2017

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February 6, 2018

Abstract

While a VAT should in principle be neutral with respect to international trade, it may in practice function as a tax on exporters' input purchases if firms receive incomplete VAT refunds. Using data for over 100 countries that span the majority of historical VAT adoption episodes, this paper finds that – consistent with this hypothesis – the VAT reduces the exports of an industry with a 10% point higher intermediate goods share of output by over 8% relative to an industry with a lower share. This effect is driven by developing countries and is absent for high-income countries.

JEL Classification: F13; F14; H25; H87; O11

Keywords: value-added tax; VAT; VAT refunds; export tax; export composition; tax administration

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1 Introduction

The worldwide spread of the value-added tax (VAT) is often described as the most significant global tax development of the past half-century (e.g. Keen and Lockwood, 2007). One of the selling points of the VAT during this period has been that it is in principle neutral with respect to international trade and so would allow countries to raise government revenue without adversely affecting their international competitiveness. This neutrality depends on two features of a properly functioning VAT: export sales are not subject to domestic taxation and firms receive credits for VAT paid on their input purchases. While firms that only sell in their domestic market will generally use these credits to offset a portion of their VAT liability on their sales, exporters will routinely have credits exceeding their sales liability and hence will require refunds from the government. Although these refunds are popularly perceived as subsidies for exporters, they in fact merely ensure that the VAT does not devolve into a tax on exporting firms' input purchases (e.g. Feldstein and Krugman, 1990).

In actual practice, the refund system has been the "achilles' heel" (Ebril et al., 2001) of the VAT in many countries. Firms are often unable to obtain the refunds that they are owed or are unable to do so in a reasonable and timely manner. This may be due to the fact that many governments lack the necessary administrative capacity to properly implement the VAT, especially given the legitimate concerns about potentially fradulent credit claims. It may also reflect government officials' reluctance to part with revenue that has ostensibly already been collected and come under their domain. These problems with the functioning of the VAT in practice give us strong reason to suspect that the VAT might indeed tax exporters' input purchases.

In this paper, I empirically evaluate whether this is in fact the case by drawing on simple consequence of an imperfect VAT: if the VAT functions as a tax on exporters' input purchases, it should disproportionately affect exports in industries that tend to rely more intensively on intermediate goods. We can therefore examine whether the VAT taxes exports through this channel by studying the differential effect of VAT adoption on exports across industries. I examine this question using product-level international trade data for over 100 countries spanning a period from 1962-2015, which includes the majority of historical VAT adoption episodes. Guided by a multi-sector theoretical model of international trade, I employ an empirical specification that relates exports at the industry level to an interaction of VAT adoption in a country and the industry's intermediate goods share of output. This specification allows us to control for a wide range of unobservable factors through the inclusion of country-year, industry-year and country-industry fixed effects. Since the intensity of intermediate goods use in a country is likely to be endogenous to the VAT, I calculate measures for each industry from US data, thus treating these intensities as technological characteristics of the industries in the spirit of Rajan and Zingales (1998).

Consistent with my hypothesis, I find that VAT adoption has a substantial negative effect on the exports of industries that rely more heavily on intermediate goods. Specifically, an industry with a 10% point higher intermediate goods share of output sees a decline in exports of over 8% relative to an industry with a lower share. To put this magnitude in context, existing estimates of the relevant trade elasticities from Hummels (2001) and Hertel et al. (2007) imply that a 8% decrease in the exports of an industry would result from approximately 1-2% higher prices. These results are robust to the inclusion of country-industry time trends and I also employ a "placebo" test that finds no apparent evidence of an effect of the VAT prior to its actual adoption.

If these results are in fact driven by imperfections in the VAT refund system, we should expect to see considerable heterogeneity across countries, since VAT refund performance is likely to be substantially worse in developing countries relative to developed countries (e.g. Harrison and Krelove, 2005). In line with these considerations, I find that the negative effect of the VAT is driven by low- and middle-income countries and that there is no significant effect for high-income countries. Providing further evidence of the role of VAT refund administration in generating the results in this paper, I also find that for a subset of countries with available information, the negative effect of the VAT is significantly more pronounced in countries where a VAT refund request is more likely to trigger an audit. Taken together, these results suggest that the VAT does function in part as a tax on exports in countries that have a weak tax administration system.

Since the VAT was often introduced as a replacement for existing policies – most commonly turnover taxes, sales taxes, and tariffs – the effect of VAT adoption identified here would be the joint effect of removing these existing taxes and introducing the VAT. Since these replaced policies could themselves tax intermediate goods – in some cases more obviously than the VAT should – it is perhaps surprising that the VAT has a large negative effect of the type identified here. This could reflect the fact that countries in practice rely on the VAT to a much greater extent than they did on the replaced policies, and so the VAT might simply be more significant in an absolute sense. Broadly consistent with this explanation, I do not find any evidence of a difference in the effect of the VAT depending on the types of policies it replaces.

This paper makes a contribution to the existing work in two distinct literatures. First, it is related to existing studies evaluating the effects of the VAT on international trade. Desai and Hines (2005) find that the VAT substantially reduces the volume of trade, with a particularly pronounced effect for developing countries. Keen and Syed (2006) and Ufier (2014), however, find no significant effects of the VAT on trade. As highlighted by Keen and Lockwood (2007), estimating the aggregate effects of the VAT is challenging because it is very difficult to disentangle the consequences of the VAT from factors that affect its adoption. By focusing on the differential effect of the VAT across industries within a country, the approach taken in the present paper helps deal with these important endogeneity challenges.

