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ESTIMATES OF INDUSTRY-SPECIFIC MULTIPLIERS FOR THE MALTESE ECONOMY ON THE BASIS OF THE SIOT FOR 2015

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Introduction

The use of the input-output methodological framework allows for an analysis of the extent to which an increase in final demand to a particular industry may also affect other parts of the economy. Such an analysis is highly reliant on the availability of the symmetric input-output table (SIOT). At its core, an SIOT disaggregates economic activity into a number of sectors (or products) and documents the monetary value of the transactions – commonly known as ‘inter-industry transactions’ – that take place among these different sectors. An SIOT therefore contains information that is useful both for the study of inter-industry linkages as well as for an analysis of changes in the production structure of an economy over time.

The purpose of this analysis is twofold. Firstly, based on the demand-driven input-output framework originally put forward by Wassily Leontief in 1941, this work presents a set of industry-specific multipliers for the Maltese economy on the basis of an SIOT for the reference year of 2015.² These derived multiplier estimates are calculated on the basis of highly-disaggregated SIOTs made available by the NSO in January 2021. The SIOTs are compliant with ESA 2010 and are disaggregated into 40 industries, consistent with the definitions of the European Statistical Classification of Economic Activities (NACE) Rev. 2. This work can be viewed as an update of previous work conducted by the Bank using SIOTs for 2010.^{3,4} In light of this previous work, in a second part, the industry-specific multipliers for the Maltese economy for 2015 are compared with the corresponding multipliers obtained from the SIOT for 2010. This makes it possible to identify any changes that may have occurred to each sectors’ underlying inter-industry linkages during this 5-year period.

Methodology

The Leontief demand-driven model is a fixed price static general equilibrium model which is derived on the basis of the respective inter-industry flows indicating the amount of input i needed by sector j to fulfil its final demand requirements. In itself, information about the relationship between an industry’s input and output allows for an analysis of the ‘direct effects’ that an increase in the final demand of a particular sector has on the other industries in the economy. The true impact of an increase in final demand on production, however, goes beyond solely the direct effects. This is because in order to produce the higher output needed to meet the increase in final demand, a sector would need – and therefore demand – more intermediate inputs. These intermediate inputs in turn represent an output for the respective sectors, which in turn stimulate further input requirements. This causes a ripple effect on other industries that in turn would

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

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

⁴ Rapa, N. (2017). “Estimates of Industry Specific Multipliers”. *Quarterly Review*, 2017(2), 19-23, Central Bank of Malta.

require more inputs themselves to meet the increase in demand. These ripple effects are better known as the ‘indirect effects’ generated by an increase in final demand of a particular sector. In addition, there are also ‘induced effects’ brought about because higher output leads to a rise in household income, which in turn is reflected in higher consumption and higher final demand for different sectors.

Sectoral multipliers derived from the open Leontief demand-driven model reflect the direct and indirect effects, across the economy, of a €1 million increase in final demand of a particular sector (simple multipliers). Alternatively, if sectoral multipliers are obtained from the closed Leontief demand-driven model (closed with respect to household behaviour), these would reflect the direct, indirect as well as induced effects (total multipliers). The magnitude of simple multipliers is largely influenced by the relative share of primary inputs in each sector’s total output. In particular, 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, resulting in lower simple multipliers. In addition, total multipliers will also be affected by the income and consumption expenditure patterns of households. The larger the share of household income that is spent on consumption of goods and services from within a specific sector, the larger would be the sectoral-induced effects, consequently resulting in larger total multipliers.

Multipliers of selected industries in Malta in 2015

Table 1 shows the simple and total output, income, value added and employment multipliers for ten industries deemed to be of strategic importance to the Maltese economy, largely due to their contribution to total output, and value added.⁵ The manufacture of electronics and transport is a core element of Malta’s manufacturing industry, while construction and retail trade are also important sectors domestically. Hospitality – which is mostly export-oriented – is represented by accommodation and food services activities, and travel agency and tour operations. Other important services industries include information and communication, the financial services, and the creative arts and gambling and betting sector. This analysis also includes real estate activities, while public administration and defence is used as a proxy for the public sector. Together, these

