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COMMENTARY

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Appendix for Hiding in Plain Sight: the Harmful Impact of Provincial Business Property Taxes

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Online Appendix

A1 Theoretical Framework for a METR Model

Building largely on McKenzie et al. (1998) and partially so on Boadway et al. (1984) and King and Fullerton (1984), we have constructed a model to perform METR calculations.

The Rate of Return on Capital

In the capital investment market, let R_g denote the gross-of-tax rate of return corresponding to the intersection of the marginal revenue product and the marginal cost of capital, and let R denote the opportunity cost of investment. Estimating the METR on capital investment thus requires two calculations: one for R_g and one for R. Denoting the METR as t_k, the METR is hence calculated as:

$$t_k = \frac{R_g - R}{R}$$

We consider a domestic investor whose investment income is subject to both provincial and federal personal income tax (PIT). He can make investment funds available for corporate capital investment either via debt, equity, or a combination of the two. In equilibrium, the investor must be indifferent between investing via debt and equity. We assume the investor's income is earned in the jurisdiction being analyzed and is sufficiently high so that any investment income earned is taxed at the highest statutory marginal tax rates. Equity income exists in the form of either dividends or capital gains, which are both subject to PIT, albeit often at different statutory marginal tax rates. Interest income earned from debt financing is subject to PIT at the regular marginal tax rates.

A few simplifying assumptions are now in order. First, equity investors can be divided into two groups: "capital gain investors" and "dividend investors." Capital gain investors purchase shares at the beginning of a year, after which they realize a capital gain at the end of the year by selling their shares on the market. Dividend investors also purchase shares at the beginning of a year, but realize a dividend at the end of the year. After receiving their dividend, but just before the year closes, dividend investors sell their shares on the market and realize an inflationary capital gain because share prices have risen with inflation over the year. With this framework in hand, we can begin building an expression for R.

Let ρ be the nominal gross-of-tax rate of return on equity (i.e., the nominal appreciation rate of shares), c be the PIT rate on capital gains, d be the PIT rate on dividends, and π be the inflation rate. A capital gain investor earns a nominal gross-of-tax return on equity of ρ, which translates into a real net-of-tax return of $(1-c)\rho-\pi$. For a dividend investor, the nominal appreciation of his shares is ρ over the course of the year. However, unlike a capital gain investor, a dividend investor receives part of ρ as a dividend and the remainder as a capital gain. Since over the course of a year the profit of a share issuer has risen by a rate of ρ less inflation, the dividend component of ρ earned is $\rho-\pi$. Once dividend investors realize their dividend, they immediately sell their shares and further realize a capital gain of π since share prices have inflated over the course of the year. So π is the capital gain component of ρ earned. Therefore, dividend investors receive a real net-of-tax return of $(1-d)\,(\rho-\pi)+(1-c)\pi-\pi$.

Letting m be the PIT rate on interest income and i be the gross-of-tax nominal interest rate for debt, the real net-of-tax return on debt is $(1-m)i-\pi$. Let e be the proportion of earnings which firms retain as opposed to divesting as dividends. Noting that the real net-of-tax rates of return on investment must be equal in equilibrium, so that the investor is indifferent between financing debt and equity, we have:

$$e(1-c)\rho+(1-e)[(1-d)(\rho-\pi)+(1-c)\pi]-\pi=(1-m)i-\pi$$

$$\rho=\frac{(1-m)i-\pi(1-e)(d-c)}{e(1-c)+(1-e)(1-d)}$$

This expression gives the nominal rate of return on equity as a function of the model's exogenous parameters, including the interest rate i.[1]

We also assume that firms' relative issuance of debt and equity for the purpose of investment is such that β is the proportion of total investment issued as debt, which is assumed to be exogenous. In equilibrium, the real opportunity cost of investment R must yield the required net-of-PIT rate of return:

$$R^n=\beta i(1-m)+(1-\beta)[e(1-c)\rho+(1-e)[(1-d)(\rho-\pi)+(1-c)\pi]]-\pi$$

By setting all PIT rates to zero in this expression, we arrive at the real opportunity cost of investment:

$$R=\beta i+(1-\beta)\rho-\pi$$

Substituting the foregoing expression for ρ yields an expression of R in terms of the model's exogenous parameters, which is the hurdle the domestic investor needs to clear in order to realize the required net-of-PIT rate of return R^n, otherwise he will invest elsewhere to earn R gross-of-PIT.

The Marginal Cost of Capital

Assuming that capital is divisible and subject to decreasing marginal product, the marginal revenue product of capital MPP_K is a decreasing function of the amount of capital used in production. If we denote MC_K as the marginal cost of capital, then in factor market equilibrium $MC_K = MRP_K$. In a capital market

1 Substituting $e=1$ reduces the expression of ρ to that found in McKenzie et al. (1998) where all equity is assumed to exist in the form of retained earnings. It is also clear that $\rho<i$ since $0<c<m$.

undistorted by taxes, $MC_K = R+\delta$, which is the opportunity cost of investment plus depreciation where δ is the rate of economic depreciation of capital; these are the two distinct costs a firm must pay to attract (R) and employ (δ) one unit of capital, and together sum to the minimum attainable marginal cost.