Another related paper that specifically emphasizes the importance of VAT refunds is Chandra and Long (2013), who use Chinese data to find that increased VAT rebates lead to an increase in exports. They evaluate the effects of an increase in VAT refunds, which is something quite distinct from the present paper, which studies the effect of adopting the VAT as a whole while emphasizing a mechanism that operates through an imperfect refund system.

This paper is also connected to a large and growing literature in international trade that examines the determinants of export composition. In addition to classical determinants of comparative advantage such as factor endowments (Romalis, 2004), this literature studies how country characteristics such as domestic institutions (e.g. Levchenko, 2007; Nunn, 2007; Chor, 2008; Manova, 2008), natural resources (Debaere, 2014) and demographic composition (Cai and Stoyanov, 2016) can also shape the composition of a country's exports.[1] The present paper uses a related style of analysis to show that domestic taxes can also significantly affect export composition. Unlike the determinants of export composition considered in this existing literature, the VAT would not properly be a determinant of comparative advantage. This is because comparative advantage is rigorously defined in terms of Autarky prices (e.g. Deardorff, 1980), whereas an imperfect VAT is effectively a tax on exports. The finding here therefore complements the existing work in this area by identifying a factor that can distort export composition *away* from patterns of comparative advantage.

The rest of this paper is organized as follows. Section 2 introduces a theoretical model that serves as a conceptual framework and helps interpret the empirical results. Section 3 discusses the empirical specification. Section 4 discusses the data sources and provides descriptive statistics. Section 5 presents the results of the empirical analysis and Section 6 concludes.

[1] See Nunn and Trefler (2014) for a review of a portion of this literature.

2 Theoretical Framework

This section develops a theoretical framework that helps motivate and interpret the subsequent empirical analysis. In order to capture some of the key effects of the VAT on exports in a parsimonious manner, I use a multi-sector version of an Armington (1969) model. The Armington assumption implies that every country produces a differentiated variety of each good. I assume that firms produce using a combination of labor and intermediate inputs, and that the VAT system does not allow for a full rebate of the VAT paid on inputs.

2.1 Preferences

Consider a setting with many countries and goods. I assume a two-tiered utility function with an upper-tier Cobb-Douglas utility over goods and a lower-tier CES utility over the varieties of the good from each country. The upper-tier utility in country i is given by:

$$U_i = \prod_Z u_i\left(z\right)^{\alpha_Z} + G_i,$$

where α_Z is the income share going to good z, $u_i\left(z\right)$ is the sub-utility from consumption of z in country i and G_i is the quantity of a public good. The sub-utility is given by:

$$u_i\left(z\right) = \left(\sum_i q_{ij}\left(z\right)^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}, \qquad (1)$$

where $q_{ij}\left(z\right)$ is the quantity consumed in country i of the variety of z from country j. With this setup, households spend a fixed fraction of their income $\alpha\left(z\right)$ on each good but can vary the fraction of their income that is devoted to the specific variety of the good produced in each country.

Labor is the only basic factor of production and labor income is the only source of household income. With this, the household demand for a variety of a good is given by:

$$q_{ij}(z) = \frac{[(1+\tau)p_j(z)]^{-\sigma}}{P(z)^{1-\sigma}} \alpha(z) w_i L_i, \quad (2)$$

where τ is the VAT rate, $p_j(z)$ is the price of country j's variety of z and $P(z)$ is the ideal price index for good z. I assume that government revenue is used to provide the public good, G_i.[2]

2.2 Production

Firms produce under constant returns to scale using labor and intermediate inputs. The production function specifically takes the form:

$$Y_j(z) = A_j(z) L_j(z)^{1-\beta(z)} M_j(z)^{\beta(z)},$$

where $\beta(z)$ is the intermediate input share of output; $A_j(z)$ is the productivity of sector j in country z; $L_j(z)$ is the labor used in j for the production of z; and $M_j(z)$ is the quantity of a composite intermediate input. I assume that this composite is a CES aggregator with exactly the same two-tiered structure as the utility function – as given by (1) and (2) – and has a pre-tax price index equal to Q.[3]

Under a VAT, firms pay a tax on intermediate inputs on their exports that is equal to $\tau(1-r)$, where τ is the VAT rate and $r \in [0,1]$ is the fraction of intermediate input expenses that are refunded.[4] Under a theoretically ideal

[2]The analysis would be similar but slightly more complicated if the tax revenue were rebated lump-sum to the household.

[3]This specification assumes that the intermediate inputs are freely tradable. The analysis here would remain almost unchanged if there were an additional non-traded intermediate input produced under constant returns to scale, or if there were iceberg trade costs.

[4]On domestic sales, firms would generally be able to use the taxes they have paid on their inputs to reduce their VAT liability on their output without requiring any refunds. As a result, difficulties in obtaining refunds do not matter as often or to the same extent.

VAT, $r = 1$ so that all taxes on intermediate inputs are fully refunded. The opposite case, where $r = 0$, captures a setting where the VAT is so imperfect so as to essentially be equivalent to a turnover tax for exporters. Given the static nature of this model, we could also think of delays in providing VAT refunds as being factors that effectively decrease r. In the same way, to the extent that VAT refunds can only be obtained by incurring additional costs (e.g. audit-related expenses, filing costs, bribes, etc.) the effective value of r will be lower. The after-tax price for the intermediate input bundle given these assumptions is $Q\left[1+\tau\left(1-r\right)\right]$.

