DRAFT for discussion
(Revised June 2022)

Tracing the Incidence of Indirect Taxes through the Production-Distribution Chain: Application to Jordan

Andrey Timofeev[*]
International Center for Public Policy
Andrew Young School of Policy Studies
Georgia State University

Abstract

In many counties, the balance of taxation has been shifting from trade taxes toward indirect taxes on domestic consumption, primarily the Value Added Tax (VAT). Policymakers need information regarding who bears the burden of tax changes. In theory, a broad-based VAT should be equivalent to a tax on income after taxes less savings. However, in practice, a VAT never applies to all commodities and sellers uniformly. Thus, the effective tax rate varies among final consumption items depending on the amount of tax levied and credited throughout the production-distribution chain. Furthermore, in addition to the VAT, in some countries, a considerable part of public revenues still derives from excises and customs duties, which in turn become part of the VAT base. In this study, we propose a practical approach to incidence analysis of indirect taxes and apply it to develop a better understanding of the current distribution of the burden of indirect taxes in Jordan.

Keywords: Tax Incidence, VAT, Import Duties, Input-Output Analysis, Jordan

JEL Codes: H22, H25, H32

[*] tel: (+1) 404-413-0230, fax: (+1) 404-413-0244, e-mail: atimofeev@gsu.edu.

Introduction

Tax incidence analysis provides policymakers with information regarding who bears the burden of a country's tax system, that is, who actually pays taxes. Because taxes may lead individuals and businesses to behave differently than they do in the absence of taxes, the economic incidence may differ from the statutory incidence of taxation. The burden of the tax may be shared by consumers in the form of increased prices, by workers in the form of lower wages, and by those that own shares in businesses by lowering returns to investment. Furthermore, the same household can be affected by the same tax change through a number of these channels simultaneously. Ultimately, the burden of taxation is measured by the change in resources available to a household as a result of taxation, which in the case of indirect taxes means higher spending on the same consumption basket than would be in the absence of taxes.

An essential component of incidence analysis is the distributional analysis of the burden of taxation among the population. "Who pays" taxes in and where they are in the distribution of household income is a relevant question for policymakers who seek to balance the need for revenue with concerns about equity in the tax system. Tax incidence analysis, therefore, can provide important information regarding the equity and efficiency aspects of proposed tax reforms as well as the current revenue system.

The conventional approach to tax incidence analysis is to allocate the burden of actually collected taxes to different taxpayer groups based on the assumptions informed by theoretical models.[1] In the case of indirect taxes, the conventional assumption is that the tax burden is entirely borne by final consumers. The challenge of practical implementation is that the bulk of VAT revenues is remitted to the tax authorities by suppliers of intermediate goods. Therefore, one has to trace those tax collections throughout the production-distribution chain to the final consumers.

In this study, we propose a practical methodological approach and apply it to analyze the incidence of Jordan's indirect taxes: customs, general sales tax, and excises. Indirect taxes are the main source of tax revenues in Jordan. They include the General Sales Tax (GST),

[1] One of the key assumptions used in these theoretical models is that goods are sold in competitive markets. Under imperfect competition, theoretical models yield predictions different from full shifting of the tax burden to final consumers. Empirical studies find the consumer share of the tax burden to differ from 100% in specific markets, such as car sales and gas stations (Carbonnier 2007). While our model allows the analyst to specify less than full shifting of tax burden for some of the 81 sectors in Jordan, the incidence analysis results presented in this paper do not make such adjustments.

Special Sales Taxes (SST), and Import Duties. Together they accounted for over three-quarters of the national tax revenues in 2014. Jordan uses the "invoice-credit" approach in its General Sales Tax (essentially a form of VAT) and Special Sales Taxes (essentially excises). GST is a broad-based sales tax with a standard rate of 16 percent and reduced rates of 0, 4, 7, and 8 percent applied to selected items or sectors.

Using a long literature on tax incidence (for a review, see Fullerton and Metcalf, 2003), we make a series of assumptions regarding the final incidence of taxes after they have been shifted in the economy. Using Jordan's 2010 Household Expenditure and Income Survey (HEIS), we then allocate the actual level of tax collections in 2014 to households based on these assumptions. The HEIS contains detailed information on the income and expenditures of each household, which allows us to allocate the amount of each tax collected based on the share of each household's consumption. We make such an attribution for each tax source and aggregate it over households to arrive at a measure of all indirect taxes borne by each household. Finally, sorting households by the size of their total budget from low to high, we report the amount of tax borne by the average household at each level of income (proxied by household budget size), and we also report tax borne divided by income—a measure of effective rate of taxation.

We find that the system of indirect taxes (customs, excise, and general sales tax) is relatively proportional over all deciles—that is, households pay roughly the same proportion of their income in these taxes (approximately 11 percent). There is mild progressivity to the burden of these taxes, with the share growing marginally from the first to the fifth decile and then slightly regressive from the sixth through the tenth decile. The rough proportionality of indirect taxes comes about from the broad base of these taxes. The burden of taxable goods consumed heavily by low-income households as a share of their budget (tobacco, for example) is offset in the total burden by goods consumed heavily by high-income households relative to the size of their budget (vehicles and fuel for vehicles, for example).

The rest of this paper is organized as following. In the next section, we lay out the methodological approach to tracing the incidence of indirect taxes through the production-distribution chain. Then, we demonstrate how this methodological approach can be applied in practice using the country case of Jordan. Next, we discuss some policy implications. We conclude with a summary of the issues and final comments.