However, in a capital market encumbered by taxes, marginal cost is raised to $MC_K = R_g+\delta$, where $R_g > R$. By constructing a gross-of-tax expression for MC_K, we can then simply subtract from it δ to arrive at an expression for R_g. We begin with the marginal cost of capital that would prevail in the absence of taxes on capital, and then building onto that the wedge generated by such taxes. The net-of-tax marginal cost is $MC_K = R+\delta$, so this is the expression upon which we build by incorporating into it the effects of the CIT and BET.[2]

Incorporating the Corporate Income Tax

We first incorporate the effect of the combined provincial and federal CIT, which is levied at a rate of u. The most visible effect of the CIT is that it reduces marginal revenue product by weighting it by a factor of $(1-u)$. This effect is equivalent to weighting marginal cost by the reciprocal factor $1/(1-u)$, which increases marginal cost to:

$$MC_k = \frac{R+\delta}{1-u}$$

Another effect of the CIT is the deductibility of nominal interest payments from corporate income.[3] For every dollar of capital, β proportion of which is financed by debt, the firm can write off $u\beta i$ cents as an operating cost which reduces the gross-of-tax marginal cost of capital to:

$$MC_k = \frac{R+\delta-u\beta i}{1-u}$$

We also know that for CIT purposes firms are able to deduct annual depreciation based on Capital Cost Allowance (CCA) depreciation rates over the deemed useful life of a capital asset. Letting A represent the present value of CCA deductions made at the end of each period related to one dollar of capital invested, A is thus the infinite sum:

$$A = \sum_{n=0}^{\infty} \frac{\alpha(1-\alpha)^n}{(1+R_f)^{n+1}}$$

2 We assume that there are no investment tax credits. We ignore taxes that have been abolished, or nullify their rates. See McKenzie et al. (1998) for details on how such credits and taxes could be incorporated into the calculation of R_g.

3 Unlike debt financing costs, the costs of raising equity are not CIT-deductible.

based on a constant CCA rate of a and where $R_f = R - u\beta i + \pi$ is the nominal opportunity cost of financing and therefore the rate used for time discounting. Applying convergence of geometric series, this sum evaluates to:

$$A = \frac{a}{R_f + a}$$

With the ability to deduct a present value of uA from CIT over the life of the capital asset, the gross-of-tax marginal cost is further lowered to:

$$MC_k = \frac{(R + \delta - u\beta i)(1 - uA)}{1 - u}$$

Incorporating Taxes Directly Levied on Capital

The final taxes incorporated into this model are those directly levied on the capital stock itself, rather than the income generated by capital: the capital tax and the BET. From the perspective of owners of capital subject to both of these taxes there is little in principle to distinguish the effect of one from the other. Since federal and provincial capital taxes however have recently been abolished, we do not concern ourselves with incorporating the capital tax into the model.

The obvious difference between the two taxes lies in the definition of the tax base – the BET is levied on only a portion of the capital stock (i.e., land and buildings) and on the market value thereof, whereas the capital tax was generally levied on the entire capital stock and on the book value thereof. The less obvious, but equally important difference is that the BET rate often changes over time in response to property reassessments, a feature not historically characteristic of the capital tax. In order to achieve exogenously determined revenue targets, provincial governments often countervail jurisdiction-wide business property appreciation by adjusting BET rates accordingly.[4] Letting n denote a time period (i.e., a year), we thus need to consider the series of BET rates t_n for $n = (0,1,2,3, \ldots)$.

Adapting the approach of McKenzie et al. (1998) with regard to the capital tax, recognizing that the BET is levied on the market rather than book value of capital, and assuming BET payments are made at year end, the present value of the amount of BET paid on a dollar of capital owned in perpetuity is:

4 In contrast to most machinery capital, property (land and buildings) often experiences net appreciation where economic depreciation from physical wear and tear is more than offset by market factors (e.g., rises in construction costs and/or obtainable rents) which work to increase market value, a feature to our knowledge not built into previous METR studies. Another feature not built into previous METR studies is CIT "recapture" of CCAs made for building depreciation where in fact building appreciation has occurred and been realized upon property sale. The offsetting of economic deprecation works to reduce the METR while CCA recapture works to increase it; however we align with previous studies in that we do not attempt to incorporate either effect into the model.

$$T = \sum_{n=0}^{\infty} \frac{t_n(1-\delta)^n}{(1+R_f)^{n+1}}$$

where again future amounts are discounted at the rate of R_f previously defined. Accounting for both the burden and CIT-deductibility of the BET, the gross-of-tax marginal cost is increased to:

$$MC_k = \frac{(R+\delta-u\beta i)(1-uA+(1-u)T)}{1-u}$$

Since in equilibrium $MC_k = R_g + \delta$, we can now substitute the above expression for MC_k and rearrange to write the equation defining R_g:

$$R_g = \frac{(R+\delta-u\beta i)(1-uA+(1-u)T)}{1-u} - \delta$$

It can be verified that indeed $R_g = R$ when $u = 0$ and $t_n = 0$ for all n.

METRs on Land and Inventories

Since land lies outside of CCA classification and has $\delta = 0$, the expression for R_g above reduces to the following for land:[5]

$$R_{g,L} = \frac{(R-u\beta i)(1+(1-u)T)}{1-u}$$

The final category of capital we consider outside of CCA classification is inventories, which like land is not subject to economic or CCA depreciation. However, the essential difference is that inventory capital, while not subject to BET, faces an inflation tax caused by a CIT deduction based on the first-in-first-out (FIFO) method of inventory accounting, where the permitted deduction is equal to the cost of producing the inventory at the time it was produced.

