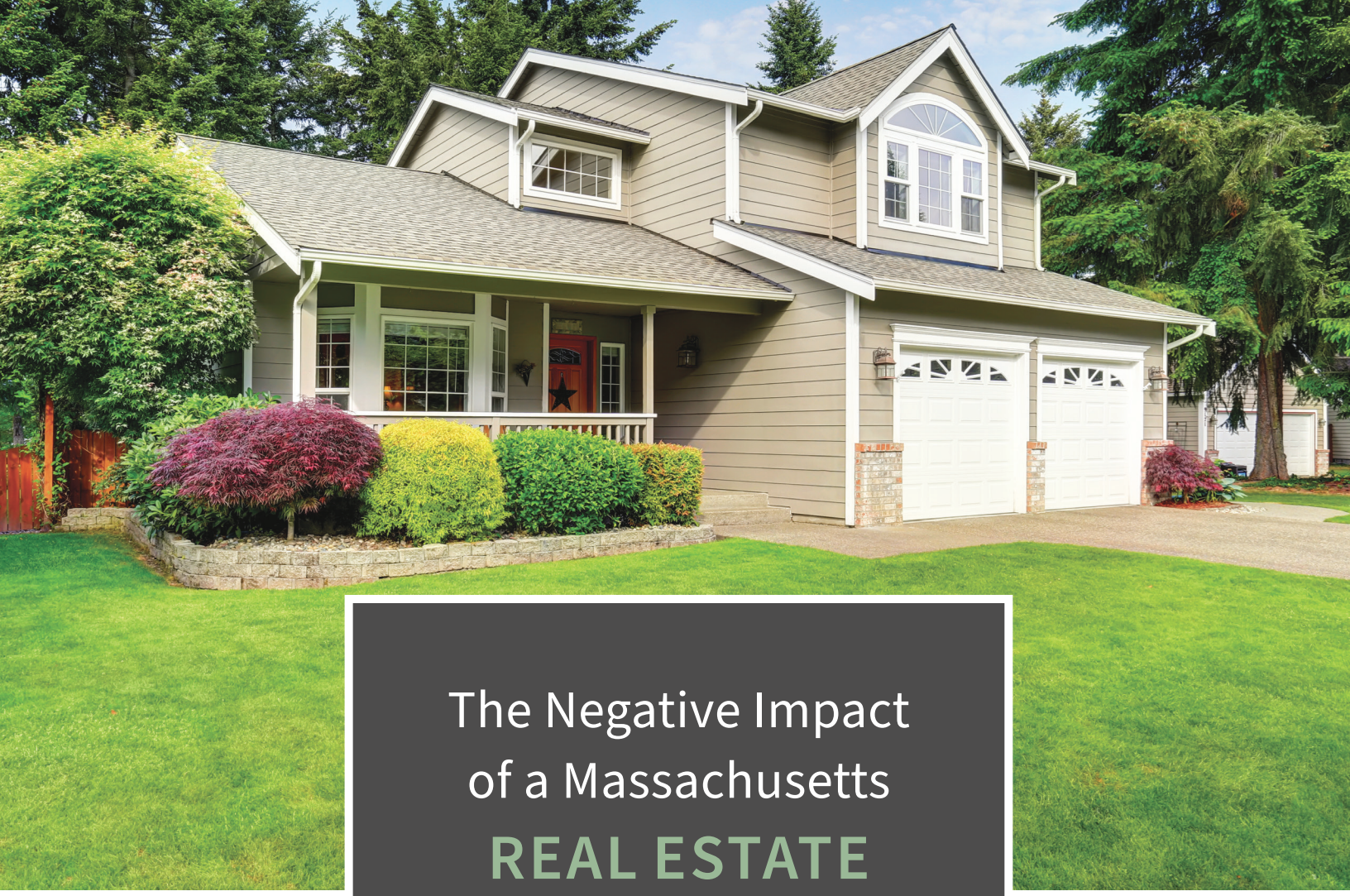

The Negative Impact of a Massachusetts REAL ESTATE TRANSFER TAX on Fiscal Revenue and Household Mobility

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The Negative Impact of a Massachusetts Real Estate Transfer Tax on Fiscal Revenue and Household Mobility*

Gilles Duranton,† Lu Han,‡ Matthew A. Turner §

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Abstract: We estimate the effect of a real estate transfer tax like the one proposed by the Affordable Homes Act. The proposed tax would raise around 384 million dollars for Massachusetts municipalities from residential real estate transactions. However, real estate transfer taxes have two well documented unintended effects: a 'lock-in' effect as people avoid the tax by moving less often, and a 'pass-through' effect as transfer taxes reduce property prices. Because of these pass-through and lock-in effects, the proposed real estate transfer tax reduces the revenue raised by existing capital gains taxes, the stamp duty, and ordinary property taxation. This leads to a net *decrease* in fiscal revenue. The proposed real estate transfer tax further harms Massachusetts homeowners by discouraging them from adjusting their housing as their circumstances change.

*This research was supported by Massachusetts Community Alliance. Any errors are our responsibility alone. The opinions expressed in this papers are those of the authors. They do not purport to reflect the opinions or views of their employers or any of the institutions they are affiliated with.

†Gilles Duranton is the Dean's Chair in Real Estate at the Wharton School of the University of Pennsylvania. email: duranton@wharton.upenn.edu.

‡Lu Han is the Nathan F. Brand Chair Professor in Real Estate and Urban Economics at the Wisconsin School of Business of the University of Wisconsin. email: lu.han@wisc.edu.

§Matthew Turner is a Professor of Economics at Brown University. email: matthew_turner@brown.edu.

1 Executive summary

The Massachusetts legislature is currently considering the Affordable Homes Act (Bill H.4138).[1] Among its many provisions, this bill creates an option for local governments to impose a real estate transfer tax of between 0.5% and 2.0% of the transaction price above one million dollars, payable by the seller. We here consider the implications of this tax for the residential property market.[2]

We are fortunate to be able to learn the effects of such real estate transfer taxes (RETTs) from other jurisdictions with similar taxes. A large, carefully conducted literature in economics shows that these taxes have two important unintended consequences for residential real estate markets. First, they reduce transaction prices, often by more than one dollar for every dollar of tax collected. Second, they reduce the volume of property transactions, probably by about 10% for every 1% of the transaction price collected as a transfer tax. It would be foolish not to expect the proposed RETT to have similar effects in Massachusetts.

That RETTs cause a reduction in prices and a reduction in transaction volume has two important implications. First, even without the new proposed tax, the transfer of properties in Massachusetts is already subject to a stamp tax and state and federal capital gains taxes. Thus, the reductions in prices and transaction volume reduce the base for these pre-existing taxes and thus their revenue. In addition, lower property prices also reduce the property tax base.

Using data that describe all transactions of residential property in Massachusetts for the past three years, we calculate that the new revenue directly raised by the proposed RETT will be less than the reduction from pre-existing taxes. Our best estimate is that if the proposed RETT were in place from 2021-23, then in an average year it would raise about 384 million dollars directly from residential transactions. At the same time, the proposed RETT reduces revenue from the stamp duty and capital gains taxes by 564 million dollars and from property tax by another 62 million dollars. In summary, the proposed RETT leads to a net loss in tax revenue of 242 million dollars per year, including a small net increase of 160 million dollars for the state and a decline of

[1] https://malegislature.gov/Bills/193/H4138, accessed May 7, 2024.

[2] Only the effects of RETTs on residential property markets have been closely studied in the economics literature. Given this, we primarily restrict our attention to the residential market, any conclusions we could draw about the commercial market are necessarily speculative.

402 million dollars for the federal government.

Second, the proposed RETT is a tax on the freedom to change residential location in response to the changing circumstances of our lives. This is harmful. The benefits of owning a home now come with the obligation to make a payment to the government should you want to live elsewhere. This obligation makes residential properties less valuable as people anticipate the need to live in a home that is too big, too small, or too far from work, in order to reduce their tax obligation. Using a conventional economic model, we estimate the dollar value of this additional harm to be close to 20 million dollars annually.

