in royalty rates in Alberta** | -0.1145* (0.0096) |
| **Constant** | 12.0199* (0.0824) |
| **N** | 11,098 |
| $\boldsymbol{R^2}$ | 0.2162 |

Note: Robust standard errors in parentheses;
* significant at 10%,** significant at 5%, *** significant at 1%

From the previous results we can conclude that the effect of the increase of royalty rates during the period of the analysis (January 2007 to December 2012) was negative for the province of Alberta; this result is significant at 10 percent and from it we can predict that holding all the other factors constant, the estimated decrease in the value of the bonus bids due to the increase in the royalty rate would be 11.4 percent. Busby obtained a similar negative effect, but with a different magnitude[27]; although, the sign of the coefficient supports the assumption that the rise in royalty rates had the consequence of reducing the value of the bonus bids, and therefore it distorts the investment on the oil and gas industry. As is stated by Busby, the Government of Alberta should rely more on auctions for collecting revenues, instead of production taxes, since it will be better off by augmenting the share that is paid up front, and not in the production stage.[28]

Volatile energy prices have a negative effect on government revenues, especially on the provinces with depleting resources, such as Alberta. This uncertainty has conducive to stop-and-go practices.[29] If the province does not have the ability to save these resources, and a long term

[27] Busby et al. (2011) result was 42 percent; however they include the province of Saskatchewan in their estimation, and use a different method to determine the parcels to be included depending on how close they are with respect to the border.
[28] Busby et al. (2011) p 22.
[29] Landon, Stuart, and Constance Smith (2010).

plan of rational spending, then future generations will suffer whenever the revenues collected by the depleting resources diminish.

Another interesting result is the coefficient corresponding to the size of the firms, as we can observe, the smaller firms have a considerable reduction in the value of their bids relative to the medium firms. This coefficient is significant at 10 percent level. Busby found that the largest firms reduced their bids more than the smaller firms[30]. They assume that the reason may be that the former have more flexibility in their operations compared with the smaller firms, therefore they can dispose and move their inputs more rapidly. However, we obtained a not significant coefficient for large firms relative to medium firms, while Busby found a negative and significant one. As we mentioned before there is a caveat in this regards due to the fact that some firms hide their identity by using brokers in the bidding process. Since the only name that is publicly available is the corresponding to the firm that actually won the auction, it is not possible to determine whether a firm is bidding for itself or using an agency to bid on its behalf.

## CONCLUSIONS

This study analyses the effects of an increase in royalty rates on the winning bonus bids in Alberta during the period of January 2007 to December 2012. By using a difference-in-difference approach we isolate the effects related specifically to the Province of Alberta from other factors that could have influenced the firm's decisions in the auctions of bonus bids. We used data from auctions on parcels that are adjacent to the border that separates Alberta from British Columbia; then we used results from an OLS regression Cluster-Robust Standard Errors

[30] Busby found that larger firms will reduce their average bid by 68 percent, whereas smaller will do it by 35 percent.

and found a negative and significant coefficient on the variable that accounts for the effects of the raise in the royalty rates on the bonus bids. Thus, we can conclude that the increment of royalty rates within the period of October 2007 to March 2010 had a negative effect by reducing the value of bonus bids, as we outlined in the data section of this analysis. This implies that royalty rates have a distortionary effect on investment and exploration decisions of the oil and gas industry, since royalties reduce the net price that firms obtain from each unit of production.

The previous result supports the argument of Henry George about the distortionary effects of taxes imposed on capital that affects investment decisions; these results also reinforce Busby's study in the sense that the Government of Alberta should rely less on the revenues collected through the Royalty system, not just because they distort incentives to invest in the oil and gas industry, but also due to the uncertainty about the pattern of energy prices. The volatility of these prices has negative effects on the Provincial government's revenues as we explained in previous sections; this problem is exacerbated by the inability of the government to save resource revenues during boom years.

In contrast, it is advantageous to collect revenues from the auction processes rather than from the production process, since, as we explained before, the bonus bids, theoretically, reflect the expected net present value that firms assign to the parcel in which they are planning to invest, this net present value should be above the profits expected including the royalties, therefore is less distorting to impose the burden of the tax in this process in which the firms are already taking into account the amount of taxes and therefore assigning a specific value that they are willing to invest; rather than depending on the variations of the production process and the uncertainty of energy prices.

One of the purposes of the Government of Alberta, when collecting taxes from the oil and gas industry, is to ensure that Albertans are obtaining a fair share from energy developments. Then, as it was Henry George's idea, the revenues obtained from the land, in this case the territory of the province of Alberta, should be redistributed among the individuals within the society to achieve a more equitable distribution of wealth.