At the time inventory is either sold or otherwise disposed, there is no provision to allow the CIT deduction to equal the cost that would have been incurred had the inventory been produced at the time of its sale/disposal, and thereby account for the inflation of corporate income over that time period. In other words, there is no provision to allow the CIT deduction to account for the inflationary increase in the cost

5 As in Boadway et al. (1984) and McKenzie et al. (1998), we consider land to be a non-depreciable capital asset which is mobile between competing uses (e.g. commercial, residential, etc.).

of producing inventory. The inflation tax implicitly facilitated by the CIT framework is thus equal to $u\pi$ for each dollar of capital inventory, hence the gross-of-tax rate of return for inventories is given by:

$$R_{g,I} = \frac{R - u\beta i + u\pi}{1-u}$$

Calculating the Weighted METR

Our model computes gross-of-tax rates of return for each CCA class, land, and inventories since each of these categories of capital correspond to different parameter values (e.g. CCA depreciation rates). We calculate the METR for each capital category as the percentage by which taxes have caused the marginal cost of capital to rise above the opportunity cost of investment R. Letting the subscript k denote the capital category, we have:

$$t_k = \frac{R_{g,k} - R}{R}$$

Since each capital category represents a certain share of the total capital stock, we apply Canadian capital stock shares (weights) w_k from McKenzie et al. (1998) to the corresponding METRs to arrive at weighted METRs given by $t_k w_k$.[6] Assuming, like in previous METR studies, that the average investment is distributed over the various capital categories in proportion to the weights w_k, the aggregate weighted METR t^w is then calculated by summing the weighted METRs over all of the capital categories $k \in K$ where K is the set of capital categories:

$$t^w = \sum_k t_k w_k$$

6 Since 1998 several new CCA classes have been created, a development which is ignored here since McKenzie et al. (1998) is at present the most recent source for Canadian capital weights available to us.

A2 Preparing Ontario's BET Rate for METR Modelling

This section outlines how we prepared the Ontario BET for incorporation into the METR model, and is primarily focused on constructing the appropriate value of T (the present value of BET levies on a dollar of capital owned in perpetuity).

The Current Effective Rate

Here, we develop a method to convert a current published BET rate into a current effective rate (CER) by taking into account Ontario's 4-year reassessment cycle. Let $t^{p}_{y,c}$ be the published rate for any given year $y \in \{1,2,3,4\}$ of an assessment cycle $c \in (1,2,3,\ldots)$, $t^{e}_{y,c}$ be the corresponding CER, and $r_c > 0$ be the (geometric) average annual nominal property appreciation over the course of assessment cycle c. The CER can be expressed as a weighted version of the published rate:

$$t^{e}_{y,c} = \left(\frac{1}{1+r_c}\right)^{y} \left[\left(1-\frac{y}{4}\right)\left(\frac{1}{1+r_{c-1}}\right)^{4} + \frac{y}{4}\right] t^{p}_{y,c}$$

When $c=1$, r_1 represents average appreciation over the 4-year period 2008-2011 (inclusive) and r_0 represents the initial average appreciation over the 3-year period 2005-2007 (inclusive) preceding the first four-year assessment cycle. Thus, since the first cycle of 2009-2012 is based on a valuation date (January 1, 2008) which is only 3 years after the previous valuation date (January 1, 2005), the exponent on the term $\left(\frac{1}{1+r_{c-1}}\right)$ should be reduced to 3 for $c=1$. This adjustment should only take place for $c=1$ as all subsequent assessment cycles are to be four years long. Since 2012 is the final year in the current assessment cycle, the above expression reduces to the following for the 2012 CER:

$$t^{e}_{4,1} = \left(\frac{1}{1+r_1}\right)^{4} t^{p}_{4,1}$$

In respect of reassessment years prior to 2009, the Municipal Property Assessment Corporation (MPAC) has not made publicly available the breakout of annual changes in assessed values between real growth (i.e. new construction) and appreciation. In the absence of this information, we default to using MPAC's Annual Reports to draw some inference on annual appreciation rates. These reports date from 2002-2010, summarizing province-wide assessment data as far back as 1997.

We first consider data corresponding to years for which MPAC did not reassess the province, those being 1998, 1999, 2001, 2004, 2006, 2007, 2009, and 2010 because changes in assessment for those years is related to real growth and not appreciation (Table A2-1). For these years, we calculate in the extracted growth column the percentage change in assessment relative to the previous year, and then average these percentages to arrive at an average annual rate of real growth of 1.70 percent. We then substitute this average as the imputed real growth for the reassessment years 2000, 2002, 2003, 2005, and 2008.

Table A2-1: Real Growth and Appreciation of Business Property in Ontario – 1997/2010

Year	Reassessment Year?	Valuation Date	Reassessment Interval (Years)	Total Business Assessment	Extracted Δ% Real Growth	Imputed Δ% Real Growth	Estimated Δ% Annual Appreciation
1997	Yes	June 30, 1996	-	$123,241,597,351	-	-	-
1998	No	-	-	$125,390,737,725	1.74%	1.74%	-
1999	No	-	-	$128,164,897,204	2.21%	2.21%	-
2000	Yes	June 30, 1999	3.0	$151,706,067,500	-	1.70%	5.19%
2001	No	-	-	$153,942,795,754	1.47%	1.47%	-
2002	Yes	June 30, 2001	2.0	$176,397,278,413	-	1.70%	6.15%
2003	Yes	June 30, 2003	2.0	$192,382,326,717	-	1.70%	3.56%
2004	No	-	-	$195,958,274,913	1.86%	1.86%	-
2005	Yes	January 1, 2005	1.5	$224,995,897,084	-	1.70%	8.43%
2006	No	-	-	$228,375,001,329	1.50%	1.50%	-
2007	No	-	-	$231,944,118,945	1.56%	1.56%	-
2008	Yes	January 1, 2008	3.0	$302,386,309,515	-	1.70%	8.63%
2009	No	-	-	$306,633,083,961	1.40%	1.40%	-
2010	No	-	-	$312,212,931,630	1.82%	1.82%	-
Average					**1.70%**	**1.70%**	**6.39%**

Note: A reassessment year is one in which MPAC reassessed the province based on a specified valuation date. Reassessments take effect for taxation the year following the relevant reassessment year and remain in effect up to and including the following reassessment year. Since there are 6 reassessment years before 2010, the data generate 5 estimated annual appreciation rates corresponding to the 5 intervals between valuation dates. The estimated annual average appreciation is a weighted average using the reassessment intervals as weights.