2 What is known about Real Estate Transfer Taxes (RETTs)

Real estate transfer taxes (RETTs) are widely used. Dachis et al. (2012) report that 34 US states and the District of Columbia all tax the transfer of real estate. RETTS are also collected in the UK and former British colonies, where they are known as a stamp duty. In Canada and many of the cities that collect them, they are known as land transfer taxes. In France and Southern Europe they are transfer duties.

The details of the different RETTs vary. Colorado, Massachusetts and Pennsylvania impose flat land transfer taxes of 0.01%, 0.46%, and 1% respectively. Some municipalities also impose their own flat rate RETTs, for example 3% in Philadelphia and Pittsburgh. Other municipalities have progressive taxes with an increasing marginal rate. Since 2022, the Chicago RETT has been zero on the first million dollars and 2.65% above this. In Los Angeles, since 2023, for properties between 5-10m$ the marginal rate is 4%, but 5.5% above.

Reliance on RETTs appears to be cyclical. India and Southern Europe had high real estate transfer taxes in the 1980s and subsequently lowered them. The RETT in West Bengal, for example, went from 22.3% in 1989 to about 5% in 2003. Similarly, France went from RETT rates above 10% in the 1980s to less than 5% in 1999 before rising again. There was another wave of adoption about 15 years ago with new RETT introductions and rate increases in the UK and Canada. After a period of relative inaction, we now observe renewed interest in RETTs with their introduction in LA and Chicago and rising rates in many jurisdictions worldwide. This type of cycle is not unusual, rent control follows a similar

pattern.

The last cycle of rate increases for RETTs triggered a wave of economic research on their effects. There is now a large, careful literature based on high-quality data examining the effects of RETTs on real estate markets. This literature documents the many complicated ways that people respond to what is, effectively, a tax on their freedom to change where they live as the circumstances of their lives change.

Two of the main conclusions of this research are consistent across places and studies. First, RETTs reduce the volume of real property transactions, at least in the short run.[3] Second, RETTs reduce transaction prices by about one dollar per dollar of tax. Because the first is a consequence of people being locked into their houses by their unwillingness to pay the RETT, we refer to this first effect as 'lock-in'. Because the second reflects the ability of buyers to pass the tax onto sellers, we call the second 'pass-through'. Understanding the magnitude of lock-in and pass-through is central to our effort to forecast the effects of the proposed RETT. In this section, we focus on learning how important these two effects are.

Dachis et al. (2012) assess the effect of a one to two percentage point increase in the land transfer tax in the city of Toronto. They compare residential property prices and the volume of transactions in a small buffer along the border between Toronto and surrounding municipalities around the time of the introduction of a land transfer tax. They estimate that, after a year, transactions fell by 15% and prices by about 1.3%. The RETT tax bill for an average affected property was about 1.1% of the transaction price. Dividing, we have a lock-in effect of about 13% per 1% of transaction value in RETT exaction, and an about 1.2 pass-through rate.

Han et al. (2022) also study the effects of the Toronto RETT using a data set that runs from 2006-2018, much longer than what was availble to Dachis et al. (2012). The primary interest of Han et al. (2022) is to understand the extent to

[3]Best practice econometric technique is better suited to estimate the effects of RETTs closer to the time they are introduced or changed when no other factor confounds the effect of the RETT. Thus, most of the available evidence on the effect of RETTs on transaction volume considers periods from a few months to a few years after they are introduced or changed. There is no evidence to suggest that the effects of RETTs on transaction volumes attenuate outside this window.

which the RETT causes people to prefer rental housing (which sells less often) to owner occupied housing. However, they also estimate the effect of the Toronto RETT on transaction volume and price. Reassuringly, their estimates are close to those of Dachis et al. (2012). They find that the RETT led to about a 13% decline in transaction volume and 1.5% decrease in price. As in the earlier study, the RETT tax bill for an average property was about 1.1% of the transaction price. Dividing, we have a pass through rate of about 1.3 and a lock-in effect of about 12%.

German states rely heavily on RETTs. In 2019, rates ranged between 4% and 6.5%. Two papers study the effects of these taxes. Comparing again taxed and untaxed jurisdictions, before and after changes in taxation, and using transaction data for German states between 2005 and 2015, Fritzsche and Vandrei (2019) find evidence of a reduction in transactions after increases in the RETT rate. They find that a 1% increase in the RETT causes a 7% reduction in transactions. That is, a lock-in effect of 7%. Dolls et al. (2024) also analyze the effects of the German RETT, but during the period 2005-2019 and using a different source of transaction data. They use a similar econometric methodology to estimate the effect of changes in the RETT on prices. They find that 1-2% increase in the RETT causes about a 3% decrease in prices. This is a pass-through rate between 1.5 and 3.

Davidoff and Leigh (2013) study the effect of changes in stamp duties on real estate markets in Australia. They also find strong pass-through effects and a reduction in the volume of transactions. Their estimates suggest a pass-through rate of about 8.3 and lock-in effect of about 10%.[4]

Besley et al. (2014) investigate the effect of the stamp duty holiday that occurred in the UK after the 2008 financial crisis. They find that the tax break resulted in a 3-8% increase in transaction volume and about a 0.7% increase in prices. Because the average stamp tax on affected properties was about 1% of the transaction price, this suggests a lock-in effect of 3-8% and a pass-through rate of

[4]Constructing lock-in and pass-through rates from the results in Davidoff and Leigh (2013) requires some arithmetic. They find that reducing the RETT tax bill by 10% increases transaction prices by about 2.5% and volumes by about 3%. Their estimate is based on a policy change that reduced the initial RETT tax bill from about 3.1% to about 2.8% of the transaction price, a 0.3% decrease. Thus, a 1% decrease in the RETT tax bill as a share of transaction price is $3\frac{1}{3}$ as large as the '10%' effect they report. Multiplying by $3\frac{1}{3}$ and get a pass-through rate of about 8.3 and a lock-in effect of about 10%.

about 0.7. It is worth noting that, unlike the changes in RETT programs discussed so far, the UK stamp tax holiday was intended to be of short duration. Some caution comparing these estimates with others is appropriate.

Many jurisdictions use progressive rate schedules for their RETTs. The proposed Massachusetts RETT is an example; transactions below the larger of one million dollars or the county median price are untaxed, and for transactions above this amount, only the amount above the threshold is subject to tax. Such tax schedules allows the marginal tax rate to increase without creating discontinuities in the tax obligation as the transaction price varies. Sometimes, however, jurisdictions introduce progressive tax rate schedules where rate increases apply to the entire transaction, not just the amount above a threshold. Absent the one million dollar exemption in the proposed Massachusetts RETT, if a transaction above one million dollars was subject to a 1% tax, then the tax bill for a one million dollar transaction would be 10,000$, and the tax bill for a 999,999$ transaction would be zero. These steps in the tax obligation, called 'notches' in the literature, create powerful incentives for market participants to change their behavior to reduce their tax bill. In our example, one expects transactions between 1,000,000$ and 1,010,000$ to be extremely rare.

An interesting and sophisticated literature uses the response to the notches created by progressive RETT tax rates to learn what market participants value and how different market participants are from one another. Best and Kleven (2018) exploit a variety of notches in the UK stamp duty for this purpose, and is a seminal paper in this literature. They find clear evidence that notches change market behavior in important and intuitive ways. In particular, Best and Kleven (2018) find that a reduction in the UK stamp duty equal to 1% of the transaction value caused an about 10% increase in transaction volume and a 2-5% increase in prices.

Kopczuk and Munroe (2015) rely on a similar methodology to Best and Kleven (2018) to investigate the effect of notches created by RETTs in New York City and New Jersey. They find that an increase in the real estate transfer tax of about 1% of the transaction value causes about a 2% decline in prices. The Kopczuk and Munroe (2015) results do not allow an estimate of the lock-in effect, except in a very small subset of transactions for which they estimate a large lock-in effect.

