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The (Declining) Role of Households in Sustaining China's Economy:

Structural Path Analysis for 1997-2007

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Abstract

Current explanations for private consumption's diminished role in China focus on the expansion of exports and investments. Using structural path analysis, we find additional contributing factors. First, growth patterns during 1997-2007 favoured sectors with low production multipliers. Secondly, income multipliers fell in most sectors, especially in fast growing sectors and partly due to urbanization. This means less trickledown from growth to household incomes. Thirdly, households became less important in sustaining domestic production processes. Together, these deep structural changes suggest that enhancing private consumption's role in China will require new (services-oriented) growth patterns and a significant realignment of industry-household linkages.

Keywords: structural path analysis, economic growth, private consumption, China
JEL classification: O12, 7R11, R15

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1 Introduction

Economic growth in China over the last three decades has been driven by exports and investment. As a result private consumption has declined dramatically in its importance—from half of gross domestic product (GDP) in the early 1990s to a third in 2010 (NBS 2011). Of course the rapid pace of economic growth in China meant that household consumption continued to grow in absolute terms, leading to remarkable improvements in welfare and poverty reduction, albeit with rising inequality (Ravallion and Chen 2007). Nevertheless, the decline in China's consumer-orientation raises concerns about the sustainability of the current growth trajectory—concerns that were heightened by the slowdown of the global economy and export demand after the late 2000s (see, for example, Guo and N'Diaye 2009; Kuijs and Wang 2006). This has prompted a concerted effort by Chinese authorities to promote private consumption as part of the country's twelfth Five Year Plan.

'Rebalancing' growth raises questions about the role of households in sustaining China's economy (see, for example, Kuijs and Wang 2006). The first concern is the link between production and household incomes. Aziz and Cui (2007) argue that the declining share of private consumption in GDP is as much due to household incomes growing more slowly than national income, as it is to changes in household savings behaviour. One explanation for slower household income growth is the shift in production away from traditional consumer goods (e.g., agriculture and textiles) towards heavier manufactures and services (e.g., machinery and finance). These changes in the composition of growth *across* sectors might have reduced the trickledown effects from national growth to household incomes. Another explanation is changes in technologies *within* sectors (i.e., across firms within the same industry), which may have weakened the linkage between production and household incomes at the sector level.

Not only do households earn income, but their consumer demand sustains production. A second concern is therefore the link running from private consumption to economic growth. This feedback from households to producers may have weakened over the last decade as production increasingly focused on export markets. Rebalancing the economy might therefore require substantial reorientation towards meeting consumer demand, with some sectors facing greater challenges than others. Both of the above concerns emphasize 'deep' structural characteristics of the Chinese economy and go beyond considerations of aggregate consumption in national GDP.

In this paper we address the above concerns using structural path analysis (SPA), which decomposes the linkages between sectoral production and household incomes and consumption. We apply this method to two purpose-built social accounting matrices (SAM) that capture China's economic structure in 1997 and 2007. This allows us to examine prevailing structural linkages, as well as their evolution over a decade of pronounced structural change. Throughout our analysis we differentiate between households in rural and urban areas. Sections 2 and 3 describe the methodology and construction of the SAMs, and Section 4 presents our results. The concluding section summarizes our findings and discusses their limitations.

2 Methodology

2.1 SAM multipliers

A SAM is an economy-wide database capturing all income and expenditure flows between economic institutions (accounts) during a given year, including production activities, households, government, and the rest of the world.[1] A SAM is square matrix with expenditures along columns and receipts along rows, as shown below for a SAM S containing n accounts:

$$S_n = \begin{bmatrix} T_{aa} & 0 & T_{ah} & T_{ax} \\ T_{fa} & 0 & 0 & T_{fx} \\ 0 & T_{hf} & T_{hh} & T_{hx} \\ T_{xa} & T_{xf} & T_{xh} & T_{xx} \end{bmatrix} \qquad a, f, h, x \subset n$$

Each sub-matrix T represents a payment from one account to another. For example, the cell T_{fa} shows payments from activities a (e.g., manufacturing) to factors of production f (e.g., labour and capital). Factor earnings are paid to households h (in cell T_{hf}) or to the government as factor taxes (as part of T_{xf}). Households then purchase the output of activities (T_{ah}) and make transfers to other households (T_{hh}) and accounts (T_{xh}) (e.g., direct taxes paid to government). Row and column totals in the SAM are equal. One account's expenditure is another's receipt. This identity can be expressed as follows, where y_n is total income for each account:

$$y_n = \sum_m T_{nm} = \sum_m T_{mn} \qquad m = n$$

The SAM can be separated into two broad sets of accounts. Exogenous accounts x include the government, investment (or capital), and the rest of the world. They are exogenous because their flows are assumed to be determined outside of the multiplier framework. The remaining endogenous accounts i include activities, factors and households (i.e., $i = a \cup f \cup h$). Average expenditure shares a_{ij} are derived by dividing each column entry by its total income:

$$a_{ij} = t_{ij}\hat{y}_i^{-1} \qquad j = i \tag{1}$$

where t_{ij} is an individual element of S_n and $\hat{y}_i$ is a diagonal matrix with entries y_i. The resulting matrix A_i refers only to endogenous accounts:

$$A_i = \begin{bmatrix} A_{aa} & 0 & A_{ah} \\ A_{fa} & 0 & 0 \\ 0 & A_{hf} & A_{hh} \end{bmatrix} \tag{2}$$

Endogenous total incomes y_i can then be derived by multiplying expenditure propensities in each row from Equation 2 by total endogenous income y_i and adding exogenous income e_i:

[1] This description of multipliers and structural path analysis is based on Arndt et al. (2011).

$$y_i = A_i y_i + e_i \quad \text{where} \quad e_i = \sum_x T_{ix}$$

This equation can be rearranged to derive the well-known multiplier matrix M_i:

$$y_i = (I - A_i)^{-1} e_i = M_i e_i \tag{3}$$

This means that changes in total endogenous income for each account can be derived by multiplying M_i by the change in the exogenous injection e_i.