Source: Authors' calculation from MPAC.

At this point, the implied real growth over a reassessment interval (i.e. between reassessment years) needs to be removed from the corresponding total percentage increase in assessment to isolate an estimated (geometric) average annual appreciation rate for the reassessment interval in question. This task is accomplished by (i) increasing the assessment for the reassessment year commencing the reassessment interval by applying and compounding the imputed real growth rates for each subsequent year up to an including the following reassessment year, (ii) dividing this result into the assessment for the reassessment

year concluding the reassessment interval, (iii) applying to this result a power equal to the reciprocal of the reassessment interval length (in years), and finally (iv) subtracting from this result unity.[7]

We then take a weighted average of these estimated average appreciation rates for the reassessment intervals to arrive at a weighted average annual appreciation rate of 6.39 percent, using the reassessment interval lengths as weights.

As of the time of writing, 2012 assessments, which will be phased in over 2013-2016, have yet to be released by MPAC. Therefore, absent the 2012 assessment information (and especially absent a breakout of assessed value increases between real growth and appreciation of existing stock), we default to assuming that business property appreciation over 2008-2011 (i.e., between the valuation dates of January 1, 2008 and January 1, 2012) has been in line with the average across the five separate reassessment intervals during 1997-2010 as indicated in Table A2-1. Thus, we set r_1=6.39 percent.

Since the largely urban municipalities of Durham Region, York Region, City of Barrie, Peel Region, and Halton Region have BET rates below the province-wide new construction rate, we construct a weighted average of the 2012 published new construction rate of 1.26 percent and the 1.14 percent weighted average commercial BET rate across those five municipalities using shares of provincial business assessment as weights.[8] This adjustment results in a weighted published BET rate of 1.23 percent, thus we set $t^{p}_{4,1}$ =1.23 percent which yields a CER of:

$$t^{e}_{4,1}=\left(\frac{1}{1+6.39\%}\right)^{4}1.23\%$$

$$t^{e}_{4,1}= 0.96\%$$

Revisiting Section A1, where t_n represents the current effective BET rate in year n and n=0 (the base year) corresponds to the year 2012, we have t_0=0.96 percent. We will now develop a method for projecting future BET rates t_n for $n\geq1$, a perquisite to calculating the present value of BET levies, T.

The Present Value of BET Levies

The provincial government has historically set annual BET rates so as to countervail the effects of reassessment since it took over the BET in 1998 from school boards, a practice which the 2012 Ontario budget indicates will continue. We refer to this policy as the Status Quo scenario, and it has led to declining annual BET rates over time as market property values have steadily risen in Ontario since 1996 as reported by MPAC.

7 Consider the reassessment interval of June 30, 1996 to June 30, 1999, valuation dates which correspond to reassessment years 1997 and 2000, respectively. Applying the imputed real growth rates for 1998-2000 to the 1997 assessment base we have ($123,241,597,351)(1.0174)(1.0221)(1.070)=$130,340,212,480. Dividing this figure into the 2000 assessment we have $151,706,067,500/$130,340,212,480=1.1639. Applying a power of 1/3 to this figure and then subtracting unity gives $(1.1639)^{\frac{1}{3}}-1=0.0519$.

8 Only the commercial components of the business assessment of these five municipalities are levied with BET rates lower than the new construction rate. We ignore a number of small rural townships which also have BET rates below the new construction rate as their inclusion in the weighting adjustment would not make an appreciable difference.

Setting BET rates in this manner contrasts with that of the former Ontario Capital Tax (OCT). For the OCT, the province would set a general tax rate – at its peak, 0.3 percent for regular corporations in 2004 (Ontario 2004) – irrespective of the value of the tax base, leaving OCT revenue to be endogenously determined according to market conditions. The OCT rate would be held constant over time with no adjustments to countervail appreciation of the provincial capital stock. The province has been setting BET rates in just the opposite manner, adjusting them to offset revaluations of the tax base in order to achieve exogenous revenue targets.

We now project post-2012 BET rates for the three policy scenarios considered (Inflation Indexed, Status Quo, and BET-RET Parity), and use the projections to calculate corresponding present values of BET levies incurred by an investment made in 2012. Consider a representative business property built in the initial year (n=0). Let r be the (geometric) average annual rate of nominal appreciation and let π be the inflation rate. Under the Inflation Indexed scenario we have $t_{n+1}=\frac{1+\pi}{1+r}t_n$ and under the Status Quo scenario we have $t_{n+1}=\frac{1}{1+r}t_n$. With the initial rate t_0 being exogenous, these expressions can be rewritten as $t_n=\left(\frac{1+\pi}{1+r}\right)^n t_0$ and $t_n=\left(\frac{1}{1+r}\right)^n t_0$, respectively.

In contrast, under the BET-RET parity scenario we have $t_n=t_0-\frac{n}{Y}(t_0-t^*)$ for $n \le N$, where N is the number of years taken to reach the (exogenous) destination CER of $t^*<t_0$ with equalized annual reductions in the rate.[9] Once t^* is reached, we have $t_n=\frac{1}{1+r}t_{n+1}$ for $n > N$ to countervail the impacts of reassessment (a la the Status Quo scenario). Thus, for $n>N$ we have $t_n=\left(\frac{1}{1+r}\right)^n t^*$. Recalling that $T=\sum_{n=0}^{\infty}\frac{t_n(1-\delta)^n}{(1+R_f)^{n+1}}$ and letting the Inflation Indexed, Status Quo, and BET-RET Parity scenarios have corresponding present value BET levies T_I, T_S, and T_P on a dollar of capital invested, we have:

$$T_I=\sum_{n=0}^{\infty}\frac{\left(\frac{1+\pi}{1+r}\right)^n t_0(1-\delta)^n}{(1+R_f)^{n+1}}$$

$$T_s=\sum_{n=0}^{\infty}\frac{\left(\frac{1}{1+r}\right)^n t_0(1-\delta)^n}{(1+R_f)^{n+1}}$$

$$T_p=\sum_{n=0}^{N}\frac{\left[t_0-\frac{n}{N}(t_0-t^*)\right](1-\delta)^n}{(1+R_f)^{n+1}}+\sum_{n=N+1}^{\infty}\frac{\left(\frac{1}{1+r}\right)^n t^*(1-\delta)^n}{(1+R_f)^{n+1}}$$