Table 1: Estimates of pass-through rates and lock-in effects in the literature.

Paper	Setting	Pass-through	Lock-in
Besley et al. (2014)	UK, 2008-2010	0.7	3-8%
Best and Kleven (2018)	UK, 2004-2012	2-5	10%
Dachis et al. (2012)	Toronto, 2006-2008	1.1	13%
Davidoff and Leigh (2013)	Autralia, 1993-2005	8.5	10%
Dolls et al. (2024)	Germany, 2005-2019	1.5-3.0	N/A
Fritzsche and Vandrei (2019)	Germany, 2005-2015	N/A	7%
Han et al. (2022)	Toronto, 2016-2018	1.3	12%
Kopczuk and Munroe (2015)	NYC, 2003-2011	2	N/A
Slemrod et al. (2017)	Washington DC, 1999-2010	0	0

Note: Several of these papers estimate the effect of the 'start of the RETT' on prices and transaction volume when the RETT imposition varies across properties. To compare magnitudes across studies, we divide the reported lock-in and pass-through estimates by the tax bill for an average transaction.

Finally, Slemrod et al. (2017) examine the effect of notches created by the Washington DC RETT. While they are primarily interested in the extent to which people adjust the price and timing of transactions to avoid discontinuous increases in their real estate transfer tax obligations, they incidentally provide a basis for thinking about the effect of the RETT on pass-through and lock-in. Unlike every other investigation of RETTs on lock-in and pass-through, they find that these effects are zero. This presents a puzzle for which we cannot offer a definitive resolution.[5]

Table 1 summarizes what we learn from the literature. While there is variation across studies, the available evidence strongly supports a pass-through rate of about one. We should expect that for each dollar of RETT collected on a transaction, the transaction price will fall by about one dollar. We should also expect that a RETT imposition equal to 1% of the transaction price will reduce the volume of transactions by at least 8%.

We also note the existence of a large literature in finance which investigates the effects of financial transaction taxes. Even if direct comparison with real

[5]Their main explanation is that the changes in DC were fairly small adjustments to an existing tax and may not have been salient to house buyers and sellers in DC. A DC-specific spike in housing demand right at the time of the implementation of the taxes, especially for the first change in early 2003, is another possibility.

properties are difficult, in a review of this literature Burman et al. (2016) highlight large lock-in effects of financial transaction taxes on the volume of transactions and extremely large pass-through effects for assets that are more frequently traded than houses.

3 The taxation of real estate transfers

Besides the proposed RETT, real estate transactions in Massachusetts are subject to a number of other taxes, both at the federal and state level. We begin by listing and describing these taxes.

RETT: This is the tax on transfers of real estate proposed in the Affordable Homes Act, and is the tax that we would like to evaluate. The proposed RETT is assessed on transaction prices above one million dollars or the county median house price, whichever is greater[6] Letting 'RETT%' indicate the transfer tax rate, the total payment required from the seller is,

$$\text{Transfer tax} = \begin{cases} (\text{Price} - 1\text{m\$}) \times \text{RETT\%} & \text{if Median price <1m\$} \\ (\text{Price} - \text{Median price}) \times \text{RETT\%} & \text{if Median price >1m\$.} \end{cases} \quad (1)$$

No tax is paid if the selling price is less than one million dollars or the median price, whichever is higher. The enabling legislation leaves the choice of RETT rate, between 0.5% and 2%, to municipalities. Like the analysis provided by the Massachusetts Executive Office of Housing and Livable Communities,[7] we primarily consider a 1% RETT adopted by all municipalities. That is, RETT%= 1% everywhere.

Stamp tax: The stamp tax is a tax paid by the seller to the relevant county or municipal government when a property is transferred. The amount of this tax is,[8]

$$\text{Stamp Tax} = \begin{cases} \text{Price} \times \frac{4.56}{1000} & \text{All Counties but Barnstable} \\ \text{Price} \times \frac{5.70}{1000} & \text{Barnstable County.} \end{cases} \quad (2)$$

[6]The details of this tax are described here: https://www.mass.gov/info-details/the-affordable-homes-act-transfer-fee-analysis. Accessed April 18, 2024.

[7]See https://www.mass.gov/info-details/the-affordable-homes-act-transfer-fee-analysis. Accessed April 18, 2024.

[8]https://www.mass.gov/directive/directive-89-14-exchange-of-property, accessed April 18, 2024.

Capital gains (federal): The sale of real estate is subject to federal capital gains tax. The details of this tax are complicated,[9] and we describe only its main features below.

If a house is sold after less than a year, short-run capital gains are taxed like ordinary income. In that case, we assume a rate of 22%, the marginal tax rate for a married couple filling jointly with income between 94k$ and 201k$.

If a house is held for more than a year, the capital gains tax rate is 15% for married couples filing jointly with income between 89k$ and 553k$, or for individuals with incomes between 44k$ and 492k$. We also use this rate in our calculations.

If the seller owns the home for less than two years, then the entire gain in value, net of investments made to the home and transaction costs is subject to the tax. For married couples who own their home for more than two years, there is an additional 500$k deduction. For singles, the deduction is 250k$. Assuming that transaction costs are 8%, we have

$$\text{US Cap. gains} = \begin{cases} (\text{Price} \times 0.92 - \text{Last Price}) \times 0.22 & \text{Own} < 1\text{yr} \\ (\text{Price} \times 0.92 - \text{Last Price}) \times 0.15 & 1\text{ yr} < \text{Own} < 2\text{yr} \\ (\text{Price} \times 0.92 - \text{Last Price} - 500\text{k\$}) \times 0.15 & \text{Own} > 1\text{yr, Married} \\ (\text{Price} \times 0.92 - \text{Last Price} - 250\text{k\$}) \times 0.15 & \text{Own} > 1\text{yr, Single.} \end{cases} \tag{3}$$

No tax is paid if there is no capital gain as described above. For the purpose of our calculations, a house with two owners gets the 'married' exemption, and a house with one owner gets the 'single' exemption.[10]

Capital gains (Massachusetts): The sale of real estate is subject to Massachusetts capital gains tax. Massachusetts capital gains tax is calculated in a similar way to

[9] For details, see https://www.irs.gov/pub/irs-pdf/p523.pdf. Accessed May 7, 2024

[10] We do not observe capital investments and so cannot evaluate their impact on capital gains taxes. We assume a small additional deduction of 2% for investments and closing costs. The 250 and 500 k$ deductions only apply to owner-occupiers. We do not observe the tenure status of sellers, and so we assume that they are all owner-occupiers. This is conservative. Country-wide, 94% of all houses and most condos are owner-occupied (https://www.statista.com/topics/5144/single-family-homes-in-the-us/#topicOverview, accessed May 7, 2024) with an even higher ownership share for the expensive properties to which capital gains taxes more often apply. We note that owner-occupiers are also more likely to buy and sell properties than rentiers (Han et al., 2022).

the federal tax,[11] except that a short run capital gains tax rate of 8.5% applies to houses owned less than one year, and a 5% rate applies to houses owned more than one year.[12] Thus, we have

$$\text{MA Cap. gains} = \begin{cases} (\text{Price} \times 0.92 - \text{Last Price}) \times 0.085 & \text{Own} < 1\text{yr} \\ (\text{Price} \times 0.92 - \text{Last Price}) \times 0.05 & 1\text{yr} < \text{Own} < 2\text{yr} \\ (\text{Price} \times 0.92 - \text{Last Price} - 500k\$) \times 0.05 & \text{Own} > 2\text{yr, Married} \\ (\text{Price} \times 0.92 - \text{Last Price} - 250k\$) \times 0.05 & \text{Own} > 2\text{yr, Single.} \end{cases} \tag{4}$$

Property tax: The property tax is paid by the homeowner in each year. Although the property tax is not a transfer tax, the proposed RETT will impact property tax payments and revenue, so we include it in our list for later reference.