Equation 3 captures direct and indirect effects from endogenous account interactions. When demand for processed food expands it not only raises food production but also household incomes, thereby generating additional demand for food products. Multiplier analysis assumes that there are enough factor resources to allow production to respond to higher demand (i.e., underutilized capital or underemployed labour). If resources are constrained then changes in production and incomes may reflect changes in factor and product prices. A further characteristic of multiplier analysis is that it estimates the final economy-wide effect of an exogenous change in demand. It does not decompose indirect impact channels. This can be addressed by decomposing multipliers using SPA.

2.2 Structural path analysis

SAM-based SPA was introduced by Defourny and Thorbecke (1984).[2] The intent of SPA is to reveal in a transparent way the network of channels through which the socioeconomic system is influenced as reflected by the SAM. As shown by Thorbecke and Jung (1996), SPA is fully general. As such, any multiplier decomposition can be viewed as a special case of SPA. SPA interprets the expenditure share a_{ji} calculated from the SAM in Equation 1 as being the magnitude or intensity of the 'influence' along the arc linking account i to account j (i.e., the direction of the expenditure flow). A 'path' consists of one or more consecutive arcs connecting the account where the exogenous shock takes place (i.e., 'pole of origin') to the final account where income changes are evaluated (i.e., 'pole of destination'). We distinguish between direct influences, total influences, and global influences.

Direct influence measures the change in income or production caused by a change in exogenous demand along a single path holding all other (indirect) paths constant (i.e., ceteris paribus). For an elementary path containing a single arc ($i \rightarrow j$) the direct influence I^D is the expenditure coefficient a_{ji} drawn from A_i in Equation 3, as follows:

$$I^D_{(i \rightarrow j)} = a_{ji}$$

[2] SPA has been applied to a range of issues. Basu and Johnson (1996) and Sonis and Hewings (1998) conduct multi-regional analysis; Thorbecke and Jung (1996) and Arndt et al. (2011) analyse growth-poverty linkages; and Wood and Lenzen (2009) examine changes in carbon emissions using an inter-temporal extension of SPA.

For more complex paths containing multiple arcs between poles i and j, the direct influence is equal to the product of the intensities of the component arcs along the path:

$$I^D_{(i\to j)_p} = I^D_{(i\ldots j)} = a_{jn} \cdot \ldots \cdot a_{mi}$$

Total influence is a broader measure capturing how the direct influence of a path p is amplified by indirect linkages *immediately adjacent* to the path. The formula for total influence I^T is:

$$I^T_{(i\to j)_p} = I^D_{(i\to j)_p} M_p$$

where $I^D_{(i\to j)_p}$ is the direct influence of path p, and M_p is the 'path multiplier'. The path multiplier capturing indirect effects is the ratio of two determinants:

$$M_p = \frac{\Delta_p}{|I - A_i|}$$

where $|I - A_i|$ is the determinant of the structure represented by the SAM and Δ_p is the determinant of the structure excluding the poles constituting path p (see Defourny and Thorbecke 1984).

Global influence is analogous to the full multiplier effects in that the global influence $I^G_{(i\to j)}$ is equal to the element m_{ji} from the multiplier matrix M_i in Equation 4, as follows:

$$I^G_{(i\to j)} = m_{ji} = \sum_{p=1}^{n} I^T_{(i\to j)_p}$$

Importantly, the global influence of a path can be decomposed into a series of total influences transmitted along each elementary paths connecting i and j (where $p = 1..n$).

Finally, following the approach introduced by Roberts (2005), global influence can be decomposed into paths passing through at least one household account, and paths that do not pass directly though any household accounts. Separating these components allows us to measure the relative contribution of households to the global influence (or total multiplier effect).

Decomposing multipliers using SPA allows us to examine how structural characteristics lead to different multiplier effects on selected outcomes. In Section 4 we use multiplier and SPA to evaluate the nature and evolution of rural and urban households' linkages, and the contribution of household consumption to sustaining China's economy.

3 Data

The structure of China's economy is captured in two purpose-built SAMs for 1997 and 2007. The main data sources for the SAMs are official input-output tables (IOTs) (NBS 1999, 2009b) and flow of funds (FOF) (NBS 2000, 2009a), both published by the National Bureau of Statistics.

In order to construct comparable SAMs, the same assumptions were made for 1997 and 2007. First, the FOF provide a complete, standard set of balanced macroeconomic accounts for corporations, government, households and the rest of the world. However, the FOF are revised retroactively as new data becomes available, implying that the aggregate entries in the IOT and FOF may diverge slightly. Given the importance of detailed sector-level information for our linkage analysis, we adopted the IOT's estimates of production and demand wherever inconsistencies between the two data sources exist.[3]

Secondly, the IOTs distinguish between rural and urban households (for consumption spending), whereas the FOF does not. We separate the FOF household account using the statistical yearbook (NBS 1998a, 2008a) and Rural Household Survey (NBS 1998b, 2008b). These provide information on the incomes and expenditures of rural households, which is subtracted from the aggregate household in FOF and the residual is attributed to urban households. Using the rural survey to derive an urban residual is preferable to the reverse approach since there were changes in the coverage of urban surveys between 1997 and 2007 (see Park 2008: 44-46).

Thirdly, labour in the IOT was disaggregated into two categories: professional labour in urban units, and all other labour. The statistical yearbook provides information on professional urban labour earnings for each industry.[4] This was subtracted from total labour earnings to derive the 'other labour' category. Rural households are not direct recipients of professional urban labour earnings.

Finally, based on the IOTs, the SAMs were constructed at a detailed product level, i.e., 124 and 135 categories for 1997 and 2007, respectively. We used cross-entropy techniques (see Robinson et al. 2001) to remove statistical discrepancies in the published 1997 and 2007 IOTs.[5] The detailed SAMs were aggregated to identical sets of accounts: 21 production activities, 3 factors and 3 institutions (see Table 1). The 1997 SAM was inflated to 2007 prices using detailed product-level producer price deflators from the statistical yearbook.[6]

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3 Nominal GDP estimates in IOT were 1.8 per cent below and 2.4 per cent above FOF estimates in 1997 and 2007, respectively.

