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ESTIMATES OF INDUSTRY SPECIFIC MULTIPLIERS

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BOX 1: ESTIMATES OF INDUSTRY SPECIFIC MULTIPLIERS[1]

A symmetric input-output table (SIOT) records the economy's inter-industry transactions via the disaggregation of economic activity in a number of sectors. This modelling technique allows to study inter-industry linkages as well as changes in the structure of an economy. This Box derives a set of industry specific multipliers computed on the basis of the demand driven input-output framework put forward by Wassily Leontief in 1941 using the SIOTs published by the National Statistics Office (NSO) for the year 2010.[2] This article updates a study conducted by the Central Bank of Malta in 2015 with the results obtained from an updated set of SIOTs.[3,4]

Data and methodology

There are a number of recent studies on the Maltese economy conducted via the application of input-output techniques. However, these either utilise input-output tables which are not highly disaggregated,[5] or which do not comply with the latest Eurostat System of National and Regional Accounts published in 2010 (ESA 2010).[6] The results derived here are based on SIOTs for 2010 published by NSO in 2013 that is compliant with ESA 2010 and that has a 40-industry level of disaggregation which follows an industry classification in line with the European Statistical Classification of Economic Activities (NACE) Rev.2.

The analysis focuses on ten key sectors. Two sectors, the electronics and pharmaceutical industries, are key for the manufacturing industry while the construction and retail sectors are important, domestically-oriented industries. The public sector is proxied by the administration and health industries while the services industry is represented by four services sectors that are also mostly export oriented – the financial services, the information technology services (which also includes publishing activities), accommodation and food services activities and creative arts and betting activities. Together, all these sectors make up almost 70% of total output and almost 54% of value added and labour income.

The Leontief demand driven model is a fixed price static general equilibrium model describing the amount of input i needed by sector j to undertake its production. At its most basic level, this information is useful to study the direct effects of an increase in final demand of any given sector on the different industries of an economy. In reality, however, increases in the final demand have a larger impact on overall production than those relating to direct effects. In order for each sector to increase its supply it will need to increase the demand for its own intermediate inputs. Furthermore the production of these intermediate inputs would require subsequent increased rounds of production in all suppliers leading to a ripple effect,

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2 See Leontief, W. (1941). *The structure of the American Economy, 1919-1929*. Cambridge: Harvard University Press. (Second Ed., 1951, New York: Oxford University Press).

3 This study was published in Cassar, I. (2015). Estimates of output, income, value added and employment multipliers for the Maltese economy. *Quarterly Review*, 2015(1), 38-42, Central Bank of Malta.

4 Both this study and the one published in 2015 are undertaken using the NACE Rev. 2 classification of industries and focus on largely the same industries. However, since these studies are consistent with different versions of ESA methodology and use a different level of disaggregation, their results might not be directly comparable.

5 See Gravino, D. (2012). Economic and policy implications of industry interdependence: An input output approach, *International Journal of Economics and Finance*, *4*(6).

6 See Cassar, I. (2015). Estimates of output income, value added and employment multipliers for the Maltese economy. Working Paper WP/03/2015, Central Bank of Malta.

or an indirect effect. Moreover increases in output lead to a rise in household income that increases demand for every sector through consumption. The latter is commonly referred to as 'induced effects'. These results can be derived by solving the Leontief demand model giving rise to Type I (capturing direct and indirect effects) and Type II (including direct, indirect and induced effects) multipliers.

The main factor affecting the magnitude of Type I multipliers is the relative share of primary inputs in the total output of each sector. The higher the share of imports, labour compensation and gross operating surplus for each sector, the higher are the leakages from the domestic inter-industry system implying a lower Type I multiplier. Given the open nature of the Maltese economy, the main determinant for the size of the Type I multiplier is the extent of import use in the input mix required by each sector. The higher the import content required by each sector, the lower will the Type I multiplier be. In addition, Type II multipliers will also be affected by the consumption pattern of households. The larger the share of household income that is spent on consumption rather than being leaked out of the system via savings or taxation, the larger will the induced effects, and therefore Type II multipliers be. A realistic estimate of the true direct and indirect effects of an increase in final demand on output, value added, income and employment is generally regarded to lie half way between Type I and Type II multipliers.[7]

Multipliers of selected industries in Malta

Table 1 shows a set of Type I and Type II output, value added, income and employment multipliers for ten key Maltese sectors.[8] A multiplier for a given industry captures the sum of direct, indirect and in the case of Type II also the induced input requirements needed to satisfy a €1 worth of increase in the final demand of the same sector. In the case of an