A point to note in relation to the empirical analysis is that this setup implies that in the absence of a VAT, intermediate goods would not have been taxed. This is not necessarily the case, particularly given that the VAT in reality replaced other taxes that were themselves not neutral with regards to intermediate goods. Such considerations are omitted from the theoretical framework here in order to more clearly highlight the central point of the paper but the potential importance of replaced policies is explored empirically and discussed in Section 5.5.

Under these assumptions, the price that the firm is able to set for its final good is determined by the Cobb-Douglas unit cost function:

$$p_j\left(z\right) = \frac{1}{A_j\left(z\right)}\left[\frac{w_j}{1-\beta\left(z\right)}\right]^{1-\beta(z)}\left[\frac{Q\left[1+\tau\left(1-r\right)\right]}{\beta\left(z\right)}\right]^{\beta(z)} \tag{3}$$

This expression relates the price of the good to the wage and the intermediate input costs.

2.3 Exports

We can now use this setup to derive an expression for exports. Each country will export its variety of a good to the rest of the world to be used for both final consumption and as an intermediate input. Given the upper-tier Cobb-Douglas assumption, (1), and the lower tier CES assumption, (2), households will spend a fraction $\frac{p_j(z)^{1-\sigma}}{P(z)^{1-\sigma}}\alpha(z)$ of their income on country j's variety of product z. Since labor is the only factor of production, the total income of households outside of country j is $\sum_{i\neq j} w_i L_i$.[5] Hence, foreign households' expenditure on country j's variety of z is $\frac{p_j(z)^{1-\sigma}}{P(z)^{1-\sigma}}\alpha(z)\sum_{i\neq j} w_i L_i$.

On the production side, firms in industry k in each country will spend a fraction $\beta(k)$ on intermediate input purchases. Hence, the total intermediate input purchases of firms in industry k in a country i is $\beta(k)P(k)Y_i(k)$. Summing across industries and countries, the total expenditure on all intermediate goods in all foreign countries is $\sum_{i\neq j}\sum_k \beta(k)P(k)Y_i(k)$. Since we are assuming the same two-tiered structure for the intermediate input composite as we are for the utility function, a fraction $\frac{p_j(z)^{1-\sigma}}{P(z)^{1-\sigma}}\alpha(z)$ of the total expenditure on intermediate goods will be on country j's variety of product z. Hence, the amount that foreign firms spend on country j's variety of z is $\frac{p_j(z)^{1-\sigma}}{P(z)^{1-\sigma}}\alpha(z)\sum_{i\neq j}\sum_k \beta(k)P(k)Y_i(k)$.

With all this in mind, the total exports (in value terms) of good z from country j can be written as:

$$\begin{aligned} x_j(z) &= \frac{p_j(z)^{1-\sigma}}{P(z)^{1-\sigma}}\alpha(z)\left[\sum_{i\neq j} w_i L_i + \sum_{i\neq j}\sum_k \beta(k)P(k)Y_i(k)\right] \\ &= \frac{p_j(z)^{1-\sigma}}{P(z)^{1-\sigma}}\alpha(z)Y_{-j} \end{aligned}$$

where Y_{-j}, the sum of total wages and total intermediate input expenses in all foreign countries, is the value of total output in the world, excluding country j.

Next, we take the log of this expression to obtain:

$$log x_j(z) = (1-\sigma)\, log p_j(z) - (1-\sigma)\, log P(z) + log \alpha(z) Y_{-j}$$

[5]To save on notation, I assume that there are no foreign taxes. This does not, however, affect the actual analysis here in any significant manner.

Plugging in (3), we get:

$$logx_j(z) = (1-\sigma)\left\{[1-\beta(z)]\,logw_j - [1-\beta(z)]\,log[1-\beta(z)] + \beta(z)\,log\frac{Q}{\beta(z)} + \beta(z)\,log[1+\tau(1-r)] - logA_j(z)\right\}$$
$$- (1-\sigma)\,logP(z) + log\alpha(z)\,Y_{-j}$$

For simplicity, I assume that the income of the rest of the world is a constant from the standpoint of the country under analysis, essentially assuming that this country is small. With this, by grouping all the terms that are constants from the standpoint of the exporting country into a single term, $\delta(z)$, and re-arranging, we can re-write log exports as:

$$logx_j(z) = (1-\sigma)\,\beta(z)\,log[1+\tau(1-r)] + (1-\sigma)[1-\beta(z)]\,logw_j + \delta(z)$$

This equation relates the exports of good z to an interaction of the country's tax system and the sector's intermediate input intensity.

This equation – which will guide the empirical specification in Section 3 – has two main terms. The first captures the fact that in industries with a higher intermediate input intensity, $\beta(z)$, the VAT will have a greater effect on exports. This is because as long as $r < 1$, the VAT directly affects the cost of using intermediate inputs. This naturally has a greater effect on an industry that relies more heavily on intermediate inputs. The second term captures the fact that a change in wages due to the VAT will have a differential effect across industries depending on their labor intensity, $1 - \beta(z)$. The change in wages is a general equilibrium, economy-wide change but this expression shows that it could potentially have different effects across industries. This is a less direct channel than the primary channel of interest and will turn out to be insignificant empirically.

It will be to useful to use an approximation that allows this equation to be expressed in a form that is more convenient to interpret and work with. Specifically, we can use the fact that for a relatively small value for $\tau(1-r)$,

$log\left[1+\tau\left(1-r\right)\right] \approx \tau\left(1-r\right)$. The earlier equation can then be re-written as:

$$logx_j\left(z\right) \approx \left(1-\sigma\right)\beta\left(z\right)\tau\left(1-r\right) + \left(1-\sigma\right)\left[1-\beta\left(z\right)\right]logw_j + \delta\left(z\right) \quad (4)$$

We will make extensive use of equation (4) later on.