4 The category 'scientific and technical personnel' was used as a proxy for 'professional staff' in 1997.

5 The differences between product-level demand and supply in the SAMs (at the aggregate level of our SPA) range from -4.0 to 1.9 per cent in 1997 and from -3.5 to 5.5 per cent in 2007.

6 For detailed inflators, please see Yang and Lahr (2010).

Table 2 reports household income sources and expenditure patterns in the 1997 and 2007 SAMs. Rural households continue to depend on labour for more than four-fifths of their total income. Urban households were similarly dependent on labour in 1997. However, non-professional labour's contribution to total urban incomes fell significantly during 1997-2007 and was replaced by earnings from capital. According to the FOF, capital earnings include property and business income for urban households, and income from property and household operations for rural households.

Table 1: Endogenous and exogenous accounts

Activities (a)		*Activities (a) (continued)*		*Institutions (h)*	
AGRI	Agriculture	UTIL	Utilities	HRUR	Rural households
MINE	Mining	CONS	Construction	HURB	Urban households
FOOD	Processed foods	TRAD	Trade, hotels, catering	ENT	Enterprises
TEXT	Textiles, clothing	TRAN	Transport, communication		
WOOD	Wood, paper, printing	FSRV	Finance, insurance	*Exogenous accounts (x)*	
FUEL	Fuel	REES	Real estate	GOV	Government
CHEM	Chemical	GSRV	Government services	GFCF	Fixed capital formation
NMET	Non-metal minerals	OSRV	Other services	CINV	Change in inventories
METL	Metals			ROW	Rest of world
MACH	General machinery	*Factors (f)*			
EMCH	Electrical machinery	FLABP	Professional urban labour		
VEHI	Transport equipment	FLABO	Other labour		
OMAN	Other manufactures	FCAP	Capital		

Note: 'Professional urban labour' includes personnel engaged in professional work or management within urban units (see NBS 2008a).
Source: China 1997 and 2007 Social Accounting Matrices.

Table 2: Household income sources and expenditure patterns

	Share of total income or expenditure (%)					
	Rural		Urban		National	
	1997	2007	1997	2007	1997	2007
Professional urban labour	0.00	0.00	10.67	8.54	6.10	6.92
Other labour	82.64	80.76	65.04	53.90	72.58	59.01
Capital	14.73	13.89	22.36	35.20	19.09	31.14
Government transfers	1.60	1.75	1.17	0.77	1.36	0.96
Foreign transfers	1.03	3.60	0.76	1.59	0.87	1.97
Total income	100	100	100	100	100	100
Consumption	77.83	78.71	58.63	55.87	66.85	60.22
Taxes	0.07	0.29	0.82	2.31	0.50	1.92
Savings	22.10	21.00	40.55	41.82	32.65	37.86
Total expenditure	100	100	100	100	100	100

Note: 'Capital' includes net operating surplus (i.e., indirect capital payments to households after corporate tax, capital depreciation allowance, and re-invested profits).
Source: Authors' calculations using the 1997 and 2007 China SAMs.

Within rural and urban areas, expenditure patterns did not change much during 1997-2007. However, China underwent rapid urbanization, with the urban population share rising from 29.9 per cent in 1997 to 44.9 per cent in 2007 (NBS 2008b). Accordingly, the weight of urban

expenditure patterns within the national expenditure basket has risen, leading to lower national consumption shares and higher private savings rates. This is consistent with trends reported in other data sources (see, for example, Aziz and Cui 2007).

In summary, the SAMs capture the economic structure of China's economy at two points in time. They are comparable because they draw on the same official data sources; are constructed following consistent procedures; and are measured in common prices. Of course, changes in official data collection and national accounting practices may influence the relative accuracy and comparability of the two SAMs. For example, the implementation and coverage of the rural household survey may have improved since 1997, explaining some of the changes in urban income sources over the study period. However, our SAMs are broadly consistent with other sources and represent the best available data for conducting SPA for China.

4 Results

4.1 Value added (GDP) multipliers

The first two columns of Table 3 report GDP (value added) multipliers for individual sectors. A weighted average multiplier is calculated using value added shares to derive a composite good that reflects domestic income sources. The average GDP multiplier in 1997 was 1.265, implying that a one yuan increase in final demand for the composite good leads to a 1.265 yuan increase in value added, after accounting for all direct and indirect linkages. The average GDP multiplier was 1.009 in 2007, which means that the same one yuan demand stimulus led to a smaller increase in value added than in 1997. Since GDP at factor cost consists of labour and capital earnings, the fall in the GDP multiplier has direct implications for household incomes.

GDP multipliers can decline for a number of reasons. First, inter-industry linkages can change and give greater weight to producers that have larger leakages. For example, a sector that becomes more dependent on import-intensive intermediates will have a smaller multiplier effect. Secondly, an increase in the ratio of intermediate inputs to gross output can reduce the effects of final demand on value added. Thirdly, even if within sector multipliers remain unchanged, economy-wide multipliers may decline if the changing pattern of production gives greater weight to sectors with smaller multiplier. Finally, the relative size of the endogenous and exogenous sectors in our multiplier analysis can change. As mentioned earlier, economic growth in China has been driven by investment and exports, and so as the share of these exogenous accounts in GDP increases, it leads to larger leakages and lower multipliers.

In order to make comparisons between 1997 and 2007, we normalize the multipliers from Table 3 by dividing sector multipliers by the weighted average multiplier. We then take the ratio of the normalized 2007 and 1997 multipliers in order to show how structural linkages have evolved over the decade. The normalized GDP multiplier ratios are shown in the first column of Table 4. If a sector's ratio is greater than one then its multiplier has increased more (or fallen by less) than the economy-wide average multiplier.