A property owner's property tax bill is simply the product of the property's assessed value and the property tax rate.

$$\text{Property tax} = \text{Assessed value} \times \text{tax rate.} \tag{5}$$

In Massachusetts, assessed values are updated regularly to track 'full and fair cash' value. Tax rates across municipalities range from 0.25% to 2.29%.[13] There are also various exemptions from property taxation for qualifying senior citizens, veterans, blind persons, etc.[14]

According to the MA Department of Revenue, in 2023 the average assessed value of the 1,437,287 residential properties subject to property tax was 601k$, and the average property tax bill was 7,056$. This implies an average annual effective tax rate of 1.17%.[15] Elementary calculations establish that total property

[11] https://budget.digital.mass.gov/govbudget/fy20/tax-expenditure-budget/personal-income-tax/exclusions-from-gross-income/1-021. Accessed May 7, 2024

[12] https://www.mass.gov/info-details/massachusetts-tax-rates, accessed April 18, 2024.

[13] An enumeration of municipal property tax rates is available here: https://dlsgateway.dor.state.ma.us/reports/rdPage.aspx?rdReport=PropertyTaxInformation.taxratesbyclass.taxratesbyclass_main. Accessed May 7, 2024

[14] See https://www.mass.gov/guides/massachusetts-municipal-property-taxes for details. Accessed May 7, 2024

[15] https://www.mass.gov/info-details/massachusetts-average-single-family-tax. Accessed May 7, 2024.

tax revenue in Massachusetts was 10.14bn$ for 2023.[16]

4 The sum of all taxes

We would like to understand how the proposed RETT will affect the taxes paid by buyers and sellers, how the number of transactions will change, and how tax revenues will be affected. To accomplish this, we first estimate the fiscal revenue collected under the current (observed) tax system by applying the formulas in Section 3 to actual transaction data.

We use the Warren Group data that describe all real estate transactions in Massachusetts between January 1, 2021 and December 31, 2023. For each transaction, we observe transaction date, transaction price, assessed value, property tax payment, the date and price of the previous transaction, the number of sellers, location, and a short list of property features. These data are the same as those used for the *Massachusetts Executive Office of Housing and Livable Communities* analysis of the proposed RETT, although we use three years instead of just one.[17]

In each of 2021, 2022 and 2023, the behavior of the real estate market was unusual. The first two years were affected by the COVID pandemic surge in housing demand, and 2023 by an increase in mortgage rates. For this reason, we consider an average over all three years. We adjust sales prices to 2023 dollars using the consumer price index for urban consumers in Massachusetts.[18]

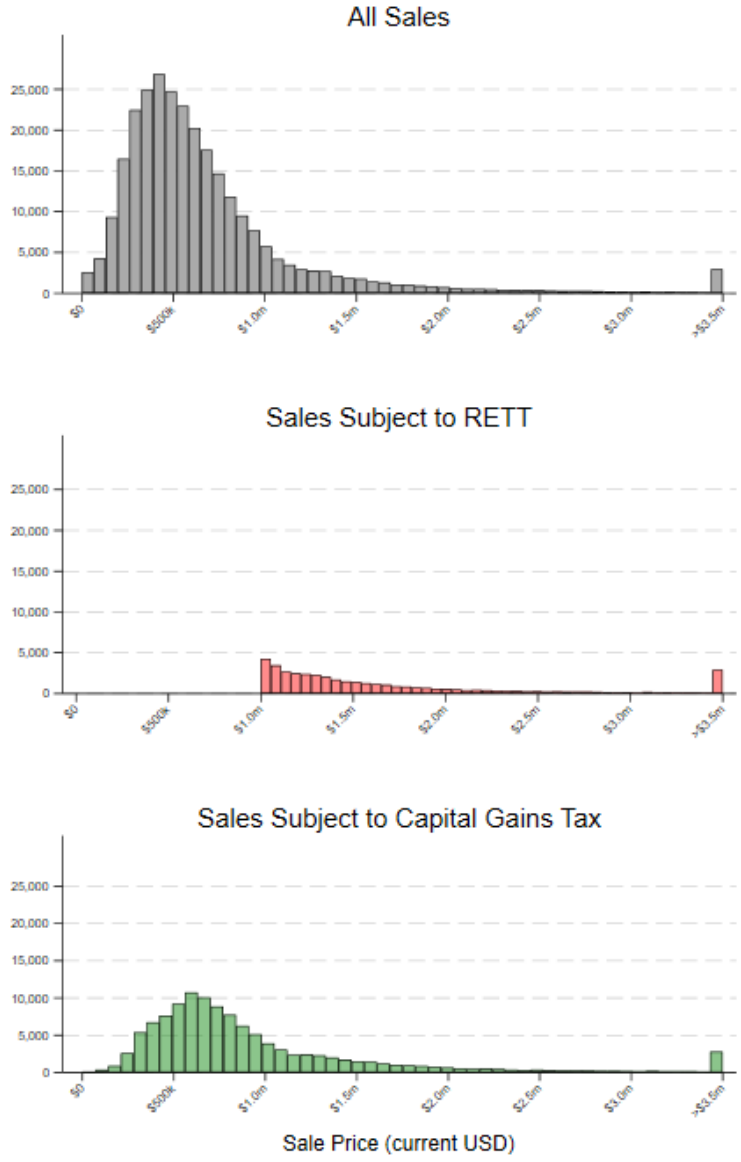
Figure 1 describes our transaction data. The first histogram describes the distribution of transactions for 2021, 2022 and 2023 by transaction price (in 2023 dollars). There are 280,983 transactions in total with an average price of 732,067$.

[16]Because of the complexity of the property tax, we estimate the effects of the proposed RETT on property tax revenue using aggregate values and averages. This contrasts with the other taxes that we consider. For all other taxes, we are able to estimate impositions on a transaction by transaction basis.

[17]These data are proprietary and are provided by the Warren Group. Using the 2022 Warren data, the Massachusetts State Government's evaluation of the RETT states that "EOHLC estimates that 17,298 transactions – 14.8% of the total – could have been subject to the proposed transfer fee in FY2022 if it was universally applicable at the time. This includes 13.4% of all residential transactions (14,332 sales), 34.1% of commercial transactions (2,253 sales)." These numbers are 16,733, 14.6%, 13.4%, 14,905, 38.0% and 2,165, respectively in the Warren data that we use.

[18]See https://fred.stlouisfed.org/series/CUURA103SA0. Accessed May 7, 2024. Note that we do not adjust prices for previous sales because capital gains taxes are computed on the basis of the unadjusted purchase price.

Figure 1: Distributions of transactions by price



Note: Transactions data for 2020, 2021, and 2022 for residential properties in Massachusetts from the Warren Group. Top panel: distribution of all properties by transaction price. Middle panel: distribution of all properties subject to a potential 1% RETT as described in section 3, by transaction price. Bottom panel: distribution of all properties subject to capital gains taxes(federal or state) following the imputation rules described in section 3.

The second histogram reports an analogous distribution for properties subject to the RETT. There are 41,589 transactions above the RETT deduction (the larger of one million dollars or the median county house price) and the average price of these houses is 2,032,637$. The third histogram reports an analogous distribution for properties subject to capital gain taxation, either federal or state. There are 116,377 transactions subject to capital taxation and the average price of these houses is 1,059,286$.

Bringing all this information together, the first row of table 2 below reports all the taxes for the average residential transaction for the years 2021, 2022, and 2023 in 2023 dollars. The stamp duty is 3,395$, the Federal capital gains tax is 27,280$, the state capital gain tax is 9,456$. In total, the total burden is 40,131$. This corresponds to an average effective tax of 5.5%.

We see in figure 1 that the distribution of house prices is skewed towards expensive houses, and so the average house is too expensive to be representative. Alternatively, if we consider the median house, we find that it sells for 543,450$, and has a lower effective transfer tax rate of 0.6%. We note that houses near the median of the price distributions are seldom subject to capital gain taxes. Only 41.4% of houses sold at prices close to the median pay any capital gain tax, typically following short holding periods. Adding 8% for transaction costs and investment, the cost of changing owners for a house is 98,696$ for the average house sold in Massachusetts or about 13.5% of its value and 46,859$ or 8.6% of its value for the median house.