Methodology

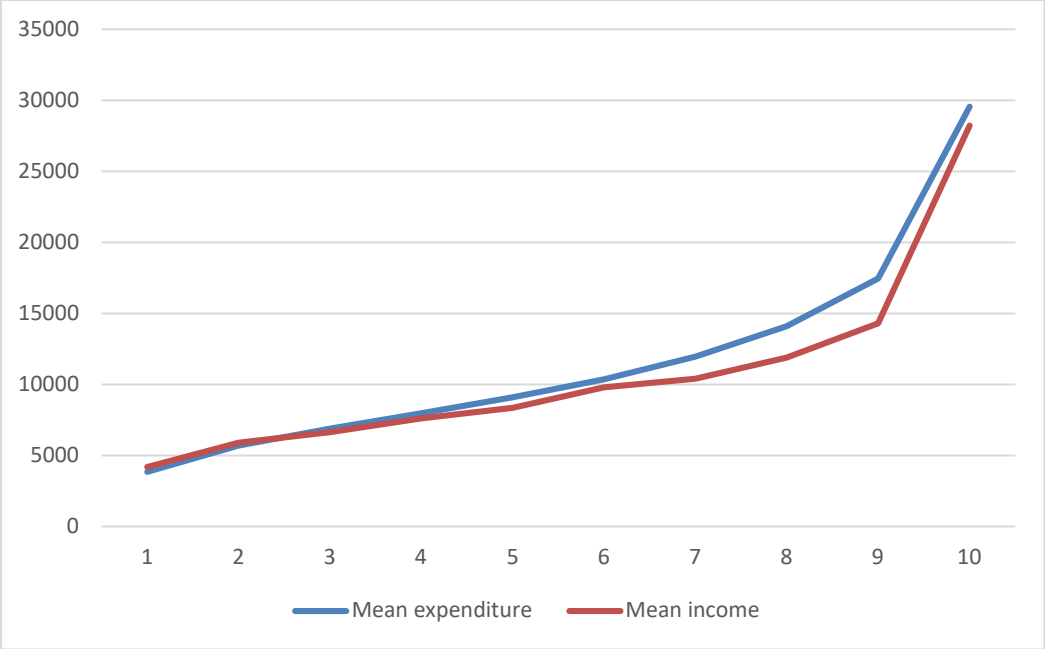
For indirect taxes, the tax burden of a particular group of households is commonly defined as a loss of their real incomes or, in other words, the reduction of the amount of consumption resulting from a reduced purchasing power of their incomes.[2] For a broad-based consumption tax, the conventional approach is to measure the tax burden as an additional amount of income that a household would need in order to just keep its wellbeing constant in the face of any price changes caused by the tax. Thus, such conventional measures disregard the second-order effect of changes in the quantities consumed.

In this study, our approach is essentially a hybrid of tax simulation and revenue allocation. Following the tax allocation approach, we start with actual taxes collected by businesses from their buyers and paid to their suppliers (or to Jordan Customs in the case of imported supplies). Then

[2] In theory, a broad-based value added tax should be equivalent to a tax on income after taxes less saving. Therefore, the distributional effects of indirect taxes can be analyzed both by the use of income for consumption (the use method) and by sources of income (the sources method). Since in practice a VAT never applies to all commodities uniformly, the sources method becomes less reliable for analysis of either tax revenue or incidence. In the presence of exemptions of various commodities and businesses as well as subjecting some commodities to non-standard (e.g. zero) rates, the equivalence between sources and uses of income can break down completely. Furthermore, in addition to the VAT, in this study we also examine excises and customs duties, for which the relation to sources of income becomes moot.

we percolate these output taxes net of input tax credits throughout the production-distribution chain in order to impute the tax element in the market price of final consumption,[3] which is the difference between the price actually paid by the final consumer and a counterfactual price that would be in place without taxes (See Annex for the analytical formulas). Once we know the amount of tax in the market price of a consumer good, we apply these price changes to the actual household expenditures on specific commodities. Similar to the micro-simulation approach, we account for the tax burden in all household purchases, including the higher prices of purchases from informal vendors responding to tax increases in the formal sector through market arbitrage.

Figure 1: Distribution of 2010 Household Expenditure and Income by Expenditure Decile, inflated to the 2014 price level



The burden of the tax is analyzed relative to the ability of the households to pay taxes. The ability to pay comes from a comprehensive definition of income, and the assumption is that the larger the income, the higher the ability to pay. To analyze the tax burden across households, we need to work with household-level data. Jordan's Household Expenditure and Income Survey

[3] For imported inputs, it is the sales taxes levied by the Customs on the duty-inclusive value of imports that are further percolated throughout the production chain.

(HEIS, 2010) provides detailed household-level information on types of income (wages, capital, rental income, etc.) and detailed information on expenditures (tobacco, fuel, clothing, food, etc.). Survey data provide substantial detail but can suffer from reporting biases—income is often underreported, and expenditures may also be misreported. Based on discussions with Jordan's Department of Statistics and practices used in many other countries, this analysis relies on total household expenditures as a measure of ability to pay.

In fact, the actual distribution of income and expenditures by household reported in the HEIS is quite similar. Figure 1 shows the distribution of households by population decile (the lowest 10 percent of the population in terms of household expenditures to the top 10 percent of the population). As seen there, income and expenditures are distributed very similarly among household deciles.

Because our tax collections are for 2014, we inflate the 2010 household expenditure base to 2014 levels using an expenditure inflation adjustment of 18.63 percent (based on macro data). We made one additional adjustment to the 2010 data for the fuel subsidy that was instituted in 2011 and thus had not been captured by the 2010 HEIS data. Initially, the subsidy was made available to all households with income less than 10,000 JD and was allocated as 70 JD per family member up to a total of six family members (420 JD limit). In 2014, the subsidy regulation was amended to exclude households that have three vehicles or net wealth over JD 250,000 in the form of land, properties, shares in companies, and bank accounts.

This subsidy adds to the households' ability to pay and consume, so it is appropriate to scale up expenditures by the amount of the subsidy. Other government subsidies are included in the total household budget (as a proxy for income) by default since they were already available in 2010.