	Output		Income		Value Added		Employment	
	Simple	Total	Simple	Total	Simple	Total	Simple	Total
Manufacture of electronics and transport equipment	1.25	1.66	0.20	0.27	0.33	0.51	8.86	12.67
Quarrying and construction	1.77	2.29	0.25	0.35	0.55	0.78	13.20	18.08
Retail trade, except motor vehicles	1.37	2.04	0.32	0.45	0.81	1.10	20.62	26.86
Accommodation & food services	1.68	2.28	0.29	0.40	0.66	0.93	17.09	22.71
Travel agency and tour operations	2.35	2.98	0.31	0.43	0.59	0.88	15.40	21.35
Information and communication	1.36	1.78	0.20	0.28	0.51	0.70	6.90	10.80
Financial service activities, except insurance	1.04	1.15	0.06	0.08	0.11	0.16	1.59	2.70
Real estate activities	1.43	1.58	0.08	0.11	0.78	0.85	3.62	5.09
Public administration and defence	1.38	2.58	0.59	0.81	0.78	1.32	22.46	33.79
Creative arts, gambling and betting	1.24	1.41	0.08	0.11	0.34	0.41	2.34	3.89

Source: Authors' calculations.

⁵ Note that in input-output terminology, output is defined as the sum of intermediate production and primary inputs and is therefore not consistent with the definition of an economy’s GDP. As a result, 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.

ten sectors accounted for more than 60% of total output produced in 2015, and more than half the gross value added generated in the Maltese economy during the same year.⁶

The respective multipliers show the direct and indirect effects (simple multipliers) and also the induced effects (total multipliers) resulting from an increase in the final demand to a given sector. By way of example, the output multiplier of sector j shows the increase in the total output produced, across all sectors in the economy, which was required in order to satisfy the input requirements needed to satisfy the increase in final demand of sector j . Following this definition, the simple output multiplier for the manufacture of electronics and transport equipment implies that for every €1 million increase in the final demand to this sector, total output in the economy rises by €1.25 million solely due to direct and indirect effects. Once the induced effects are factored in the analysis, total output would rise by a further €0.41 million, such that the total output multiplier for this industry is estimated at €1.66 million. Similar definitions apply for the income, value added and employment multipliers.⁷

In 2015, travel agency and tour operations, accommodation and food services, and quarrying and construction score the highest simple output multiplier out of the ten industries considered in this study. Conversely, manufacturing and service-oriented industries, namely financial services, and the creative arts, gambling and betting sectors, score relatively low output multipliers, a finding that may be explained by the high import content required by these sectors.

The high import content of manufacturing, financial services, and the creative arts and gambling and betting is also reflected in relatively low value added multipliers for these sectors. To the contrary, among the selected industries, the highest value added multipliers are recorded for industries that are more labour intensive and generally have a low import content, such as retail trade, real estate activities and public administration. It is also noticeable that in all 40 industries, the sum of the direct and indirect effects on value added generated by an increase in final demand is less than one. By way of example, this implies that a €1 million increase in the final demand of accommodation and food services generates a €0.66 million increase in total value added in the economy. It is only when considering the induced effects resulting from household consumption (total multiplier) that the value added multiplier for some industries exceeds one.

In reflection of its high labour intensity, public administration scores the highest income and employment multipliers out of the ten industries considered in this analysis. Other labour-intensive sectors such as retail trade, travel agency and tour operations, accommodation and food services, and quarrying and construction also record relatively large income and employment multipliers. In contrast, the income and employment multipliers for real estate activities, the financial services, and the creative arts, gambling and betting are quite low, especially when compared with the other sectors incorporated in this analysis. Although these sectors are also largely labour intensive, these results are consistent with those derived from the 2010 SIOTs. These findings reflect the high productivity of labour enjoyed by these sectors, which limits the amount of labour input needed to meet the increase in the level of output resulting after a shock to final demand of these sectors.

⁶ It should be noted that the share of the ten sectors to total output and gross value added has remained fairly stable during the years following 2015 and up to 2019.

⁷ Employment multipliers are defined as the change in employment generated by direct, indirect and induced effects brought about by a €1 million change in final demand of a given sector.

