

**China Economic Journal**  
**Industrial Interdependence: China 1995-2010**  
--Manuscript Draft--

<b>Full Title:</b>	Industrial Interdependence: China 1995-2010
<b>Manuscript Number:</b>	
<b>Article Type:</b>	Original Article
<b>Keywords:</b>	industrial structural change; input-output decomposition; trajectories over 1995-2010
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# Industrial Interdependence: China 1995-2010

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## **Abstract**

The present paper focuses on inter-industrial activity via a useful decomposition of the input-output model and deals with the changes of domestic industrial/sectoral backward and forward linkages (i.e. the pull and push of the economy) as well as the changes in their domestic and imported components (i.e. via import substitution/penetration) over the 1995-2010 period. There are three distinctive periods of import substitution/import penetration, which seems to correspond to the East-Asian crisis of 1997 and the global crisis of 2008 as well as the main reform and policies of the periods. The secondary and tertiary sector show a positive increase in both the pull of backward linkages and the push of forward linkages, showing important levels of absolute import substitution. This is especially true for the pull of light and heavy industry on the economy and secondarily for domestic trade, heavy industry becoming the main engine of the economy by far.

**Key Words:** China, industrial structural change, input-output decomposition, trajectories over 1995-2010.

**JEL Classification:** L16, O4, B4, E2

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## 1. Introduction

This paper is both a contribution to the quantitative study of structural change in China and a complement to previous papers. The latter focussed on an import growth decomposition (Pei, Dietzenbacher et al. 2011), on the structural change of important indicators such as capital productivity, capital intensity, participation rate and total factor productivity for China and its main regions, at an aggregate level (Albala-Bertrand 2013); and on structural change at an inter-industrial level (Albala-Bertrand 2016). As the latter one, the present paper focusses on inter-industrial activity via the input-output model. In the same vein, there is no intention to forecast the state of the economy in the future, but to assess what happened in the recent past. To such an aim, we resort to the available input-output statistics and via the input-output model we attempt to assess the evolution of the industrial interdependence of China, in terms of backward and forward linkages, between 1995 and 2010. This is in turn the period of the most momentous policy thrusts, and just about bounded by two international crises: the Southeast Asian crisis of 1997 and the world crisis that started in 2007/8.

Many other studies of structural change in China have been produced in especially the last 15 years or so. Some concentrate on exports (e.g. He and Zhang 2010, Amiti and Freund 2010, Feentra and Wei 2010), on employment (e.g. Cai and Wang 2010, Evans and Stavetieg 2009), or on industrial productivity and change (e.g. Zheng, Wang and Shi 2008, Yueh 2011). And some have also used input-output analysis, such as Ichimura and Wang (2003) on interregional analysis and Pan, Yang and Lin (2012) on technological spillovers; Hummels et al. (2001), Dean et al. (2011) and Yang et al (2015) on vertical specialization. And there are many others that deal with the environment, energy, and the like. The difference with the ones that use input-output analysis is that ours, first, propose a useful decomposition of total intermediate input linkages that allows to differentiate consistently between domestic and foreign sources; second,

1 we use tables for each year of our period (1995-2010), composed of 33 industries; and we show  
2 the structural change trajectory of linkages over the period. This type of study has not been  
3 done before for China and offers a good deal of information in itself and for complementary  
4 studies in the area.  
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11 Our main conclusions is that the the secondary and tertiary sector show a positive increase in  
12 both the pull of backward linkages and the push of forward linkages, showing some important  
13 levels of absolute import substitution. This is especially the case for the pull of light and heavy  
14 industry on the economy and secondarily for domestic trade. Given its high output share of the  
15 economy, the secondary sector has become the main engine of the economy by far. In addition  
16 there are three distinctive periods of import substitution/import penetration, which seems to  
17 correspond to the East-Asian crisis of 1997 and the global crisis of 2008 as well as the main  
18 reform and policies of the period<sup>(1)</sup>.  
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33 For presentational clarity, the method to assess industrial interdependence is divided into two  
34 sub-sections. Firstly, we describe the way we use the general input-output framework (2.1);  
35 and, secondly, we define backward and forward linkages and present the final form of their  
36 decompositions into domestic and imported inputs (2.2), reserving derivations and other  
37 aspects to our Appendix. After its application to China, we proceed to analyze the resulting  
38 data by means of Table No.1 and associated charts via the growth rates of backward and  
39 forward linkages between 1995 and 2010 (3). This latter is divided into three sections: an  
40 aggregate analysis (3.1), a sectoral analysis (3.2) and an analysis of the linkage trajectories over  
41 the period (3.3). We end up with our conclusions (4).  
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## 2. Methodology