Table 3: Value added and household income multipliers

		Value added		All households		Rural households		Urban households	
		1997	2007	1997	2007	1997	2007	1997	2007
AGRI	Agriculture	1.566	1.333	1.340	1.102	0.613	0.251	0.727	0.851
MINE	Mining	1.081	0.744	0.814	0.497	0.340	0.093	0.474	0.404
FOOD	Processed foods	1.262	1.089	1.012	0.826	0.451	0.176	0.561	0.650
TEXT	Textiles, clothing	1.161	1.020	0.901	0.739	0.396	0.150	0.505	0.589
WOOD	Wood, paper, printing	1.151	0.958	0.899	0.666	0.395	0.131	0.504	0.535
FUEL	Fuel	0.938	0.768	0.690	0.511	0.289	0.095	0.401	0.416
CHEM	Chemical	0.982	0.792	0.739	0.529	0.318	0.099	0.421	0.430
NMET	Non-metal minerals	1.184	0.936	0.897	0.624	0.387	0.117	0.510	0.507
METL	Metals	1.032	0.830	0.780	0.544	0.332	0.100	0.448	0.444
MACH	General machinery	0.941	0.761	0.703	0.508	0.300	0.095	0.403	0.413
EMCH	Electrical machinery	0.912	0.639	0.682	0.422	0.292	0.078	0.390	0.344
VEHI	Transport equipment	1.014	0.808	0.757	0.549	0.322	0.104	0.435	0.445
OMAN	Other manufactures	1.150	0.797	0.846	0.520	0.366	0.096	0.480	0.424
UTIL	Utilities	1.155	0.998	0.825	0.630	0.341	0.109	0.484	0.521
CONS	Construction	1.270	0.995	0.999	0.684	0.435	0.131	0.564	0.553
TRAD	Trade, hotels, catering	1.243	1.053	0.963	0.694	0.418	0.129	0.545	0.565
TRAN	Transport, communication	1.253	1.039	0.906	0.650	0.380	0.112	0.526	0.538
FSRV	Finance, insurance	1.036	1.145	0.760	0.717	0.301	0.116	0.459	0.601
REES	Real estate	1.300	1.077	0.819	0.597	0.330	0.090	0.489	0.507
GSRV	Government services	1.416	1.223	1.141	0.931	0.457	0.165	0.684	0.766
OSRV	Other services	1.180	0.950	0.911	0.638	0.386	0.114	0.525	0.524
	Weighted average	1.265	1.009	0.995	0.701	0.432	0.133	0.563	0.568

Note: Weighted average calculated using 1997 and 2007 value added shares.
Source: Multiplier results using the 1997 and 2007 China SAMs.

Table 4: Normalized multiplier ratios (2007/1997)

		Value added	All households	Rural households	Urban households
AGRI	Agriculture	1.067	1.168	1.328	1.161
MINE	Mining	0.862	0.867	0.887	0.845
FOOD	Processed foods	1.081	1.159	1.265	1.149
TEXT	Textiles, clothing	1.101	1.165	1.228	1.157
WOOD	Wood, paper, printing	1.043	1.052	1.075	1.053
FUEL	Fuel	1.026	1.052	1.066	1.029
CHEM	Chemical	1.011	1.016	1.009	1.013
NMET	Non-metal minerals	0.991	0.988	0.980	0.986
METL	Metals	1.008	0.990	0.977	0.983
MACH	General machinery	1.013	1.026	1.027	1.017
EMCH	Electrical machinery	0.878	0.879	0.866	0.875
VEHI	Transport equipment	0.998	1.030	1.047	1.015
OMAN	Other manufactures	0.868	0.873	0.850	0.876
UTIL	Utilities	1.083	1.084	1.036	1.068
CONS	Construction	0.982	0.972	0.976	0.973
TRAD	Trade, hotels, catering	1.061	1.023	1.001	1.028
TRAN	Transport, communication	1.039	1.019	0.956	1.015
FSRV	Finance, insurance	1.385	1.340	1.250	1.299
REES	Real estate	1.038	1.035	0.884	1.028
GSRV	Government services	1.082	1.159	1.171	1.111
OSRV	Other services	1.009	0.994	0.958	0.990
	Weighted average	1.000	1.000	1.000	1.000

Note: Multipliers normalized by dividing by the weighted average multiplier. Weighted average calculated using 1997 and 2007 value added shares.
Source: Multiplier results using the 1997 and 2007 China SAMs.

The ratios are generally less than one in industries that experienced fast economic growth during 1997-2007 (e.g., mining and electrical machinery). In contrast, they are often greater than one in slower growing sectors (e.g., agriculture, processed foods, textiles). One exception is services, where fast growth occurred alongside *relative* increases in the ratios (e.g., transport, finance, real estate). In fact, financial services was the only sector to experience an absolute (i.e., non-normalized) increase in its value-added multiplier (see Table 3).

In summary, the decline in China's economy-wide GDP multiplier effect during 1997-2007 was partly due to changes in the composition of final demand, which favoured exports and investments. Changing patterns of economic growth also contributed, i.e., there was a shift towards heavier industries, where multipliers were already lower in 1997, and have since fallen faster than average. These results indicate that an increase in demand in 2007 led to smaller increases in value added than in 1997, and hence smaller increases in household incomes.

4.2 Household income multipliers

Table 3 reports income multipliers for all households, and separately for rural and urban households. The weighted average income multiplier indicates that a one yuan increase in final demand led to a 0.995 yuan increase in overall household incomes in 1997, but to only a 0.701

yuan increase in 2007. This decline in the average income multiplier is expected given the fall in the GDP multiplier.

Variation in income multipliers across sectors depends to a large extent on the share of labour in total value added. The larger this share, the larger the household income multiplier, because labour is households' main income source (see Table 2). Moreover, capital is not paid directly to households and faces additional leakages, such as corporate taxes, which reduce income multipliers. For example, in 1997, labour accounted for 90.5 and 79.5 per cent of total value added in agriculture and government services, respectively. This is higher than the economy-wide average of 63.5 per cent, and, as a result, these sectors' multipliers are larger than the GDP multiplier. The reverse is true for the capital-intensive energy sectors, i.e., fuel and utilities.

Again, we normalize the income multipliers to control for changes in the relative size of endogenous and exogenous accounts. This is done by dividing the sectoral multipliers in Table 3 by the weighted average, and then taking a ratio of 2007 over 1997. As shown in Table 4, the households and GDP ratios follow a similar pattern, i.e., they are greater than one for agriculture, light industries and services, and less than one for mining and heavier industries. Unfortunately, the fast growing sectors have ratios less than one, implying that the uneven sectoral composition of economic growth contributed to the decline in the economy-wide income multiplier during 1997-2007. This is over and above the shift towards exports and investments, which receive greater attention in the literature (see, for example, Aziz and Cui 2007).