Immediately below, we provide detailed information on the incidence assumptions and allocation methods used for each indirect tax. These assumptions and methods are summarized in Table 1.

Incidence assumptions for sales taxes. Following the conventional approach (e.g., Younger et al. 1999), in this study, the incidence of the sales taxes is assumed to be on the final consumer.[4]

[4] While this analysis utilizes the tax incidence predictions from conventional theoretical models, the main purpose of this analysis is to apply these predictions to the real-life settings of the "tax-credit" VAT. In contrast to the theoretical models treating VAT as a tax on the value of primary inputs (value added) used in the production of a given output,

Using data from HEIS allows us to relate the tax burden of the sales taxes to the size of a household budget. The Income and Sales Tax Department (ISTD) under the Ministry of Finance reports sales tax receipts by business activity code (ISIC) of the supplier. First, we aggregate the receipts into 81 industries in Jordan's input-output table, provided by the Department of Statistics under the Ministry of Planning. This allows us to calculate the "average actual rate" for each industry as the ratio of the total amount of net taxes paid in each industry divided by the total domestic sales for that industry.[5] In addition, we estimate input taxes paid on imported inputs to each industry. This is calculated as a product of the average actual rate for a given imported input times the input-output coefficient from the I-O table for imported inputs.

However, with the exception of the part of the output that is exported abroad at given world prices, the market prices of the final domestic consumption of goods and services are expected to include indirect taxes paid by businesses throughout the production-distribution chain. Therefore, next, we map outputs from these 81 industries into 33 main groups of commodities in the HEIS (16 groups of food commodities and 17 groups of non-food commodities). The impact of taxes on the market prices of products of respective industries is accounted for in household budgets according to the relative shares of those products in total household expenditures. For example, in Group 8 (Dried & canned legumes) of household food expenditures, on average, 47% of expenditures are on dried legumes produced by industry 3 (Crops & Other Agriculture), while the remaining 53% of expenditures are on canned legumes produced by industry 17 (Other Food Products). Therefore, the average effective rate of the sales tax estimated for industry 3 at 3.03% is accounted for with a 0.47 weight, while the 11.57% effective rate on industry 17 is accounted for with a weight of 0.53 to arrive at the "tax element" of 0.47*3.03%+0.53*11.57%=7.56% in the

in real life the "tax-credit" liability also includes a tax on the intermediary inputs undertaxed at the previous stage of production (e.g., exempt or subject to a reduced rate). Conceptually, there is an interplay of two distinct tax elements: one is a tax on the primary factors at the rate of the output tax and the other is an excise (or subsidy) on each intermediary input taxed at the rate equal to the difference between the output tax rate and respective input tax rate.

[5] In our analysis, we consider each sector as comprised of two parts with identical technology: one producing outputs supplied to domestic buyers and the other producing the same output for exports. We only consider the former part for estimating the price changes faced by domestic buyers. To the extent that the tax on the intermediary inputs might not completely wash out due to breaks in the credit-invoice chain in the production of exported outputs, it will have to be absorbed by production factors if the world prices are exogenously given. Conceptually, there are two ways to approach these sectors producing tradable goods. One way is to assume that domestically produced tradable goods are perfect substitutes for their imported counterparts and thus sold at the world price (plus import tariffs) to domestic consumers and as a result any excises on their inputs would have to be entirely absorbed by the primary factors of production. Alternatively, one can assume imperfect substitution between domestically produced tradable goods and their imported counterparts by using the Armington aggregator to allow the excises on intermediate inputs to be partially shifted forward to the final consumers.

household expenditures on food group 8. While the share of the "tax element" in household expenditures on a particular commodity group is estimated to be the same for households at all income levels, when applying this share to actual household expenditures, which vary across income deciles, we arrive at different amounts of the tax burden for different groups of households. This exercise is done for each of the 33 commodity groups. Finally, based on percentage price changes for each group of household expenditures, we compute the loss of real income (or purchasing power) for each decile of households.

Incidence assumptions for import duties. Incidence analysis of import duties on final products relies on the same assumptions as used in the analysis of sales taxes. However, for import duties on intermediate inputs, the incidence assumptions will differ between industries producing non-tradable outputs as opposed to products that have to compete with imports. For industries producing non-tradable outputs (e.g., personal services), we assume that import duties on inputs are fully passed forward to the final consumers. More specifically, for domestic products that do not compete with imports (non-tradable), factor incomes per physical unit of output are assumed to remain intact so that import duties on all inputs upstream the production chain have to be accommodated in the price of this non-tradable output, similar to shifting of sales taxes.[6] Thus, average actual rates for each industry are translated into effective rates on non-tradable outputs (or percentage price changes caused by import duties) based on the matrix of the use of tradable inputs in the production of non-tradable outputs. To account for the use of non-tradable goods as inputs to other non-tradable goods, we also apply the Leontief inverse matrix for the non-tradable segment of the economy.

However, for tradable products, the market price is determined by world markets, and thus domestic producers will have to absorb import duty on their inputs. In addition to the change in real incomes of consumers (through market prices), customs duties also affect the income of the owners of factors of production in the tradable sector.[7] The impact of import duties on the aggregate factor income in the economy is derived by weighting percentage changes in sectoral

[6] The assumption of constant factor incomes per physical unit of non-tradable output is made to simplify the analytics. Combined with the assumption of constant returns to primary inputs under full shifting, it also implies the use of their fixed quantities to produce one unit of physical output. An alternative, but more computationally involved assumption would be that a certain percent of the import duty change is born by the factors of production.

[7] Conceptually, the net burden of import taxes is a sum of three elements: 1) effect on the consumer prices; 2) effect on factor incomes; 3) offset to the burden of direct taxes due to the impact on factor incomes. Because direct taxes are smaller relative to indirect taxes, in our analysis of tax incidence we disregard the last element of the burden of import taxes.

value-added with the shares of those sectors in the total income of factors of production. We allocate losses in factor income across households based on the share of wage and capital income in each decile.