The method to evaluate structural changes in industrial interdependence, i.e. structural change for intermediate market interactions, is based on multiplier analysis leading to backward and forward linkages. The main difference between our analysis and standard linkage analysis is that, in input-output theory, the latter represent an *ex-ante* approach to the planning potentials for economic expansion (Hirschman 1958, 1977; Syrquin 1992). In our version, given that our focus is the analysis of the effective change of structural linkages overtime, the linkages represent the *actual* or *effective* (or *ex-post*) interdependence of the economy over the 1995-2010 period. This greatly reduces the restrictiveness of the assumptions required for standard analysis (see also Albala-Bertrand 1999). In addition, we decompose total interdependence into domestic and imported ones. This allows to assess how dependent the domestic industrial (gross) output is on intermediate imports and how this evolved over our focus period.

### 2.1 The General Input-Output Framework

Input-output tables or matrices are statistical tools that account for all the market transactions that any industry has in an economy, i.e. intermediate transactions with all classified industries and with its demand for final output. This accounts for the total gross output (i.e. intermediate and final output) of an economy, disaggregated into industries and/or regions. It also account, at the level of each industry, for the cost of primary inputs or value added. So at the level of intermediate transactions, this gives rise to a symmetrical double-entry table or matrix that contains the same classified industries in both columns (intermediate demands) and rows (intermediate supplies). In addition, it provides another matrix for the final output supplies of all classified industries, and another for primary inputs. Let's then assume that we have

1 available input-output matrices for a given economy for at least two years, i.e. a base year “0”  
 2 and a comparison year “1.” This would include the following matrices: an  $n \times n$  matrix  $W$  of  
 3 intermediate demands for the domestic and imported inputs of all the  $n$  classified industries; an  
 4  $n \times m$  matrix  $F$  of output for domestic final demands from the same industries, including both  
 5 domestic and imported commodities; an  $n \times 1$  vector  $E$  of exports from the same industries;  
 6 and an  $n \times n$  matrix  $M$  of intermediate and final imports of all industries. Hence, the  $n \times 1$   
 7 domestic gross output vector  $X$  of the  $n$  industries will be given by:

$$18 \quad X = Wi + Fi + E - Mi \quad (\text{domestic gross output: supply viewpoint})^{(2)} \quad (1)$$

22 Where  $i$  is an  $n \times 1$  unity vector. So let  $a_{ij}$  represent the input from the  $i^{\text{th}}$  industry that is required  
 23 by the  $j^{\text{th}}$  industry to produce one unit of its output, which in terms of standard technical  
 24 coefficients is  $a_{ij} = W_{ij} / X_j$ . This therefore generates an  $n \times n$  matrix  $A$  of coefficients, or in matrix  
 25 terms:  
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$$32 \quad W = AX \quad (2)$$

35 Substituting (2) into (1):

$$37 \quad X = AX + Fi + E - Mi \quad (3)$$

41 In turn, the intermediate (input-mix) demand viewpoint or *production-cost* includes the same  
 42  $n \times n$  matrix  $W$  of intermediate demands for the domestic and imported inputs of all the  $n$   
 43 classified industries, the  $1 \times n$  row vector  $V'$  of value added (associated with labor and capital)  
 44 of the same industries, and finally the  $1 \times n$  row vector  $M^{W'}$  of intermediates imports for the  
 45 said industries. The prime sign (“’”) indicates a row vector. The  $1 \times n$  domestic gross output  
 46 vector  $X'$  of the  $n$  industries will be given by:

$$56 \quad X' = i'W + V' - M^{W'} \quad (\text{domestic gross output: demand viewpoint}) \quad (4)$$

## 2.2 Industrial or Sectoral Interdependence

We analyze two kinds of linkages: backward linkages and forward linkages. Both operate at the level of intermediate transactions and are defined and calculated as follows.

