THE ECONOMIC INFLUENCE OF INFRASTRUCTURAL EXPENDITURE IN SOUTH AFRICA: A MULTIPLIER AND STRUCTURAL PATH ANALYSIS

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Abstract

The construction sector in South Africa will play an important role in the upcoming years. A R845 billion infrastructure investment program has been put in place and is viewed as a key component to promote economic growth. In this paper we analyse the economic impact of the planned infrastructural investment program on the South African economy. In conducting this analysis, we hope to shed light on the mechanisms through which the infrastructural spending will stimulate the economy. In addition, an important contribution that this study makes is the development and strengthening of the use of Structural Path Analysis (SPA) as a tool for policy analysis in South Africa. The analysis shows that the construction sector is a good choice for demand injection due to its stimulatory effect on other production activities and households at all income levels.

JEL Classification: D57, H54, L98, N77, O55

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1. INTRODUCTION

Like most emerging economies, South Africa was also affected by the global economic crisis. Following two consecutive quarters of contraction in the last quarter of 2008 and the first quarter of 2009 South Africa went into a recession for the first time in 17 years. The global decrease in the demand for raw materials hit South Africa hard. In 2009, the economy contracted by 1.8% with the manufacturing and mining sectors contributing significantly to the decline. Overall, companies downscaled their production activities and capacity during the first quarter of 2009.

In response to the downturn, an infrastructure investment program was planned. It is hoped that the construction sector and other infrastructure related sectors will play an important role in boosting the South African economy. According to the National Budget Review 2010 government plans on spending R845 billion on infrastructural investments over the next 3 years with an estimated tranche of R262 billion to be spent in the 2010/11 fiscal year followed by tranches of R283 and R300 billion in the 2011/12 and 2012/13 fiscal years respectively (see, Table 1). These funds will be used for public transport, roads and rail networks; school buildings, hospitals and other provincial infrastructure projects as well as municipal infrastructure and bulk water systems. A number of projects have already been conceived and Table 2 gives a brief description of each.

In this paper we analyse the economic impact of the planned infrastructural investment program on the South African economy. In conducting this analysis, we hope to shed light on the mechanisms through which the infrastructural spending will stimulate the economy. In addition, an important contribution that this study makes is the development and strengthening of the use of Structural Path Analysis (SPA) as a tool for policy analysis in South Africa.

The hypothesis underlying SPA, as Defourny and Thorbecke (1984) points out, is that different sectors will be more or less important as ‘connections’ for transmitting influence between accounts in the economic system depending on the combination of expenditure patterns, and sourcing of inputs. As with most infrastructural projects a large proportion of the expenditure will go toward construction activities and a look at Table 2 shows that the proposed projects are no different. Therefore this paper focuses on the construction sector, which will most likely be the single biggest beneficiary of the proposed infrastructural expenditure.

Table 1: Public sector infrastructure expenditure and estimates

R million	2006/07	2007/08	2008/09	2009/10 Revised estimate	2010/11	2011/12	2012/13
		Outcome				Medium-term estimates	
Total	83,605	130,191	196,447	235,161	261,914	283,315	300,417
Percentage of GDP	4.6%	6.3%	8.5%	9.6%	9.7%	9.5%	9.1%
Gross domestic product	1,833,191	2,081,626	2,320,117	2,449,858	2,699,888	2,967,560	3,295,749

Source: National Budget Review 2010

The analysis seeks to provide answers to the following questions:

- Which sectors play an important role in the transmission of influence in the economy following an increase in infrastructural expenditure?
- In which sectors does the additional employment, by skill group, occur following an increase in the demand for construction services?
- Which other sectors in the economy are the primary beneficiaries of an increase in the demand for construction services?
- How does this intervention affect the sectoral distribution of employment?
- Finally, which household groups benefit the most?

Table 2: Major infrastructure projects

Project name	Total project cost R billion	Implementation agent	Project objective and completion target date
Energy			
Kusile power station	140.7	Eskom	Construction of a 4 800 MW coal-fired power station (to be completed in 2018).
Medupi power station	125.7	Eskom	Construction of 4 764 MW coal-fired power station- first unit (2012), last unit (2015).
Ingula pumped-storage scheme	16.6	Eskom	Construction of 1 368 MW hydroelectric power station (2013).
	283		
Transport			
Gautrain rapid rail link	25.2	Gauteng Department of Roads, Transport and Public Works	Construction, operation of commuter rail link. OR Tambo - Sandton link (2010), Johannesburg -Pretoria (2011).
Gauteng freeway improvement scheme-phase 1	22.0	South African National Roads Agency Limited	Upgrade, lane additions and construction of 3 new highways. Phase 1 (2012), phase 2 and 3 (2020).
New multipurpose pipeline phase 1	12.6	Transnet	8.7 billion litres per year pipeline (2011). Based on demand, expansion to 12.2 billion litres (2019) and 26.2 billion litres (2031).
Iron-ore line	11.6	Transnet	Upgrade of the iron-ore line to 60 million tons per year (2013), expansion to 105 million tons per year (2015).
Ngqura container terminal	7.9	Transnet	Improving port capacity by an additional 800 00020-foot equivalent units (2013).
	79.3		
Water			
Mokolo-Crocodile water augmentation project	14.7	Trans-Caledon Tunnel Authority	Phase 1 of project to deliver water (2012), phase 2(2015).
Olifants River water resource development project - phase 2	13.7	Department of Water Affairs and the Trans-Caledon Tunnel Authority	Construction of dam (2013) and bulk distribution system (2016).
	28.4		
Housing			
Comubia housing development	5.1	The Housing Development Agency and eThekwini Metropolitan Municipality	19313 mixed-income, mixed-density houses (201 6/1 7).
N2 gateway	2.3	The Housing Development Agency and Western Cape Department of Housing	22000 low-income houses (2013).
	7.4		
Hospitals			
Frere Hospital	2.5	Eastern Cape Department of Health	Upgrade and rehabilitation of a 550-bed regional hospital (2013).
Limpopo Academic Hospital	1.5	Limpopo Department of Health	A new 600-bed hospital. Construction to start April 2011.
Cecilia Makiwane Hospital - phase 1	1.4	Eastern Cape Department of Health	Upgrade and rehabilitation of 650-bed regional hospital. Phase 1 (2013).
Natalspuit Hospital	1.7	Gauteng Department Health	Replacement of an existing hospital (2011).
	7.1		
	405.2		

Source: National Budget Review 2010

2. LITERATURE REVIEW

2.1 The importance of infrastructure expenditure

The provision of infrastructure confers a number of benefits to an economy. Infrastructure lowers the cost of production and consumption, and makes it easier for participants in the economy to enter into transactions. Increasing the efficiency of infrastructure will thus improve growth performance, service provision and development outcomes. The the availability or absence of the ‘right’ infrastructure often affects the decisions producers and consumers make about where to live or work, what to produce and also whether to produce. This in turn affects the ability of the economy as a whole to adjust to changes and external shocks[1].