9 Our calculations for the BET-RET Parity scenario are based on the effect of announcing the policy in 2012 and implementing it over 2013-2027.

Appealing to the convergence of geometric series, these expressions reduce to the following, respectively:

$$T_I = \frac{t_0(1+r)}{(1+r)(1+R_f)-(1+\pi)(1-\delta)}$$

$$T_s = \frac{t_0(1+r)}{(1+r)(1+R_f)-(1-\delta)}$$

$$T_p = \frac{1}{(1+R_f)}\left[\sum_{n=0}^{N}\frac{\left[t_0-\frac{n}{N}(t_0-t^*)\right](1-\delta)^n}{(1+R_f)^n} + \frac{t^*T_s\left(\frac{1}{1+r}\right)^{N+1}(1-\delta)^{N+1}}{t_0(1+R_f)^{N+1}}\right]$$

Several parameter and endogenous variable values used for the METR model, such as π and R_f, are specified in Section A3. Since the Commission on the Reform of Ontario's Public Services (2012) indicates that Ontario has entered a period of slow economic growth, we adopt the assumption that appreciation accrues in line with inflation for 2012 onward, implying that $r=\pi$. Such an approach would seem reasonable from the long-run perspective of investors, and implies that inflation indexing is equivalent to fixing the initial BET rate at t_0 in perpetuity.[10] In accordance with this assumption, we replace r with π in the above expressions, yielding:

$$T_I = \frac{t_0}{R_f+\delta}$$

$$T_s = \frac{t_0\,(1+\pi)}{(1+\pi)(1+R_f)-(1-\delta)}$$

$$T_p = \frac{1}{(1+R_f)}\left[\sum_{n=0}^{N}\frac{\left[t_0-\frac{n}{N}(t_0-t^*)\right](1-\delta)^n}{(1+R_f)^n} + \frac{t^*T_s\left(\frac{1}{1+\pi}\right)^{N+1}(1-\delta)^{N+1}}{t_0(1+R_f)^{N+1}}\right]$$

10 Adopting an assumption of equality between appreciation and inflation rates may be relevant to investors' perspectives for another reason. Whereas the OCT rate was exogenous, with real-dollar revenue determined endogenously, these roles are reversed with the BET. With real-dollar BET revenue as the exogenous variable, investors' may estimate the METR contribution of BET in a manner that lowers that contribution only if the government lowers the exogenous revenue variable. This approach, which would differ from the conventional approach to METR modeling followed in this *Commentary*, would disregard the endogenous tax rate reductions required to maintain exogenous revenue when assessed values are appreciating. With the assumption of $r=\pi$, the two approaches would yield the same METR contribution in the Status Quo and Inflation Indexed scenarios. In the Inflation Indexed scenario, both real-dollar BET revenue and the BET rate would remain constant over time, so there is obviously no difference between the two approaches. In the Status Quo scenario, percentage BET rate changes and percentage real-dollar BET revenue changes are equal year-by-year, so again there is no difference between the two approaches. In the event that the $r=\pi$ assumption does not hold, a likely explanation is that property appreciation outpaces inflation so that $r>\pi$ (the recent experience in Ontario). In this case, our use of a conventional approach to estimating the BET's METR contribution will understate investors' METR estimates, and increasingly so over time if property appreciation continues to outpace inflation

Table A2-2: Real Growth and Appreciation of Residential Property in Ontario – 1997/2010

Year	Reassessment Year?	Valuation Date	Reassessment Interval (Years)	Total Residential Assessment	Extracted Δ% Real Growth	Imputed Δ% Real Growth	Estimated Δ% Annual Appreciation
1997	Yes	June 30, 1996	-	$552,703,474,944	-	-	-
1998	No	-	-	$559,261,652,324	1.19%	1.19%	-
1999	No	-	-	$568,457,786,928	1.64%	1.64%	-
2000	Yes	June 30, 1999	3.0	$648,363,700,626	-	1.78%	3.87%
2001	No	-	-	$662,172,587,846	2.13%	2.13%	-
2002	Yes	June 30, 2001	2.0	$756,324,486,898	-	1.78%	5.94%
2003	Yes	June 30, 2003	2.0	$883,705,870,072	-	1.78%	7.15%
2004	No	-	-	$905,504,300,517	2.47%	2.47%	-
2005	Yes	January 1, 2005	1.5	$1,044,737,792,129	-	1.78%	8.72%
2006	No	-	-	$1,064,929,621,051	1.93%	1.93%	-
2007	No	-	-	$1,082,504,109,085	1.65%	1.65%	-
2008	Yes	January 1, 2008	3.0	$1,331,086,292,068	-	1.78%	6.51%
2009	No	-	-	$1,349,557,802,795	1.39%	1.39%	-
2010	No	-	-	$1,373,990,795,380	1.81%	1.81%	-
Average					**1.78%**	**1.78%**	**6.12%**

Note: A reassessment year is one in which MPAC reassessed the province based on a specified valuation date. Reassessments take effect for taxation the year following the relevant reassessment year and remain in effect up to and including the following reassessment year. Since there are 6 reassessment years before 2010, the data generate 5 estimated annual appreciation rates corresponding to the 5 intervals between valuation dates. The estimated annual average appreciation is a weighted average using the reassessment intervals as weights.