3 Empirical Specification

The theoretical model from Section 2 explains why the VAT is likely to have heterogeneous effects on exports across industries that vary in terms of their intermediate input intensity. The empirical specification will be guided by equation (4), which relates the log of exports to an interaction between the VAT and the intermediate input intensity. The primary empirical specification will take the following form:

$$x_{cit} = \alpha_1 + \alpha_2\left(v_{ct} \times i_{it}\right) + \gamma_{ct} + \delta_{it} + \phi_{ci} + \epsilon_{cit}, e \quad (5)$$

where x_{cit} is the log of exports from country c in industry i in year t; v_{ct} is a measure of the VAT in country c in year t; i_{it} is a measure of the intermediate input intensity of industry i in year t; γ_{ct}, δ_{it}, and ϕ_{ci} are country-year, industry-year and country-industry fixed effects. The key coefficient of interest is α_2, the coefficient on the interaction term $v_{ct} \times i_{it}$.

The fixed effects in this specification allow us to control for a variety of unobserved factors. The country-year fixed effects control for country-level changes that affect exports across all sectors. The industry-year fixed effects control for global shocks to the exports of each industry. Finally, the country-industry fixed effects control for all time-invariant determinants of export composition. The regression estimates with this specification will be identified off of variation in the exports of particular industries in particular countries following VAT adoption.

As for measures of the VAT, v_{ct}, I will make use of both a binary measure of VAT adoption and a more continuous measure that takes into account the VAT rate. While my empirical results will be consistent for the two types of measures, for interpretational reasons, my preferred specification makes use of the binary rather than the continuous measure. A difficulty with using a measure such as the VAT rate is that countries with strong administrative capacities are likely to have high refund rates and are also more easily able to set a high VAT rate. This means that it can be misleading to treat a high VAT rate as an indicator of a more intense treatment for the purposes of this analysis.

As discussed in Section 3, in addition to the direct effect of higher input taxes, the VAT could also have general equilibrium effects that vary across industries. The regression specification (5) does not attempt to disentangle these general equilibrium effects from the direct effect of higher input taxes. To take these general equilibrium effects into account, we can, again keeping equation (4) in mind, modify the regression specification to take the following form:

$$x_{cit} = \alpha_1 + \alpha_2 \left(v_{ct} \times i_{it}\right) + \omega \left[w_{ct} \times \left(1 - i_{it}\right)\right] + \gamma_{ct} + \delta_{it} + \phi_{ci} + \epsilon_{cit}, \qquad (6)$$

where w_{ct} is a measure of income per person. The only difference here relative to equation (5) is that we have a new term that captures the differential general equilibrium effects.

4 Data

4.1 Data Sources

We can now turn to the data sources and variables that will be used to estimate the regression model. I obtain information on the VAT across the world from Ebril et al. (2001), supplemented by Adhikari (2016). From these sources, I make use of the date of VAT adoption, the VAT rate at adoption[6] and information about policies that the VAT replaced. For some specifications, I make use of data on the time it takes to obtain VAT refunds, submit VAT refund requests and the likelihood of a refund request being audited, from PwC and the World Bank (2017).

Data on exports are obtained from UNCOMTRADE. The original data I use is reported in SITC-1 and available from 1962-2015. This is first concorded to SITC-2 using Feenstra's (1996) concordance and then from SITC-2 to 1997 NAICS using Feenstra and Lipsey's concordance. In order to provide a consistent level of aggregation across products, the analysis is conducted throughout at the 3-digit NAICS level. I compute the exports for each country by summing up the imports reported by the country's trade partners. To ensure a consistent sample of reporters, I only use reporting countries who are available for the entire 1962-2015 period.

Another key variable in equation (5) is the intermediate goods intensity. I treat the intermediate goods intensity as a technological characteristic of an industry and measure it using US data, in the spirit of Rajan and Zingales (1998) and the existing literature on the determinants of export composition. This ensures that the actual input intensity of a sector in a given country is not endogenous to the country's policy choices. The relevant measure of intermediate goods intensity should include any expenses that a firm would

[6] The literature commonly uses the VAT rate at introduction rather than the VAT rate in each year due to the difficulty of obtaining a long time-series of VAT rates for such a large sample of countries.

incur for which it would be owed a VAT refund. In most countries, this would include expenses on intermediate inputs and capital goods. Accordingly, the two measures I consider are intermediate input purchases as a fraction of output in the industry, and the sum of capital expenses and intermediate input purchases as a fraction of output. For manufacturing industries, this information is obtained from the NBER-CES database. The coverage of the NBER-CES only extends to 2011 and so I use the 2011 data for 2012-2015. For non-manufacturing industries, intermediate input shares are obtained using the 1997 US Input-Output Tables from the BEA.

In my baseline specification, I focus exclusively on manufacturing exports. This is for two reasons. First, as mentioned above, the NBER-CES only includes manufacturing industries and so I have more complete information on these industries. Second, the treatment of services, agriculture and natural resources under the VAT tends to vary widely across countries. Despite this, as I report in Section 5, I obtain very similar results for non-manufacturing industries.

Finally, I apply three restrictions to the sample. First, I drop very small countries, defined as those with a population – obtained from the Penn World Tables 9.0 (Feenstra et al., 2015) – of less than 1 million in any sample year. Second, I only include countries that have at least 5 years of trade data available before and after VAT adoption. Finally, I drop very small trade flows, defined as country-industry-year exports of less than $1 million. These restrictions leave us with 105 countries, 2,915 country-industries and a total of 100,719 observations at the country-industry-year level.[7]

[7]While countries that never adopted the VAT could also be included in the sample, these countries – with the notable exception of the U.S. – tend to be either very small or are have exports that are extremely concentrated in natural resources, and so are not particularly well-suited to serve as a control group.