The decline in the 'all households' income multiplier was driven by falling rural multipliers, with the urban multiplier remaining virtually unchanged (see Table 3). It is particularly important to normalize rural and urban income multipliers because of these areas' changing population shares. As mentioned earlier, the share of the urban population rose from 29.9 to 44.9 per cent during 1997-2007. Thus while the urban income multiplier remained constant, it was in fact being distributed across a larger share of the population, implying that it fell in per capita terms. Table 5 shows that a one million yuan increase in aggregate final demand led to a 1.522 yuan increase in per capita urban incomes in 1997, but to only a 1.022 yuan increase in 2007.

Table 5: Per capita household income multipliers

	All households	Rural households	Urban households
Population (millions)			
1997	1,236	866	370
2007	1,321	728	594
Per capita income multiplier			
1997	0.805	0.499	1.522
with 1997-2007 population growth	0.753	0.467	1.424
with 1997-2007 urbanization	0.805	0.635	1.014
with 1997-2007 pattern of growth	0.756	0.461	1.446
2007	0.567	0.196	1.022

Note: Per capita income multiplier show the yuan increase in per capita income per one million yuan increase in aggregate final demand, weighted across sectors using 1997 and 2007 value added shares.
Source: Multiplier results using the 1997 and 2007 China SAMs.

Table 5 takes the 1997 per capita income multiplier and imposes the population growth, urbanization and shifts in production patterns that were observed during the period 1997-2007. This decomposition suggests that most of the observed decline in urban per capita income multipliers was due to urbanization, and, to a lesser extent, by national population growth and shifts in the sectoral composition of GDP. Urbanization has the opposite effect for rural per capita income multipliers, i.e., the multiplier increases because rural incomes are distributed across a smaller population share. This implies that other factors, such as changes within sector level multipliers and the size of exogenous accounts, explain the large decline in rural per capita income multipliers.

In summary, the results from the multiplier analysis provide initial evidence of weakening linkages between economic growth and household incomes over the decade 1997-2007. One explanation for this was the changing sectoral composition of GDP in favour of heavier industries, where household income multipliers are lowest. Urbanization also contributed to falling per capita income multipliers for urban households.

4.3 Structural path analysis

The multiplier analysis focused on changes in the economy-wide GDP and income multipliers. Below we use SPA to examine changes in structural linkages within and between individual sectors. We first demonstrate SPA by presenting results for three selected output multipliers. Output multipliers show changes in a sector's production from a one yuan increase in another sector's final demand.

Table 6 shows the path analysis from processed foods (origin pole) to agriculture (destination pole) using the 1997 SAM. The global influence indicates that a one yuan increase in demand for processed foods leads to a 0.97 yuan increase in agricultural production. The table shows the 20 most important paths, which cover 96 per cent of the global influence.[7] SPA decomposes the total multiplier effect into separate paths. Most of the increase in agricultural production (AGRI) from a stimulus in demand for processed foods (FOOD) arises from the demand for intermediate agricultural inputs into food processing (i.e., a *direct* production linkage). The second most important path arises when expanding production of processed foods causes incomes for 'other labour' (FLABO) and rural households (HRUR) to increase, which in turn raises household spending on agricultural goods (i.e., an *indirect* consumption linkage).

[7] We exclude paths with more than five arcs. The choice arc limits largely depends on the aggregation of the SAM. Sensitivity analysis indicates that a 5 arc limit is sufficient for our 27 endogenous and 4 exogenous accounts.

Table 6: Path analysis from processed foods to agriculture in 1997

Overall path details		Structural paths ranked by influence (excluding origin and destination poles)	Direct influence $I^D_{(i\to j)_p}$	Path multiplier M_p	Total influence $I^T_{(i\to j)_p}$	Share of global influence (%)	Cumulative share (%)
	1	(direct)	0.4162	2.0566	0.8559	88.43	88.43
Origin	2	FLABO → HRUR	0.0100	2.3325	0.0233	2.40	90.83
pole (i):	3	FLABO → HURB	0.0042	2.4000	0.0102	1.05	91.88
FOOD	4	FCAP → ENT → HRUR	0.0031	2.9255	0.0092	0.95	92.83
	5	FCAP → ENT → HURB	0.0026	2.9904	0.0077	0.79	93.62
Destination	6	TRAD	0.0016	2.4229	0.0039	0.41	94.03
pole (j):	7	WOOD	0.0014	2.7020	0.0038	0.39	94.42
AGRI	8	TRAD → FLABO → HRUR	0.0012	2.6505	0.0033	0.34	94.76
	9	CHEM	0.0010	3.1413	0.0030	0.31	95.07
Global	10	TRAD → FLABO → HURB	0.0005	2.7120	0.0014	0.15	95.21
influence:	11	WOOD → FLABO → HRUR	0.0004	3.0482	0.0013	0.13	95.35
0.9679	12	CHEM → FLABO → HRUR	0.0003	3.5110	0.0010	0.10	95.45
	13	FLABP → HURB	0.0004	2.2884	0.0010	0.10	95.55
	14	TRAN → FLABO → HRUR	0.0003	2.5236	0.0008	0.08	95.63
	15	TEXT	0.0002	3.3895	0.0006	0.06	95.70
	16	FLABO → HURB → TEXT	0.0002	3.8588	0.0006	0.06	95.76
	17	OSRV → FLABO → HRUR	0.0002	2.5404	0.0006	0.06	95.82
	18	WOOD → FLABO → HURB	0.0002	3.1340	0.0006	0.06	95.88
	19	OMAN	0.0002	2.2769	0.0005	0.05	95.93
	20	FLABO → HRUR → TEXT	0.0001	3.7643	0.0004	0.04	95.98

Source: Structural path analysis results using the 1997 China SAM.