Table 1: Summary of Taxes Analyzed, Level of Revenue, Incidence Assumption, and Allocation Methods

Tax source	Collection Attributed (2014)	Incidence assumption	Allocation method
GST	TOTAL: 1,998,061,545 Domestic: 100% Foreign: 0%	100% Borne by consumers.	Input and output taxes declared by vendors mapped to HEIS data on final consumption
Excise taxes	TOTAL: 1,349,611,551 Domestic: 100% Foreign: 0%	100% Borne by consumers.	SST amounts as declared by importers and domestic vendors mapped to HEIS data on final consumption
Customs duties	TOTAL: 297,178,046 Domestic: 100% Foreign: 0%	Duties on final goods borne by consumers, who also pay for increased value-added in domestic production of these goods; Duties on intermediate inputs to the production of non-tradable goods borne by final consumers; Duties on intermediate inputs to the production of tradable goods borne by production factors.	Duties paid by importers mapped to HEIS data on final consumption; I-O table used to estimate factor income as the difference between values of output and intermediary inputs

Notes: Revenue data from the Income and Sales Tax Department. HEIS is used for the distribution of tax revenue at the household level.
GST: Taxes on inputs to the production of means of production are not allocated to final consumption due to a lack of data on the consumption of fixed capital broken down by sector. The tax burden is estimated only for private households but not for residents of collective living quarters (hotels, rooming houses, and other lodging houses, institutions, and camps)

Empirical Model

The indirect tax model analyzes the burden of the General Sales Tax (GST), Special Sales Taxes (SST), and Import Duties while taking household budgets as fixed according to the Household Expenditure and Income Survey (HEIS). The model is based on a set of national input-output (I-O) accounts that capture the goods and services produced by each industry and the use of these goods and services by industries and final users. We use an 81-sector input-output table that is produced by the Department of Statistics, Ministry of Planning and International Cooperation. Input and output taxes declared by vendors are aggregated into these 81 industries on the basis of the business activity (ISIC) code of each registered taxpayer. The net taxes (output taxes adjusted for input tax credits) are then traced through the input-output table to determine their impact on the prices of final goods. Output prices in these 81 industries are then mapped into 33 main groups of commodities in the HEIS (16 groups of food commodities and 17 groups of non-food commodities). Once we determine the tax elements as percentages of market prices of final consumption goods, we apply them to the observed expenditures of households in each category of commodities. The input-output accounts are combined with data on imports declared by commodity code (HS), which allows the user to account for the tax burden associated with imports of intermediary inputs and final consumption items.

The taxes that are analyzed in this paper are: customs duties, general sales tax, and excises. We use 2014 as the base year for the analysis and allocate a total of 3.6 billion JD in revenue, allocated as follows:[8]

- Excise: 1,350 million JD[9]
- Customs duties: 297 million JD
- General sales tax (GST): 1,998 million JD
- TOTAL 3,645 million JD

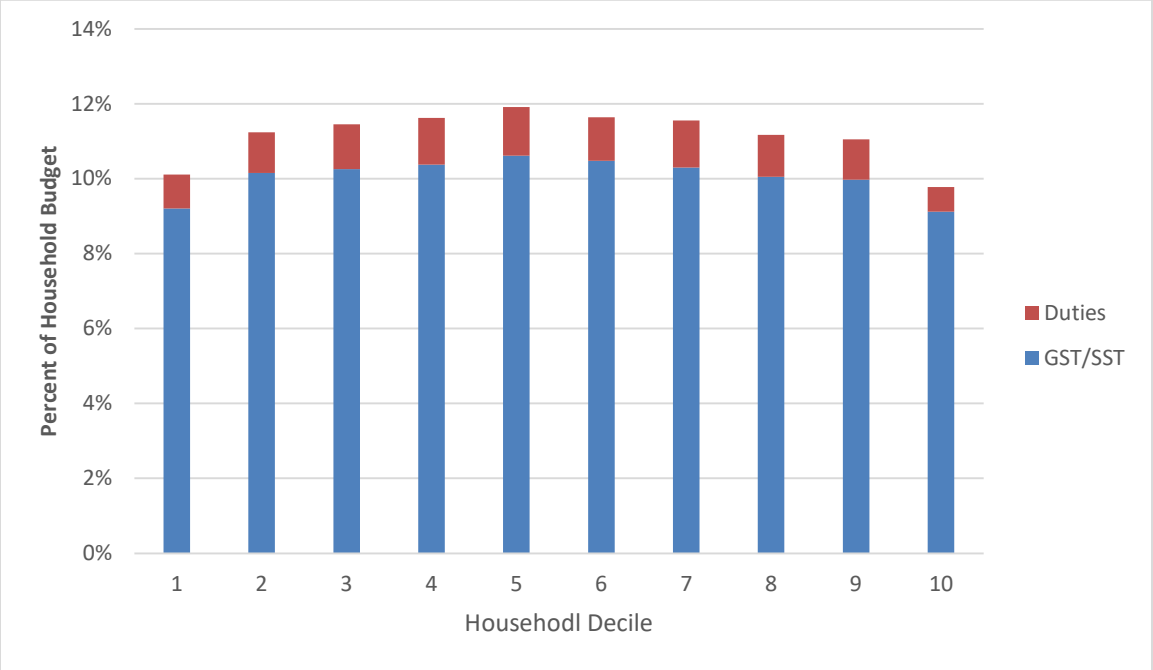
[8] Accuracy of the incidence analysis relies on good estimates of actual tax collections for tax liabilities that occurred in a given fiscal year. Ideally, the collections should not include arrears, fines, penalties, etc. since we are estimating the impact of *tax policies* of Jordan. In practice, it may be difficult to get collections that are "clean" (that do not include arrears, etc.), but working with the Income and Sales Tax Department we understand that we have reasonable numbers.