4.2 Descriptive Statistics

Table 1 shows the list of countries included in the sample together with the year of VAT adoption. We have a total of 105 countries with adoption years spanning every decade from the 1960s onward. The earliest adopters in the sample are Brazil, Denmark, France, Germany and Uruguay, while the latest are Sierra Leone, Laos, Burundi, Bosnia and Herzegovina and Zimbabwe. As noted by Ebril et al. (2001), the VAT was adopted across the world in waves with relatively early adoptions in Europe and South America and adoptions in LDCs picking up starting in the 1990s.

Table 2 provides information on the 3-digit NAICS industries and their relevant characteristics. As discussed earlier, the baseline results in this paper make use only of manufacturing industries (NAICS 300-400). The table reports the average intermediate input share and capital expenditure shares of output for each sector across the sample period. We see that there is a considerable amount of variation in the intermediate input shares across the industries. For manufacturing industries, the shares mostly range from about 0.40 for industries such as Printing and Related Support Activities and Computer and Electronic Product Manufacturing to about 0.60 for Primary Metals Manufacturing and Food Manufacturing. Petroleum and Coal Product Manufacturing is somewhat of an outlier, with an intermediate input share above 0.83. The investment share of output also varies substantially between the industries and has a weak negative correlation (≈ -0.22) with the intermediate input shares.

Of the non-manufacturing industries, three are agricultural, two are related to natural resource extraction and two are service industries. There is no clear pattern in terms of how these intermediate input intensities compare to those for manufacturing industries. For example, Animal Production and Aquaculture has the highest intermediate input share among all the industries, while Fishing, Hunting and Trapping has one of the lowest.

5 Results

5.1 Baseline estimates

The baseline estimates for equation (5) are presented in Table 3. In the first column, the coefficient of interest is the interaction between a binary variable that records VAT adoption and the value of intermediate inputs as a share of output at the sector-year level. The coefficient value is negative and precisely estimated. The magnitude of the estimate suggests that an industry with a 10% point higher intermediate input share sees a relative decrease in exports of over 12% following VAT adoption.

To get a sense of the magnitude of this coefficient, it is useful to consider some reasonable values for the relevant trade elasticity. From equation (5), we see that the elasticity that matters here is the Armington elasticity within an industry. Hummels (2001) and Hertel et al. (2007) estimate these elasticities at a level of aggregation that is comparable to the one used here, and find that depending on the specification, the average of the estimated elasticities tends to range from 5 to 7. This would mean that a 12% decrease in exports would correspond to an approximately 1.5-2% increase in prices.

Columns 2-4 in Table 3 make use of different measures of input intensity. Column 2 uses the value of intermediate inputs plus capital investments as a share of output. It makes sense to consider such a specification because capital investments are generally treated in a manner similar to intermediate inputs under the VAT in most countries. The estimated coefficient is very similar to Column 1. The third and fourth columns show that these effects seem to be driven by intermediate inputs rather than capital expenses. This is possibly the case because capital investments account for a small share of output as compared to intermediate inputs (see Table 2).

Table 4 shows the results from empirical specifications that are closer to equations (4) and (6), allowing us to make greater use of the theoretical framework in interpreting the estimates. Column 1 uses the standard VAT rate at introduction as a measure of the VAT rather than a binary indicator, and yields a point estimate of about -5. Assuming a trade elasticity of 7, (4) would imply that $1 - r \approx 0.70$ and so $r \approx 0.30$. Taking the model literally, this is a refund rate that is of a reasonable order of magnitude, though perhaps small as an average for the entire cross-section of countries. One should note, however, that there are factors missing in the model which would imply a larger refund rate given the same coefficient estimates. For example, the model does not include compliance costs associated with VAT refunds, costs from refund delays or the potential adverse productivity effects of facing higher intermediate input costs. If such factors were incorporated into the model, the inferred refund rate would likely be higher.

Turning to the other columns in Table 4, column 2 shows that when both the binary and the continuous measures are included, only the binary variable is statistically significant. As discussed earlier, the continuous measure is unlikely to truly measure the intensity of the treatment across countries because countries with a high VAT rate are often those with strong tax administration and so are likely to have a relatively high refund rate. The true intensity of the treatment depends on both having a relatively low refund rate and a high tax rate – something that would be quite difficult to measure.

Columns 3 and 4 bring us even closer to equation (4) by allowing the general equilibrium effects of the VAT to have a heterogeneous effect across industries as in the regression specification (6). To do this, I include an interaction of GDP per capita with one minus the intermediate input share of the industry, consistent with equation (4). The coefficient on the differential general equilibrium effect term is insignificant in both columns, suggesting that this indirect channel does not seem to play a major role in practice.

5.2 Heterogeneity across income levels

Table 5 considers heterogeneity in these effects across countries of different income levels. Column 1 includes the interaction of the main treatment variable with a binary variable that records whether the country is a high income country or not.[8] The coefficient on the new interaction term is statistically significant and implies that the net effect on high income countries is close to zero, suggesting that the baseline results are driven primarily by low- and middle-income countries. Consistent with this, a test that the sum of the two coefficients is equal to zero yields a t-statistic of about -0.51 (P-value $\approx$ 0.614), meaning that there is no statistically significant effect for high-income countries.