The first row of table 3 also reports that the total tax that the state and federal government derive from residential real estate transactions in Massachusetts is 11.3bn$. Of this, 3.6bn$ is collected by the state of Massachusetts [19]

In addition to real estate transfer taxes, we recall that Massachussetts municipalities collected about 10.14bn$ of property tax in 2023.

5 The effects of introducing a RETT

We now turn our attention to the case where the proposed RETT is in place. We start with a 'naive' calculation to consider what the aggregate tax revenue of the RETT would be *in absence of any other change on the residential property market*.

[19] These values are estimated using the assumptions described above in the text. They will differ slightly from their true value depending on sellers' exact fiscal situations and various exemptions about which we have no information.

This calculation is performed in the second row of table 3 where we retain all the figures of the observed situation from the first row and add a 1% RETT generating 422m$.

While useful as a benchmark, this naive calculation is not a useful guide to what we expect to happen after the introduction of a RETT. As we saw above, the imposition of the RETT has two effects on property markets. First, with the pass-through effect transaction prices with a RETT are not the same as without. Second, with the lock-in effect, the volume of transactions decreases under the RETT and so the set of transactions also changes. This creates a conceptual problem. We observe prices and transactions without the RETT, but to evaluate the RETT we require the counterfactual prices and transactions realized once the RETT is in place.

Let τ indicate the dollars of RETT collected from a given transaction. We know that these taxes are passed through into prices. Suppose that for every dollar of RETT collected, transaction prices decrease by β. If we let P^1 be the unobserved counterfactual price, and P^0 be the observed actual price, then these two prices are related in the following way:

$$P^1 = P^0 - \beta\tau. \tag{6}$$

In words, the price after the introduction of the RETT will be equal to the price in absence of RETT minus the pass-through of the RETT. As buyers expect of residential properties expect to be taxed, they are willing to pay less for a property.

In theory, values of the pass-through rate of the tax β between zero and about four can be defended as prospective buyers may account, not only for the RETT to be paid for their upcoming purchase, but also the effect of the RETT on its eventual re-sale and subsequent future sales. See Appendix A for a formal calculation leading to pass-through rates around four using a conventional technique for addressing these sorts of dynamic valuation problems.

We discuss the empirical magnitude of the pass-through rate β of the tax above. From past experiences of RETT introductions, the most likely estimate seems to be that it is at least one. Hence, conservatively and in line with the results of previous studies, we assume $\beta = 1$. For each dollar of RETT collected on a transaction, the transaction price falls by one dollar: $P^1 = P^0 - \tau$.

Next, we need to handle the following difficulty. The amount of tax collected by the RETT is calculated on the basis of the counterfactual and thus unobserved transaction price P^1 that obtains when the RETT is imposed. Not only do we not know the counterfactual price P^1 under the RETT, but because we do not immediately know P^1, we cannot calculate the amount of RETT paid, τ. Both quantities are interdependent.

In Appendix B, we provide a solution to that problem using the equations that determine the tax on a property as a function of its price (equation 1) and the price of a property as a function of the tax it faces (equation 6). After solving these two equations for the counterfactual price for each observed transaction , we can evaluate all counterfactual taxes, RETT, stamp, and capital gains at the federal and state levels.

The next problem to solve relates to the sample of transactions subject to real estate transaction taxes given the lock-in effect. Under the prospective RETT, some of our observed transactions would not occur, and common sense suggests the higher the RETT faced by a property, the less likely the transaction. Beyond this, however, we have no way to determine which of the observed transactions, exactly, would not occur in the counterfactual case.

In Appendix C, we argue from results in the literature that it is natural to assume that the probability of transaction of a property that would otherwise be transacted in absence of a RETT declines with the effective RETT tax being paid (the share of the RETT tax bill in the transaction price). Slightly more formally, we assume that the probability of a transaction falls by $\gamma \frac{\tau}{P^1}$, where $\frac{\tau}{P^1}$ is the effective RETT tax rate and γ is the lock-in factor.

Applying this logic, if a RETT bill of 1% of the transaction price gives us a 12% decrease in transaction volume (as in Toronto in 2009 Dachis et al., 2012), then we have $\gamma = 12$. For the proposed RETT with a 1m$ deduction and 1% tax rate, transactions with a sale price below 1m$ are unaffected, but of 100 observed transactions with a counterfactual price of 2m$ only 94 would occur.[20] In our main estimates, we assume the value of 12 for the lock-in effect, is consistent with estimates presented in table 1. To investigate the sensitivity of our

[20]With a 1% RETT rate and a 1m$ deduction, a 2m$ transaction pays 10,000$ in tax. This is 0.5% of the transaction price, so with $\gamma = 12$, we have that 6% of these transactions do not occur because of the lock-in effect of the RETT.

Table 2: Mean tax per transaction with and without RETT

	RETT	Stamp	U.S. Cap. Gains	MA Cap. Gains	Total
Observed	0	3,395	27,280	9,456	40,131
0.5% RETT	748	3,391	27,185	9,424	40,748
1.0% RETT	1,488	3,388	27,092	9,392	41,360
1.5% RETT	2,221	3,385	27,000	9,360	41,965
2.0% RETT	2,946	3,381	26,908	9,329	42,565

Note: In all cases, the average is taken over the set of transactions that would have been subject to each tax on the basis of its observed transaction price. In all cases, we assume a price pass-through of one. Figures all in 2023 dollars.

conclusions to this choice of lock-in, we also consider scenarios with larger and smaller lock-in effects.

Using the transaction probabilities just defined, the counterfactual transaction prices, and the definition of the proposed RETT, we can calculate average aggregate transaction volume and tax revenue from the RETT.[21] The change in the number of transactions also reduces the revenue from the stamp duty and capital gains taxes. We can calculate this reduction in the same way.

Because the ordinary property tax applies to all properties, not just those that change hands, we require a different method to evaluate property tax revenue with the proposed RETT. We postpone this calculation until the end of this section.

The proposed RETT affects only about 15% of residential properties sold. Moreover, because of the one million dollars (or more if the median house price is higher), many houses subject to the RETT pay only a small amount. As table 2 reports, even a 2% RETT would generate on average less than 3,000$ per property. For a 1% RETT, the effective average tax rate would be about 0.2% of the transaction price, even less than the 0.456% stamp duty that applies in most of the state.

After factoring in the pass-through of this tax into the price and its lock-in

[21] In more detail. To compute the expected tax revenue from the RETT, we take into account both the decrease in price and volume caused by the imposition of the proposed RETT. Then, we can calculate the expected revenue generated by this tax, by calculating the τ for all observed transactions with a counterfactual price above the relevant threshold, and then summing them, weighted by the probability that the transaction would occur.

Table 3: Tax revenue with and without 1% RETT

	RETT	Stamp	U.S. Cap. Gains	MA Cap. Gains	Total
Observed	0	954	7,665	2,657	11,276
Naive 1% RETT	422	954	7,665	2,657	11,698
Pass-through only	418	952	7,612	2,639	11,621
Lock-in only	388	930	7,310	2,536	11,165
Pass-through & lock-in	384	929	7,263	2,520	11,096

Note: Expected total revenues where the probability any observed transaction occurs under the counterfactual is given by the equations in Appendix C. In all cases, we assume that pass-through is 1 and lock-in is 12. Figures all in 2023 dollars.

effect, in table 3, we calculate that the proposed 1% RETT will generate 384 million dollars in revenue from residential transactions. This is 38m$ less than the 422 million dollars in the naive calculation. The difference arises because the naive estimate does not account for the reduction of the tax base resulting from the pass-through and lock-in effects.