Source: Authors' calculation from MPAC.

Projecting RET Current Effective Rates

Since under the BET-RET Parity scenario a 15-year schedule of ceiling BET rates is to be specified so that approximate parity with the RET is reached in 2027, we need to calculate a destination effective RET rate (i.e. t^*) for 2027. With an approach analogous to that applied to the previous Table A2-1, total residential assessment comprises four property classes: regular residential, multi-residential, farmland, and managed forests (Table A2-2).

We ignore the effects of a 75 percent tax rate discount given to farmland and managed forests since those classes together typically represent only about 5 percent of the assessment base classified as residential. We also ignore the effects of residential property tax rebates and credits, which are largely geared towards seniors and low-income residents. The 2012 published RET rate is 0.221 percent. Using

the preceding CER formula, and making assumptions analogous to the business property case, the 2012 CER for the RET is:

$$t_{4,1}^{e,RET} = \left(\frac{1}{1+6.12\%}\right)^{4} 0.221\%$$

$$t_{4,1}^{e,RET} = 0.17\%$$

As with business property, we assume residential appreciation accrues in line with inflation over 2012-2027 to again reflect Ontario's economic prognosis as suggested by the Commission on Reform of Ontario's Public Services. However, we further assume that the province continues to adjust RET rates (a la the Status Quo scenario) to countervail appreciation, implying that the 2027 CER for the RET is:

$$t_{3,5}^{e,RET} = 0.17\% \left(\frac{1}{1+2.0\%}\right)^{15}$$

$$t_{3,5}^{e,RET} = 0.13\%$$

where 2027 will be the third year of the fifth four-year assessment cycle and where $\pi=r=2.0$ percent. To calculate the value of T_p, we set $N=15$ and $t^*=0.13$ percent.

The Equivalent Level Effective Rate

Revisiting previous notation, we have $T \in \{T_I, T_S, T_P\}$ for the purpose of inputting a single quantity into the METR model which reflects a typical investor's expectations regarding future BET payments under a given policy scenario. There are two main categories of capital for which the BET applies: land and buildings. The value of T will vary across these categories due to likewise varying parameter values.

In order to provide an intuitive relationship between T and an infinite series of variable current effective BET rates t_n, we construct a notional quantity referred to as the equivalent level effective rate (ELER), hereafter denoted by t^E, which is the constant BET rate that would generate the same present value of BET levies on a dollar of capital owned as would the series t_n. Since in our view t^E is a more intuitive quantity with which to work compared to T, in this section we also modify Section A1's formula for R_g so that t^E becomes the relevant input which ultimately incorporates the BET into the METR model.

Defining $\overline{T}$ as the value of T when $t_n=\bar{t}$ for all n (i.e. is constant) where t_n is the current effective BET rate in period n and $\bar{t}$ is a BET rate that is constant over all periods n, we have $\overline{T} = \left(\frac{1}{R_f+\delta}\right)\bar{t}$. Thus, by definition t^E is the value of $\bar{t}$ which solves $\overline{T}=T$, so that $t^E=(R_f+\delta)T$ where $T \in \{T_I, T_S, T_P\}$ as outlined previously. Keeping in mind that T must be calculated for each policy scenario and relevant capital category (i.e. land and buildings), below are our calculated values for t^E:

$$t_I^{E,L} = 0.96\%$$

$$t_I^{E,B} = 0.96\%$$

$$t_S^{E,L} = 0.66\%$$

$$t_S^{E,B} = 0.78\%$$

$$t_P^{E,L} = 0.32\%$$

$$t_P^{E,B} = 0.48\%$$

As expected, the values of the ELERs under the Inflation Indexed scenario are equal to the corresponding CERs as calculated previously. It is the ELERs which are directly inputted into the Ontario METR model after modifying the formula for R_g as follows:

$$R_g = \frac{(R+\delta-u\beta i)\left[1-uA+(1-u)\left(\frac{1}{R_f+\delta}\right)t^E\right]}{1-u} - \delta$$

A3 Inter-Provincial METR Modelling

This section summarizes our modelling parameters, variables, and output for the METR model as tailored to each of the three provinces considered, contrasting BET-excluded and BET-included METR values. Combined with the material thus far presented, the information presented in this section can be used to reconstruct our model and replicate our results. In short, this section takes the reader through the development of Tables 3-5.

By assuming some commonality of modelling parameters (e.g. interest rates) among the three provinces, Alberta and British Columbia BET METR contributions are calculated on an order-of-magnitude basis and compared to that of Ontario. For this purpose, Alberta and British Columbia published 2012 BET rates are transformed in an equivalent manner as Ontario's was, taking the current BET rate setting policies in those provinces as given.

Parameters and Variables for Modelled Provinces

We summarize the values of the parameters and variables of the METR model common to all capital categories (i.e. CCA classes, land, and inventories) by province, corresponding to the year 2012 (Table A3-1 and Table A3-2).

The values for all of the exogenous parameters have been derived and/or taken from outside sources.[11] In particular, the values for the parameters m,c, and d are based on information obtained from the Canada Revenue Agency and provincial budgets, including 2012 PIT rates, credits and legislation applicable to investors within the highest provincial and federal PIT brackets. The value for u is the sum of the provincial and federal CIT rates, where a rate of 15 percent applies at the federal level as of July 1, 2012. The values for the endogenous variables ρ and R are calculated as shown previously in Section A1.