Columns 2 and 3 explore further heterogeneity based on income level by including an interaction of the treatment with a low-income country indicator.[9] Column 2 suggests that the impact is indeed greater for low-income countries. Column 3 includes interactions of the main treatment with both high- and low-income indicators and finds that the effect on low income countries is greater than for middle-income countries – the omitted group – but that this difference is not statistically significant.

Taken together, these results imply that the VAT discourages intermediate input intensive exports specifically in middle and low-income countries. A natural interpretation for this finding is that the VAT refund system works in a more ideal manner in high-income countries, a point that would be consistent with anecdotal and survey evidence (e.g. Harrison and Krelove, 2005).

5.3 Evidence on VAT refund administration

While these results are suggestive of the importance of the quality of VAT refund administration, it would useful to see whether we can link these results directly to information about VAT refunds across the world. We can obtain some relevant information from PwC and the World Bank (2017), which is a study that considers various aspects of the tax system faced by the same

[8] The countries that are classified as high-income are those in Western Europe, as well as Australia, Canada, Japan, and New Zealand. These are the countries that have been relatively high-income throughout the sample period.

[9] Low-income status is based on the World Bank's classification system.

hypothetical firm across the world and specifically provides some data on VAT refunds. The main limitation of this study as applied to the current paper is that the hypothetical case study firm is one that does not export, and the study only provides information on VAT refunds when a refund is available to the case-study firm. Since, as documented in the study, VAT refunds are in practice restricted to exporters in many countries, we have relevant refund information on much fewer countries than those that are technically covered by the study.

Owing to these limitations, we can only consider a subsample of 56 countries for which we have the necessary information. Column 1 of Table 6 repeats the baseline regression on this subsample, and shows that the estimated coefficient is comparable to the one obtained in the full sample. The three available indicators relating to VAT refunds are the likelihood of a VAT refund request triggering an audit, the number of weeks it generally takes for excess VAT credits to be refunded, and the number of compliance hours it takes to file a VAT refund. The remaining columns of Table 6 report the results of regressions that include an interaction of the main treatment variable with these characteristics of the refund system.

Column 2 uses an indicator variable that records whether an audit is either likely or very likely, as opposed to being unlikely or very unlikely. The coefficient estimates show that the negative effect of the VAT on intermediate input intensive industries is driven by countries where audits are more likely. The implied point estimate for countries where audits are unlikely is almost equal to zero. This is again consistent with VAT refund considerations being central to the results identified in this paper.

Columns 3 and 4 consider interactions of the main treatment with variables that record whether it takes more than 6 months for the firm to receive a refund and whether the refund request takes more than 24 hours of compliance time, respectively. There is some evidence that longer refund times are associated with a more negative effect on intermediate input intensive exports, though there is no evidence of a significant effect of compliance time. When we include all three additional interaction terms in Column 5, we can see that only the interaction with audit likelihood is statistically significant.

Taken together, these results are suggestive of an important role for the VAT refund audits. Frequency of audits presumably indicate a government that is reluctant to provide refunds and perhaps is weary of false claims. These results imply that such a reluctance can have a serious distortionary effect on exports, and so there is potentially a substantial benefit from improving this aspect of VAT administration.

5.4 Non-manufacturing industries

These baseline results look specifically at the exports of manufacturing industries. It is natural to ask whether the results are substantially different for non-manufacturing industries such as agriculture, natural resources and services. The first column of Table 7 includes agriculture and natural resource sectors. We see that the main coefficient of interest is essentially the same with these inclusions. The second column includes the two services industries that we have data for. In this case, the coefficient drops to a certain extent but is still of a similar general magnitude. When all industries are included, as in column 3, the main coefficient of interest is about 0.80. This provides us with a somewhat more conservative magnitude than the baseline manufacturing results. This magnitude implies that an industry with a 10% point higher intermediate input share sees a decline in exports of about 8% following VAT adoption. Based on the trade elasticities discussed earlier, this would correspond to an increase in prices of about 1-1.5%.

5.5 Replaced policies

The VAT was often introduced as a replacement for existing taxes. The most common taxes replaced by the VAT are different forms of turnover taxes, sales taxes, and tariffs (Ebril et al., 2001).[10] When the VAT replaces such existing policies, our estimates would capture the joint effect of removing these policies and adopting the VAT. Given that policies such as turnover taxes more obviously tax intermediate goods than the VAT does, it is perhaps surprising that we do find a large negative effect of VAT adoption. This could reflect in part the fact that countries in practice rely on the VAT to a much greater extent than they relied on the policies it replaced and so the VAT might simply matter more in an absolute sense.

Table 8 draws on information about the policies that the VAT replaced from Ebril et al. (2001) to examine whether the impact of VAT adoption varies depending on which policies it replaced. Since this information is missing for many countries in our sample, the first column repeats the baseline regression for the 77 countries for which we have information on replaced policies. We see that the estimated coefficient for this sample of countries is comparable to the baseline. The second column of Table 7 introduces an interaction of the main treatment variable with a binary variable that records whether the policies replacing the VAT include trade taxes. The second and third columns repeat this exercise but with turnover and sales taxes, respectively, rather than trade taxes. The final column includes all of the additional interaction terms.

Across these specifications, we do not find any significant heterogeneity in the effect depending on the policies that were replaced by the VAT. This is perhaps especially surprising in the case of turnover taxes, which apply in principle to every stage of production without a crediting system as with the VAT. One explanation, as mentioned above, could be that countries rely more on the VAT than they did on the turnover taxes it replaced. Another relevant factor here is the fact that – as noted in Ebril et al. (2001) – even prior to the VAT, countries made use of various methods to avoid cascading,

[10]Based on Ebril et al. (2001), the VAT does not seem to have commonly replace direct taxes.

such as imposing reduced rates on input goods. Particularly combined with the less significant nature of these taxes in an absolute sense as compared to the VAT, this might help explain why we find no evidence of heterogeneity in the effect based on differences in replaced policies.