Fedderke and Garlicky (2008) conducted an extensive review of the relationship between infrastructure and economic growth. The paper identified five channels through which infrastructure affects growth; as a factor of production, a complement to other factors of production, a stimulus to factor accumulation, a stimulus to aggregate demand and a tool of industrial policy. They develop a framework for evaluating empirical analyses of the relationship between infrastructure and economic growth which is used to assess the empirical literature on South Africa. Fedderke and Garlicky find that both the theoretical and empirical evidence seems to support the existence of a robust positive relationship between infrastructure and economic growth. The overall recommendation for South Africa is that caution should be exercised when planning infrastructure investment since the driving relationship between economic output and infrastructure varies significantly across different types of physical infrastructure.

[1] Heymans and Thome-Erasmus (1998)

2.2 *Empirical applications of structural path analysis*

The SPA decomposition technique was developed by Defourny and Thorbecke (1984) and ever since then its application has been relatively rare, as such; this review will concentrate on the few papers that have been published to date. Khan and Thorbecke (1989) used SPA to analyze the macroeconomic effects of technology choice on output, employment and income distribution. This was done by looking at the impact of the gradual substitution of traditional technologies by modern technologies in Indonesia. The paper demonstrated the difference between ordinary multiplier decomposition and path analysis. Whereas the former exercise showed that an increase of 100 Rupiahs into the hand-pounded rice activity (traditional technology sector) led to an increase of 22 Rupiah in the income of agricultural employees. The structural path analysis was able to reveal the entire network of paths through which the impact of a particular technology was transmitted to the disaggregated socioeconomic system. This showed that 44.1% of the additional income to agricultural employees was transmitted via the following path, from the hand-pounded rice activity to the other food crops industry, to income accruing to agricultural paid rural workers involved in paddy production and then to the income of the household group headed by agricultural employees. The latter indirect path was greater than the direct contribution of hand-pounded rice to agricultural employees. This additional detail is a good example of some of the benefits of using SPA over conventional decomposition methods.

Roberts (2005) illustrated how SPA can be used to analyze the role of different types of households in rural economies. To be specific, she showed the extent to which different types of households transmit economic influence or act as connections within the local economic system. Her study was on a rural region of Scotland – the Western Isles a region with several rural development problems including lagging per capita GDP, large trade deficits and a declining and aging population. In her analysis, the agricultural sector was selected as the source account for each of the micro-level examples of path analysis. Each of the examples focused on the effects arising from a unit increase in the demand for output from agriculture for another productive sector (the destination account). The three destination sectors were the banking, extraction and catering sectors, which were selected to illustrate the variety in the kind of paths that exist within the economy. Some indirect paths were shown to be more important than more direct paths because of the amplifying effect of adjacent circuits. Specifically, paths including the household accounts exhibited far higher multipliers than those contained within the production sphere of the economy. Furthermore, households with children were shown to play a more important role in generating the overall global influence than households with no children or retired households. Finally, 'other income' was shown to be the most important factor of production. This is not surprising, given that self-employment income as opposed to salaried employment dominates agriculture in the region and thus acts as the main transmitter of influence into the household sector.

3. METHODOLOGY

In order to illustrate the amount of detail that can be got from structural path analysis this paper decomposes multipliers from a SAM (Social Account Matrix) of South Africa using two types of decompositions. Multipliers can be used to identify key sectors within an economy, particularly those that have the potential for generating high demand-led multiplier effects. The importance of a sector is based on the column sums of particular rows of the multiplier matrix from a closed input – output or SAM model. Sectoral multipliers are useful for considering the economy-wide impacts arising from exogenous increases in sector income. Multiplier analysis can be complemented by multiplier decompositions and Structural Path Analysis (SPA). Multiplier decompositions were developed formally by Pyatt and Round (1979), Defourny and Thorbecke (1984), and Stone (1985).

SPA focuses on how individual elements lead to the global influence that we get from conventional SAM based multipliers by tracing the transmission of influence within an economic structure. It is a means of identifying the paths through which structural relationships in an economy lead to ultimate effects on endogenous variables. It reveals aspects of an economy that are not apparent from an examination of either direct transactions between accounts or an examination of the global influence which is the solution of conventional decompositions (Roberts, 2005).

Structural path analysis has two key objectives;

1) To identify the most important interactions or paths within an economic system
2) To identify which individual poles (sectors, factors or households) are important transmitters of economic influence.

SPA is designed to provide a more detailed picture of the effects of shocks to exogenous accounts. SAM-multipliers measure the cumulative effects from a shock, where as path analysis not only decomposes these multipliers into direct and indirect components but it also reveals the network of transmission channels. The SPA decomposition is, in this context, useful in coming to grips with the nature and strength of linkages that work through the economic sector. Multiplier analysis, multiplier decompositions, and structural path analysis are attractive methodologies that can help provide insights into a range of policy questions around government's employment targets, stimulus policy, issues related to industrial policy and many other policy questions.

In order for the results of multipliers and SPA to strictly apply to the economy, two important assumptions must hold simultaneously. First, supply side constraints to economic expansion are not binding. As a result, the level of demand determines the level of economic activity. Second, one must either assume that prices are constant or that preferences and technology are of the Leontief form. In other words, consumers consume in fixed proportions and producers use inputs in fixed proportions either because fixed relative prices provide no incentives to change those proportions or because preferences and technology are specified in that way.

Ordinarily, these assumptions are considered highly onerous. Multiplier analysis is often viewed as providing useful insights into demand forces on the economy that may be important for the nature and rate of economic growth; however, the interpretation of results is usually tempered by a more realistic view of supply side, prices, preferences, and technology. However, in the context of the current economic downturn, these assumptions become more plausible. With an economic contraction, supply side constraints are clearly less problematic. At the same time, while prices, preferences, and technology almost surely maintain some flexibility, fixed proportions preferences and technology provide a valuable first order approximation to the effects of demand shifts within the South African economy.

3.1 Data

This paper uses the 2003 SAM for South Africa, which is accurate and consistent. A SAM provides a detailed snapshot of the economy at a point in time. Unlike input-output analysis, multiplier analysis in a SAM framework permits incorporation of feedback effects from household consumption. In addition, the detailed representation of households present in the 2003 SAM allows one to consider the distributional impacts of various types of demand injections.

The 2003 SAM includes a total of 73 accounts, which can be divided into endogenous and exogenous accounts. The endogenous accounts include 46 commodities, 4 factors, and 15 institutions (enterprises and households). The exogenous accounts include 4 types of taxes, government, savings-investment balance, changes in stocks, and the rest of the world. In a multiplier decomposition, as proposed by Pyatt and Round (1979) and Defourny and Thorbecke (1984), the effect of injections from exogenous accounts can be traced on the economy through the endogenous accounts. Under the assumptions mentioned above (fixed prices and no supply restrictions), multiplier analysis and SPA can reveal the interaction between and across production activities, factors of production, and institutions.

4. RESULTS

4.1 Multiplier Decomposition analysis

This section will start with conventional multiplier decomposition analysis which generates the multipliers in a non-transparent way, creating the basis for structural path analysis which exposes the network of channels through which economic influence flows in the economy. The first step is to calculate the accounting multipliers (Table 1) which measure the global effect of an exogenous increase in the demand of a sector. When construction is stimulated via, for example, a government infrastructure investment program, demand for intermediate inputs used by construction expands. For example, construction is a significant user of non-mineral metal products. Non-mineral metal products, in turn, is both produced domestically and imported. In the multiplier analysis, the financial flows to imports and to taxes are examples of flows to exogenous accounts which are "leakages" from the system. Purchases of domestically produced non-mineral metal products remain within the system. The stimulus to the non-metal mineral products sector stimulates further intermediate demand for commodities.