[9] This includes JD 236 million of SST levied by Jordan Customs on imported cars in addition to the net tax liability of JD 520 million reported by the Income and Sales Tax Department, which does not include any SST on cars.

Findings

Under the aforementioned incidence assumptions, the burden of the sales taxes is practically flat (Figure 2). It is only mildly progressive at the bottom, increasing from 9.20% for the first decile to 10.62 % for the fifth decile, and then slightly regressive over deciles 6-10, dropping to 9.12 % for the top decile. Thus, all households essentially pay the same share of their budgets in sales taxes, with the middle class sacrificing a slightly higher share of their incomes than the poor or the rich.

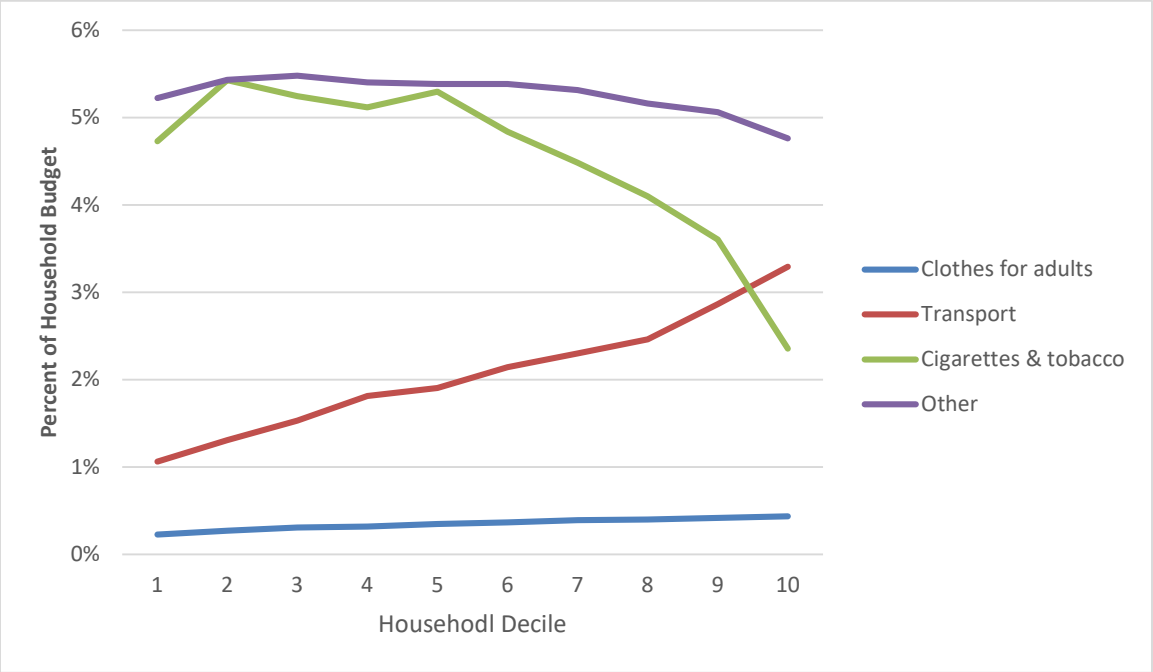
Figure 2: Sales taxes and import duties as a share of household expenditures, 2014



The burden of the import duties has a similar distributional pattern. The tax burden is increasing from 0.91% for the first decile to 1.30% for the fifth decile, and then mildly declining over deciles 6-9, and dropping to 0.65% for the top decile. This distribution of net burden accounts for gains in wage and capital income in sectors benefiting from tariff protection against foreign competition.

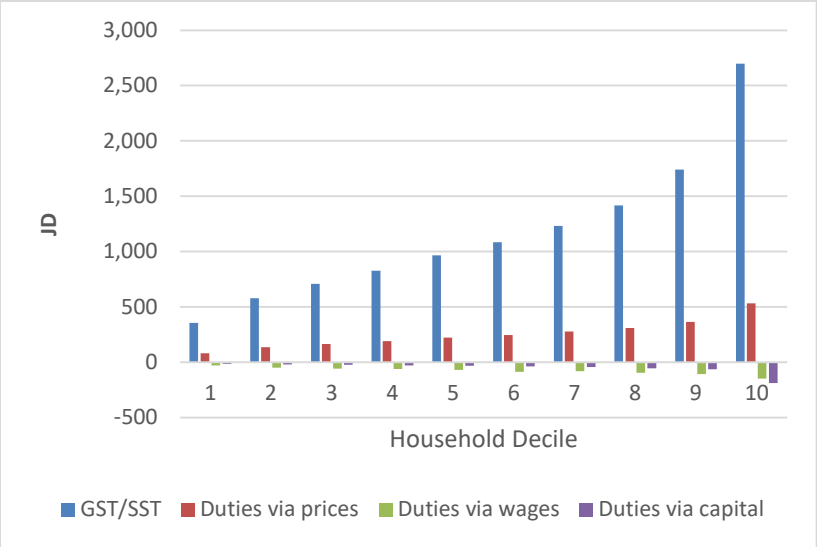
All in all, the combined burden of all indirect taxes is mildly progressive at the bottom, increasing from 10.11% for the first decile to 11.92% for the fifth decile and then mildly decreasing over deciles 6-9 before dropping to 9.77% for the top decile (Figure 2).

Figure 3: Indirect tax by item as a Percent of Household Expenditure, 2014



This incidence is determined by the interplay of the progressive burden of taxes on transport-related commodities and the regressive burden of taxes on most other groups of commodities, especially tobacco (Figure 3).

