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BAT Signals from Asset Markets: Estimating the U.S. Dollar Response to a Destination-Based Cash-Flow Tax¹

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Introduction

In early 2017, there was substantial discussion about changing the U.S. corporate tax system to a destination-based cash-flow tax (DBCFT). The DBCFT proposal, also often referred to as a border-adjusted tax (BAT), would exclude exports from taxable revenues and exclude imports from allowable deductions.

The discussion highlighted that the economic implications of switching to a BAT depended crucially on how the exchange rate would respond. The BAT proposal, by introducing an effective export subsidy and an effective import tax relative to the existing system, could potentially encourage exports and discourage imports. Given that the proposed rate of the BAT is 20 percent, the effect could be dramatic. But the effects depend on how much the exchange value of the dollar responds. Proponents of the BAT, such as Auerbach (2017), argued that the dollar would appreciate sufficiently to offset the direct effects on export and imports of the tax and would therefore not distort international trade. However, Erceg, Prestipino and Raffo (2018) cast doubt on those claims. Their structural macroeconomic models would imply that the response to such a tax change would be only half as large as would be needed to isolate the economy from the effects of a BAT tax change. In contrast, the model in Barbiero, Farhi, Gopinath and Itskhoki (2018) implies that the dollar appreciates by almost as much as the tax adjustment. Finally, Linde and Pescatori (2017) finds that the amount of exchange rate appreciation is conditional on a number of modeling assumptions. Given the differences in model-derived results, empirical evidence regarding the responsiveness of the dollar would be helpful. But the challenge in assessing the effects of a BAT is that there are very few historical episodes that can guide us in how much the exchange rate might respond.

In order to provide some empirical evidence, we use daily asset price movements in late 2016 and early 2017 to assess the likelihood market participants attached to the passage of the BAT and, conditional on passage, how much they expected the dollar to appreciate.

Although the actual tax bill that was passed in late 2017 is a territorial-based tax system rather than a destination-based system, our estimates may still be useful in quantifying the expected effects of a destination-based system should such a system would be considered in the future either in the United States or elsewhere.

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Our methodology, based on movements in oil prices, stock prices, and the exchange value of the dollar, suggest that market participants' estimates of the probability of passage of BAT peaked on March 7, 2017, with an estimated probability almost 20 percentage points higher relative to its value before the November 2016 U.S. election. Subsequently, the estimated probability declined and continued to decline through late April, when the White House first announced a tax plan that excluded a border tax. In addition, according to our estimates, market participants expected that the dollar would increase less than half as much as the proposed magnitude of the border tax, suggesting that market participants were not expecting dollar appreciation to fully offset the direct effects of the BAT on international trade.

Data and Model

We consider three asset prices that are likely to be affected by passage of the BAT.

The first is oil prices. We look at the difference between oil prices for Brent and WTI, which is referred to as *the spread*. The price of Brent is the benchmark price for international crude, whereas the price of WTI (West Texas Intermediate) is the benchmark price for crude produced in the United States. Rather than looking at the current price of oil, we consider the futures quotes for oil to be delivered 12 months in the future.

Because oil imports would no longer be deductible and oil exports would not be taxed, passage of the BAT would discourage U.S. imports of foreign crude and encourage U.S. exports of domestic crude. Passage of the BAT should therefore cause the spread to narrow from its current positive value.

Our analysis is based on the following derivation. Define the spread one year from today as

$$Z_{t+k} = P_{t+k}^{Brent} - P_{t+k}^{WTI},$$

where $t+k$ denotes the value one year from now. The expected value of the spread EZ_{t+k} today is related to its expected value conditional on the BAT becoming law $E(Z_{t+k}|BAT)$, its expected value conditional on the BAT not being passed $E(Z_{t+k}|No\ BAT)$, and the probability that the BAT becomes law $Prob(BAT)$ in the following way:

$$EZ_{t+k} = Prob(BAT) * E(Z_{t+k}|BAT) + (1 - Prob(BAT)) * E(Z_{t+k}|No\ BAT),$$

or equivalently

$$E(Z_{t+k}) = Prob(BAT) * (E(Z_{t+k}|BAT) - E(Z_{t+k}|No\ BAT)) + E(Z_{t+k}|No\ BAT).$$

Futures quotes that are reported today for Brent and WTI to be delivered 12 months in the future are equal to the expected values of the respective oil price plus a risk premium.

$$F_{t,k}^{WTI} = EP_{t+k}^{WTI} + \phi_t^{WTI}$$

and

$$F_{t,k}^{Brent} = EP_{t+k}^{Brent} + \phi_t^{Brent}.$$

(Note that the time subscript for daily data somewhat obscures that future quotes are expressed as delivery for a specific month rather than for a specific day. However, this distinction is not important for our analysis.)