At the same time, expansion of the construction sector requires increased use of factors of production—labour and capital. These resources are presumed to be unemployed and thus available for use. In the South African case, unemployment of unskilled and semi-skilled labour has been a reality for decades. However, supply side constraints have been evident with respect to highly skilled labour and capital. Nevertheless, within the context of the current economic contraction, these constraints are likely to be far less binding. Increased factor income is distributed to households (with taxes and savings representing leakages). Household, in turn, expand consumption of commodities.

These internal loops persist resulting in a larger increase in aggregate demand than the initial stimulus into the construction sector. Assuming that the R845 billion infrastructure project over three years is entirely used in construction and construction related activities and the division of financing is roughly equal per year, the activity multiplier of nearly 5 implies that the initial increase will swell to nearly R1.3 trillion worth of sales as the secondary effects are felt throughout the South African economy. This means that a one unit increase in construction demand (via, for example, a government infrastructure investment program) results in nearly four additional units of sales in construction and other industries. Similarly, factor incomes (GDP at factor cost) expand by more than R333 billion and household incomes expand by nearly R250 billion on an annual basis.

These numbers are clearly too large in the context of an economy where GDP was valued at R1.26 trillion in 2003, which is the base year for the SAM (World Bank, 2009). This result highlights the need for appropriate consideration of results and perhaps reconsideration of the magnitude of the package. At the same time, the results show that expansion of the construction sector has considerable potential to provide demand side stimulus. To the extent that supply side constraints within the overall economy remain non-binding, the stimulus has potential to significantly push the economy towards the production possibilities frontier.

The following section will now present the results of the analysis; these will be grouped into impacts on productive activities, factors and institutions.

4.1.1 Production activities

The stimulus in the construction sector generates motion in all other activities. Within the productive activities, the largest sales stimulus (outside of construction) is received by the business services sector (0.52). Only one sector, furniture, provides a larger impetus to sales by domestic producers, with an activity multiplier over 5.

4.1.2 Factors

As mentioned above, the initial stimulus to construction also increases factor usage (capital and labour) and factor income. These factor earnings are then passed to households, though some of the incremental income leaks to factor taxes, corporate taxes, and retained earnings. The net result is that, even though value added represents only about 20% of total construction costs, the overall stimulus to factors (value added) amounts to 1.32 once all indirect effects are accounted for. The impact on total household income is less at 0.95 due to the leakages mentioned above. Retained earnings and corporate taxes are the main elements that account for the differences for two reasons. First, the construction sector is reasonably capital intensive with a share of capital in value added of 41%. While less than the economy-wide average capital intensity of 48%, the share still implies that significant payments are directed to capital. Second, these payments to capital are subject to corporate and factor taxes as well as retained earnings. These leakages represent nearly 50% of capital income.

4.1.3 Institutions

Given the resulting stimulus on all production activities, enterprises receive, directly and indirectly, a large portion (65%) of the investment from the infrastructure program. The households in the SAM are grouped by income deciles, with the first group representing households with incomes between the 0 and 10 percentile, and the last one for the household with incomes between 98.75 to 100 percentile. By further grouping these households into only three categories, the results can be more easily presented and explained. The distribution was made as follows: low (0-50), medium (50-90), and high (90-100).

The distribution of benefits of augmented construction spending across households is not as favourable as one might like. The incomes of middle and upper income households each increase by 0.42 while lower income households benefit from a 0.11 stimulus. However, this is more a feature of the South African economy than of the construction sector. Relatively few sectors provide a greater stimulus to overall household income than construction and even fewer provide a larger stimulus to lower income households. The low multipliers for low income households reflect a high degree of dependence of these households on government transfers as a source of income. For households in the lower 50% of the income distribution, government transfers represent a bit less than 33% of income. The small shares of factor earnings garnered by low income households imply relatively low multipliers for these households.

Overall, the multiplier effect of construction spending on factor incomes is generally strong relative to other sectors, though not as strong as with respect to activities. Sectors with larger shares of value added in total sales and higher labour intensities, such as government services, produce larger multipliers with respect to factor incomes. Nevertheless, the construction multiplier is relatively high, and the sector is of sufficient size to transmit a macroeconomically significant stimulus.

4.2 Structural Path Analysis

This section presents the results of the SPA which goes a step further than the multiplier decomposition presented in the previous section. The previous multiplier decomposition gave us the global influences that exist between the construction sector and other poles (that is, production activities, factors, and institutions). Using structural path analysis, we now proceed to identify various paths, through which economic influence is transmitted from one sector, in our case from the construction sector (the sector of origin), to other sectors in the economy. Theses destination sectors have been chosen on account of their close relationship with the construction sector as sources of inputs. The results for the structural path analysis in Tables 2 to 4 only show the ten most important paths in each case. These are not exhaustive since in any given SAM, there are thousands of possible paths.

4.2.1 Production activities

Table 2 shows the path analysis of construction on other production activities. Case I in Table 2 shows the impact of an injection in construction on basic iron and steel. From the previous accounting multipliers it can be seen that an injection of R1 billion into the construction sector generates an increase of R86 million in the income of basic iron and steel. Structural path analysis shows us that only 27.1 % (Column 8) of this additional production is caused directly by the demand for basic iron and steel inputs by the construction sector through the path linking the two sectors without any other poles. The other paths shown under Case I: Table 2 reveal that a significant part of the global influence of construction on basic iron is exercised indirectly through the demand for metal products (33.1%). Path analysis allows us to see exactly which sectors benefit from the expansion of construction. We are able to see the different paths through which economic influence flows from construction to basic iron and steel. From these results the most important sector in transmitting influence between the construction and basic iron and steel is the metal products sector since it is the only sector that appears 4 times in the 10 most significant paths between the two sectors.

The global influence of construction on metal production is 0.12. We find that almost 75% of that comes from the direct path link the two sectors. A smaller portion comes from indirect paths via the increased spending on iron, electrical machinery, and non-metallic products. Case II is interesting and demonstrates that sometimes indirect paths transmit greater influence than direct paths between two sectors. This is highlighted by the fact that the direct path between the construction sector and the non-ferrous metal sector is not in the top 10 most influential paths. 30.5% of the influence is actually transmitted by an indirect path via the electrical machinery sector. Again the metal products sector emerges to be an important transmitter of influence in this instance.

4.2.2 Factors

The increase in income following the exogenous expenditure on construction can be interpreted as a rise in the employment of the destination factor. Thus, with path analysis, we can establish the sectoral sources of additional employment following an increase in construction services. Conventional multiplier decomposition only tells us the overall impact without saying from which sectors the additional employment will come. Case II: Table 3 shows us which sectors the additional employment of low skilled workers will come from following an increase in the expenditure on construction. The results show that 49% will come directly from the construction sector itself and the rest from other sectors, with non-metal products, other mining and gold being some of the top contributors to the increase in employment. The path analysis also shows that, out of the top 10 paths, other mining plays the most important role in transmitting the economic influence from construction to low skilled workers.