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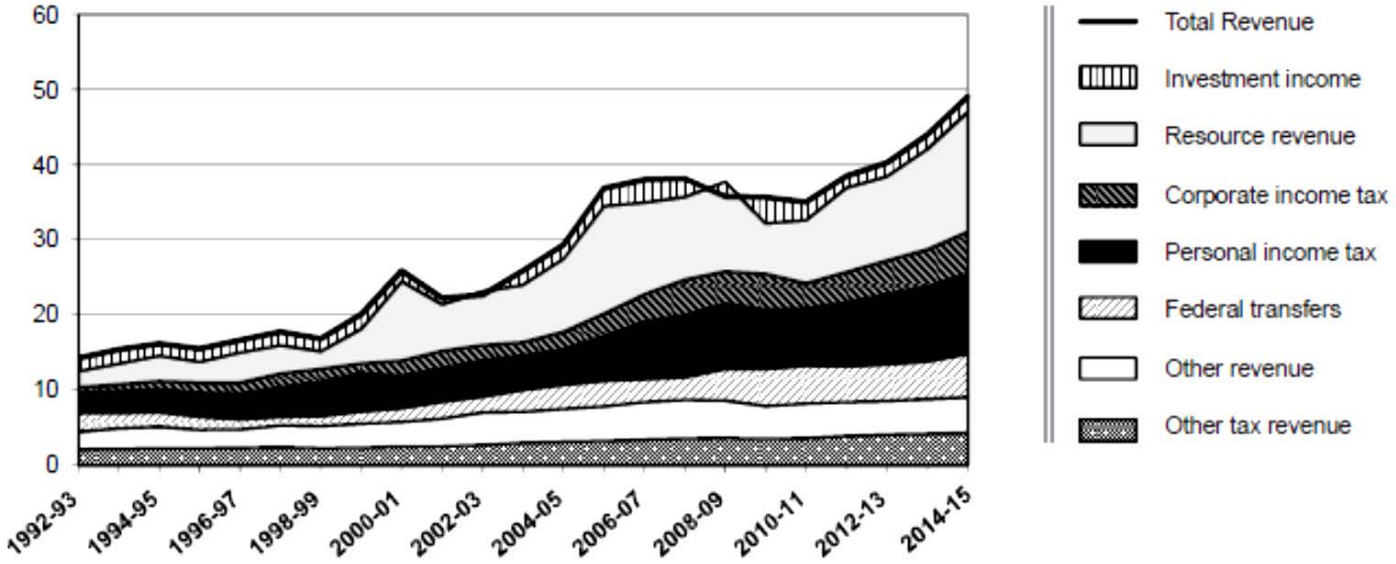
## APPENDIX A

### Chart A-1

### Alberta's Total Revenue

**1992-93 to 2014-15**
**(billions of dollars)**

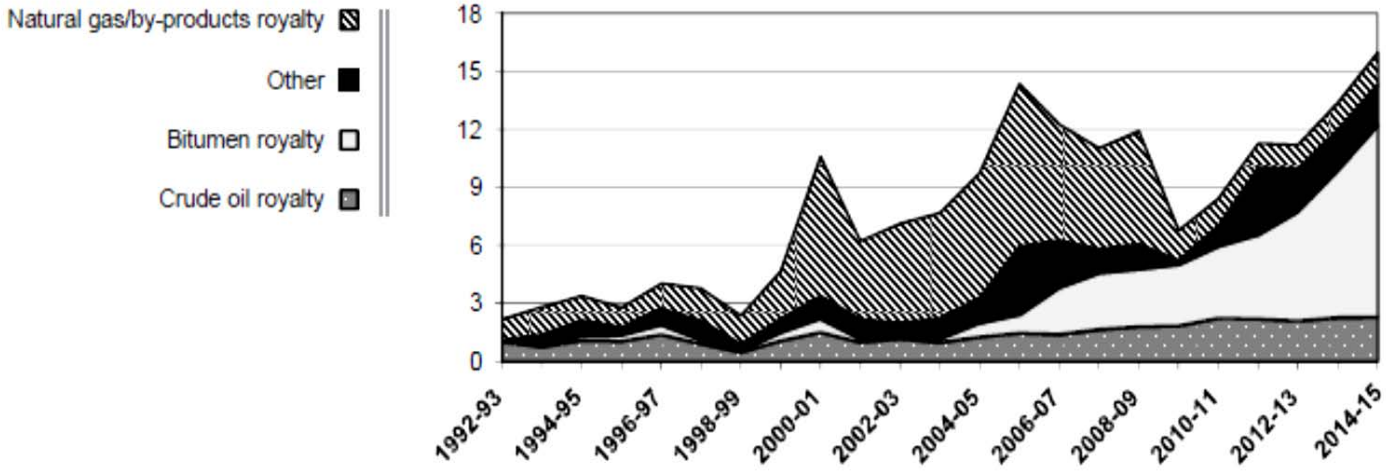



Source: Alberta Treasury Board and Finance. Economic Outlook. Fiscal Plan 2012-15. Investment income