Despite its small size, a 1% RETT has a large negative effect on revenue raised by existing taxes, mainly the capital gains taxes. To understand why this occurs, note that the effective tax rate of the RETT is highest for the most expensive homes. For homes at the 95th percentile of the price distribution (that is, the fifth most expensive in a hundred) the RETT imposition is 0.69% of the transaction price. This decreases to 0.58% and 0.38% for homes at the 90th and 75th percentile. Even though the RETT imposition is small on average, it is largest for the very expensive homes that are responsible for most of the capital gains tax revenue. For these houses, the pass-through and lock-in effects are correspondingly larger, and as we will see, this reduces the tax base of the capital gains taxes in an economically important way.

To generate 384 million dollars in fiscal revenue, the RETT discourages the sale of the most expensive residential properties, which disproportionately pay capital gain taxes and, to a lesser extent, the stamp duty. As a result of the lock-in effect and the pass-through effect, the revenue from state capital gains tax declines by 137 million dollars. For the state, the revenue from the stamp duty also declines by a further 25 million dollars. Finally, the federal capital gain taxation declines by a further 402 million dollars, more than offsetting what the RETT raises.

These decreases are mainly driven by the lock-in effect. Consider for instance

Table 4: Tax revenue with 1% RETT accounting for pass-through and lock-in

Lock-in (γ)	RETT	Stamp	U.S. Cap. Gains	MA Cap. Gains	Total
6	401	940	7,438	2,579	11,358
8	396	936	7,379	2,560	11,271
10	390	933	7,321	2,540	11,183
12	384	929	7,263	2,520	11,096
20	362	913	7,030	2,441	10,745

Note: Expected total revenues where the probability any observed transaction occurs under the counterfactual is given by the equations in Appendix C. In all cases, we assume a price pass-through of 1. Figures all in 2023 dollars.

a property at the 95th percentile of the price distribution. This house is subject to an effective RETT rate of 0.69%. With our assumption of a pass-through rate of 1, the RETT reduces the price of this property by 0.69% which, in turn, leads to small reductions in RETT payments, stamp duty and capital gains. At the same time, a 0.69% effective RETT rate is expected to reduce the probability of sale by 12 times this amount or 8.28%. Thus, we expect an 8.28% decline in transaction volume for such houses. Even without a pass-through effect, this gives an 8.28% reduction in transfer tax revenue for these houses.

Table 4 considers a variety of alternative scenarios for the lock-in rate, from $\gamma = 6$ to $\gamma = 20$. This table shows that even for a lock-in rate of 8, the fiscal revenue from the RETT is still more than offset by the reduction in revenue from other taxes.

The RETT will also affect the revenues of the property tax, assuming a constant mill rate. To obtain the counterfactual property tax revenue for Massachusetts, we need to know how the value of the entire stock is affected by the RETT because the RETT affects the value of all residential properties, not just those that change hands.

In the absence of detailed information on the stock of residential properties in Massachusetts, we first measure the value of all properties sold in 2021-2023. For these three years, the average number of transactions is 93,661 at an average 2023 value of 732,067$. This implies a volume of transactions of 68.6 bn$. As reported above, there are 1,437,287 residential properties in Massachusetts valued by their municipalities at 601k$ each on average. This implies a stock of housing of about 864bn$ for the entire state or 12.6 times the value of annual

transactions in our data.

For actual transactions, a 1% RETT would yield 422m$ in revenue, as per the second row of table 2. With a pass-through rate of one, this also represents a reduction of in the value of sold houses of the same amount. Extrapolating to the value of the entire stock, 12.6 times the value of annual transactions, we obtain a reduction in the value of the stock of residential housing in Massachusetts of $12.6 \times 422 = 5.32$bn$.[22] With an effective property tax rate of 1.17% for the state, the loss for the property tax revenue is another $62.2m annually. This lower property tax only reflects the pass-through rate, which we took to be a conservative one for one with the RETT, and is independent from anything we assume about the lock-in rate.

Summing up, a 1% RETT consistent with the Affordable Homes Act would raise 384m$ of revenue, but would reduce the tax bases for other taxes. This results in a 564m$ decline of stamp duty and capital gains revenue. In addition, the ordinary property tax yields 62m$ less municipal revenue (without increases in the mill rate). In total, with a 1% proposed RETT the state and its jurisdictions would raise a net of only 160m$ (384m$ from the RETT minus lost fiscal revenues of 137m$ from state capital gain taxes, 25m$ from stamp duty, and 62m$ from property taxation), while the federal government would lose 402m$ from capital gain taxation. Overall, the net fiscal revenue would decline by 242m$. This figure is under our preferred assumptions regarding the lock-in and pass-through rates. Even with a lock-in effect only half of what we assume ($\gamma = 6$), at the very low end of estimates from the literature, the introduction of the RETT would increase total fiscal revenue by only about 20m$.

We do not account for the Massachusetts Millionaire Tax, an income surtax of 4 percentage points for taxable incomes above 1m$ introduced in 2023. Because we cannot link real estate transactions to owners' incomes, a precise analysis of how the RETT will interact with this tax is beyond our ability. However, the following example suggests the magnitudes involved. Consider a house sold for 1.8m$, This house is at about the 95th percentile of the house price distribution in Massachusetts. Assume that the taxable capital gain from

[22] This calculation assumes the same effective RETT rate for sold and unsold residential properties, even though the latter are cheaper and pay on average a lower effective rate. On the other hand, it is also safe to assume to that the effective rate of property taxation of more expensive homes is higher since they are less likely to benefit from targeted exemptions.

the sale of this house is 700,000$, about at the 95th percentile of taxable capital gains for the state. Finally, assume this house is sold by an owner at the 95th percentile of the Massachusetts income distribution, earning about 414,000$ in 2023 without the capital gains.[23] With the sale of the house, the owner's 2023 taxable income is $414{,}000 + 700{,}000 = 1.114m. In this example, the surtax of 4% for income above 1m$ leads to a tax obligation of 4,560$. For comparison sake, a 1% RETT obligation on the 1.8m$ sale would be 8,000$. With an income of 514,000$ instead of 414,000$, this household would end up paying 9,560$ of millionaire's tax when selling their house.

We draw the following conclusions from this example. When it applies following the sale of a residential property, the millionaire income surtax is likely to be of about the same magnitude as a 1% RETT. While the millionaire income surtax only affects a small fraction of Massachusetts tax payers (less than 1% of them)[24], it mechanically affects sellers of expensive houses paying significant capital gains and non-trivial income tax surcharges. To the extent that the lock-in effect of the new RETT reduces the volume of transactions, we should expect the new RETT to also reduce the revenue raised by the income tax surcharge. In turn, this decreases the net revenue raised by the RETT beyond our estimates above.

6 The RETT and welfare

A principle of good public finance is that the tax system 'distort' the economy as little as possible. This jargon is arcane, but easily illustrated by an example. Consider a legislator who must raise 100$ per person in tax revenue. She has the choice of a a tax which simply collects 100$ from everyone, or a tax which collects 100$ from everyone who stands on one foot for a minute on April 15, and 200$ from everyone else. We expect both systems of taxation to raise the same revenue, but one makes the average taxpayer worse by whatever discomfort they endure standing on one foot for a minute. This example is trivial in order to illustrate the idea. In practice, distortions caused by the tax code are more subtle and harder to measure. More realistic examples include choosing to work a little less because an hourly wage is taxed, investing less

[23] https://dqydj.com/income-by-state/, accessed May 21, 2024.

[24] https://www.fiduciary-trust.com/insights/2023-ma-millionaires-tax/, consulted May 21, 2024.

because investment is taxed, reducing the number axles on large trucks to reduce the per-axle tax obligation, etc.

The RETT is a tax on the right to change your place of residence when circumstances change and it is distortionary. The empirical literature demonstrates that the people respond to RETTs in part by staying in their houses longer than they would in the absence of the tax. The loss in welfare that people experience from this reduced ability to adjust their residential location to suit the changing conditions of their lives, to move closer to school, work or family, is a loss to society just as wasteful as was the time spent standing on one foot in the example that motivates this discussion. In the jargon of economics, the RETT causes a deadweight loss.