These are important results. The infrastructure program is expanding employment for unskilled workers in sectors that are suffering particularly weak demand in the context of the global economic contraction. This implies that, via this channel at least, the infrastructure program is likely to be effective in (at least partially) counteracting the slump in demand. In addition, the multiplier effects are less likely to encounter supply side constraints.

With respect to skilled and highly skilled labour, the business services sector stands out. The effect of the contraction on the demand for business services is less clear. Hence, constraints to the expansion of business services may limit the propagation of the demand injection from construction. Beyond business services, the sources of additional employment for skilled and high skilled labour seem to be evenly distributed without any one sector dominating as an important transmitter of influence. In particular, the additional employment for high skilled labour comes from a diverse combination of sectors. The construction sector spends about 9% of its budget on capital, and 13% on labour (5.6% on low skilled, 2.5% on skilled, and 4.5% on high skilled labour). We previously found that construction has a multiplier effect of 0.7 on capital. Path analysis shows us that the direct demand for capital by the construction sector represents only 21.3% of total influence. The rest of the influence is transmitted indirectly through paths which flow past other production activities as the increase in capital income also comes from business services (5.9%), non-metallic metal products (4.5%), and metal products (1.09%), among others.

Low skilled labour has the highest budget share, but the lowest multiplier (0.16). On the other hand, high skilled labour has a relatively high multiplier (0.26). Almost half of the increase on low skilled labour income comes from its direct path with construction. Other sectors that employ additional units of labour are metal products, non-metallic metals, other metals, and gold. Conversely, business services, and financial and real estate services play an important role in the increase of high skilled labour income.

4.2.3 *Institutions*

Lastly, as in the case with labour, path analysis can also give us a better sense of the distribution of incremental income for institutions (households and enterprises). Cases II, III and IV: Table 4 show us that the income of all households comes from a combination of diverse sectors; furthermore, path analysis tells us that the incremental income of middle income households comes mainly from three sources: the business services, metal products and non-metal products sectors. This is revealed by the fact that these sectors appear an equal number of times in the paths that connect construction and middle income households. Path analysis also shows that enterprises receive most of their income through the direct path via capital, which explains 21.3% of the global influence. The remaining share comes indirectly through capital but initially going from construction to business services (5.9%), non-metallic metal products (4.5%), other mining (2.27%) metal products (1.09%), and electricity and gas (0.93%), among others.

Low income households receive 23.2% of the income generated through low skilled labour, 5.6% from skilled, and 2.15 from high skilled labour. They also receive 4.36% of the income generated by construction, through capital invested in enterprises. Medium income households followed a similar pattern, but with a more even distribution among the paths explained above, where the income coming from low skilled labour represents 12.4% of the multiplier. Last but not least, high income households receive 11.2% of their income through capital invested in enterprises, followed by 10.7% from high skilled labour. Production activities that consistently participate in the paths of income generation for enterprises and households are non-metallic metal products, metallic products, and business services. These results show that South African households have relatively strong links to the industrial sector, and that many of the sectors involved in construction hire labour with different set of skills.

4.2.4 *A graphical representation*

The analyses presented above relied only on the quantitative results generated by SPA. Nonetheless, SPA is a construct of relationships within the economy and a graphical representation allows a potentially more straightforward interpretation of this construct. Figures 1-6 showcase the 10 most important paths. The thickness of the lines connecting the accounts represents the strength of the connection between the corresponding accounts. The thicker the line, the greater the relative volume of flow along the path. It is important to note that the thickness is not related to income magnitudes. Rather, the importance of the path relates to both its influence and the path multiplier of adjacent circuits.

In Figure 1, we begin by looking at the movement of the influence generated by the injection in the construction sector. The four sectors below construction are sectors with paths connected to more than one factor. For example, metal production uses labour at all skill levels (together with construction), while business services mainly uses skilled and high skilled labour. Low skilled labour receives income from seven out of the ten production activities, and generates income for all households. High skilled labour is similarly benefited, whereas skilled labour is the least connected factor.

In Figure 2 we simulate the influence from a direct injection in the production of electricity and gas, and in Figure 3, for transport services. By looking at two related sectors we can better assess the efficacy of an injection in the construction sector. In the electricity and gas sector, we can observe that fewer production activities benefit in the top 10 paths. Business services do not have a strong effect on high skilled labour, and do not generate income for skilled labour, when compared to the construction case. The households with more connections in this case are middle income households. Lastly, with an injection in transport services, lower income households present strong ties to skilled labour. When comparing Figures 1, 2, and 3, we can see that an injection of income in construction generates much more activity than injections in either transport services or electricity and gas.So as to better understand the distributional effects caused by the infrastructure plan, we generate three set of figures (showing up to four arcs) with corresponding effects on low income (Figure 4), middle income (Figure 5), and high income households (Figure 6). As expected, low income households benefit from stronger ties with low skilled workers. Nonetheless, they also receive income from enterprises. The skilled labour in low income households obtained their incremental income primarily from construction, and indirectly from financial services used by business services.

In the case of middle income households, there was a large flow between construction and business services, which in turn used financial services, capital, skilled and high skilled workers. Invested capital in enterprises created a lot of income activity with this household. Only four production activities are present in the top 10 paths, with business services being the most connected sector. This household enjoyed a more evenly distributed influence from all factors.

Our last figure showcases how income travels to high income households. This household is highly connected to enterprises and high skilled labour. The structure of this case resembles the one observed by middle income households, but with the other mining sector having greater importance and metal products no longer present. Enterprises in this case receive income from a greater number of activities including business services, non-metallic products, and other mining.

The results from the structural path analysis show that an infrastructure programme that generates income in the construction sector generates movement in a large number of production activities, factors, and institutions. The business services sector appears to be an important actor in this economy, together with non-metallic metal products. Income received by low income households comes from a very diverse set of activities, whereas high income households received capital rents from a larger set of activities, which is thereafter invested in enterprises.

5. SUMMARY AND CONCLUSIONS

Over the next 3 years, the South African government plans on spending R787 billion on infrastructure investments, including work on transportation, education, and healthcare. This program is expected to promote growth at a time when the economy is stalling. In this project we analyzed this infrastructure program using a multiplier analysis, multiplier decompositions, and structural path analysis.

We use a social account matrix (SAM) for South Africa, from 2003, to begin our analysis. This SAM included numerous production activities such as agriculture, construction, energy, and gold. Our first step was to develop a multiplier analysis. The use of multipliers needs to satisfy assumptions on supply and prices. These assumptions become more plausible in the context of the current economic downturn. Our accounting multipliers show that when construction is stimulated via, for example, a government infrastructure investment program, demand for intermediate inputs used by construction expands. Assuming that the R787 billion infrastructure project over three years is entirely used in construction activities, the total effect during the first year generates an increase of over R1.3 trillion in income of all production activities and R250 billion in household incomes. These are implausibly large numbers within the context of the South African economy. They derive both from the magnitude of the stimulus (the R787 billion) and the large size of the multiplier effects. The basic multipliers indicate that considerable stimulus to the economy could be achieved even with a less ambitious budgetary expenditure.