Table 1
INDUSTRY MULTIPLIERS FOR MALTA: SELECTED INDUSTRIES

	Output		Income		Value Added		Employment	
	Type I	Type II	Type I	Type II	Type I	Type II	Type I	Type II
Manufacture of chemical products and pharmaceuticals	1.24	1.73	0.23	0.32	0.50	0.71	11.06	16.44
Manufacture of electronics and transport equipment	1.21	1.51	0.14	0.19	0.32	0.45	7.45	10.70
Quarrying and construction	1.75	2.34	0.28	0.39	0.59	0.84	17.28	23.78
Retail trade, except of motor vehicles	1.52	2.29	0.36	0.50	0.78	1.10	26.04	34.48
Accommodation & food services	1.70	2.42	0.34	0.47	0.63	0.94	24.75	32.62
Financial service activities, except insurance	1.04	1.13	0.04	0.06	0.08	0.12	1.73	2.77
Information technology services and broadcasting activities	1.42	1.92	0.23	0.32	0.58	0.79	9.97	15.42
Creative arts, gambling & betting	1.12	1.27	0.07	0.10	0.34	0.40	2.60	4.26
Public administration	1.39	2.70	0.62	0.86	0.78	1.34	26.42	40.85
Human health	1.27	2.40	0.53	0.74	0.81	1.29	22.09	34.52

Source: Author's calculations.

[7] See Osterhaven, J., Piek, G., & Stedler, D. (1986). Theory and practice of updating regional versus interregional inter-industry tables. *Papers in Regional Science, 59*(1), 57-72.

[8] Note that in input-output terminology, output is defined as the sum of intermediate production and final inputs and is therefore not consistent with the definition of an economy's GDP. In this respect, value added multipliers are generally regarded to be a better measure of the change in GDP brought about by a marginal change in final demand.

output multiplier this translates into the increase in output brought about by an increase in the final demand of a given sector. Analogous interpretations apply for income, value added and employment multipliers. Thus, for instance for every €1 million increase in the final demand for the manufacturing of electronics and transport equipment, overall output increases by €1.21 million due to direct and indirect effects. When considering also induced effects output increases by an additional €0.3 million, such that the overall Type II multiplier for this sector leads to a €1.51 million increase in output. Similarly, the Type I value added multiplier for the manufacturing of electronics and transport equipment implies that a €1 million euro increase in the final demand for this sector generates a €0.32 million increase in Maltese GDP via direct and indirect effects. Endogenising household behaviour leads to induced effects that amount to €0.13 million, implying that the overall increase in Maltese GDP rises to €0.45 million.

The two manufacturing sectors consistently score relatively low multipliers out of the ten industries under consideration. The low output and value added multipliers might be expected considering the high import content of this sector, while low income and employment multipliers might be due to the high capital intensity of this sector. Quite unexpectedly, the three fast growing export oriented services sectors − financial services, information technology and betting industries − also score relatively low multipliers. The low output and value added multipliers are driven by relatively high import leakages of these sectors. Despite being labour intensive industries, the income and employment multipliers for these sectors are also relatively low. This result may be driven by the relatively high labour productivity enjoyed by these sectors implying that for a given increase in output, the required increase in labour input is quite low.

Driven mainly by low direct import requirements, quarrying and construction, and accommodation and food and services sectors score the highest Type I output multipliers out of the industries considered in this analysis. Estimates also show that sectors that are traditionally regarded as labour intensive, such as public administration, health, retail trade and tourism tend to have the highest value added, income and employment multipliers.

The multipliers pertaining to the financial services (excluding insurance) sector are the lowest across the industries under consideration in this exercise. This result contrasts sharply with that obtained from the input-output tables of 2008. Indeed, according to the SIOT for 2008, the financial sector scores considerably higher multipliers with the Type II output and income multipliers ranking first and second respectively out of the ten industries under consideration. The low multipliers derived for the new input-output tables may be driven by the inclusion of Special Purpose Vehicles (SPE) within ESA 2010 data. Since SPEs contain a very high import content, their inclusion reduces the relative magnitude of the local intermediate input requirements of the sector, resulting in artificially low multipliers.

It should be noted that while the industries under consideration in this box make up a substantial part of Malta's total GVA, they do not necessarily feature as having the highest multipliers amongst the 40 sectors considered in the 2010 SIOT. For instance, the highest Type I output multiplier stands at 2.1 and is registered by the sector covering other professional, scientific and technical activities including advertising and research.

Quarrying and construction, which has the highest Type I output multiplier out of the ten key industries identified in this exercise, ranks only sixth out of the 40 industries covered by the SIOT. While the employment activities sector makes up only 0.8% of the share in total GVA, it scores very high Type I and Type II multipliers, ranking first in terms of output and value added Type II multipliers, and second in terms of Type I and Type II employment multipliers.

