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Domestic Taxes and Export Composition: Evidence from VAT Adoption Worldwide

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Abstract

In principle, a VAT should be neutral with regards to both the level and composition of exports. In practice, this may not be the case because exporters in many countries receive incomplete VAT refunds. When VAT refunds are incomplete, the exports of industries that rely heavily on intermediate goods are especially likely to be negatively affected by a VAT. Motivated by these considerations, this paper uses trade data for over 100 countries spanning 1962-2015 to evaluate the differential effect of the VAT across industries. I find that 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. This effect is particularly pronounced for low-income countries and essentially absent for high-income countries.

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1 Introduction

International trade considerations have become increasingly prominent in public discussions of domestic tax policies and tax reforms across the world. While the role of trade taxes in shaping the pattern of trade has always been a major area of study among economists, the potential effects of domestic taxes have received considerably less attention. The current paper contributes to this topic by studying how domestic tax systems can affect the composition of a country's exports. I study this question through the lens of one of the most significant global tax changes in the 20th century: the worldwide adoption of the VAT.

While the VAT is in principle neutral in its treatment of international trade (Feldstein and Krugman, 1990) – so that it should affect neither the volume nor the composition of trade – this neutrality relies on the government providing refunds to exporters for any excess input taxes they pay. In practice, however, businesses in many countries either do not always receive the refunds they are owed or do not do so in a timely manner (Harrison and Krelove, 2005). To the extent that there are such imperfections in the VAT refund system, the VAT acts in part as a tax on exports. Furthermore, this tax is unlikely to be uniform across all exports because industries that rely more heavily on intermediate goods would be particularly hurt by the incompleteness of refunds. As a result, such an imperfect VAT would also be likely to affect the composition of a country's exports.

Motivated by these considerations, this paper studies the differential effect of VAT adoption across industries using international trade data for over 100 countries spanning a period from 1962-2015. Guided by a multi-sector Armington (1962) model of trade, I consider an empirical specification that relates exports at the industry level to the interaction of VAT adoption in a country and the industry's intermediate goods share of output. By studying a large sample of countries and industries, I am able 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 good 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).

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 relevant trade elasticities from Hummels (2001) and Hertel et al. (2007) – which are based on an aggregation level for the trade data that is comparable to the analysis in the current paper – would imply that a 8% decrease in the exports of an industry would result from approximately 1-2% higher prices. I argue that this is a large but plausible effect size.

These results mask some important heterogeneity across countries. Specifically, I find that the negative differential effect of the VAT is driven by low- and middle-income countries. The effect is particularly strong in the case of low-income countries and essentially absent for high-income countries. This type of heterogeneity across countries is consistent with both anecdotal and survey evidence that VAT refund performance tends to be very poor in low-income countries, especially as compared to high-income countries (Harrison and Krelove, 2005). For a subset of countries with available information, I also find direct evidence that the negative differential effect of the VAT is significantly more pronounced in countries where a VAT refund request is more likely to trigger an audit.

The VAT was often introduced as a replacement for existing policies such as turnover taxes, sales taxes, and tariffs. This means that the effect of the VAT introduction identified here would be the joint effect of removing existing taxes and introducing the VAT. Since these replaced policies are

themselves likely to tax intermediate goods – often more obviously than the VAT should – it is perhaps surprising that the VAT does have a large negative effect on industries that are more reliant on intermediate goods. 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 matter more in an absolute sense. Broadly consistent with this, I do not find any evidence of a difference in the effect of the VAT depending on which types of policies it replaced.

This paper makes a contribution to the existing work in two distinct literatures. First, it is connected to existing research on the effects of the VAT on international trade. Desai and Hines (2005) find that the VAT reduces the volume of exports, with a particularly large effect for low-income countries. Keen and Syed (2006) find no significant effect of the VAT on net exports in their preferred specifications. Ufier (2014) finds no significant effect of the VAT on trade. Using firm-level data from China, Chandra and Long (2013) use variation in local government revenue needs to find that increased VAT rebates lead to an increase in exports. The current paper complements this existing body of work by emphasizing the *composition* of exports rather than the volume.