While economic stimulus is achieved, the distribution of benefits across households is not as favourable as one might like, with lower income households receiving only a fourth of the stimulus when compared to middle or upper income households. However, this is more a feature of the South African economy than of the construction sector. Relatively few sectors provide a greater stimulus to overall household income than construction and even fewer provide a larger stimulus to lower income households. Of these, none are of sufficient size to be capable of absorbing a stimulus package of macroeconomic significance.

Structural path analysis is used to identify how the effect of the infrastructure programme moves throughout the economy. We find that the income generated in the construction sector generates a momentum in the economy that reaches all households through other production activities that are directly and indirectly related to the infrastructure programme. Within the production activities, business services, non-metallic metal products, mining and metal products are some of the most important sectors through which income is transmitted to households via factor payments.

These are important results. Due to the economic downturn, most of these sectors are likely to be categorized by significant excess capacity. This implies that a demand injection into construction for infrastructure spending may be particularly well directed in terms of a stimulus to aggregate demand. A potential exception is business services where the effects of the contraction to date have been less pronounced.

Based on our results, the planned infrastructure programme has the potential to significantly offset the contractionary effects of the global downturn. The construction sector is an excellent choice for demand injection because it is large and thus able to accommodate a significant stimulus and it stimulates all other production activities and households at all income levels. In addition, if it results in useful infrastructure, it should provide an improved foundation for growth into the future.

6. REFERENCES

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Table 1. Selected accounting multipliers

	CBUSS	CCONS	CELEG	CELMA	CFURN	CIRON	CMACH	CMETP	CNMMP
CAPPA	0.04	0.04	0.04	0.03	0.05	0.04	0.03	0.04	0.03
CBCHM	0.06	0.09	0.06	0.14	0.10	0.06	0.05	0.07	0.14
CBUSS	1.59	0.52	0.44	0.40	0.50	0.46	0.33	0.44	0.42
CCOAL	0.01	0.03	0.16	0.02	0.02	0.09	0.02	0.05	0.02
CCOME	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01
CCOMM	0.15	0.13	0.12	0.11	0.14	0.12	0.09	0.12	0.10
CCONS	0.05	1.30	0.13	0.03	0.03	0.03	0.02	0.03	0.03
CELEG	0.04	0.06	1.10	0.05	0.05	0.05	0.03	0.06	0.05
CELMA	0.02	0.12	0.09	1.15	0.02	0.02	0.04	0.04	0.02
CFINS	0.57	0.21	0.20	0.17	0.20	0.19	0.13	0.19	0.17
CFURN	0.02	0.03	0.02	0.01	1.02	0.02	0.01	0.02	0.01
CGLAS	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CGOLD	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CGOVS	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.00
CHCAT	0.04	0.04	0.04	0.03	0.04	0.04	0.03	0.04	0.03
CIRON	0.03	0.09	0.04	0.08	0.08	1.16	0.11	0.39	0.05
CLEAT	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.00	0.00
CMACH	0.04	0.06	0.05	0.04	0.04	0.05	1.10	0.07	0.05
CMAOS	0.07	0.07	0.07	0.05	0.07	0.06	0.04	0.06	0.06
CMETP	0.03	0.12	0.05	0.05	0.06	0.15	0.08	1.15	0.04
CNFRM	0.02	0.04	0.02	0.14	0.03	0.06	0.04	0.12	0.02
CNMMP	0.02	0.16	0.02	0.02	0.01	0.01	0.01	0.02	1.09
COCHM	0.11	0.12	0.11	0.10	0.14	0.11	0.07	0.12	0.10
COTHI	0.08	0.07	0.08	0.07	0.08	0.07	0.05	0.07	0.06
COTHM	0.06	0.16	0.07	0.10	0.08	0.34	0.07	0.17	0.24
COTHP	0.12	0.14	0.13	0.11	0.14	0.15	0.09	0.13	0.14
CPAPR	0.05	0.05	0.04	0.04	0.08	0.04	0.03	0.04	0.05
CPETR	0.11	0.15	0.11	0.12	0.13	0.13	0.08	0.12	0.12
CPLAS	0.03	0.05	0.03	0.08	0.05	0.03	0.03	0.04	0.03
CTRAD	0.25	0.30	0.26	0.40	0.66	0.37	0.36	0.35	0.29
CTRAN	0.15	0.19	0.18	0.18	0.23	0.28	0.16	0.20	0.23
CTRNE	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.01
CVEHI	0.11	0.11	0.12	0.12	0.12	0.12	0.10	0.12	0.11
CWATR	0.02	0.02	0.02	0.01	0.02	0.02	0.01	0.01	0.01
CWOOD	0.01	0.05	0.02	0.02	0.25	0.01	0.01	0.02	0.02
FCAP	0.81	0.70	0.83	0.55	0.67	0.71	0.42	0.64	0.67
FLABHI	0.27	0.26	0.33	0.23	0.26	0.23	0.17	0.24	0.21
FLABLS	0.06	0.16	0.11	0.10	0.14	0.11	0.06	0.14	0.10
FLABSK	0.23	0.20	0.20	0.17	0.24	0.20	0.15	0.21	0.17
HENTRP	0.75	0.65	0.77	0.51	0.62	0.65	0.39	0.59	0.62
HHDLOW	0.09	0.11	0.10	0.08	0.11	0.09	0.06	0.10	0.08
HHDMID	0.40	0.42	0.44	0.33	0.42	0.38	0.25	0.39	0.34
HHDWHI	0.44	0.42	0.48	0.34	0.41	0.39	0.26	0.39	0.36