Table 2
INDUSTRY ACCOUNTING MULTIPLIERS FOR MALTA IN 2015: SELECTED INDUSTRIES

Per cent of total

	Output	Income	Value Added	Employment
Manufacture of electronics and transport equipment	4.60	4.67	3.57	4.99
Quarrying and construction	4.01	3.70	3.68	4.59
Retail trade, except motor vehicles	3.32	5.05	5.79	7.65
Accommodation & food services	6.55	7.31	7.69	10.20
Travel agency and tour operations	0.79	0.67	0.59	0.79
Information and communication	3.04	2.92	3.40	2.36
Financial service activities, except insurance	19.84	7.06	6.22	4.67
Real estate activities	3.24	1.12	5.23	1.26
Public administration and defence	3.86	10.63	6.51	9.66
Creative arts, gambling and betting	19.89	8.32	16.15	5.74

Source: Authors' calculations.

The multipliers considered so far – generally referred to as *modelling* multipliers – show the impact that a marginal increase in final demand has on output, income, value added, and employment. However, these multipliers do not account for the relative size of the respective industries or the magnitude of the final demand for their goods and services. A measure that does allow to account for the relative size heterogeneity across sectors is what is referred to as an *accounting* multiplier. A set of accounting multipliers is presented in Table 2. Accounting multipliers represent the share of total output, income, value added and employment that is needed to meet the direct and indirect effects generated by each industry's final demand.⁸ In other words, the accounting multipliers show each industry's (direct and indirect) contribution to total output, income, value added, and employment in the economy, when accounting for each sector's final demand.

Since accounting multipliers take into consideration the final demand of each industry, results can vary considerably from the modelling multipliers estimates presented in Table 1. In particular, while the financial services industry (except insurance) and the creative arts, gambling and betting had relatively low output and value added modelling multipliers, these industries boast among the highest output accounting multipliers out of the 40 industries considered in this analysis. In fact, these two industries rank highest in terms of output accounting multipliers, directly and indirectly contributing close to 20% (each) of the total output in the Maltese economy. The creative arts, gambling and betting sector also ranks top in terms of the value added accounting multiplier, contributing slightly more than 16% of the economy's total value added in 2015. Among the 40 industries included in the 2015 SIOT, public administration and education are the largest contributors to total income while in terms of employment, only the accommodation and food services industry contributed more (directly and indirectly) in 2015.

Industry-specific multipliers in 2015: comparison with 2010

In what follows, the industry-specific output, income, value added and employment multipliers for the Maltese economy in 2015 are compared with the corresponding multipliers calculated from the 2010 SIOT. Overall, with the exception of a few industries, minor differences were observed between 2010 and 2015 multiplier estimates, suggesting a relative stability in the inter-industry

⁸ Accounting multipliers are calculated as the product of each sector's output, income, value added and employment simple multipliers with the final demand of the respective sector, considered as a share of the economy's total output, income, value added and employment.

linkages and the sectoral composition of the production structure of the Maltese economy between 2010 and 2015.

Table 3 shows a comparison between the output modelling and accounting multipliers recorded in 2015 with the corresponding values in 2010.⁹ Among the simple modelling multipliers, travel agency and tour operations have seen the largest positive change between 2010 and 2015. While in 2010, the direct and indirect effects of a €1 million increase in the final demand of this sector resulted in a €1.81 million rise in total output, this went up to €2.35 million in 2015. As a result, travel agency and tour operations recorded the highest simple output multiplier in 2015. On the other hand, the sector covering other professional, scientific and technical activities (including advertising and research) saw the largest drop in its simple output multiplier during the period 2010-2015. While in 2010, this sector registered the highest simple output multiplier, it ranked 21st out of the 40 industries included in the 2015 SIOT utilised for this study.

Changes in accounting multipliers show that the direct and indirect contribution of the creative arts, gambling and betting sector to total output almost doubled between 2010 and 2015. On the other hand, the contribution of the financial services industry to total output declined from 24% in 2010 to 20% in 2015. Although this industry saw the largest drop in contribution to total output during this period, it remained the second highest contributor to the total output in the Maltese economy in 2015, slightly lagging behind the creative arts, gambling and betting sector.