*Backward Linkages.* We define the *backward linkage (BL)* as the direct and indirect *input demand* dependence that all industries have on a particular industry, as the latter requires intermediate inputs from them to satisfy its own production. So an industry will demand intermediates from many other industries to satisfy its output requirement (direct linkage). But then all these industries in turn will have to demand intermediates from many other industries to satisfy the requirement of this first industry, and so on (indirect linkage). These direct and indirect demands are measured by the column sum of the Leontief matrix. We expect dynamic industries to increase their backward demand, becoming more specialized as they develop, whether because they demand more of a more varied input-mix or because they “unbundle” production previously done in-house. Leading industries with strong domestic backward linkages are then expected *to pull* all the economy with them and, if they are technologically advanced, increase the technological sophistication of the overall economy. To assess how the *BLs* change over time, we simply calculate the first difference of *BL* between any two given years. However, as matrix *B* contains both domestic and imported intermediates, a useful decomposition is necessary to discriminate between the two. That is:

$$\Delta BL = i' \Delta C = i'(C_0 \Delta A^d C_1) + i'(C_0 \Delta A^m C_1) \quad (\Delta BL \text{ decomposition})^{(3)} \quad (9)$$

The superindexes *d* and *m* stand for “domestic” and “imported,” respectively. Following the numeration from Appendix I.1, Equation (9) is then a row vector of backward linkage differences between two years, “0” and “1”, decomposed into domestic and imported

1 contributions. This can be more usefully presented in terms of growth rates (or rates of change)  
 2 by dividing equation (9) by the *BL* of the initial year, as it is used in the Table No.1 below.  
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7 *Forward Linkages.* Analogously to backward linkages, we define *forward linkage (FL)* as the  
 8 direct and indirect *input supply* dependence that many industries have on a particular industry,  
 9 as they require intermediate inputs from it to satisfy their own production. That is, a particular  
 10 industry (say agriculture) supplies intermediates to its direct customer industries, say textile,  
 11 hotels and chemicals (direct linkage). These latter industries then use these intermediates to  
 12 produce their own output and so supply their own customer industries. By doing so, they  
 13 generate input supplies all over the economy (indirect linkage). The addition of direct and  
 14 indirect supply linkages, which is measured by the row sum of the Leontief inverse (calculated  
 15 in different way than above) is then the measure of forward linkages at a given time. Leading  
 16 industries with strong forward linkages are then expected *to push* all the economy. Given that  
 17 *BL* and *FL* do not have to exhibit similar strengths, we have to calculate also *FL* for a more  
 18 complete picture about overall intermediate transactions. As with *BL*, we calculate the first  
 19 difference disaggregated into domestic and imported linkages.  
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$$39 \Delta FL = (\Delta C^*)_i = (C^*_0 \Delta A^{*d} C^*_1)_i + (C^*_1 \Delta A^{*m} C^*_1)_I \quad (\Delta FL \text{ Decomposition})^{(4)} \quad (10)$$

40 Following the numeration from Appendix I.2, equation (10) is a column vector of forward  
 41 linkage differences between two years, “0” and “1”, decomposed into domestic and imported  
 42 contributions. This equation can also be more usefully presented in terms of growth rates (or  
 43 rates of change) by dividing it by the *FL* of the initial year, as in Table No.1 below.  
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54 Notice that it is the pull of backward domestic linkage the most important consideration for an  
 55 economy that “globalizes” domestically, i.e. integrate industries and sectors into the national  
 56 economy, which may have been fragmented or non-existing otherwise, creating useful  
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1 multisectoral and multiregional interdependences. Notice also that if backward linkages are  
2 significantly made of imported inputs, this cannot benefit this integrative process, as the  
3 demands will only benefit industries abroad. This does not mean that intermediate imported  
4 inputs are not necessary, as they are an integral process of industrial development in a  
5 globalized world, but it does mean that a portion of such industrial value added does not accrue  
6 to the importing country (Yang et al., 2015). On the other hand, foreign forward linkages may  
7 stimulate output and interdependence. That is, if a firm (e.g. clothes), learns that now the supply  
8 of required intermediates (e.g. fabrics) is more available, it might stimulate it to increase its  
9 production, and if so this will start a new process of backward intermediate demands in the  
10 economy. But ultimately this will depend on whether it can sell it. So at the end it is the existing  
11 or potential demand for final output (clothes) that will determine such a decision. So it will be  
12 included in *ex-post* backward linkages.  
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### 31 *2.3 Application to China*