Second, this paper is connected to a growing empirical literature that studies the determinants of export composition. In addition to classical determinants of comparative advantage such as factor proportions (Romalis 2004), the literature has explored several other potential sources of comparative advantage. These determinants include institutions (e.g. Levchenko, 2007; Nunn, 2007; Manova, 2008; Cunat and Melitz, 2012), natural resources (Debaere, 2014) and demographic composition (Cai and Stoyanov, 2015).[1] The current paper uses a related type of analysis to show that domestic taxes can also significantly affect the composition of exports. It should be

[1]For an analysis that combines different sources of comparative advantage, see Chor (2010) and for a review of this literature, Nunn and Trefler (2014).

noted that as a matter of terminology, it would not be accurate to say that the VAT is a determinant of comparative advantage. Rigorous definitions of comparative advantage are generally phrased in terms of Autarky prices (e.g. Deardorff, 1980) whereas as discussed earlier, an imperfect VAT essentially acts as an export tax. In this sense, the finding here is that the VAT distorts export composition *away* from comparative advantage.

An important difference between taxes and the type of determinants of export composition considered in the existing literature is that taxes are policy choices that can be implemented and changed in a relatively short period of time. As institutions and factor endowments are only likely to change substantially over longer periods, the existing work in this area generally uses cross-country variation in the determinants of export composition.[2] The current paper, by contrast, is able to study how a policy change – the adoption of the VAT – affects a country's subsequent export composition. As noted by Nunn and Trefler (2014), an advantage of an empirical specification based on a policy change in this context is that it can help reduce concerns about reverse causality. Furthermore, the inclusion of country-industry fixed effects allows us to control for all time-variant invariant sources of export composition.

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.

[2]A notable exception is Manova (2008), who makes use of equity market liberalization episodes.

2 Theory

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 (1962) 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 the VAT system potentially does not allow for a full rebate of intermediate input taxes.

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 preferences over the varieties of the good from each country. The upper-tier utility in country i is given by:

$$U_i = \sum_z u_i(z)^{\alpha_Z},$$

where α_Z is the income share going to good z and $u_i(z)$ is the sub-utility from consumption of z in country i. This sub-utility is in turn given by:

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

where $q_{ij}(z)$ is the quantity consumed in country i of the variety of z from country j. With this setup, households in each country spend a fixed fraction of their income $\alpha(z)$ 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 so labor income is the only source of household income. With this, the household demand for a

variety of a good is given by:

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

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.

2.2 Production

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

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

where $\beta(z)$ is the intermediate input share of output, $L_j(z)$ 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 the same two-tiered structure as the utility function, and has a pre-tax price index equal to Q.[3]

Under a VAT, firms pay a tax on intermediate inputs 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. Under a theoretically ideal 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 costs as being factors that effectively decrease r. In the same way, to the extent that VAT refunds can only be obtained by incuring compliance costs, audit-related expenses, or by paying bribes, the value of r will effectively

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

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 neccesarily 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 ommited from the theoretical framework here in order to more clearly highlight the central point of this paper but the potential importance of replaced policies will be explored empirically and discussed in Section 5.

The price that the firm is able to set is then determined by the Cobb-Douglas unit cost function:

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

This expression relates the price of the good to the wage and the intermediate input cost. Note that the tax on intermediate inputs only matters when $r<1$, i.e. when the VAT rebate is incomplete.

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. With this in mind, the total exports of good z from country j can be written as[4]:

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

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

Plugging in our earlier expression for prices, we can write exports as:

$$
x_j(z) = \left[\frac{w_j}{1-\beta(z)}\right]^{[1-\beta(z)](1-\sigma)}\left[\frac{Q[1+\tau(1-r)]}{\beta(z)}\right]^{\beta(z)(1-\sigma)} P(z)^{-1}\frac{\alpha(z)}{1-\beta(z)}\sum_{i\neq j} w_i L_i
$$

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

$$
\begin{aligned}
log x_j(z) &= (1-\sigma)\, log p_j(z) - log P(z) + \frac{\alpha(z)}{1-\beta(z)}\sum_{i\neq j} w_i L_i \\
&= (1-\sigma)\{[1-\beta(z)]\, log w_j - [1-\beta(z)]\, log[1-\beta(z)] + \beta(z)\, log Q + \beta(z)\, log[1+\tau(1-r)]\} \\
&- log P(z) + log\frac{\alpha(z)}{1-\beta(z)}\sum_{i\neq j} w_i L_i
\end{aligned}
$$

I assume that world income is a constant from the standpoint of the country under analysis, essentially assuming that the 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:

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

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 the wage due to the VAT will have a differential effect on industries depending on their labor intensity, $1 - \beta(z)$. The change in the wage 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 unimportant empirically.