With the exception of activities of households as employers (including activities produced for own use and of extra-territorial bodies), any industry-specific changes in the income multipliers

Table 3					
INDUSTRY OUTPUT MULTIPLIERS FOR MALTA IN 2015: COMPARISON WITH 2010					
Industries with largest positive change	2010 Multiplier	Change in 2015	Industries with largest negative change	2010 Multiplier	Change in 2015
Simple Modelling Multipliers					
Travel agency and tour operations	1.81	0.54	Other personal service activities	1.51	-0.16
Electricity and water collection	1.95	0.32	Architectural and engineering activities	1.73	-0.20
Fishing and aquaculture	1.30	0.25	Sports activities and recreation	1.79	-0.24
Insurance, reinsurance and pension funding	1.14	0.23	Rental and leasing activities	1.54	-0.26
Manufacture of textile	1.38	0.22	Other professional, scientific and technical activities	2.09	-0.70
Accounting Multipliers					
<i>Per cent of total</i>					
Creative arts, gambling and betting	10.03	9.86	Manufacture of chemical products and pharmaceuticals	2.74	-0.67
Other professional, scientific and technical activities	0.36	1.66	Information and communication	3.97	-0.93
Transport	4.83	0.79	Quarrying and construction	5.3	-1.29
Real estate activities	2.65	0.59	Manufacture of electronics and transport equipment	8.38	-3.78
Fishing and aquaculture	0.38	0.45	Financial services activities, except insurance	24.39	-4.55

Source: Authors' calculations.

⁹ In light of space concerns, this analysis focuses only on simple modelling and accounting multipliers.

Industries with largest positive change	2010 Multiplier	Change in 2015	Industries with largest negative change	2010 Multiplier	Change in 2015
Simple Modelling Multipliers					
Activities of households as employers	0.00	1.00	Other professional, scientific and technical activities	0.26	-0.08
Manufacture of wood	0.22	0.11	Rental and leasing activities	0.20	-0.10
Activities auxiliary to financial services	0.18	0.09	Crop and animal production	0.24	-0.11
Manufacture of textiles	0.24	0.08	Repair of computers and personal goods	0.26	-0.12
Manufacture of electronics and transport equipment	0.14	0.06	Security and investigation services	0.62	-0.14
Accounting Multipliers					
<i>Per cent of total</i>					
Creative arts, gambling and betting	3.92	4.40	Wholesale trade, except motor vehicles	3.31	-0.82
Other professional, scientific and technical activities	0.28	1.39	Public administration	11.61	-0.99
Transport	5.35	0.81	Information and communication	4.04	-1.12
Activities auxiliary to financial services	0.82	0.69	Manufacture of electronics and transport equipment	5.98	-1.31
Financial services activities, except insurance	6.50	0.56	Quarrying and construction	5.23	-1.53
Source: Authors' calculations.					

between 2010 and 2015 were rather small (Table 4).¹⁰ Similar to the 2010 analysis, the highest simple modelling income multipliers in 2015 are recorded in labour-intensive sectors, namely employment activities, education and social work activities. Possibly due to reasons put forward earlier in this analysis, the modelling income multipliers pertaining to the financial services (except insurance), real estate activities, and the creative arts, gambling and betting activities remain the lowest among the 40 industries included in the 2015 SIOT.

When considering the size of each sector's final demand, the direct and indirect contribution of the creative arts, gambling and betting industry to total income is found to have increased from below 4% in 2010 to more than 8% in 2015. As a result, this industry stood as the third-highest contributor to total employee income in 2015, still lagging behind public administration, and education. Less pronounced increases in contribution to total income were also observed in the other professional, scientific and technical activities, transportation, activities auxiliary to financial services and insurance, and the financial services (except insurance), among others. On the other hand, the industries with the largest negative change in contribution to total income between 2010 and 2015 included wholesale trade (except motor vehicles), public administration, information and communication (including publishing activities), manufacture of electronics and transport equipment, and quarrying and construction. Nonetheless, the negative change was relatively marginal in all sectors.

Turning to the value added multipliers presented in Table 5, differences between 2010 and 2015 were also limited. In fact, the most pronounced increase in the simple modelling value added

¹⁰ The substantial increase in the modelling income multiplier of activities of household as employers, including activities produced for own use and of extra-territorial bodies is due to the compensation to employees making up the entire gross value added of this industry in 2015. Moreover, no inter-industry demand, imports, taxes or subsidies were recorded by this sector during the same year, causing the industry's output to equal its gross value added. It follows that the share of compensation to employees in the industry's total output in 2015 equalled 1. The corresponding share of compensation to employees in the industry's total output in 2010 was 0.