Another important point relates to the fact that the Type I value added multiplier for all sectors under consideration is less than one. This implies that an additional euro of final demand in any of the 40 sectors included within the input-output table will generate a total impact in Malta's GDP of less than €1 when considering direct and indirect effects. When considering induced effects, the value added multiplier of some industries rises above one, implying that when considering household consumption patterns the ripple effects created by a €1 increase in the final demand of those industries will cause a larger increase in value added. Most notably, the public administration and health sectors have Type II value added multipliers which roughly equal 1.3. This implies that an increase in government expenditure of €1 million in terms of public administration or health will increase Maltese GDP by €1.3 million.[9]

The multipliers derived and discussed up till now are often defined as *modelling multipliers* which specifically measure the resultant effect on output, value added, income and employment due to a *marginal* change in final demand. Thus these multipliers do not account either for the relative size of the industry or for the amount of final demand each industry is driving throughout the economy via its multipliers. For this reason, an analysis based solely on these results may give only a partial overview of the importance of the sectors under consideration. Table 2 shows a set of *accounting multipliers* which are equivalent to modelling multipliers that are adjusted to account for the size of the sector as well as for the activity supported by its final demand.[10]

Table 2
INDUSTRY ACCOUNTING MULTIPLIERS FOR MALTA: SELECTED INDUSTRIES

Per cent of total

	Output	Income	Value Added	Employment
Manufacture of chemical products and pharmaceuticals	2.74	3.16	3.37	2.91
Manufacture of electronics and transport equipment	8.38	5.98	6.81	6.14
Quarrying and construction	5.30	5.23	5.46	6.23
Retail trade, except of motor vehicles	3.15	4.64	4.89	6.41
Accommodation & food services	6.23	7.67	7.05	10.80
Financial service activities, except insurance	24.39	6.50	5.89	4.84
Information technology services and broadcasting activities	3.97	4.04	4.94	3.31
Creative arts, gambling & betting	10.03	3.92	9.20	2.77
Public administration	4.20	11.61	7.22	9.52
Human health	2.67	6.95	5.20	5.54

Source: Author's calculations.

[9] For a more detailed analysis of fiscal multipliers in Malta see: Micallef, B., Grech, O., & Borg, I. (2016). Fiscal multipliers in the Maltese economy. In *Understanding the Maltese Economy*. Edited by Grech A. G. (Ed.), Valletta: Central Bank of Malta.

[10] Accounting multipliers are derived as the product of each industry's output, value added, income and employment Type I multipliers with its respective final demand.

Results in Table 2 show the percentage of total output, value added, income and employment needed by the economy in order to satisfy both direct and indirect activities brought about by each industry's final demand. These results are somewhat different from those shown earlier in Table 1. For instance, the financial sector has fared poorly in terms of modelling multipliers, ranking second from last out of 40 industries included in the 2010 SIOT. When considering the size of its final demand, the financial sector has the fifth highest value added and income accounting multipliers with results showing that this sector directly and indirectly contributes to around 6% and 6.5% of total value added and income generated in Malta.[11] Similarly while the creative arts and betting sector fares poorly in terms of modelling multipliers, it scores highly in terms of output and value added accounting multipliers, ranking first and second respectively out of 40 industries. Estimates also show that in line with the results pertaining to the modelling multipliers, accommodation and food services and public administration have the highest value added, income and employment accounting multipliers.

Conclusion

The input-output analysis presented above helps to identify the strength of the inter-industry relations and how these can impact the generation of output, value added, income and employment in the Maltese economy. The results discussed in this Box provide policy makers with a range of estimates with which to evaluate the importance of each industry. Labour intensive industries such as public administration and the tourism industry tend to possess the highest value added, income and employment multipliers both when considering only the inter-industry linkages as well as when accounting for the size of the sector and of its final demand. Despite their growing share in overall value added, financial services, information technology and the betting sector rank consistently among the bottom quartile with regards to the size of their Type I and Type II multipliers, implying relatively low additional output, value added, income and employment generated per one euro of final demand. However when accounting for their relative size, these sectors score considerably high accounting multipliers with creative arts, gambling and betting accounting for almost 10% of overall value added when considering both direct and indirect production needed to sustain its final demand.

The measures described above can be of crucial aid to policy makers for identifying industry specific policies aimed at improving Malta's competitiveness. However a correct use of such estimates necessitates a complete understanding of the limitations that lie behind the methodology used in this exercise. As implied by the name of the model used in this analysis, the multipliers derived here focus exclusively on the demand side and completely ignore capacity constraints. Moreover, since the Leontief demand driven model is based on a fixed price assumption, an increase in the final demand of one sector (no matter how large) will neither be constrained by the supply of labour or of intermediate goods and services, nor will it result in a change in relative prices. Thus the multipliers derived here are likely to overestimate the true impact following a change in final demand. While industry specific multipliers need to be interpreted with caution, they are still considered to be a very important tool designed to identify key sectors within an economy as well as to estimate sectoral impacts.

[11] The high output multiplier for the financial services sector is affected by its relatively large final demand component. The latter might be driven by the inclusion of SPEs within ESA 2010 data resulting in an artificially high accounting multiplier.