It will be to useful to use an approximation that allows the 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 $\tau(1-r)$, $log[1+\tau(1-r)] \approx \tau(1-r)$. The earlier equation can then be re-written as:

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

We will refer to this expression 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 (1), which relates the log of exports to an interaction between the VAT and the intermediate input intensity. The primary specification will take the following form:

$$x_{cit} = \alpha + \beta \left(v_{ct} \times i_{it} \right) + \gamma_{ct} + \delta_{it} + \phi_{ci} + \epsilon_{cit}, \tag{2}$$

where x_{cit} is the log of exports from country c in industry i in yea 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 the β, the coefficient on the interaction term $v_{ct} \times i_{it}$.

The fixed-effects in this specification control for a range of unobservable 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 sources of export composition. The regression estimates with this specification will be identified off of changes in the exports of particular industries in particular countries after VAT adoption.

For a measure of the VAT, v_{ct}, I will use 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 rebate 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 study.

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 (2) does not attempt to disentangle these general equilibrium effects from the more direct effect of higher input taxes. To take this into account, we can, again keeping equation (1) in mind,

modify the regression specification to take the following form:

$$x_{cit} = \alpha + \beta\left(v_{ct} \times i_{it}\right) + \omega\left[w_{ct} \times (1 - i_{it})\right] + \gamma_{ct} + \delta_{it} + \phi_{ci} + \epsilon_{cit}, \quad (3)$$

where w_{ct} is a measure of income per person. The only difference here relative to equation (2) is that we have a new term that captures differential general equilibrium effects.

4 Data

4.1 Data Sources

We can now turn to the data sources and measures used to estimate equation (2). I obtain information on the VAT across the world from Ebril et al. (2001), supplemented by Adhikari (2016). From these sources, I primarily make use of the date of VAT adoption, the VAT rate at adoption and information about policies that the VAT replaced. For some specifications, I make use some information on the time it takes to obtain VAT refunds, submit VAT refund requests and the likelihood of a refund request being audited from the "Paying Taxes" study by PricewaterhouseCoopers and the World Bank.

Data on exports are obtained from UNCOMTRADE. The original data I use is reported in SITC-1 and available from 1962-2015. This is then concorded to NAICS via SITC-2. 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. Importer-reported data is generally considered more reliable than exporter-reported data because countries have stronger incentives to collect information on imports in order to properly levy tariffs. 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 (2) is the intermediate goods intensity. I treat the intermediate goods intensity as a technological characteristic and measure it using US data. This ensures that the actual input intensity of a sector in a given country is not endogenous to that country's policies (c.f. Rajan and Zingales, 1998). The relevant measure of intermediate goods intensity should include any expenses that a firm would 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 main measures I use 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 ratios 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 discuss in Section 4, the results I obtain are fairly similar 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 which have at least 5 years of trade data available before VAT adoption and at least 5 years afterwards. Finally, I drop very small trade flows, defined as country-industry-year exports of less than $1 million.

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 Iran, Burundi, Laos, Liberia and Sierra Leone. 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 noted 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. Note once again that these values are calculated using US data.

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 strong pattern of intermediate input intensity in these industries relative to manufacturing. 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 (2) are presented in Table 3. In the first column, the coefficient of interest is the interaction between the 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 10% following VAT adoption.

To get a sense of the magnitude of this effect, it is useful to consider some reasonable values for the relevant trade elasticity. From equation (2), 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. Depending on the specification, the average of the estimated elasticities tends to range from 5 to 7. This would mean that 10% decrease in exports would correspond to an approximately 1.5-2% increase in the price, a magnitude that appears to be reasonable.

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 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 very small share of output compared to intermediate inputs (see Table 2).

Table 4 adopts specifications that are closer to equation (1). 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, (1) would imply that $1 - r \approx 0.70$ and so $r \approx 0.30$. Taking the model literally, this would be a rather small rebate rate but is certainly of a reasonable order of magnitude, especially given what is missing in the theoretical model. For example, the model does not include compliance costs associated with the VAT refund system, costs from refund delays or the potential adverse endogenous productivity effects of facing higher intermediate input costs. All these factors would contribute to a larger negative effect.

Turning to other columns in Table 4, column 2 shows that when both the binary and the continuous measures are included, only the binary variable seems to matter. As discussed earlier, the continuous measure is unlikely to truly measure the intensity of the VAT 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 (1) by allowing the general equilibrium effects of the VAT to have a heterogeneous effect across industries as in the regression specification (3). To do this, I include an interaction of the GDP per capita with one minus the input share of the industry, consistent with equation (1). 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 in the effect

5.2.1 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. The coefficient on the new interaction term implies that the net effect on high income countries is close to zero, suggesting that the results are driven primarily by low- and middle-income countries.