5.6 Trends and Placebo Tests

The empirical specification employed in this analysis looks at the differential effect of VAT introduction across industries. By doing so, it helps reduce both simultaneous causality and policy endogeneity concerns relative to an analysis of country-level outcomes. For example, the country-year fixed effects would help control for any tendency for countries to adopt the VAT in a period of greater growth of overall trade. The empirical strategy would be invalid if countries were more likely to introduce the VAT when industries that rely more on intermediate inputs were performing poorly. While there is to my knowledge no obvious reason to think that this might be the case, it is still worthwhile to consider some robustness tests that could help address such concerns.

Table 9 shows two distinct ways of doing this. While we cannot include country-industry-year fixed effects, we can include time trends at the country-industry level. The first two columns of Table 8 include 5- and 10- year linear growth trends of exports at the country-industry level. We can see that the main coefficient of interest is largely unchanged with the inclusion of these trends.

Columns 3 and 4 of Table 9 consider a type of placebo test. Specifically, we "pretend" that the VAT was introduced either 10 or 20 years before the actual introduction date and see whether this placebo introduction has an effect by the year of true VAT introduction. This specifically means that we are using a placebo treatment variable in place of the VAT variable and we drop the data for a country for all the years following VAT adoption. The results show that the placebo estimates are insignificant, suggesting that my main results are are in fact capturing the effect of VAT adoption rather than other coincidental trends.

6 Conclusion

This paper provides evidence of a substantial effect of the VAT on international trade. Specifically, I find that VAT adoption leads to a large negative effect on the exports of industries that tend to rely more heavily on intermediate goods. This effect is driven by low- and middle-income countries and is absent for high-income countries. These results are consistent with the VAT functioning as a tax on the input purchases of exporters in countries where, due to poor tax administration, governments fail to fully provide refunds to businesses with excess VAT credits. In evaluating the effect of the VAT historically, these results imply that the adoption of the VAT had negative efficiency effects well beyond those generally expected of a consumption tax. Especially given the importance attached to export competitiveness in many developing countries, these findings suggest that there could be a substantial benefit from moving towards a more effective system of VAT refund administration.

Table 1: VAT adoption year by country

Country	Year	Country	Year
Albania	1996	Kenya	1990
Algeria	1992	Laos	2009
Argentina	1975	Lebanon	2002
Australia	2000	Madagascar	1994
Austria	1973	Malawi	1989
Bangladesh	1991	Mali	1991
Belgium	1971	Mauritania	1995
Benin	1991	Mauritius	1998
Bolivia	1973	Mexico	1980
Bosnia and Herzegovina	2006	Mongolia	1998
Brazil	1967	Morocco	1986
Bulgaria	1994	Mozambique	1999
Burkina Faso	1993	Nepal	1998
Burundi	2009	Netherlands	1969
Cambodia	1999	New Zealand	1986
Cameroon	1999	Nicaragua	1975
Canada	1991	Niger	1986
Central African Republic	2001	Nigeria	1994
Chad	2000	Norway	1970
Chile	1975	Pakistan	1990
China	1994	Panama	1977
Colombia	1975	Paraguay	1993
Congo	1997	Peru	1973
Costa Rica	1975	Philippines	1988
Croatia	1998	Poland	1993
Côte d'Ivoire	1992	Portugal	1986
Denmark	1967	Republic of Korea	1977

Dominican Republic	1983
Ecuador	1970
Egypt	1991
El Salvador	1992
Ethiopia	2003
Finland	1994
France	1968
Gabon	1995
Gambia	2003
Germany	1968
Ghana	1998
Greece	1987
Guatemala	1983
Guinea	1996
Guinea-Bissau	2001
Haiti	1982
Honduras	1976
Hungary	1988
Indonesia	1985
Ireland	1972
Israel	1976
Italy	1973
Jamaica	1991
Japan	1989
Jordan	2001
Romania	1993
Rwanda	2001
Senegal	1980
Sierra Leone	2010
Singapore	1994
Slovenia	1999
South Africa	1991
Spain	1986
Sri Lanka	1998
Sudan	2000
Sweden	1969
Switzerland	1995
Thailand	1992
Macedonia	2000
Togo	1995
Trinidad and Tobago	1990
Tunisia	1988
Turkey	1985
Uganda	1996
United Kingdom	1973
Tanzania	1998
Uruguay	1968
Venezuela	1999
Viet Nam	1999
Zambia	1995
Zimbabwe	2004

Table 2: Intermediate input and investment shares by industry

NAICS	Description	Input Share	Investment Share
541	Professional, Scientific, and Technical Services	0.31	
323	Printing and Related Support Activities	0.40	0.04
339	Miscellaneous Manufacturing	0.41	0.03
334	Computer and Electronic Product Manufacturing	0.42	0.04
114	Fishing, Hunting and Trapping	0.45	
327	Nonmetallic Mineral Product Manufacturing	0.45	0.05
312	Beverage and Tobacco Product Manufacturing	0.46	0.03
337	Furniture and Related Product Manufacturing	0.47	0.02
332	Fabricated Metal Product Manufacturing	0.47	0.03
562	Management of Companies and Enterprises	0.47	
333	Machinery Manufacturing	0.48	0.03
325	Chemical Manufacturing	0.48	0.05
335	Electrical Equipment Manufacturing	0.50	0.03
326	Plastics and Rubber Products Manufacturing	0.50	0.04
315	Apparel Manufacturing	0.50	0.01
111	Crop Production	0.51	
212	Mining (except Oil and Gas)	0.51	
316	Leather and Allied Product Manufacturing	0.52	0.01
322	Paper Manufacturing	0.55	0.05
313	Textile Mills	0.59	0.03
336	Transportation Equipment Manufacturing	0.60	0.03
211	Oil and Gas Extraction	0.60	
321	Wood Product Manufacturing	0.60	0.03
314	Textile Product Mills	0.61	0.02
331	Primary Metal Manufacturing	0.63	0.04
311	Food Manufacturing	0.65	0.02