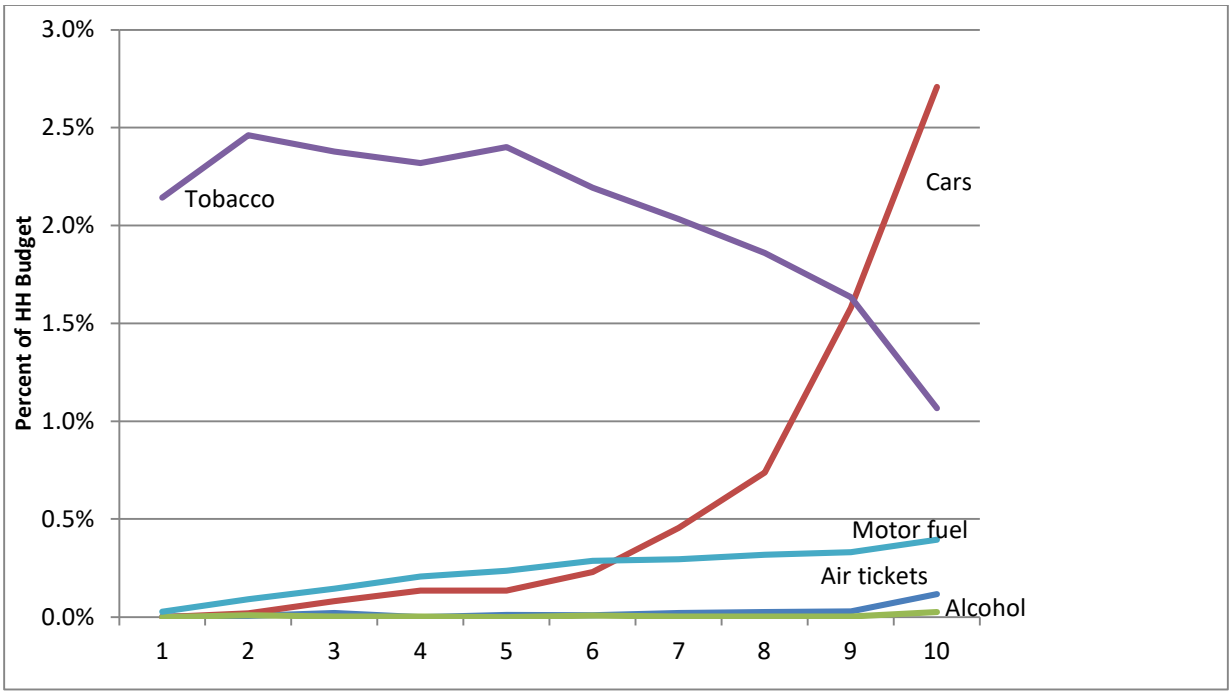
Figure 4: Mean burden of sales taxes and import duties, JD 2014



Even though the burden for better-off households might be declining relative to their ability to pay, nevertheless it is increasing in absolute amounts (Figure 4). Thus, the top decile pays seven

times more in indirect taxes than the bottom decile, roughly in line with differences in the size of household budgets

Figure 5: Special Sales Tax Burden, a share of household expenditure, 2014



Finally, it has to be pointed out that the deviations from the proportional distribution of the tax burden for selected commodities are largely due to the Special Sales Tax (see Figure 5). As one can see from the figure below, the burden of the SST on cars and motor fuels is sharply progressive.

Conclusions

The distributional implications are generally as expected, with the burden of indirect taxes falling proportionally among the household deciles. Compared to other countries, the general distribution of Jordan's taxes is similar to that found in Pakistan, Jamaica, and Chile. However, the level of indirect taxes as a share of the household budget in Jordan is higher than that found in those comparator countries. In Pakistan, the equivalent level of effective tax rate for indirect taxes is approximately 9 percent (Wahid and Wallace, 2008).

From the perspective of equity, some might argue that a proportional consumption tax is unfair. How much equity is fair is a decision for Jordanians. However, the expenditure side of the budget could be used to offset the consumption tax burden, as in the case of vehicle-related

taxes. Equity considerations should include an analysis of the expenditure side of the budget (Martinez-Vazquez, 2007). Thus, the progressivity of vehicle-related taxes would be offset if these revenues were earmarked for roads, disproportionally benefiting car owners.

References:

Alleyne, Dillon, James Alm, Roy Bahl, and Sally Wallace, (2004). "Tax Burden in Jamaica," International Study Program, Andrew Young School of Policy Studies, Georgia State University, Atlanta, GA.

Bird, Richard M. and Barbara D. Miller (1991). "The Incidence of Indirect Taxes on Low-Income Households in Jamaica," in Roy Bahl (ed) *The Jamaican Tax Reform*, Lincoln Institute of Land Policy, Cambridge, MA.

Carbonnier, C. (2007), 'Who Pays Sales Taxes? Evidence from the French VAT Reforms, 1987–1999', *Journal of Public Economics*, 91, 1219–29.

Caspersen, Erik and Gilbert Metcalf (1994). "Is A Value Added Tax Progressive? Annual Versus Lifetime Incidence Measures," *National Tax Journal* 47: 731-746.

Devarajan, Shantayanan, Don Fullerton and Richard A. Musgrave (1980). "Estimating the Distribution of Tax Burdens: A Comparison of Different Approaches," *Journal of Public Economics* 13: 155-182.

Fullerton, Don and Gilbert Metcalf. (2003) "The Distribution of Tax Burdens: Introduction" Cheltenham, UK

Gemmell, Norman (2005). "Distribution and Poverty Impacts of Tax Structure Reform in Developing Countries: How little We Know," *Development Policy Review*, 23 (2): 131-144.

Hines, James (1999). "Three Sides of Harberger Triangles," *Journal of Economic Perspectives* 13(2): 167-188.