Table 5
INDUSTRY VALUE ADDED MULTIPLIERS FOR MALTA IN 2015: COMPARISON WITH 2010

Industries with largest positive change	2010 Multiplier	Change in 2015	Industries with largest negative change	2010 Multiplier	Change in 2015
Simple Modelling Multipliers					
Activities auxiliary to financial services and insurance	0.36	0.15	Information and Communication	0.58	-0.07
Electricity and water collection	0.39	0.15	Insurance, reinsurance and pension funding	0.55	-0.08
Rental and leasing activities	0.53	0.13	Real estate activities	0.86	-0.08
Sports activities and recreation	0.65	0.11	Repair of computers and personal goods	0.68	-0.11
Repair and installation of machinery	0.46	0.10	Other professional, scientific and technical activities	0.60	-0.16
Accounting Multipliers					
<i>Per cent of total</i>					
Creative arts, gambling and betting	9.20	6.94	Crop and animal production	1.24	-0.72
Other professional, scientific and technical activities	0.31	1.58	Manufacture of chemical products and pharmaceuticals	3.37	-1.12
Retail trade, except motor vehicles	4.89	0.91	Information and communication	4.94	-1.54
Transport	5.09	0.82	Quarrying and construction	5.46	-1.78
Accommodation and food services	7.05	0.64	Manufacture of electronics and transport equipment	6.81	-3.24

Source: Authors' calculations.

multiplier between the two years – observed for activities auxiliary to financial services and insurance, and electricity and water collection – stood at just 0.15. This implies that while in 2010 an increase of €1 million in final demand of this sector generated an additional €0.36 million in value added (through direct and indirect effects), €0.51 million were generated in value added in 2015. Similarly, the direct and indirect value added effects of a €1 million increase in the final demand of electricity and water collection rose from €0.39 million in 2010 to €0.54 million in 2015. Similar to 2010, the highest simple value added multipliers are recorded for activities of household as employers (including activities produced for own use and of extra-territorial bodies), education and manufacture of basic metals. By contrast, the modelling value added multiplier pertaining to the financial services industry (except insurance) remains the lowest among all 40 industries included in the 2015 SIOT, possibly due to the high import content associated with Special-Purpose Vehicles (SPVs).

The accounting value added multipliers show that the creative arts, gambling and betting remains Malta's largest contributor in 2015, with around 16% of all value added generated in the economy during 2015 being either directly or indirectly linked to the sector. This represents an increase of 7 percentage points, relative to the contribution by the same industry in 2010, mainly driven by the relative increase in the share of final demand attributed to creative arts, gambling and betting. The largest negative change between 2010 and 2015 is recorded in the manufacture of electronics and transport equipment, which dropped from around 7% in 2010 to below 4% in 2015. Differences in the contribution of the other industries to total value added between 2010 and 2015 were relatively small and limited to less than 2 percentage points.

Table 6 shows a comparison between the employment multipliers in 2010 and 2015. Only nine out of 40 industries registered a positive change in the simple employment multiplier. Moreover, with the exception of the activities of household as employers (including activities produced for

Table 6
INDUSTRY EMPLOYMENT MULTIPLIERS FOR MALTA IN 2015: COMPARISON WITH 2010

Industries with largest positive change	2010 Multiplier	Change in 2015	Industries with largest negative change	2010 Multiplier	Change in 2015
Simple Modelling Multipliers					
Activities of households as employers	0.03	63.71	Education	38.24	-9.08
Manufacture of wood	15.97	6.16	Sports activities and recreation	36.93	-10.32
Manufacture of basic metals	14.98	4.71	Employment activities	48.87	-12.38
Manufacture of textiles	13.35	2.01	Security and investigation services	42.09	-15.85
Manufacture of electronics and transport equipment	7.45	1.41	Activities of membership organisations	95.69	-20.07
Accounting Multipliers					
<i>Per cent of total</i>					
Creative arts, gambling and betting	2.77	2.97	Crop and animal production	1.00	-0.69
Retail trade, except motor vehicles	6.41	1.24	Wholesale trade, except motor vehicles	3.46	-0.74
Other professional, scientific and technical activities	0.27	1.18	Information and communication	3.31	-0.95
Transport	4.53	1.10	Manufacture of electronics and transport equipment	6.14	-1.15
Social work activities	3.44	1.02	Quarrying and construction	6.23	-1.64