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36 We produce both a 33-industry disaggregation and some relevant sectoral subgrouping for the  
37 1995-2010 period. The source data comes from both the World Input-Output Database (WIOD)  
38 and the National Bureau of Statistics of China (NBS). WIOD input-output tables were available  
39 in dollar terms for current (1995-2011) and previous year (1996-2009) basic prices<sup>(5)</sup>. The latter  
40 tables were used to derive implicit price indexes to deflate the current-price series, at an  
41 industrial level. Additional prices for 2010 and 2011 were obtained from the National Bureau  
42 of Statistics of China (NBS). The latter has only produced tables for four given years with 23  
43 comparable industries (1997, 2000, 2005 and 2010), which were used as a general check. But  
44 we prefer WIOD tables as they seem to be more consistent, with a full public documentation  
45 of the methodology used (WIOD, 2015). Given our purpose, we transformed the tables into  
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1 constant Yuan prices of 1995. In addition, to secure further consistency and stability, we  
2 calculated a 3-year moving average of the tables for all the period. Not having available a 1994  
3 table for a 3-year average for 1995, we decided to keep the 1995 table as a single year, as this  
4 is the base year for the constant series. So our series go from 1995 to 2010.  
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### 10 11 **3. Analysis of Results**

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16 The analysis below is divided into three parts. Firstly, we analyzed the change between 1995  
17 and 2010 for aggregations of primary, secondary and tertiary sectors. Secondly, we  
18 disaggregate such sectors into some key constituent industries to show how they evolved and  
19 contributed to the aggregation. And thirdly, we look at the trajectory of changes of these sectors  
20 year after year from 1995 to 2010.  
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#### 31 *3.1 Aggregate Analysis*

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36 Table No.1 is divided into two panels: the left panel shows relevant indicators of the backward  
37 linkages (BL) of the economy between 1995 and 2010, while the right panel shows that for  
38 forward linkages (FL).  
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#### 44 **TABLE No.1            About Here**

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48 The initial two columns are the share of each industry and sector in total gross output (SX) for  
49 1995 and 2010 respectively, so it represent their weight in those years. For the left panel, the  
50 columns from left to right are as follows: BL: level of backward linkages in the base year 1995;  
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1 imported origin, respectively; DBL: domestic BL; DFL: domestic FL; and  
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3 DBLW: sectoral/industrial BL weight in total domestic BL. The right panel columns are the  
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5 equivalent for forward linkages. In addition, the bottom section regroup the industries in the  
6  
7 standard categories of primary, secondary and tertiary sectors, with its main constituent  
8  
9 industries. Finally, the bottom row presents either averages or sums for the whole economy.  
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12 With a view to analyze orderly this table, we resort to visual charts. Chart 1 below shows the  
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14 sectoral share change over the period in terms of percentage points.  
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### 20 **Chart 1      About Here**

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24 Chart 1 shows that in terms of gross output shares (SX), the secondary sector increased  
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26 massively its share in gross output at the expense of especially the primary sector. The  
27  
28 secondary sector increase was due to heavy industry (17.6pp) [pp: percentage points] at the  
29  
30 expense of light, medium and construction industries. As shown in Table No.1, within heavy  
31  
32 industry, the increase was especially due to “Electrical and optical equipment” (No.14) and  
33  
34 “Transport equipment” (No.15), increasing their share by 11pp and 3pp, respectively. All  
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36 sectors and subsectors, however, had significant gross output growth rates, which on a  
37  
38 weighted average increased by nearly 4 times over the period (not shown in the table)<sup>(6)</sup>.  
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41 Actually, the rates of growth of output of sectors/industries were systematically positive, but  
42  
43 at differential speeds, creating large disparities in their shares of the economy. That is, the fact  
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45 that some sectors, subsectors and industries fell in share terms does not mean that they had  
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47 negative growth rates (Albala-Bertrand 2016)<sup>(6)</sup>. Over such basis, the aim of this paper is to  
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49 learn about the importance and evolution of backward and forward linkages.  
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Table No.2 derives form Table No.1 and presents the sectoral domestic BL and FL weights (DBLW and DFLW) in the economy for 1995 and 2020.