Table 7: Path analysis from processed foods to fuels in 1997

Overall path details		Structural paths ranked by influence (excluding origin and destination poles)	Direct influence $I^D_{(i\to j)_p}$	Path multiplier M_p	Total influence $I^T_{(i\to j)_p}$	Share of global influence (%)	Cumulative share (%)
	1	AGRI	0.0036	2.2820	0.0083	18.10	18.10
Origin	2	(direct)	0.0021	1.5575	0.0033	7.23	25.33
pole (i):	3	TRAN	0.0012	1.7085	0.0020	4.29	29.61
FOOD.	4	AGRI → CHEM	0.0005	3.4689	0.0017	3.75	33.36
	5	AGRI → TRAN	0.0005	2.4818	0.0012	2.51	35.87
Destination	6	CHEM	0.0004	2.4262	0.0010	2.20	38.07
pole (j):	7	TRAD	0.0005	1.8660	0.0009	1.96	40.03
FUEL.	8	UTIL	0.0004	1.7410	0.0008	1.66	41.70
	9	AGRI → FLAB_O → HRUR	0.0002	2.5764	0.0006	1.21	42.91
Global	10	AGRI → FLAB_O → HURB	0.0002	2.6480	0.0006	1.19	44.10
influence:	11	METL	0.0002	2.4500	0.0004	0.97	45.07
0.0457	12	AGRI → UTIL	0.0002	2.5357	0.0004	0.87	45.95
	13	NMET	0.0002	1.8444	0.0003	0.71	46.66
	14	AGRI → GSRV	0.0001	2.4166	0.0003	0.62	47.28
	15	AGRI → TRAD	0.0001	2.6771	0.0003	0.55	47.83
	16	MINE	0.0001	1.8170	0.0002	0.52	48.35
	17	FLAB_O → HRUR → AGRI	0.0001	2.5764	0.0002	0.49	48.84
	18	AGRI → CHEM → UTIL	0.0001	3.8323	0.0002	0.47	49.31
	19	AGRI → CHEM → TRAN	0.0001	3.7569	0.0002	0.45	49.76
	20	TRAD → TRAN	0.0001	2.0311	0.0002	0.39	50.15

Source: Structural path analysis results using the 1997 China SAM.

Table 7 presents the path analysis from processed foods to fuels (petroleum products) using the 1997 SAM. Together the 20 most important paths cover 50.2 per cent of the global influence. Most of these paths are indirect production linkages, and the global influence is less concentrated in a single path than in the previous example. The most important paths typically arise from food processing's demand for intermediate goods, the producers of which demand fuels for their own production processes. For example, the third most important path accounts for 4.3 per cent of the global influence, and arises from food processing's (FOOD) direct use intermediate transport services (TRAN) and therefore indirectly, transport's use of fuel intermediates (FUEL). In fact, the direct linkage from food to fuel is only the second most important path in this example. There are also very few consumption linkage paths, i.e., paths that pass through households. Only three paths include households in rural (HRUR) and urban (HURB), and together they cover only 2.9 per cent of the global influence.

Paths evolve over time. Table 8 again shows the path analysis from processed foods to fuels (petroleum products), but this time using the 2007 SAM. A number of changes occurred between 1997 and 2007. First, the 20 most important paths now cover slightly more of the global influence (55.7 per cent), which itself has risen over the decade (from 0.0457 to 0.0674). Secondly, while the contribution of the direct linkage remained constant over the period (from 7.23 to 7.31), the importance of most indirect linkages increased, pushing the direct linkage's ranking into fourth. Thirdly, agriculture's contribution to GDP fell while transport's contribution rose. As a result, agriculture was replaced by transport as the most important path. Finally, households play a stronger role in supporting the food-fuel multiplier—the number of paths passing through households rose from three to four, and their cumulative share of the global influence increased from 2.9 to 4.8 per cent.

The selected path analysis discussed above illustrates the usefulness of SPA. The method allows us to decompose the detailed paths between sectors, as well as identify the changing contribution of households to sustaining economy-wide production.

4.4 Contribution of private consumption to sectoral multipliers

The above illustrations of SPA examined individual paths that together make up the global influence of a demand stimulus for an individual sector. In this section we combine the influences that each sector has on production in all other sectors (i.e., total multiplier effects). The first two columns of Table 9 report gross output multipliers for individual sectors, as well as an economy-wide average multiplier calculated using the value of gross output as weights. The table shows, for example, that, in 1997, a one yuan increase in demand for agricultural goods leads to a 3.823 yuan increase in gross output across all sectors. These are larger than the GDP multipliers in Table 3 since all sector level multiplier effects included and so are both value added and intermediates.

Table 8: Path analysis from processed foods to fuels in 2007

Overall path details		Structural paths ranked by influence (excluding origin and destination poles)	Direct influence $I^{D}_{(i\to j)_p}$	Path multiplier M_p	Total influence $I^{T}_{(i\to j)_p}$	Share of global influence (%)	Cumulative share (%)
	1	TRAN	0.0038	1.8297	0.0070	10.35	10.35
Origin	2	AGRI	0.0029	2.0782	0.0060	8.90	19.25
pole (i):	3	AGRI → CHEM	0.0016	3.3764	0.0053	7.79	27.03
FOOD.	4	(direct)	0.0030	1.6333	0.0049	7.31	34.34
	5	CHEM	0.0015	2.6828	0.0041	6.14	40.48
Destination	6	AGRI → TRAN	0.0010	2.3172	0.0023	3.42	43.90
pole (j):	7	AGRI → FLAB_O → HURB	0.0007	2.4665	0.0016	2.40	46.30
FUEL.	8	UTIL	0.0004	2.5263	0.0011	1.65	47.95
	9	OSRV	0.0003	1.8462	0.0006	0.88	48.83
Global	10	TRAD → TRAN	0.0003	2.0066	0.0006	0.85	49.68
influence:	11	METL	0.0002	2.6749	0.0005	0.78	50.47
0.0674	12	FLAB_O → HURB	0.0002	2.1001	0.0005	0.75	51.22
	13	FLAB_O → HURB → TRAN	0.0002	2.2894	0.0005	0.74	51.96
	14	WOOD → CHEM	0.0001	3.9410	0.0005	0.69	52.65
	15	AGRI → UTIL	0.0001	3.2059	0.0004	0.62	53.27
	16	NMET	0.0002	1.9741	0.0004	0.57	53.84
	17	AGRI → CHEM → TRAN	0.0001	3.7508	0.0004	0.54	54.38
	18	FCAP → ENT → HURB	0.0001	2.3314	0.0003	0.47	54.85
	19	AGRI → FLAB_O → HRUR	0.0001	2.2963	0.0003	0.47	55.32
	20	CHEM → TRAN	0.0001	2.9915	0.0003	0.42	55.74

Source: Structural path analysis results using the 2007 China SAM.