The values of the parameters δ,α, and w_k, which vary by capital category (Table A3-3), have been taken from McKenzie et al. (1998) and we assume they are common to all provinces. We have combined CCA Classes 1 and 3 into a "Buildings" capital category, where the corresponding values used for δ and α are weighted averages of those separately applicable to Classes 1 and 3 using their capital stock weights w_k as weights. Where applicable in Table A3-3, which displays Ontario model output for the case of the Status Quo scenario, algebraic symbols appear immediately beneath the column headings they represent as well as in parentheses to the right of terms indicated in the row headings.[12] The BET contribution to Ontario's METR as implied by Table A3-3 is 7.20 percentage points.

Equivalent Level Effective BET Rates in Alberta and British Columbia

The 7.20 percentage point BET METR contribution calculated for Ontario under the Status Quo scenario can be compared to analogous estimates for Alberta and British Columbia. Assuming modelling

11 McKenzie et al. (1998) did not specify a value for e since they assumed all investment income was of the capital gain form, which implicitly assumes e=1. Incidentally, the METR is strongly insensitive to the value assumed for this parameter.

12 Analogous tables for the other two Ontario scenarios and for the other two provinces are available from the authors upon request.

Table A3-1: Values of Exogenous Parameters By Province Common to All Capital Categories – 2012

Symbol	Ontario	Alberta	B.C.	Weighted	Description	Source
i	5.80%	5.80%	5.80%	5.80%	Nominal interest rate on debt	Finance Canada
β	37.50%	37.50%	37.50%	37.50%	Proportion of investment financed by debt	Bank of Canada
e	29.34%	29.34%	29.34%	29.34%	Proportion of equity held as retained earnings	Statistics Canada
m	49.53%	39.00%	43.70%	44.63%	Combined Provincial and Federal PIT rate on interest income*	Canada Revenue Agency
c	24.77%	19.50%	21.85%	22.32%	Combined Provincial and Federal PIT rate on capital gain income**	Canada Revenue Agency
d	34.49%	19.29%	25.78%	27.36%	Combined Provincial and Federal PIT rate on dividend income***	Canada Revenue Agency
π	2.00%	2.00%	2.00%	2.00%	Inflation rate	McKenzie et al. (1998)
u	26.50%	25.00%	25.00%	N/A	Combined Provincial and Federal CIT rate	Canada Revenue Agency

* Accounts for surtaxes and the new 13.16% maximum PIT rate (as of 2013) in the case of Ontario.

** Set to 50% of m since only half of capital gain income is taxable.

*** Accounts for provincial and federal enhanced dividend tax credits for eligible canadian dividends.

Note: In order to achieve uniformity in the opportunity cost of investment (R) across provinces (Table A3-2), the exogenous PIT rates of m, c, and d are weighted by 2011 provincial shares of total corporate physical capital sourced from Statistics Canada and then summed. The exogenous variables i, β, e, and π are assumed to be identical across provinces. The CIT rate u is left to vary across provinces as its inter-provincial variation is clearly integral to METR comparisons, hence the nominal opportunity cost of financing R_f and present value of CCA deductions A will vary slightly by province because they depend on u.

Source: Authors' calculation from sources listed.

Table A3-2: Values of Endogenous Variables Common to All Capital Categories and Modelled Provinces – 2012

Symbol	Value	Description
ρ	4.24%	Nominal rate of return on equity
R	2.82%	Real rate of return on investment (opportunity cost of investment)

Source: Authors' calculation from sources listed.