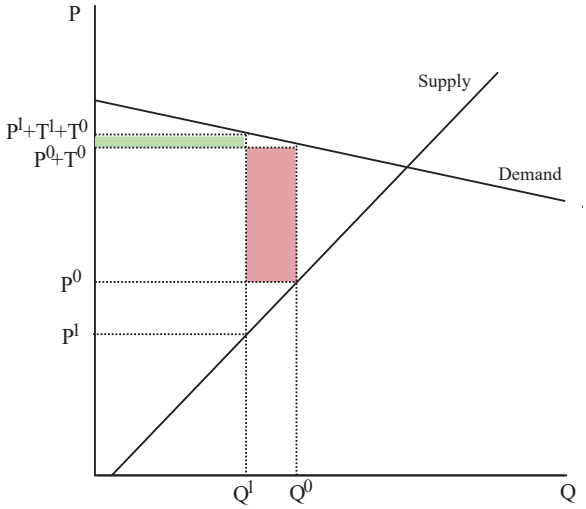
Our problem is to place a dollar value on this deadweight loss. This is a well understood problem and can be answered in a straightforward way.

Figure 2 provides a stylized description of the Massachusetts housing market with and without the proposed RETT. The horizontal axis of the graph describes the number of units transacted in a given year, and the vertical axis, the price of an average unit. The upward sloping black line describes the supply of houses brought to market. As prices rise, more people are induced to build or sell. In this sense, the supply curve is a 'willingness to accept' curve. It describes the number of people willing to accept a given price in exchange for their property. The downward sloping black line describes the demand for housing. As prices rise, fewer people buy houses. We can also think of the demand curve is a 'willingness to pay' curve.

Absent taxes, we would expect transactions to occur as long a there are buyers who's willingness to pay is above some seller's willingness to accept. But even without the RETT, real estate transactions are subject to a substantial tax, here the quantity T^0. In order for a transaction to occur, the buyer must be willing to pay enough to satisfy the seller, and to pay the transaction tax. This condition is satisfied at price P^0 and quantity Q^0 in the figure. Similarly, with the addition of the RETT, the total tax per transaction increases to $T^0 + T^1$. In the resulting equilibrium, prices and quantities fall as fewer buyers are willing to pay enough to satisfy sellers after sellers pay the tax.

We can read tax revenues and deadweight loss from Figure 2. The RETT

Figure 2: Supply, demand, tax revenue and deadweight loss with and without the RETT



Note: A simple model of the housing market. In the observed state of the world, equilibrium price and quantity of housing transactions are P^0 and Q^0. This equilibrium reflects the initial tax rate, T^0, on the transfer of real estate. With the addition of the RETT, the total tax on real estate transfers increases to $T^0 + T^1$. When this occurs, the new equilibrium price and quantity of transactions are P^1 and Q^1. The addition of the RETT leads to extra tax revenue, $T^1 \times Q^1$, the green area. However, because the volume of transaction falls, $T^0 \times (Q^0 - Q^1)$ tax revenue is lost, the pink area. Net tax revenue from the RETT is difference between these two quantities. The deadweight loss from the RETT is larger than lost tax revenue by the area of the two triangles above and below the pink box describing lost tax revenue.

increases total tax revenue by $Q^1 \times T^1$, the highlighted green area in the figure. That is, the average RETT tax rate times the counterfactual number of units sold when the RETT is in place. We can read these quantities from table 3. On the other hand, by decreasing the volume of transactions, the RETT decreases the revenue generated by the pre-existing transaction taxes, T^0. The magnitude of this loss is given by $(Q^0 - Q^1) \times T^0$, the pink area in the figure.

The net revenue generated by the RETT is the area of the green rectangle minus the pink one. From table 3, we calculate that this net tax revenue is actually negative.[25] Figure 2 provides some intuition for why this occurs. In the figure, we see that the pre-existing tax is large relative to the incremental revenue

[25]We ignore the property tax in this welfare calculation because property taxation occurs regardless of the number of transactions, the focus of the graph in figure 2.

generated by the RETT. This together with the fact that the volume of transactions is sensitive to the extra tax, means that the loss of tax revenue outweighs gains.

Figure 2 also allows us to calculate deadweight loss, the economic cost resulting from buyers not buying and sellers not selling because of the RETT. Consider a transaction foregone because of the new RETT. Such a transaction would lie between Q^1 and Q^0 on the x-axis. For this property, there is a buyer willing to pay more than the seller requires, but less than the sum of what the seller requires and the new transaction tax, $T^0 + T^1$. The gap between willingness to pay and willingness to accept for this transaction gives the dollar value of the loss in welfare from this foregone transaction. Summing the area between demand and supply over all transactions between Q^1 and Q^0 we have the total deadweight loss from the RETT. This area is bigger than the loss in tax revenue by the area of the two small triangles above and below the pink rectangle indicating the loss of tax revenue. The dollar value of the deadweight loss is the area of this trapezoid, or $\frac{(T^0+T^1)+T^0}{2} \times (Q^0 - Q^1)$.

Appendix D shows how this expression can be evaluated using only the numbers reported in table 2. The result of this calculation is that deadweight loss from the proposed RETT is about 583m$. We show in section 5 that the fiscal loss created by a 1% RETT is 564m$. The difference between lost revenue and deadweight loss, close to 20m$, is an invisible tax on mobility for Massachusetts residents.

7 Conclusion

The real estate transfer tax proposed in the Affordable Homes Act is a tax on peoples' freedom to adjust the location of their residence as their circumstances change. We have compelling evidence that people respond to RETTs by moving less often. Because there are large pre-existing taxes on real estate transactions, these pre-existing taxes generate less revenue after the RETT than before, and this loss substantially offsets the new revenue generated by the RETT, which we estimate to be about 384m$ annually. Moreover, the distortions to peoples' moving behavior are costly for them. While these costs are hard to observe directly, we can calculate their magnitude using standard methods from economics. This calculation suggests that the deadweight loss from the RETT is

about 583m$.

Interestingly, the ordinary property tax, mill rate times assessed value, is famous for being non-distortionary. Indeed, a well known theorem of public finance, the 'Henry George Theorem', establishes that a system of public finance based entirely on the taxation of land will not distort behavior at all. That is, it collects tax revenue from the citizenry while causing no additional incidental harm.

A good system of public finance collects needed revenue and causes the smallest possible distortions in peoples' behavior. The proposed RETT cannot be part of such a system of taxation in Massachusetts for three reasons. It generates little or no marginal revenue. It causes distortions to peoples' decisions about residential mobility that are costly relative to the revenue the tax raises. And finally, a much better alternative is ready to hand. Any municipality wishing to raise revenue with a RETT can do so with the ordinary property taxes that they are already empowered to set. Unlike the proposed RETT, this tax does not interfere with peoples' behavior in costly ways, and unlike the proposed RETT, the ordinary property tax actually raises revenue.

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Appendix A Why the pass-through rate could be well above one

Consider the following notations:

$$
\begin{aligned}
P_i^0 &\sim \text{observed price of transaction } i \\
P_i^1 &\sim \text{counterfactual under RETT} \\
\tau_i &\sim \text{RETT tax payment in any transaction year} \\
\delta &\sim \text{market discount factor} \\
V &\sim \text{Flow value of service for property } i \\
s &\sim \text{ Share of properties transacting each year}
\end{aligned}
$$

Assume that RETT tax payments are completely capitalized into the property price. In this case, the counterfactual price under there RETT will be different than the observed price in our data. In turn, this means that the RETT tax assessment will be based on a price that we do not observe.