Therefore the spread based on futures quotes can be defined as

$$X_t = F_{t,k}^{Brent} - F_{t,k}^{WTI}$$

which can be rewritten as

$$X_t = EZ_{t+k} + \phi_t^{Brent} - \phi_t^{WTI}.$$

Therefore we have that the spread based on futures quotes can be written as:

$$X_t = E(Z_{t+k}|No\ BAT) + Prob(BAT)_t * (E(Z_{t+k}|BAT) - E(Z_{t+k}|No\ BAT)) + \phi_t^{Brent} - \phi_t^{WTI}.$$

Now we must make some strong identifying assumptions. First, we assume that daily changes in the differential of the risk premium are not correlated with changes in the probability of BAT passage. Second we assume that $E(Z_{t+k}|BAT)$ and $E(Z_{t+k}|No\ BAT)$ are constant during our estimation period. In other words, we assume that, during late 2016 and early 2017, no major disruptions changed the expected spread except for changing probabilities of BAT passage.

$$\Delta X_t = \Delta Prob(BAT)_t * (E(Z_{t+k}|BAT) - E(Z_{t+k}|No\ BAT)) + \Delta \phi_t^{Brent} - \Delta \phi_t^{WTI}$$

Therefore, the resulting equation can be written as

$$\Delta X_t = \Delta Prob(BAT)_t * \lambda_x + v_t^x$$

where

$$\lambda_x = E(Z_{t+k}|BAT) - E(Z_{t+k}|No\ BAT)$$

The additional variable v_t^x represents both changes to the risk premium plus any other shocks to the system that are not correlated with changes in the probability that the BAT becomes law.

Knowing the value of λ_x is needed to identify the value of $\Delta Prob(BAT)$. Therefore, our working assumption is that BAT passage will cause next year's spread to equal 0, whereas, a lack of passage implies that the spread will be its historical value over the past year. This assumption for λ_x is likely a reasonable upper bound on its true value. If the true value of λ_x would be half its assumed value, then the estimated value of $\Delta Prob(BAT)_t$ would be twice its actual value.

In isolation, changes in oil price spreads could not determine what are movements in $\Delta Prob(BAT)_t$ versus movements in v_t^x . However, by studying simultaneous movements in two other variables that are also affected by $\Delta Prob(BAT)_t$, the exchange value of the dollar and the relative return on stock prices of U.S. retailers, we can estimate $\Delta Prob(DBCFT)$.

The other two variables in our analysis will be

- Changes in the broad nominal dollar, ΔS – Increased probability of BAT passage should cause the dollar to appreciate. The broad nominal dollar is a weighted average

of the foreign exchange value of the dollar against the currencies of major advanced U.S. trading partners. As is discussed in Auerbach et al. (2017), in theory, the BAT should result in enough dollar appreciation to offset the differential tax treatment under BAT of imports and exports. However, in our analysis, we do not assume that effect, but rather estimate the assumed rate of appreciation.

Our estimating equation is based on uncovered interest parity,

$$S_t = ES_{t+k} + i_t - i_t^* + \phi_t^S + u_t^S,$$

according to which the current exchange rate equals the expected exchange rate plus the differential between domestic and foreign interest rates, a risk premium, and an error term.

With a similar derivation as above, the estimation equation becomes

$$\Delta S_t = \Delta Prob(BAT)_t * \lambda_S + v_t^S$$

where v_t^S includes both any interest rate differential changes as well as any currency risk premium. The estimated value of λ_S will be the expected rate of appreciation conditional on passage ($S_{BAT} - S_{no\ BAT}$).

- Changes in the daily return on U.S retail stocks minus the daily return on all U.S. stocks (excluding the oil sector), ΔR . In early 2017, many newspapers articles reported that retailers were those most concerned about BAT passage, reflecting the retail sector's relatively greater reliance on imported goods. An increased probability of BAT passage should cause retail stocks to perform worse than the overall stock market. However, if the dollar were to increase completely to offset the effect of the BAT, then there should be no effect of the BAT on retail stocks performance over all U.S. stocks. Therefore, the resulting equation is

$$\Delta R_t = \Delta Prob(BAT)_t * \lambda_R + v_t^R.$$

Stacking these equations results in the following system of equations.