Table 2. Structural path analysis: Selected activities

Case	(1) Origin	(2) Dest.	(3) Global Infl.	(4) Path	(5) Direct Infl.	(6) Path Mult.	(7) Total Infl.	(8) Prop.	(9) Accum. Prop.
I	CCONS.	CIRON.	0.09	CCONS. CMETP. CIRON.	0.0174	1.64	0.0286	33.1	33.1
				CCONS. CIRON.	0.0156	1.50	0.0234	27.1	60.2
				CCONS. CELMA. CIRON.	0.0025	1.72	0.0043	5.0	65.2
				CCONS. CNMMP. CIRON.	0.0023	1.62	0.0037	4.3	69.4
				CCONS. CMACH. CIRON.	0.0007	1.65	0.0011	1.3	70.8
				CCONS. CBUSS. CIRON.	0.0003	2.34	0.0007	0.9	71.6
				CCONS. CELMA. CMETP. CIRON.	0.0003	1.88	0.0006	0.7	72.3
				CCONS. COTHP. CIRON.	0.0003	1.70	0.0005	0.6	72.9
				CCONS. CNMMP. CMETP. CIRON.	0.0003	1.78	0.0005	0.5	73.4
				CCONS. CFURN. CIRON.	0.0002	1.52	0.0003	0.4	73.8
				CCONS. CMACH. CMETP. CIRON.	0.0002	1.80	0.0003	0.3	74.1
II	CCONS.	CNFRM.	0.03	CCONS. CELMA. CNFRM.	0.0054	1.94	0.0105	30.5	30.5
				CCONS. CMETP. CNFRM.	0.0037	1.93	0.0071	20.7	51.3
				CCONS. CMETP. CIRON. CNFRM.	0.0005	2.13	0.0010	3.0	54.2
				CCONS. CIRON. CNFRM.	0.0004	1.95	0.0008	2.4	56.7
				CCONS. CNMMP. CNFRM.	0.0002	1.84	0.0003	0.9	57.6
				CCONS. CMACH. CNFRM.	0.0001	1.87	0.0003	0.8	58.4
				CCONS. CBUSS. CNFRM.	0.0001	2.66	0.0003	0.8	59.2
				CCONS. CIRON. CMETP. CNFRM.	0.0001	2.13	0.0002	0.6	59.7
				CCONS. CMETP. CELMA. CNFRM.	0.0001	2.21	0.0002	0.5	60.2
				CCONS. CELMA. CIRON. CNFRM.	0.0001	2.23	0.0002	0.5	60.7
				CCONS. CELMA. CMETP. CNFRM.	0.0001	2.21	0.0002	0.5	61.1
III	CCONS.	CMETP.	0.12	CCONS. CMETP.	0.0590	1.49	0.0878	73.4	73.4
				CCONS. CIRON. CMETP.	0.0015	1.64	0.0024	2.1	75.5
				CCONS. CELMA. CMETP.	0.0011	1.70	0.0019	1.6	77.1
				CCONS. CNMMP. CMETP.	0.0009	1.61	0.0014	1.2	78.3
				CCONS. CMACH. CMETP.	0.0006	1.63	0.0009	0.8	79.0
				CCONS. CBUSS. CMETP.	0.0004	2.32	0.0008	0.7	79.7
				CCONS. COTHM. CMETP.	0.0003	1.55	0.0005	0.4	80.1
				CCONS. CELMA. CIRON. CMETP.	0.0002	1.88	0.0005	0.4	80.5
				CCONS. CNMMP. CIRON. CMETP.	0.0002	1.78	0.0004	0.3	80.8
				CCONS. CWOOD. CMETP.	0.0002	1.92	0.0004	0.3	81.1
				CCONS. CGOLD. CMETP.	0.0002	1.49	0.0003	0.3	81.4
IV	CCONS.	CMACH.	0.06	CCONS. CMACH.	0.0120	1.43	0.0172	29.3	29.3
				CCONS. CNMMP. CMACH.	0.0017	1.55	0.0027	4.6	33.9
				CCONS. CMETP. CMACH.	0.0013	1.63	0.0021	3.6	37.4
				CCONS. COTHM. CMACH.	0.0009	1.49	0.0014	2.4	39.8
				CCONS. CBUSS. CMACH.	0.0004	2.24	0.0010	1.7	41.5
				CCONS. CELMA. CMACH.	0.0004	1.64	0.0006	1.1	42.6
				CCONS. CNMMP. COTHM. CMACH.	0.0004	1.62	0.0006	1.0	43.6
				CCONS. CGOLD. CMACH.	0.0004	1.43	0.0006	1.0	44.6
				CCONS. FLABHI. HHDWHI. CMACH.	0.0002	2.03	0.0004	0.8	45.3
				CCONS. FLABLS. HHDMID. CMACH.	0.0002	1.93	0.0004	0.7	46.0
				CCONS. CPETR. CMACH.	0.0002	1.63	0.0004	0.6	46.6
V	CCONS.	CELEG.	0.06	CCONS. CELEG.	0.0120	1.42	0.0170	28.5	28.5
				CCONS. CNMMP. CELEG.	0.0011	1.54	0.0017	2.8	31.3
				CCONS. FLABLS. HHDMID. CELEG.	0.0005	1.89	0.0010	1.7	33.0
				CCONS. CELMA. CNFRM. CELEG.	0.0004	2.10	0.0009	1.6	34.6
				CCONS. FLABLS. HHDLOW. CELEG.	0.0005	1.59	0.0009	1.5	36.0
				CCONS. CMETP. CELEG.	0.0005	1.62	0.0009	1.4	37.5
				CCONS. CGOLD. CELEG.	0.0005	1.42	0.0007	1.2	38.6
				CCONS. FLABHI. HHDMID. CELEG.	0.0003	2.01	0.0007	1.1	39.7
				CCONS. COTHM. CELEG.	0.0005	1.48	0.0007	1.1	40.9
				CCONS. CMETP. CNFRM. CELEG.	0.0003	2.10	0.0006	1.1	41.9
				CCONS. FLABHI. HHDWHI. CELEG.	0.0003	1.99	0.0005	0.9	42.8

Table 3. Structural path analysis: Factors

Case	(1) Origin	(2) Dest.	(3) Global Infl.	(4) Path	(5) Direct Infl.	(6) Path Mult.	(7) Total Infl.	(8) Prop.	(9) Accum. Prop.
I	CCONS.	FCAP.	0.70	CCONS. FCAP.	0.0904	1.65	0.1489	21.3	21.3
				CCONS. CBUSS. FCAP.	0.0177	2.34	0.0414	5.9	27.2
				CCONS. CNMMP. FCAP.	0.0177	1.78	0.0316	4.5	31.7
				CCONS. CBUSS. CFINS. FCAP.	0.0087	2.39	0.0207	3.0	34.7
				CCONS. COTHM. FCAP.	0.0093	1.70	0.0159	2.3	36.9
				CCONS. CMETP. FCAP.	0.0041	1.87	0.0076	1.1	38.0
				CCONS. CNMMP. COTHM. FCAP.	0.0036	1.83	0.0067	1.0	39.0
				CCONS. CELEG. FCAP.	0.0037	1.77	0.0065	0.9	39.9
				CCONS. CAGRI. FCAP.	0.0031	1.80	0.0055	0.8	40.7
				CCONS. CCOMM. FCAP.	0.0024	2.25	0.0055	0.8	41.5
				CCONS. CPETR. FCAP.	0.0030	1.83	0.0054	0.8	42.3
II	CCONS.	FLABLS.	0.16	CCONS. FLABLS.	0.0556	1.40	0.0777	49.0	49.0
				CCONS. CMETP. FLABLS.	0.0033	1.59	0.0053	3.3	52.3
				CCONS. CNMMP. FLABLS.	0.0032	1.51	0.0048	3.0	55.3
				CCONS. COTHM. FLABLS.	0.0033	1.45	0.0048	3.0	58.3
				CCONS. CGOLD. FLABLS.	0.0028	1.40	0.0040	2.5	60.8
				CCONS. CWOOD. FLABLS.	0.0018	1.80	0.0032	2.0	62.8
				CCONS. CELMA. FLABLS.	0.0019	1.60	0.0030	1.9	64.7
				CCONS. CNMMP. COTHM. FLABLS.	0.0013	1.57	0.0020	1.3	66.0
				CCONS. CPLAS. FLABLS.	0.0006	1.59	0.0010	0.6	66.6
				CCONS. CAGRI. FLABLS.	0.0005	1.55	0.0008	0.5	67.1
				CCONS. CPETR. COTHM. FLABLS.	0.0004	1.61	0.0006	0.4	67.5
III	CCONS.	FLABSK.	0.20	CCONS. FLABSK.	0.0256	1.53	0.0393	19.4	19.4
				CCONS. CBUSS. CFINS. FLABSK.	0.0040	2.32	0.0093	4.6	23.9
				CCONS. CBUSS. FLABSK.	0.0025	2.27	0.0057	2.8	26.8
				CCONS. CMETP. FLABSK.	0.0025	1.75	0.0043	2.1	28.9
				CCONS. CNMMP. FLABSK.	0.0017	1.66	0.0029	1.4	30.3
				CCONS. CWOOD. FLABSK.	0.0012	1.97	0.0024	1.2	31.5
				CCONS. CELMA. FLABSK.	0.0012	1.75	0.0022	1.1	32.6
				CCONS. COTHP. FLABSK.	0.0012	1.68	0.0021	1.0	33.6
				CCONS. COTHM. FLABSK.	0.0011	1.59	0.0018	0.9	34.5
				CCONS. CCOMM. FLABSK.	0.0007	2.11	0.0015	0.8	35.2
				CCONS. CGOLD. FLABSK.	0.0006	1.53	0.0009	0.5	35.7
IV	CCONS.	FLABHI.	0.26	CCONS. FLABHI.	0.0445	1.58	0.0702	26.8	26.8
				CCONS. CBUSS. FLABHI.	0.0047	2.30	0.0108	4.1	30.9
				CCONS. CBUSS. CFINS. FLABHI.	0.0029	2.36	0.0069	2.6	33.6
				CCONS. CNMMP. FLABHI.	0.0032	1.71	0.0055	2.1	35.6
				CCONS. CELMA. FLABHI.	0.0030	1.80	0.0053	2.0	37.7
				CCONS. CMETP. FLABHI.	0.0025	1.80	0.0044	1.7	39.4
				CCONS. COTHP. FLABHI.	0.0019	1.71	0.0033	1.3	40.6
				CCONS. CELEG. FLABHI.	0.0016	1.70	0.0028	1.1	41.7
				CCONS. COTHM. FLABHI.	0.0015	1.63	0.0025	1.0	42.6
				CCONS. CWOOD. FLABHI.	0.0008	2.03	0.0015	0.6	43.2
				CCONS. CPLAS. FLABHI.	0.0007	1.79	0.0013	0.5	43.7