Columns 2 and 3 explore further heterogeneity based on income by including an interaction of the treatment with a low-income country indicator. Column 2 suggests that the impact is indeed significantly higher for low income countries. Column 3 includes interactions of the main treatment with both high- and low-income indicators and finds that the point estimate for the effect on low income countries is lower than in middle income countries 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 (Harrison and Krelove, 2005).

5.2.2 Evidence on VAT Refund Administration

While the results here suggest the importance of the quality of VAT refund administration, it would useful to see whether there we can link these results directly to information about VAT refunds across the world. We can obtain some information on this from the "Paying Taxes" study conducted by the The World Bank and PriceWaterhouseCoopers. This study considers various aspects of the tax system faced by the same hypothetical firm across the world and provides some information about the VAT refund system specifically. The main limitation of this study as applied to the current paper is that the hypothetical case study firm in 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 essentially restricted to exporters in many countries, we have 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 relevant information. The three available indicators include 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. Table 6 considers regressions that include an interaction of the main treatment variable with these characteristics of the VAT refund system.

Column 1 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 consistent with VAT refund considerations being central to the results identified in this paper.

Columns 2 and 3 consider interactions of the main treatment with variables that record whether it takes more than 6 months for the firm to receive the 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 interaction terms in Column 4, 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 are probably suggestive of a government that is reluctant to provide refunds and perhaps is weary of false refund claims. These results imply that such a reluctance can have a serious distortionary effect on the composition of exports, and so there might be a substantial benefit from improving this aspect of VAT administration.

5.2.3 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 agriculture, natural resources and services. The first column of Table 5 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%.

5.2.4 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). When the VAT replaces such existing policies, our estimates would capture the joint effect of scrapping existing policies and adopting the VAT, rather than the effect of the VAT in itself. 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 be a more substantial policy.

Table 7 draws on information about the policies that the VAT replaced from Ebril et al. (2001) to consider whether the impact of VAT adoption

varies substantially depending on which policies it replaced. Since this information is missing for many countries in our sample, the first column repeats the baseline regression with only 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 column repeat this exercise but with turnover taxes and sales taxes in place of the VAT. 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 discussed earlier, could be that countries in practice rely more on the VAT than 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. Particularly combined with the less significant nature of these taxes in an absolute sense as compared to the VAT, this may help explain why we find no evidence of heterogeneity in the effect based on differences in replaced policies.

5.3 Robustness 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. The empirical strategy would be invalid if countries were more likely to introduce the VAT when industries that rely on intermediate inputs were performing poorly. While there seems to be

no obvious reason to think that this might be the case a priori, it is still worthwhile to conduct some robustness tests that could help address such concerns.

Table 8 does this is a number of different ways. While we cannot include country-industry-year fixed effects, we can include some 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 8 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 statistically insignificant and if anything, positive in sign. This suggests that my main results are are in fact capturing the effect of the VAT rather than some other co-incidental trends.

6 Conclusion

This paper provides evidence that domestic taxes can significantly affect the composition of a country's exports by evaluating the impact of VAT adoption worldwide. I find that VAT adoption leads to a large negative effect on the exports of industries that rely more heavily on intermediate goods. This effect is primarily driven by low- and middle-income countries and is largely absent in the case of high-income countries. These results are consistent with the idea that the VAT acts as a tax on exporters in countries where, due to poor tax administration, governments are unable to promptly provide exporters with refunds for the VAT paid on their intermediate goods.

The analysis in this paper finds that the VAT as it exists in practice has a significant distortionary effect on export patterns. In evaluating the effect of the VAT historically, these results imply that the adoption of the VAT could have had negative efficiency effects beyond those generally expected of a consumption tax. Looking to the future, these results suggest that many countries could benefit substantially by moving towards a more effective VAT refund system.

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

	(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.

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

Table 4: Regression based on equation 3

	(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. 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. 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)
	Dependent variable: log of exports			
VAT × input share	0.177	-0.723*	-0.974**	0.172
	(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
R-squared	0.948	0.948	0.948	0.948

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

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

Table 7: Regressions 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. 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. Country-year, sector-year and country-sector and sector-year fixed effects are included.

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

Table 9: Robustness tests

	(1)	(2)	(3)	(4)
	Dependent variable: log of exports			
	All years		Only data upto 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. Country-year, sector-year and country-sector fixed effects are included.

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

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