Source: Authors' calculations.

own use and of extra-territorial bodies), the extent of the positive changes in simple employment multipliers were marginal.¹¹ In terms of the contribution of the respective sectors to total employment, differences between 2010 and 2015 were also relatively small in magnitude. In fact, the accommodation and food services, public administration, education, and retail trade (except motor vehicles) remain the largest contributors to employment in Malta. Following an increase of almost 3 percentage points, relative to 2010, the creative arts, gambling and betting sector registered the 5th highest contribution to employment in 2015 at slightly less than 6%. The industries with the largest negative change in their contribution to total employment include quarrying and construction, and the manufacture of electronics and transport equipment, which, however, remain important contributors to total employment in Malta.

Conclusion

The application of the input-output methodology presented in this analysis allows for the identification and analysis of inter-industry relationships in the Maltese economy. In particular, this methodology is useful in the calculation of the marginal effects that an increase in the final demand to one sector has on total output, income, value added and employment across the production structure of the Maltese economy, through direct, indirect and induced effects. Moreover, accounting for the size and final demand of each sector, this analysis should also prove useful in the assessment of the direct and indirect contribution of different sectors to the total output, income, value added and employment generated in the Maltese economy.

Based on the SIOT for the reference year of 2015, this analysis shows that the highest income and employment multipliers in Malta are observed predominantly in labour-intensive sectors, namely employment activities, education, social work activities, and public administration. Consistent with a similar analysis for 2010, the financial services and the creative arts, gambling and betting register among the lowest simple and total multipliers. However, when accounting for each

¹¹ The sectoral employment data available for 2010, provided by the NSO, which was employed for the study, did not show any employees working in activities of households as employers (including activities produced for own use and of extra-territorial bodies). This is largely behind the large positive change in the employment multiplier for this industry in 2015, compared to 2010.

industry's size and final demand, these sectors score among the highest multipliers, particularly in terms of output and value added. In fact, in 2015, the creative arts, gambling and betting industry accounted for 20% and 16% of the economy's total output and value added, respectively. In terms of its contribution to total income, this sector trails only the public administration, and education sectors, whose contributions to total employment income amount to 11% and 10%, respectively. In turn, these two labour-intensive industries trail only the accommodation and food services industry in their contribution to total employment.

The availability of previous work based on the 2010 SIOT allows the changes in the Maltese economy structure and inter-industry linkage that have occurred between 2010 and 2015 to be tracked. Overall, with the exception of few industries, differences observed between the two years were relatively small in magnitude suggesting that inter-industry linkages and sectoral structure of the Maltese economy have remained quite stable over this 5-year period. Nonetheless, certain sectors – namely the creative arts, gambling and betting, other professional, scientific and technical activities, and transportation – consistently registered the largest increases in contribution to the economy's total output, income, value added, and employment between 2010 and 2015. On the other hand, quarrying and construction, information and communication, and the manufacture of electronics and transport equipment seem to have lost some of their relative importance in total output, income, value added, and employment generated in the Maltese economy.

While the input-output methodology and the analysis presented in this article should provide useful insights to policy makers, its limitations need to be acknowledged. Firstly, the methodology focuses specifically on the demand side, taking no consideration of constraints in supply of labour or of intermediate goods and services. In addition, while new Keynesian theory suggests that an increase in demand of one sector should exert upward pressure on prices, the Leontief demand-driven quantity model applied in this study assumes fixed prices. Since the model employed in this analysis does not allow to internalise changes in prices following final demand shocks, the results suggested by the industry-specific multipliers might overestimate the true impact of an increase in the final demand of an industry. Despite these limitations, the industry-specific multipliers presented in this analysis should be useful in assessing inter-industry linkages and the relative importance of different economic sectors in the Maltese economy.