### Chart A-2

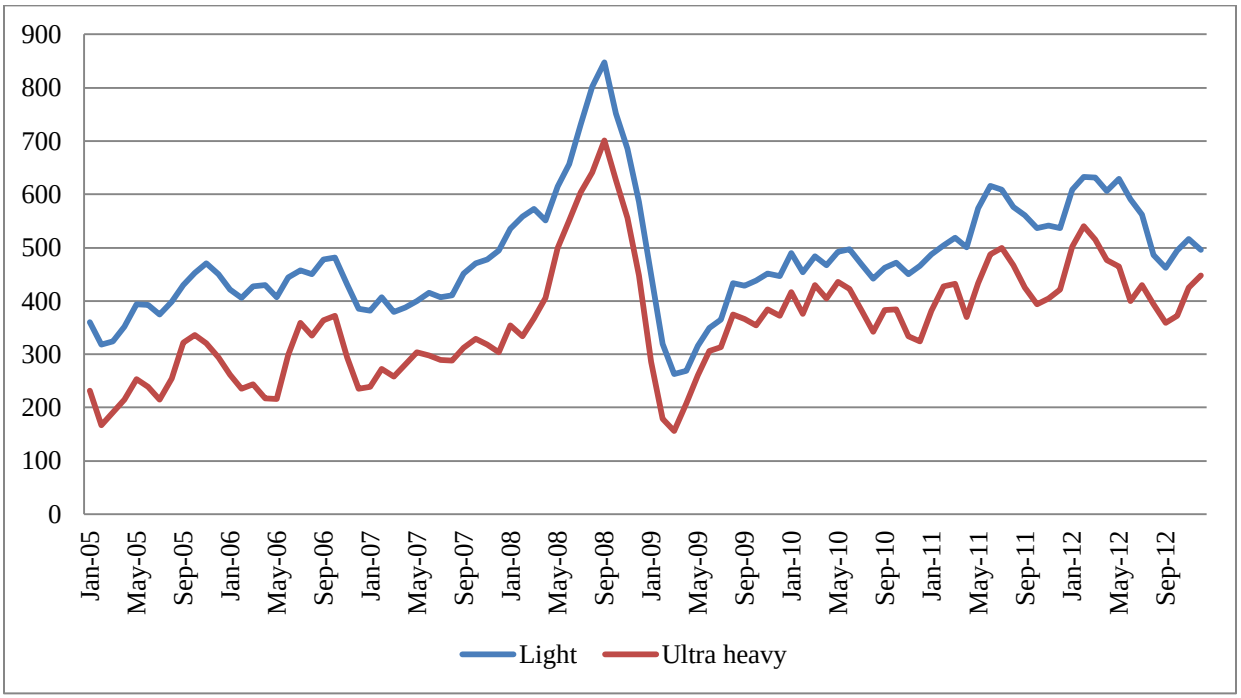
### Non-Renewable Resource Revenue

**1992-93 to 2014-15**
**(billions of dollars)**




Source: Alberta Treasury Board and Finance. Economic Outlook. Fiscal Plan 2012-15

**Chart A-3**
**Crude Bitumen Prices**
**2005-2012**




Source: Authors' chart using data from Alberta Energy.

## APPENDIX B

## SUMMARY STATISTICS

**Table B-1**
**General Statistics**

| Variable | Observations | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| Bonus bids | 11,098 | 745,520.10 | 4,472,589.00 | 160 | 156,837,942.39 |
| Number of hectares | 11,098 | 580.51 | 1,028.99 | 1 | 12,222.23 |
| Province (=1 if Alberta) | 11,098 | 0.73 | 0.45 | 0 | 1 |
| Northern Alberta (relative to Foothills) | 11,098 | 0.60 | 0.49 | 0 | 1 |
| Small firms (relative to medium firms) | 11,098 | 0.16 | 0.36 | 0 | 1 |
| Large firms (relative to medium firms) | 11,098 | 0.35 | 0.48 | 0 | 1 |
| Dummy for the period of the higher royalty rates | 11,098 | 0.45 | 0.50 | 0 | 1 |

**Table B-2**
**Alberta's Statistics**

| Variable | Observations | Mean | Standard deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| **Period with lower royalty rates** | | | | | |
| Bonus bids | 4,788 | 320,653.20 | 1,152,466.00 | 160 | 31,110,144.00 |
| Number of Hectares | 4,788 | 471.99 | 891.28 | 1.25 | 12,222.23 |
| **Period with high royalty rates** | | | | | |
| Bonus bids | 3,283 | 257,851.80 | 1,056,579.00 | 160 | 28,846,771.20 |
| Number of Hectares | 3,283 | 512.76 | 971.49 | 1.25 | 11,268.27 |

**Table B-3**
**British Columbia's Statistics**

| Variable | Observations | Mean | Standard deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| **Period with lower royalty rates** | | | | | |
| Bonus bids | 1,367 | 1,274,206.00 | 3,465,009.00 | 1650 | 35,099,961.29 |
| Number of Hectares | 1,367 | 774.48 | 1,111.61 | 65 | 7,726.00 |
| **Period with high royalty rates** | | | | | |
| Bonus bids | 1,660 | 2,500,077.00 | $1.07 \times 10^7$ | 1000 | 156,837,942.39 |
| Number of Hectares | 1,660 | 867.71 | 1,322.53 | 1 | 7,578.00 |