Table 4. Structural path analysis: Institutions

Case	(1) Origin	(2) Dest.	(3) Global Infl.	(4) Path	(5) Direct Infl.	(6) Path Mult.	(7) Total Infl.	(8) Prop.	(9) Accum. Prop.
I	CCONS.	HENTRP.	0.65	CCONS. FCAP. HENTRP.	0.0834	1.65	0.1373	21.3	21.3
				CCONS. CBUSS. FCAP. HENTRP.	0.0163	2.34	0.0382	5.9	27.2
				CCONS. CNMMP. FCAP. HENTRP.	0.0163	1.78	0.0291	4.5	31.7
				CCONS. COTHM. FCAP. HENTRP.	0.0086	1.70	0.0146	2.3	34.0
				CCONS. CMETP. FCAP. HENTRP.	0.0037	1.87	0.0070	1.1	35.1
				CCONS. CELEG. FCAP. HENTRP.	0.0034	1.77	0.0060	0.9	36.0
				CCONS. CAGRI. FCAP. HENTRP.	0.0028	1.80	0.0051	0.8	36.8
				CCONS. CCOMM. FCAP. HENTRP.	0.0022	2.25	0.0050	0.8	37.6
				CCONS. CPETR. FCAP. HENTRP.	0.0027	1.83	0.0050	0.8	38.3
				CCONS. CELMA. FCAP. HENTRP.	0.0025	1.88	0.0048	0.7	39.1
				CCONS. CGOLD. FCAP. HENTRP.	0.0028	1.65	0.0046	0.7	39.8
II	CCONS.	HHDLOW.	0.11	CCONS. FLABLS. HHDLOW.	0.0174	1.47	0.0257	23.2	23.2
				CCONS. FLABSK. HHDLOW.	0.0039	1.60	0.0063	5.7	28.9
				CCONS. FCAP. HENTRP. HHDLOW.	0.0028	1.73	0.0048	4.4	33.2
				CCONS. FLABHI. HHDLOW.	0.0014	1.68	0.0024	2.2	35.4
				CCONS. CMETP. FLABLS. HHDLOW.	0.0010	1.68	0.0017	1.6	37.0
				CCONS. CNMMP. FLABLS. HHDLOW.	0.0010	1.59	0.0016	1.4	38.4
				CCONS. COTHM. FLABLS. HHDLOW.	0.0010	1.52	0.0016	1.4	39.8
				CCONS. CGOLD. FLABLS. HHDLOW.	0.0009	1.47	0.0013	1.2	41.0
				CCONS. CWOOD. FLABLS. HHDLOW.	0.0006	1.90	0.0011	1.0	41.9
				CCONS. CELMA. FLABLS. HHDLOW.	0.0006	1.68	0.0010	0.9	42.8
				CCONS. CBUSS. FLABSK. HHDLOW.	0.0004	2.35	0.0009	0.8	43.6
III	CCONS.	HHDMID.	0.42	CCONS. FLABLS. HHDMID.	0.0292	1.77	0.0517	12.4	12.4
				CCONS. FLABHI. HHDMID.	0.0190	1.88	0.0356	8.5	20.9
				CCONS. FCAP. HENTRP. HHDMID.	0.0141	1.95	0.0275	6.6	27.5
				CCONS. FLABSK. HHDMID.	0.0143	1.82	0.0261	6.3	33.7
				CCONS. CBUSS. FLABHI. HHDMID.	0.0020	2.60	0.0052	1.2	35.0
				CCONS. CBUSS. FLABSK. HHDMID.	0.0014	2.56	0.0036	0.9	35.8
				CCONS. CMETP. FLABLS. HHDMID.	0.0017	2.01	0.0035	0.8	36.7
				CCONS. CNMMP. FLABLS. HHDMID.	0.0017	1.91	0.0032	0.8	37.4
				CCONS. COTHM. FLABLS. HHDMID.	0.0017	1.82	0.0031	0.8	38.2
				CCONS. CMETP. FLABSK. HHDMID.	0.0014	2.07	0.0028	0.7	38.9
				CCONS. CNMMP. FLABHI. HHDMID.	0.0014	2.03	0.0028	0.7	39.5
IV	CCONS.	HHDWHI.	0.42	CCONS. FCAP. HENTRP. HHDWHI.	0.0249	1.87	0.0466	11.2	11.2
				CCONS. FLABHI. HHDWHI.	0.0239	1.86	0.0444	10.7	21.9
				CCONS. FLABLS. HHDWHI.	0.0089	1.81	0.0162	3.9	25.7
				CCONS. FLABSK. HHDWHI.	0.0073	1.90	0.0138	3.3	29.1
				CCONS. CBUSS. FLABHI. HHDWHI.	0.0025	2.53	0.0064	1.5	30.6
				CCONS. CNMMP. FLABHI. HHDWHI.	0.0017	2.01	0.0034	0.8	31.4
				CCONS. CELMA. FLABHI. HHDWHI.	0.0016	2.12	0.0034	0.8	32.2
				CCONS. CMETP. FLABHI. HHDWHI.	0.0013	2.11	0.0028	0.7	32.9
				CCONS. COTHP. FLABHI. HHDWHI.	0.0010	1.96	0.0020	0.5	33.4
				CCONS. CBUSS. FLABSK. HHDWHI.	0.0007	2.56	0.0018	0.4	33.8
				CCONS. CELEG. FLABHI. HHDWHI.	0.0009	1.99	0.0017	0.4	34.2