Taking the simplest asset pricing valuation approach, the price of a house is the net present value of all future housing services. Hence, the observed price is,

$$P_i^0 = \sum_{t=0}^{\infty} \delta^t V.$$

Then, suppose that under the RETT, all properties transact every $1/s$ years, exactly. In this case, the counterfactual price is

$$
\begin{aligned}
P_i^1 &= \sum_{t=0}^{\infty} \delta^t V - \sum_{t=0}^{\infty} \delta^{t/s} \tau_i \\
&= P_i^0 - \frac{1}{1-\delta^{1/s}} \tau_i.
\end{aligned}
$$

For example, if houses transact every seventh year, then $s = \frac{1}{7}$, $\frac{1}{s} = 7$, and the second term reflects the fact that the RETT is zero in six years out of seven.

Assuming for reference that the discount factor δ is 0.96 (corresponding to an about 5% interest rate) and that a property is transacted every seven year (which is more frequent than we observe in the data but not out of the ordinary), $\delta^{(1/s)} = 0.96^7 \approx 0.75$ leading to a pass-through rate of $1/(1-0.75) \approx 4$. The available evidence suggests that capitalization happens very quickly, so we should expect this logic to apply almost immediately once the RETT comes into effect. It is easy to see from the last formula above that with higher discount

factors (i.e., lower interest rates) and greater frequency of transactions that the pass-through rate can reach values even higher than 4.

Appendix B Pass-through: calculating counterfactual prices and RETT revenue

To compute the counterfactual price of residential properties under the RETT, we consider the following notations:

$$\begin{aligned} r &= \text{RETT\%} \\ P_i^0 &\sim \text{observed price of transaction } i \\ P_i^1 &\sim \text{counterfactual under RETT} \\ \tau_i &\sim \text{RETT tax payment} \\ k &\sim \text{ RETT deduction} \\ \beta &\sim \text{pass-through rate} \end{aligned}$$

Next, we know how much the counterfactual price decreases for each dollar of RETT tax from equation (6). Rewriting this equation, we have a first equation linking the counterfactual price P^1 to the tax τ for any property i,

$$P_i^1 = P_i^0 - \beta\,\tau_i.$$

From equation (1), we also know the RETT tax as a function of the counterfactual price. Rewriting a simplified version of this equation, we obtain a second equation linking the counterfactual price P^1 to the tax τ for any property i,

$$\tau_i^1 = \begin{cases} r(P_i^1 - k) & P_i > k \\ 0 & P_i \leq k \end{cases}$$

Substituting the second equation into the first above and solving, we have

$$P_i^1 = \begin{cases} (P_i^0 + \beta r k)(1+\beta r)^{-1} & \text{if } \frac{P_i^0 + \beta r k}{1+\beta r} > k \\ P_i^0 & \text{otherwise} \end{cases}$$

This equation lets us calculate a counterfactual price for every observed transaction.

To implement this equation with the data at hand, we assume a pass-through rate $\beta = 1$ as discussed in the main text. We also consider a RETT rate of $r = 1\%$.

To illustrate the working of our formula in a simple case, consider also a typical county for for which the deduction is one million dollars: $k = 1{,}000{,}000$. The previous equation can then be rewritten as

$$P_i^1 = \begin{cases} \frac{P_i^0 + 10{,}000}{1.01} & \text{if } P_i^0 > 1{,}000{,}000 \\ P_i^0 & \text{otherwise} \end{cases}$$

For counties for which the median price is higher than 1m$. For counties for which the median price in above 1 m$, just replace 1,000,000 and 10,000 by the median price and 1% of the median price, respectively.

Once, the counterfactual price P_i^1 with the RETT is computed, we can calculate all of the taxes on the basis of this price (RETT, stamp, and federal and state capital gains).

Appendix C Lock-in effect: calculating counterfactual transactions

To compute the counterfactual transactions for residential properties under the RETT, we consider the following notations:

$r =$ RETT%

$P_i^0 \sim$ observed price of transaction i

$P_i^1 \sim$ counterfactual under RETT

$\tau_i \sim$ RETT tax payment in any transaction year

$k \sim$ RETT deduction

$\gamma \sim$ lock-in factor (decreased probability of transacting with a 1% RETT)

$\rho_i^1 \sim$ counterfactual probability that property i transacts $\in [0,1]$

To think about what a counterfactual sample would look like, note first that we do not have a basis for determining whether any particular transaction will or will not occur in the counterfactual case. What we do know from the literature is that transactions are less likely to occur in the counterfactual case, and the probability of their not occurring is increasing in their tax bill.

While there is room to argue about the best way to specify the relationship between the probability of transaction under a RETT depending on the effective tax being paid, we assume for simplicity that the decline in the probability of

transaction of a property that would otherwise be sold in the absence of a RETT is about linear in the magnitude of the effective RETT rate, taking into account the deduction. That is, we assume that the probability of transaction is reduced by $\gamma \times \frac{\tau}{P^1}$ when a transaction is subject to the RETT (and is otherwise sold in absence of a RETT) and not affected if this transaction not subject to the RETT. This can be summarized by the following formula,

$$\rho_i^1 = \begin{cases} 1 - \gamma \frac{\tau_i}{P_i^1} & \text{if } P_i^1 > k \text{ and } \rho_i^0 = 1 \\ 1 & \text{otherwise} \end{cases}$$

If a RETT bill of 1% of the transaction price gives us an 8% decrease in transaction volume, then we would have $\gamma = 8$. For the proposed RETT with a 1m$ deduction and 1% tax rate, transactions with with a price of less than one million dollars are unaffected, but of 100 observed transactions with a counterfactual price of 2m$ only 96 would occur under a 1% RETT.

With this formula, we can compute an expected counterfactual sample, by summing existing transactions weighted by their probability of transaction under the RETT, ρ_i^1. Following this, we can calculate the expected counterfactual tax revenue for each tax by evaluating each tax and averaging, weighted by transaction probability. This gives us the change in the flow of revenue from the stamp and capital gains tax in addition to the revenue from the RETT.

Appendix D Evaluating deadweight loss from the RETT

The deadweight loss from the RETT is given by the area between the demand and supply curves on the vertical axis of figure 2 and between pre- and post RETT transaction volumes, Q^0 and Q^1 on the horizontal axis. This is the area of the pink shaded area together with the small triangles immediately above and below. Because the units of the horizontal axis are houses, and the units of the vertical axis are the price per house, their product, an area in the graph, is measured in dollars. Thus, the deadweight loss trapezoid gives the difference between willingness to pay and willingness to accept for all transactions foregone under the proposed RETT.

As noted in the text, because the deadweight loss is a trapeziod, its area is given by $\frac{1}{2}((T^0 + T^1) + T^0)(Q^0 - Q^1)$. That is, the average of the two long sides times the distance between them.

To evaluate deadweight loss using the quantities reported in table 2, we rewrite the expression as

$$\frac{1}{2}((T^0+T^1)+T^0)(Q^0-Q^1) = \frac{1}{2}\left[Q^0(T^0+T^1) - Q^1(T^0+T^1) + T^0Q^0 - T^0Q^1\right]$$

Each of the four terms that appears in the right hand side can be read directly or easily calculated from table 2.

$Q^0(T^0+T^1)$ is the product of the initial transaction volume with the total post RETT tax. This is the total tax collected under the naive scenario, 11,698m$. $Q^1(T^0+T^1)$ is the total tax collected under the counterfactual scenario where the RETT is imposed and market prices and volume adjust, 11,096m$. T^0Q^0 is the total tax revenue collected in the observed state, before the RETT is imposed, 11,276m$. Finally, T^0Q^1 is the tax revenue generated by the pre-existing taxes once the RETT is imposed. This is total post-RETT revenue less the revenue generated by the RETT, $11{,}096 - 384 = 10{,}712m. Plugging these value into the equation above, we have

$$\begin{aligned}\frac{1}{2}\left[Q^0(T^0+T^1) - Q^1(T^0+T^1) + T^0Q^0 - T^0Q^1\right] &= \frac{1}{2}\left[11{,}698 - 11{,}096 + 11{,}276 - 10{,}712\right] \\ &= 583\text{m\$}\end{aligned}$$

Thus, deadweight loss from the proposed RETT, with a pass through value of one and a lock-in of 12 is about 583m$, of which 564m$ is a loss of fiscal revenue.