Table 9: Households' contribution to global influence

		Global influence (gross output multiplier)		Total influence from household-related paths		Household share of net global influence (%)	
		1997	2007	1997	2007	1997	2007
AGRI	Agriculture	3.824	3.573	1.126	0.917	39.89	35.64
MINE	Mining	3.595	2.668	0.380	0.260	14.63	15.60
FOOD	Processed foods	3.924	3.845	0.469	0.406	16.03	14.27
TEXT	Textiles, clothing	3.886	4.198	0.535	0.337	18.54	10.54
WOOD	Wood, paper, printing	3.691	3.839	0.526	0.294	19.55	10.34
FUEL	Fuel	3.577	3.338	0.227	0.161	8.81	6.91
CHEM	Chemical	3.629	3.558	0.344	0.191	13.07	7.45
NMET	Non-metal minerals	3.988	3.689	0.408	0.223	13.64	8.31
METL	Metals	4.057	3.754	0.321	0.172	10.49	6.24
MACH	General machinery	3.428	3.514	0.353	0.175	14.55	6.97
EMCH	Electrical machinery	3.662	3.359	0.285	0.123	10.71	5.20
VEHI	Transport equipment	3.870	3.924	0.339	0.173	11.81	5.92
OMAN	Other manufactures	3.625	3.135	0.416	0.195	15.85	9.15
UTIL	Utilities	3.613	3.598	0.329	0.285	12.60	10.96
CONS	Construction	4.240	3.987	0.466	0.221	14.38	7.41
TRAD	Trade, hotels, catering	3.547	3.102	0.574	0.332	22.56	15.79
TRAN	Transport, communication	3.423	3.115	0.534	0.326	22.03	15.43
FSRV	Finance, insurance	2.949	2.675	0.440	0.453	22.57	27.02
REES	Real estate	2.787	2.229	0.508	0.377	28.42	30.66
GSRV	Government services	3.930	3.582	0.688	0.547	23.49	21.20
OSRV	Other services	3.807	3.221	0.419	0.290	14.94	13.04
	Weighted average	3.783	3.520	0.529	0.302	19.12	12.43

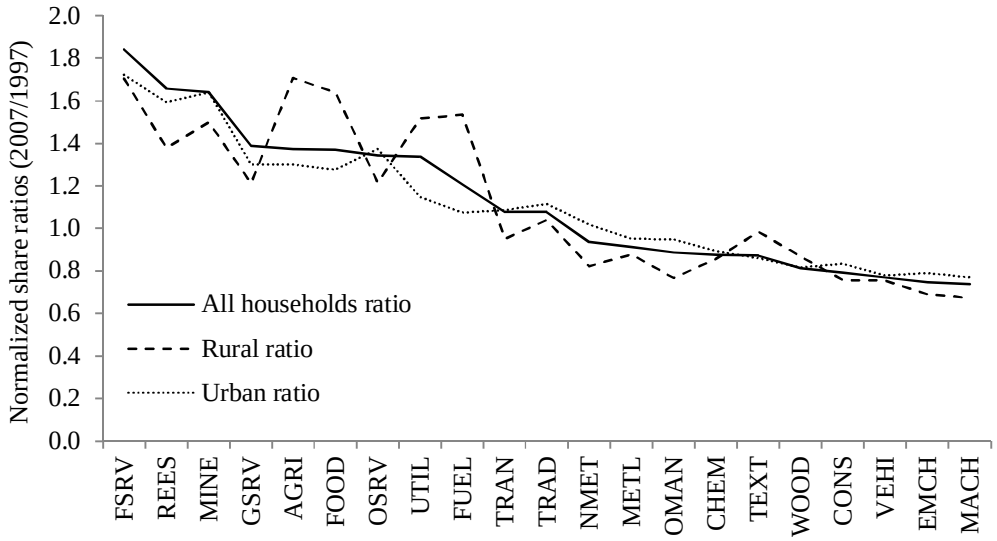
Note: Net sectoral multiplier is the gross output multiplier (global influence) less the demand shock value of one value unit. Weighted average calculated using 1997 and 2007 gross output shares.
Source: Structural path analysis results using the 1997 and 2007 China SAMs

The third and fourth columns in the table show the total influence that arises from paths passing through at least one household account; i.e., HRUR or HURB. In agriculture, for example, the total influence of household-related paths sum to 1.216 in 1997. This means that household demand linkages account for 39.9 per cent of agriculture's global influence of 3.824. This is the measure we use to evaluate households' contribution to economy production. The table shows that the share of household linkages varies across sectors, ranging from 8.8 per cent in the fuel sector to 39.9 per cent in agriculture (see columns five and six). The highest shares are in agriculture and services, and the lowest shares are in heavy industries.

The contribution of household consumption to total multiplier effects declined during 1997-2007. The weighted average share fell from 19.1 per cent in 1997 to 12.4 per cent in 2007. This suggests a declining *indirect* role for private consumption linkages in sustaining economy-wide production. In other words, not only did multipliers decline but the contribution of households to the multipliers declined even faster.

Figure 1 reports normalized household consumption share ratios, which are by dividing the sector shares by the weighted average share in Table 9, and then taking the ratio of 2007 to 1997. If the ratio is greater than one, then the contribution of private consumption to the total multiplier effect rose by more (or fell by less) than the average change in private consumption's contribution across all sectors during 1997-2007. The figure ranks sectors from left to right based on the normalized ratios for all households. Normalized ratios are also reported for rural and urban household consumption shares.