Institute on Taxation and Economic Policy (2003). *Who Pays? A Distributional Analysis of the Tax Systems in all 50 States* (Washington, D.C.: Institute on Taxation and Economic Policy).

Kiefer, Donald W. (1984). "Distributional Tax Progressivity Indexes," *National Tax Journal,* December 37: 497-513.

MacKenzie, G. A. (1992). Estimating the base of the value-added tax in developing countries: the problem of exemption. Public Finance, 47 (2), 257±270.

Martinez-Vazquez, Jorge (2007). "The Impact of Budgets on the Poor: Tax and Expenditure Benefit Incidence Analysis," in Moreno-Dodson, Blanca and Quentin Wodon (eds.) *Public Finance for Poverty Reduction* (Washington, D.C.: The World Bank).

Martinez-Vazquez, Jorge (1993). "The Incidence of Tax Evasion: A Review of the Issues," Andrew Young School of Policy Studies, Policy Research Program archived papers, Georgia State University, Atlanta, GA.

Sahn, David E. and Stephen D. Younger (2003). "Estimating the Incidence of Indirect Taxes in Developing Countries," in Bourguignon, Francois and Luiz A. Pereira DaSilva, eds. *The Impact of Economic Policies on Poverty and Income Distribution Evaluation Techniques and Tools* (Washington, D.C.: The World Bank and Oxford Press).

Wahid, Umar and Sally Wallace (2008). *The Incidence of Taxes in Pakistan: Primer and Estimates*, International Studies Program Working Paper, Andrew Young School of Policy Studies, Georgia State University, Atlanta, GA.

Younger, Stephen D., David E. Sahn, Steven Haggblade, and Paul A. Dorosh (1999). "Tax Incidence in Madagascar: An Analysis Using Household Data," *World Bank Economic Review,* 13(2): 303-331.

Annex: Derivation of the amount of tax in the market price of a consumer good

As the actual collection of sales taxes is carried out separately for imported and domestically-produced goods (by Jordan Customs and Income and Sales Tax Department, respectively), we consider the allocation of these two revenue figures separately.

Sales taxes levied on imports

For imported final consumption goods, it is reasonable to assume that the buyer price p^b of these goods is formed as the sum of the world market price plus import duties plus sales taxes levied at the border. Therefore, in the absence of sales taxes, the market price would be lower by the amount of the sales taxes. In percentage terms, this price change can be expressed as[10]

$\Delta p^b/p^b$ = – *[sales tax collections from imports]/[value of imports inclusive of duties and sales taxes].*

Furthermore, some imported goods are not directly consumed by households but instead are used in the domestic production of other goods. Then it is reasonable to assume that the sales taxes levied on those imported inputs, unless fully refunded to domestic producers, can lead to higher prices faced by domestic households.[11] Immediately below, we derive the tax burden associated with the taxation of inputs to domestic production.

Sales taxes levied on domestic production

Regardless of the tax-shifting assumptions, in an accounting sense, the *buyer* (market) price p^b of a domestically-produced commodity can be decomposed into sales taxes, (tax inclusive) costs of intermediary inputs, and value-added (income of factors of production and production-based taxes and subsidies):

p^b = *output tax + inputs costs – credit for input taxes+ value-added,* (1)

where all amounts are expressed per physical unit of output.

For this so-called "value equation" to hold under any tax regime, changes in taxes and subsidies have to be accommodated by changes in *buyer prices* of commodities (inputs and outputs) as well as factor incomes (value-added). Since this identity has to hold for each sector, it is convenient to write it in a matrix form:

[10] The negative sign indicates a negative change, or in other words a price decrease. As pointed out above, in the absence of sales taxes, the market price would be lower by the amount of the sales taxes.

[11] As discussed earlier, for domestically produced tradable goods that are substitutes for their imported counterparts the output price is determined by the world price (plus import tariffs) and thus excises on their inputs might have to be at least partially absorbed by the primary factors of production.

p^b = *output tax* + p^b • A – *credit for input taxes* + v,

where v is a row vector of value-added coefficients.[12]

As some of the inputs to domestic production are imported, this equation can use the decomposition of the input-output matrix into domestic and import components: $A=A^d+A^m$. Then the matrix equation will look as following:

p^b = *output tax* + p^b • A^d + (p^m + *duties*+*import taxes*)• A^m – *credit for input taxes* + v,

where p^m is a row of world-market prices.

This, in turn, can be rearranged as

p^b • $[I–A^d]$ = *output tax* + (p^m + *duties*+*import taxes*)• A^m – *credit for input taxes* + v

or

p^b = {*output tax*+(p^m +*duties*+*import taxes*)• A^m –*credit for input taxes*+v}• $[I–A^d]^{-1}$ (2)

Thus, the allocation of the indirect taxes requires the analyst to make an assumption about the share of the change in net taxes {*Δoutput tax*+ *Δimport taxes*• A^m – *Δcredit for input taxes*} absorbed by the factors of production (v). With this assumption in hand, it is conceptually straightforward to estimate the shifting of the remaining part of the tax burden to the final consumers of different products. Thus, if α percent of a tax change is borne by the factors of production, then the remaining share $(1– \alpha)$ will be shifted to consumers via changes in buyer prices:[13]

$\Delta p^b = (1– \alpha) \bullet \{\Delta \text{ net tax}\} \bullet [I–A^d]^{-1}$, (3)

where *Δ net tax*= *Δ output tax*+ *Δ import taxes*• A^m – *Δ credit for input taxes*, and

$[I–A]^{-1}$ is the so-called Leontief inverse.[14]

[12] Besides the payroll, the value added also includes returns on investment, which among other things includes the use of capital assets manufactured by various domestic industries or imported from abroad. Conceptually, taxation of production and importation of these capital assets affects the rate of returns on these investments throughout their useful life. However, we cannot estimate how taxation of these capital inputs of production affects the output price because we do not know either the consumption of fixed capital assets by each sector in a given year nor the breakdown of used capital assets by industry it was produced by. In a tax system without exemptions and with proper refunding of taxes paid on all purchases of business inputs, including capital assets, this would be a wash. However, under such a clean system we would not need to employ an Input-Output model because the sales tax would be just a tax on final consumption.