324	Petroleum and Coal Products Manufacturing	0.83	0.03
112	Animal Production and Aquaculture	0.85	

Table 3: Baseline results

	(1)	(2)	(3)	(4)
	Dependent variable: log of exports			
VAT × input share	-1.264***			-1.343***
	(0.285)			(0.305)
VAT × input plus investment share		-1.331***		
		(0.300)		
VAT × investment share			-1.225	-3.050
			(2.219)	(2.353)
Observations	100,719	100,719	100,719	100,719
R-squared	0.933	0.933	0.933	0.933

Standard errors are clustered at the country-level (105 clusters).
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Regression based on equation (6)

	(1)	(2)	(3)	(4)
	Dependent variable: log of exports			
VAT × input share		-2.044***	-1.225***	
		(0.646)	(0.284)	
VAT rate × input share	-5.219***	5.014		-5.126***
	(1.846)	(4.047)		(1.816)
log GDP per capita × (1 - input share)			0.202	0.228
			(0.305)	(0.309)
Observations	100,719	100,719	97,581	97,581
R-squared	0.933	0.933	0.933	0.933

Standard errors are clustered at the country-level (105 clusters). Country-year, sector-year and country-sector fixed effects are included.

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Heterogeneity by income level

	(1)	(2)	(3)
	Dependent variable: log of exports		
VAT × input share	-1.582***	-1.120***	-1.452***
	(0.326)	(0.301)	(0.353)
VAT × input share × high income	1.354**		1.241**
	(0.516)		(0.533)
VAT × input share × low income		-1.048*	-0.754
		(0.600)	(0.622)
Observations	100,719	100,719	100,719
R-squared	0.933	0.933	0.933

Standard errors are clustered at the country-level (105 clusters).
Country-year, sector-year and country-sector fixed effects are included.
*** p<0.01, ** p<0.05, * p<0.1

Table 6: VAT refund administration

	(1)	(2)	(3)	(4)	(5)
	Dependent variable: log of exports				
VAT × input share	-1.144***	0.177	-0.723*	-0.974**	0.172
	(0.318)	(0.553)	(0.393)	(0.370)	(0.553)
VAT × input share×audit likely		-1.884***			-1.579**
		(0.641)			(0.653)
VAT × input share×long refund delay			-1.414*		-0.831
			(0.776)		(0.887)
VAT × input share×lengthy compliance				-0.806	0.187
				(0.860)	(0.984)
Observations	54,822	54,822	54,822	54,822	54,822
R-squared	0.948	0.948	0.948	0.948	0.948

Standard errors are clustered at the country-level (56 clusters). Country-year, sector-year and country-sector fixed effects are included.

*** p<0.01, ** p<0.05, * p<0.1

Table 7: Including agriculture and/or services

	(1)	(2)	(3)
	Dependent variable: log of exports		
	Including agriculture	Including services	All industries
VAT × input share	-1.099***	-0.851***	-0.829***
	(0.257)	(0.250)	(0.230)
Observations	119,565	110,969	129,817
R-squared	0.922	0.929	0.920

Standard errors are clustered at the country-level (105 clusters).
Country-year, sector-year and country-sector fixed effects are included.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 8: Heterogeneity based on replaced policies

	(1)	(2)	(3)	(4)	(5)
	Dependent variable: log of exports				
VAT × input share	-1.174***	-1.218***	-1.125***	-1.023**	-0.799
	(0.303)	(0.309)	(0.392)	(0.396)	(0.664)
VAT × input share ×replaced tariffs		0.820			0.698
		(0.822)			(0.815)
VAT × input share ×replaced turnover			-0.112		-0.387
			(0.526)		(0.679)
VAT × input share ×replaced sales taxes				-0.293	-0.480
				(0.523)	(0.673)
Observations	77,370	77,370	77,370	77,370	77,370
R-squared	0.938	0.938	0.938	0.938	0.938

Standard errors are clustered at the country-level (77 clusters). Country-year, sector-year, and country-sector fixed effects are included.

*** p<0.01, ** p<0.05, * p<0.1

Table 9: Linear trends and placebo test

	(1)	(2)	(3)	(4)
	Dependent variable: log of exports			
	All years		Only data up to VAT year	
VAT × input share	-1.136***	-1.106***		
	(0.307)	(0.298)		
Lagged five-year change in log of exports	0.232***			
	(0.00863)			
Lagged ten-year change in log of exports		0.253***		
		(0.00824)		
10-year placebo VAT × input share			0.167	
			(0.397)	
20-year placebo VAT × input share				-0.239
				(0.363)
Observations	83,178	74,018	43,688	43,688
R-squared	0.944	0.952	0.910	0.910

Standard errors are clustered at the country-level (105 clusters). Country-year, sector-year and country-sector fixed effects are included.

*** p<0.01, ** p<0.05, * p<0.1

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