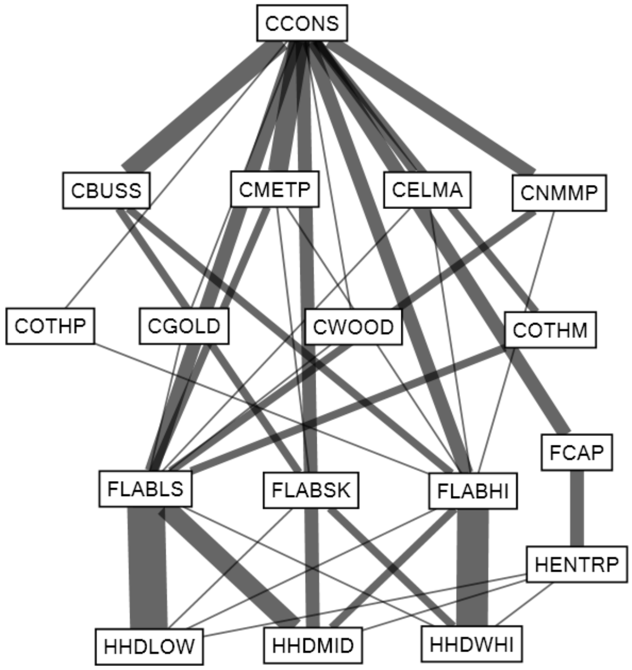

Figure 1 – Construction: Structural path to all institutions[2]

[2] All figures created using the weighted graph scheme of NodeXL.

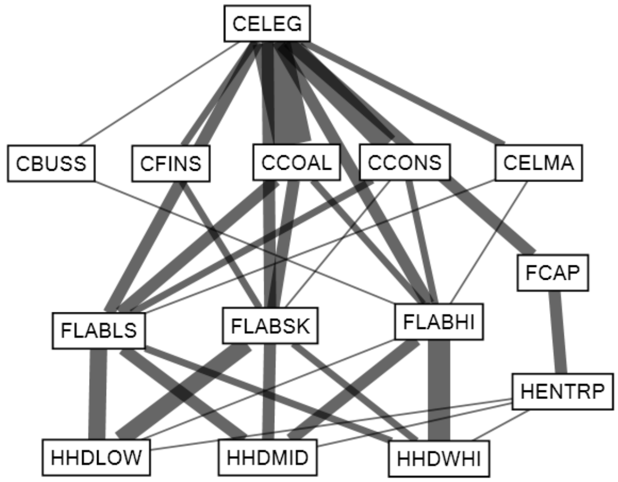

Figure 2 – Electricity and gas: Structural path to all institutions

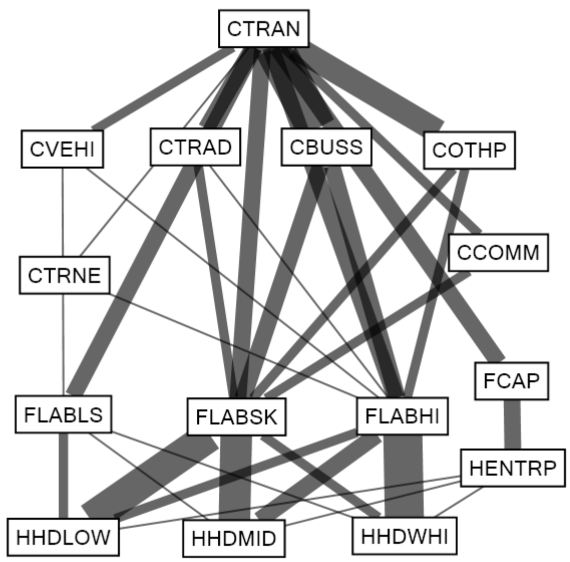

Figure 3 –Transportation: Structural path to all institutions

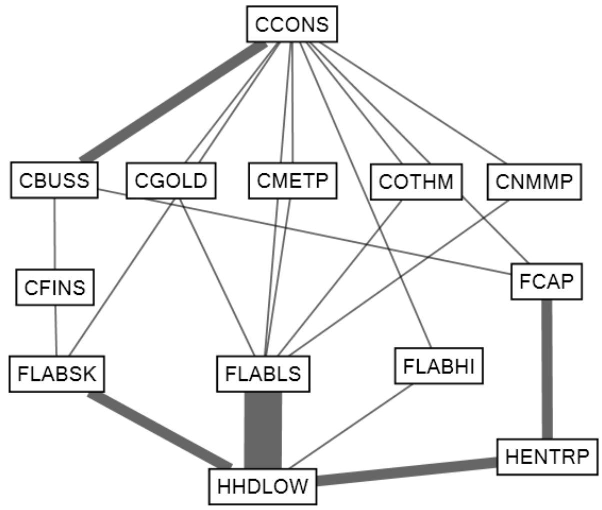

Figure 4 – Construction: Structural path to lower income households

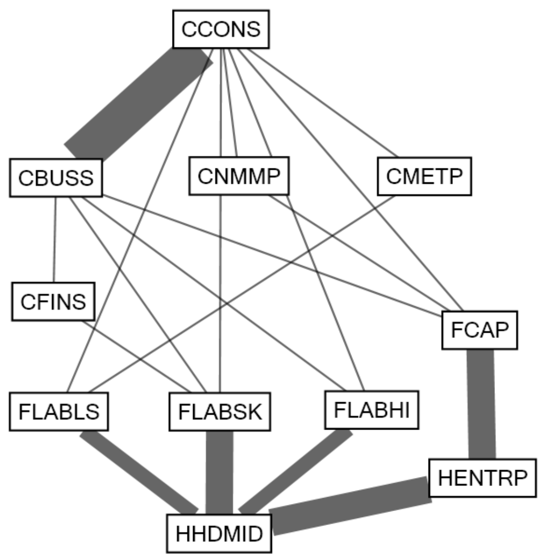

Figure 5 – Construction: Structural path to middle income households

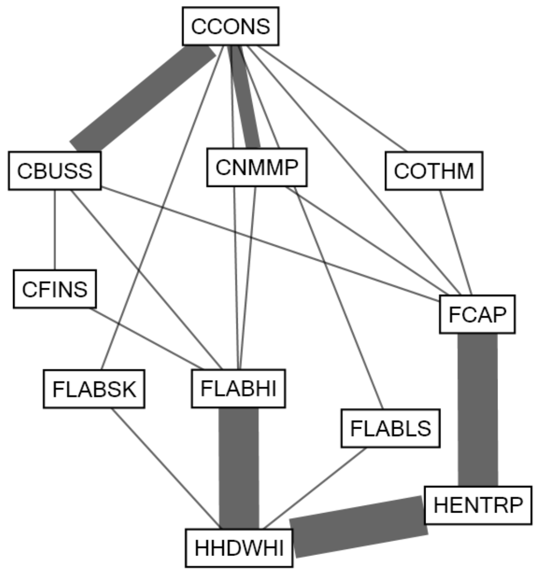

Figure 6 – Construction: Structural path to higher income households