[13] Here it is assumed that the input-output matrix A is the same under the current and counterfactual tax regimes. This is in contrast to our assumptions for aging the transaction matrix, which assumes unitary substitution between inputs of production.

[14] This inversion is named after Wassily Leontief, who won a Nobel Memorial Prize for his finding of the relationship between final demand and total output in the economy.

Import duties

Because the burden of the sales taxes is analyzed in a separate model described immediately above, here we assume that there are no sales taxes so that the buyer price p^b is the same as the seller price $p^{s,}$ and therefore we will denote this one single price as p^0.

Then, regardless of the tax-shifting assumptions, in an accounting sense, the (market) price p^0 of a domestically-produced commodity can be decomposed into the costs of intermediary inputs, inclusive of import duties, and value-added (income of factors of production and production-based taxes and subsidies):

$$p^0 = inputs\ costs + value\ added, \quad (4)$$

where all amounts are expressed per physical unit of output.

For this so-called "value equation" to hold under any tax regime, changes in taxes and subsidies have to be accommodated by changes in *market prices of* commodities (inputs and outputs) as well as factor incomes (value-added). Since this identity has to hold for each sector, it is convenient to write it in a matrix form:

$$p^0 = p^0 \bullet A + v, \quad (5)$$

where v is a row vector of value-added coefficients.

Because import duties do not directly affect the consumption of items that cannot be imported (non-tradables), the incidence analysis has to distinguish between two groups of goods: tradable and non-tradable. Following the notation proposed by MacKenzie (1991), we can decompose the input-output matrix as

$$A = \begin{Bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{Bmatrix}$$

where

A_{11} describes tradable inputs used in the production of tradable outputs;

A_{21} describes non-tradable inputs used in the production of tradable outputs;

A_{12} describes tradable inputs used in the production of non-tradable outputs;

A_{22} describes non-tradable inputs used in the production of non-tradable outputs.

For a domestically produced good that has to compete with imports (a tradable good), the price of its output is determined by a combination of its world-market price and import duties:

$p_1^0 = p_1^m + p_1^m \bullet \tau_1^m$, where p_1^0 is the row of prices of domestic outputs, p_1^m is the row of world-market prices, and $p_1^m \bullet \tau_1^m$ is the row of the amounts of import duties expressed per physical unit of the imported good.

Therefore, the price change relative to the baseline prices can be expressed as

$$\Delta p_1^0 = p_1^m \bullet \Delta \tau_1^m \quad (6)$$

In the case of no sales taxes, the accounting identity (5) makes it clear that the value added (i.e., factor income) is determined by the set of prices of outputs and inputs:

$$v = p^0 \bullet [I-A] \quad (7)$$

Then, for the scenario with no duties and no sales taxes, equation (7) can be expressed in differences relative to the baseline (with duties levied but not sales taxes) as following

$$\{\Delta v_1 \quad \Delta v_2\} = \{\Delta p_1^0 \quad \Delta p_2^0\} \bullet \begin{Bmatrix} I_{11} - A_{11} & -A_{12} \\ -A_{21} & I_{22} - A_{22} \end{Bmatrix} \quad (8)$$

For domestic products that do not compete with imports (non-tradable), factor incomes per physical unit of output are assumed to remain intact ($\Delta v_2 = 0$) so that import duties on all inputs upstream the production chain have to be accommodated in the price of this non-tradable output, similar to shifting of sales taxes.[15]

Therefore, equation (8) can be rewritten as

$$\{\Delta v_1 \quad 0\} = \{\Delta p_1^0 \quad \Delta p_2^0\} \bullet \begin{Bmatrix} I_{11} - A_{11} & -A_{12} \\ -A_{21} & I_{22} - A_{22} \end{Bmatrix} \quad (9)$$

Thus, for the non-tradable sector, it follows from equation (9) that

$$\Delta p_2^0 \bullet [I_{22}-A_{22}] - \Delta p_1^0 \bullet A_{12} = 0$$

Therefore,

$$\Delta p_2^0 = \Delta p_1^0 \bullet A_{12} \bullet [I_{22}-A_{22}]^{-1} \quad (10)$$

In addition to the change in real incomes of consumers (through market prices), customs duties also affect the income of the owners of factors of production in the tradable sector.[16]

For the tradable sector, it follows from equation (6) that

[15] The assumption of constant factor incomes per physical unit of non-tradable output is made to simplify the analytics, which has to rely on constant input-output coefficients. Combined with the incidence assumption of constant returns to primary inputs under full shifting, it also implies the use of their fixed quantities to produce one unit of physical output. An alternative, but more computationally involved assumption would be that α percent of the import duty change is born by the factors of production.

[16] Conceptually, the net burden of import taxes is a sum of three elements: 1) effect on the consumer prices; 2) effect on factor incomes; 3) offset to the burden of direct taxes due to the impact on factor incomes. Because direct taxes are smaller relative to indirect taxes in Jordan, in our analysis of tax incidence we disregard the last element of the burden of import taxes.

$$\Delta v_1 = \Delta p_1^0 \bullet [I_{11} - A_{11}] - \Delta p_2^0 \bullet A_{21} \quad (11)$$

In a practical application, the computation is somewhat more complicated because the input-output table (A) is only available for a manageable number of aggregate industries, each producing a range of different physical products. Since physical units of different products cannot be added together, one has to work with the monetary values of outputs produced by different industries in the form of a so-called transaction matrix.