Figure 1: Normalized household consumption share ratios



Note: Normalized shares are the household consumption share of a sector's global influence divided households' economy-wide consumption share (see Table 9). The figure shows the ratio of this measure in 2007 over 1997.
Source: Structural path analysis results using the 1997 and 2007 China SAMs. Authors' illustration.

The results indicate that private consumption's contribution to the global influence of heavy industries, which was already low in 1997 (see Table 9), declined faster than the economy-wide average. For example, electrical machinery's (EMCH) normalized ratio of 0.75 means that this sector's household influence share of 10.7 per cent in 1997 fell by 25 per cent more than the average decline in household influence over 1997-2007. The opposite is true for agriculture (AGRI), whose private consumption linkages were the highest in 1997 (39.9 per cent), and its normalized ratio of 1.37 means that its share fell more 37 per cent slowly than the average. Financial services (FSRV) and real estate (REES) also had relatively high consumption shares in 1997, and, unlike other sectors, these shares increased over the decade. The figure indicates that not only was services a fast growing sector during 1997-2007, but its private consumption linkages strengthened and offset the effects of agriculture's slow growth, and the deteriorating linkages within fast growing heavy industry.

Finally, Figure 1 shows how, for most sectors, there were similar declines in the role of household consumption linkages in sustaining sectoral production. Notable exceptions are for agriculture (AGRI), processed food (FOOD), utilities (UTIL) and petroleum fuels (FUEL). For these sectors rural consumption became a significantly more important source of demand than urban consumption. This is not surprising given the more pronounced drop in food consumption shares for urban households, and the large increase in energy consumption shares for rural households (see Table A1 in the appendix). Therefore, changing incomes and household demand preferences also influenced the changing role of rural and urban consumption in sustaining the Chinese economy.

5 Conclusions

Enhancing the role of private consumption in China will require strengthening the links between economic growth and household incomes, and between domestic consumer demand and production patterns. In this paper we examined the evolution of growth-income-consumption linkages during 1997-2007. We constructed two comparable economy-wide databases and used these to conduct multiplier and structural path analysis.

Current explanations for the diminished role of households and private consumption in China focus on the rising importance of exports and investments. Our analysis highlights additional contributing factors. First, the sectoral pattern of economic growth favoured industries with initially low GDP and income multiplier effects, e.g., capital-intensive machinery. Secondly, income multipliers fell in almost all sectors, but particularly in the faster growing sectors. Together these factors imply less trickledown from economic growth to household incomes. Thirdly, population and urbanization pressures lowered per capita income multipliers even further, with urban households being the most affected. Finally, consumer demand has become far less important for supporting domestic production processes, implying a diminished role for households in guiding production patterns.

The sectoral composition of economic growth and the deep structural changes within sectors during 1997-2007 suggest that, while reducing aggregate investment and exports will be a necessary step towards rebalanced growth, it may not be sufficient to reverse the declining role of private consumption in sustaining the economy. This will require a shift in the composition of growth, as well as a realignment of inter-industry and household linkages. Here our results indicate an important role for (already fast growing) consumer-oriented services, and possibly a diminished role for heavier industries, whose linkages to domestic consumers are weakest.

Our analysis extends the literature on structural change in China. There are, however, at least three areas for further research. First, our analysis examined changes in structural linkages over time. However, other approaches to inter-temporal decomposition may offer additional insights (see Wood and Lenzen 2009). Secondly, as is standard in multiplier analysis, we assumed fixed prices and unconstrained resources, which mean that our findings should be viewed as indicative of current structure, rather than predictive of future change. Finally, a more disaggregated labour market might enhance the decomposition of growth-income linkages. As data collection and availability improves, there will be greater scope for more nuanced assessments of the role of households and structural change in China.

Table A1: Value added and household consumption

		Value added			Consumption shares (%)			
		Shares (%)		Ratio	Rural		Urban	
		1997	2007	(2007/1997)	1997	2007	1997	2007
AGRI	Agriculture	21.73	11.74	1.63	37.46	22.08	20.07	8.78
MINE	Mining	3.83	5.04	3.98	0.71	0.35	0.34	0.08
FOOD	Processed foods	3.68	3.02	2.47	20.19	18.23	21.64	17.53
TEXT	Textiles, clothing	5.11	3.11	1.84	5.22	4.87	9.06	6.82
WOOD	Wood, paper, printing	1.63	1.58	2.92	0.26	0.22	0.25	0.25
FUEL	Fuel	1.04	1.20	3.49	0.26	0.36	0.32	0.86
CHEM	Chemical	4.58	4.52	2.98	3.18	2.49	2.21	2.39
NMET	Non-metal minerals	3.15	2.18	2.09	0.70	0.20	1.79	0.31
METL	Metals	3.41	5.30	4.69	0.87	0.28	0.99	0.45
MACH	General machinery	3.23	3.23	3.02	0.07	0.02	0.16	0.08
EMCH	Electrical machinery	2.43	4.06	5.05	2.46	3.50	3.41	4.11
VEHI	Transport equipment	1.38	2.08	4.56	1.37	2.07	0.97	2.65
OMAN	Other manufactures	3.36	3.05	2.74	1.85	1.48	3.04	2.64
UTIL	Utilities	2.61	4.11	4.76	1.13	2.41	2.79	3.07
CONS	Construction	8.50	5.86	2.09	0.00	0.00	0.00	1.24
TRAD	Trade, hotels, catering	8.52	7.82	2.78	7.53	13.61	9.77	14.08
TRAN	Transport, communication	5.82	8.12	4.22	2.47	4.63	3.52	5.54
FSRV	Finance, insurance	2.16	5.13	7.18	2.16	2.88	3.36	4.77
REES	Real estate	2.60	4.57	5.32	5.56	9.11	3.30	7.15
GSRV	Government services	8.64	9.11	3.19	2.78	7.51	6.79	9.71
OSRV	Other services	2.57	5.19	6.10	3.76	3.67	6.21	7.47
	Total	100.00	100.00	3.02	100.00	100.00	100.00	100.00

Note: The value added ratio is the value of GDP in 2007 over the value of GDP in 1997 (measured in 2007 prices—see Section 3).
Source: Authors' calculations using the 1997 and 2007 China SAMs.

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