$$\begin{pmatrix} \Delta S_t \\ \Delta R_t \\ \Delta X_t \end{pmatrix} = \begin{pmatrix} \lambda_S \\ \lambda_R \\ \lambda_X \end{pmatrix} \Delta Prob(BAT)_t + \begin{pmatrix} v_t^S \\ v_t^R \\ v_t^X \end{pmatrix}.$$

We estimate this system of equations along with the following additional equation, the state equation.

$$\Delta Prob(BAT)_t = \phi \Delta Prob(BAT)_t + \varepsilon_t.$$

The error term $(v_S \ v_R \ v_P)'$ is assumed to be mean zero with a diagonal variance covariance matrix with variances $(\sigma_S^2 \ \sigma_R^2 \ \sigma_X^2)$ and uncorrelated with ε_t .

Our working assumption is that all of these asset prices will respond to changes in $\Delta Prob(BAT)_t$, but that the response of the exchange rate is not large enough to generate complete pass-through, which would leave the other asset prices unaffected. In addition, our exercise requires that no other common shock to all three variables exists. For example, although the literature on

commodity currencies suggests that oil prices and exchange rates might be correlated, the price spread between Brent and WTI oil should not be correlated with the exchange rate.

The model is estimated on daily data from November 1, 2016 to April 27, 2017. Our estimation sample begins a week before the November 2016 U.S. election to capture any effects from the election and the end of the sample is when the White House released its tax proposal, which did not include a BAT. Being such a short period limits the ability of other events to influence the regression.

Results

Table 1 shows the model estimates. As mentioned above, the value of λ_S , is the expected rate of appreciation conditional on passage therefore if the probability of passage became one then the expected appreciation of the dollar in response to BAT becoming law would be about 8.6 percent. Such an estimate seems reasonable and is about half of the full response to a 20 percent BAT tax. The 90 percent confidence interval for λ_S is from negative 5 to 22 percent. This confidence interval does include full appreciation; so we cannot reject the null hypothesis that the exchange rate response would be complete. However, given the point estimate, a partial response seems a better estimate of market participants' views.

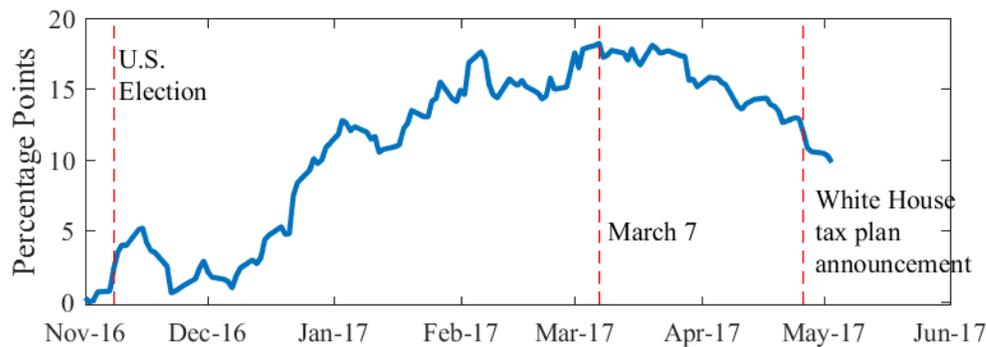
In addition, as mentioned before, the estimated value of λ_S is conditional on the assumed value for λ_x , the effect of the BAT on oil price spread. We have assumed a value of λ_x that could be on the high side. If the true value of λ_x is smaller than we have assumed, then the true value of λ_S will be smaller than we have estimated.

Table 1: Coefficient Estimates

Coefficient	Estimate	Standard Error
ϕ	0.116	0.484
λ_S	0.086	0.071
λ_x (Constrained)	-0.042	
λ_R	-0.324	1.854

Figure 1 shows the estimated cumulative change in the probability of BAT passage since November 1, 2016. The probability of BAT passage peaked on March 7, 2017. Given our assumption of how much a BAT would affect the oil spread, the maximum increase in probability is 18 percentage points more likely than on November 1, 2016. The probability of BAT passage then steadily declines throughout the period leading up to the White House tax proposal announcement on April 26, 2017, though it still remains 10 percentage points more likely than it was before the election.

Figure 2: Change in the Probability of BAT passage Relative to November 1 2016.



Conclusion

Taken as a whole, the evidence suggests that the financial markets expect the dollar to appreciate only 8 percent in response to a proposed 20 percent BAT, and thus only partially insulate the economy from the effects of the BAT. It bears repeating that both the probability of BAT passage and the exchange rate response are estimated with some uncertainty. Moreover, at best we are only estimating what the markets think will happen. What actually happens could be different.

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