Table A3-3: Model Output for 2012 METR on Capital – Ontario, Status Quo Scenario

CCA Class or Capital Category	Economic Depreciation Rate	CCA Depreciation Rate	PV of CCA Depreciation on $1 of Capital	Equivalent Level Effective BET Rate	Overall Capital Share	Adjusted Capital Share**	BET Included			BET Excluded		
							Real Gross Rate of Return	METR on Capital	Weighted METR on Capital	Real Gross Rate of Return	METR on Capital	Weighted METR on Capital
k	δ	α	A	t^E		w_k	$R_{g,k}$	t_k	$t_k\ w_k$	$R_{g,k}$	t_k	$t_k\ w_k$
Land (L)	0.00%	0.00%	$0.00	0.66%	9.000%	9.342%	3.40%	20.58%	1.92%	3.06%	8.27%	0.77%
Buildings (B)*	3.68%	6.13%	$0.59	0.78%	28.400%	29.478%	3.70%	31.07%	9.16%	3.12%	10.54%	3.11%
6	3.90%	10.00%	$0.70	0.00%	0.380%	0.394%	2.91%	2.98%	0.01%	2.91%	2.98%	0.01%
13	4.30%	20.00%	$0.82	0.00%	3.600%	3.737%	2.66%	-5.77%	-0.22%	2.66%	-5.77%	-0.22%
26	2.90%	5.00%	$0.54	0.00%	0.011%	0.011%	3.10%	9.77%	0.00%	3.10%	9.77%	0.00%
33	15.00%	15.00%	$0.78	0.00%	0.017%	0.018%	3.62%	28.18%	0.00%	3.62%	28.18%	0.00%
41a	10.00%	100.00%	$0.96	0.00%	0.680%	0.706%	2.43%	-14.05%	-0.10%	2.43%	-14.05%	-0.10%
4	6.60%	6.00%	$0.59	0.00%	0.015%	0.016%	3.57%	26.41%	0.00%	3.57%	26.41%	0.00%
7	7.50%	25.00%	$0.85	0.00%	0.250%	0.259%	2.76%	-2.34%	-0.01%	2.76%	-2.34%	-0.01%
8	15.30%	20.00%	$0.82	0.00%	5.300%	5.501%	3.35%	18.83%	1.04%	3.35%	18.83%	1.04%
9	18.30%	25.00%	$0.85	0.00%	1.200%	1.246%	3.32%	17.69%	0.22%	3.32%	17.69%	0.22%
10	27.00%	30.00%	$0.88	0.00%	6.600%	6.850%	3.55%	25.90%	1.77%	3.55%	25.90%	1.77%
12	38.20%	100.00%	$0.96	0.00%	1.700%	1.765%	2.84%	0.63%	0.01%	2.84%	0.63%	0.01%
14	11.10%	11.00%	$0.72	0.00%	0.078%	0.081%	3.59%	27.06%	0.02%	3.59%	27.06%	0.02%
15	20.00%	100.00%	$0.96	0.00%	0.003%	0.003%	2.57%	-8.84%	0.00%	2.57%	-8.84%	0.00%
16	33.30%	40.00%	$0.90	0.00%	0.520%	0.540%	3.48%	23.15%	0.12%	3.48%	23.15%	0.12%
17	2.90%	48.00%	$0.92	0.00%	0.170%	0.176%	2.40%	-15.08%	-0.03%	2.40%	-15.08%	-0.03%
24	12.30%	46.00%	$0.92	0.00%	0.160%	0.166%	2.69%	-4.72%	-0.01%	2.69%	-4.72%	-0.01%
27	11.80%	46.00%	$0.92	0.00%	0.140%	0.145%	2.67%	-5.26%	-0.01%	2.67%	-5.26%	-0.01%
34	11.80%	48.00%	$0.92	0.00%	0.071%	0.074%	2.66%	-5.84%	0.00%	2.66%	-5.84%	0.00%
35	6.60%	7.00%	$0.62	0.00%	0.140%	0.145%	3.45%	22.24%	0.03%	3.45%	22.24%	0.03%
36	7.00%	7.00%	$0.62	0.00%	0.006%	0.006%	3.51%	24.17%	0.00%	3.51%	24.17%	0.00%
37	15.00%	15.00%	$0.78	0.00%	0.046%	0.048%	3.62%	28.18%	0.01%	3.62%	28.18%	0.01%
38	17.00%	30.00%	$0.88	0.00%	0.490%	0.509%	3.11%	10.06%	0.05%	3.11%	10.06%	0.05%
41b	10.00%	25.00%	$0.85	0.00%	0.330%	0.343%	2.89%	2.29%	0.01%	2.89%	2.29%	0.01%
42	12.00%	12.00%	$0.74	0.00%	0.036%	0.037%	3.59%	27.14%	0.01%	3.59%	27.14%	0.01%
43	10.90%	30.00%	$0.88	0.00%	7.000%	7.266%	2.83%	0.40%	0.03%	2.83%	0.40%	0.03%
Inventories (I)	0.00%	0.00%	$0.00	0.00%	30.000%	31.139%	3.78%	33.82%	10.53%	3.78%	33.82%	10.53%
Total (t^w)									**24.56%**			**17.36%**

* In 2007, the CCA depreciation rate for Class 1 manufacturing structures was increased from 6 percent to 10 percent. Ontario CVA shares from the 2010 FIR provincial summary for the industrial and non-industrial business classes are used to weight the 10 percent and 6 percent CCA rates, respectively, prior to merging Classes 1 and 3 as discussed in the foregoing text.

** The exploration and development sector and oil and gas sector, as defined in McKenzie et al. (1998), are excluded from the capital stock base.

Note: Weighted METRs for individual capital categories have been rounded to four decimal places prior to translation into percentages.

commonality with Ontario in terms of modeling parameters (aside from the provincial CIT rate of course), Alberta and British Columbia BET rates can be incorporated into the METR model to provide order-of-magnitude comparisons to Ontario. In order to incorporate British Columbia's 2013 reinstatement of the PST, however, we multiply the first term of the expression for R_g by $(1+t_s)$ as follows

$$R_g = \frac{(1+t_s)(R+\delta-u\beta i)\left[(1-uA+(1-u)\left(\frac{1}{R_f+\delta}\right)t^E\right]}{1-u} - \delta$$

where t_s is the effective sales tax rate.

In absence of a chart (like Figure 5) breaking out British Columbia's METR among the various taxes on capital, we assume that its reinstated PST will contribute to the METR in a manner consistent with Ontario's PST on a METR percentage point per PST percentage point basis. Ontario's 8% PST contributed 11.4/8 = 1.43 METR percentage points per PST percentage point as implied by Figure 5. Applying this result to British Columbia's forthcoming 7% PST rate, the PST's METR contribution in that province will be 1.43*7 = 10.01 percentage points. Such a METR contribution implies British Columbia's PST will impose an effective sales tax rate of 3.42 percent on capital investment, thus we set t_s = 0.0342 when estimating the British Columbia METR.

The published 2012 BET rate for Alberta is 0.397 percent, while the weighted average published 2012 BET rate for British Columbia is 0.597 percent once industrial tax credits are netted out. Since both provinces implement province-wide reassessments on an annual basis, these rates can be treated as CERs. The 2012 Alberta Budget has frozen BET rates, so we assume that an investor will expect the CER to remain at 0.397 percent over time.[13] Thus Alberta's ELER is 0.397 percent for both land and buildings. According to the 2012 British Columbia budget, that province will continue to adjust its BET rate to maintain revenue in real dollars. Maintaining the assumption that property appreciation is congruent with inflation, this policy is equivalent to fixing the 2012 effective rate of 0.597 percent in perpetuity. Thus British Columbia's ELER is 0.597 percent for both land and buildings.

13 Since Alberta cut residential and business education taxes as recently as 2011, investors could still expect BET rates in Alberta to change over time despite the 2012 rate freeze. For the purposes of modelling Alberta on an order-of-magnitude basis, we interpret the current freeze as holding indefinitely from the perspective of investors.