**TABLE No.2            About Here**

The economy had a weighted average BL of 2.6 in 1995, i.e. an increase of one unit of output for final demand would create 2.6 input demands over the economy. The secondary sector had the largest BL pull (2.9), with all industrial subsectors having a similar strength; then the tertiary one (2.3), with similar pull for its subsectors, although slightly lower for finance; and only then the primary one (2.1). But as indicated above, backward linkages (BL) only make integrative sense if they are domestic, as imported input cannot exert a pull on domestic producers. Table No.1 shows the gross output sectoral shares (SX), the 1995 domestic proportion of BL (DOM/BL), and the rate of change of BL over the period ( $\Delta BL/BL_{1995}$ ), which allows to calculate both the 1995 and 2010 sectoral/industrial domestic BL weights in the total (DBLW), and the same for forward linkages. Table No, 2 shows that for the three sectors of the economy. The primary sector (SI) has the largest DBL in 2010, but its domestic pull is significantly lower than in 1995 given its fall in output share. It actually fell from 12% in 1995 to only 5% in 2010. This is then the case of a sector that while becoming better domestically integrated, its share decline makes its pull significantly less influential for the whole economy. The secondary sector (SII), in turn, has become by far the one with the highest domestic pull weight in the economy, representing 77% of total pull of the economy. The table above shows that the secondary sector in 1995 had 6 times more pull weight than the primary sector and 3 times more than that of the tertiary one. By 2010 this weight became 15 times as large as that of the primary sector and still 3 times that of the tertiary sector (DBLW/SI). The later sector lost some

1 of its domestic pull weight over this period, although it also increased its relative pull as  
2 compared to the primary sector.  
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7 Regarding forward linkages (FL), in 1995 the economy had similar FL for the secondary and  
8 tertiary sectors as above, but the primary sector had a stronger push value. But again, the  
9 domestic weight push is significantly lower given its reduced output share. The rest of this  
10 story can be seen directly from Table No.2, which Table No.1 shows in a more disaggregated  
11 fashion. As indicated above, *ex ante* and so for policy purposes, the FL is less important than  
12 BL, as the former represents only a possible demand incentive, while the latter represents an  
13 effective demand incentive<sup>(7)</sup>. However, an increase in available imports, if taken up, may *ex*  
14 *ante* stimulate also the domestic economy<sup>(8)</sup>. Lastly, a sector/industry can have large forward  
15 linkages but small backward ones. This means that the sector/industry has a large domestic  
16 input supply push contribution downstream (to all industries), but a small domestic input  
17 demand pull upstream over the economy.  
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36 Table No.1 shows the domestic proportion of BL and FL in 1995. For BL, this is 91%, with all  
37 industries around it. For FL this is 94% and slightly more uneven for all industries, but with all  
38 of them larger than 80%. The largest proportion is in the primary sector (94%) and the lowest  
39 in the secondary one (90%). So the question is how this has evolved over the period and what  
40 proportion of it is imported. Table No.3 will help us to assess the trade structural change in  
41 terms of import substitution or import penetration that derives from the relationship between  
42 the domestic (DOM) and imported (IMP) change rate contributions, which are behind the rate  
43 of change of backward or forward linkages over the period.  
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58 **TABLE No.3**                      **About Here**  
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3 *3.2 Sectoral Analysis*  
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7 On the basis of the previous table, Table No.4 shows how the sectors and its main subsectors  
8 fare on average in terms of import substitution/penetration over the 1995-2010 period.  
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13 **TABLE No.4**            **About Here**  
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17 Given that these sectors and subsectors vary in both linkage strength and output share, and that  
18 they are industry averages, a more detailed analysis is required. First, the primary sector has  
19 the largest BL increase (59%), notably mining and quarrying (industry 2), but with a slight  
20 decrease in its domestic pull (as  $IMP > DOM$ ). This shows a sector that while becoming  
21 relatively less important, and so with less pull over the whole economy, it also shows some  
22 relative import penetration, as its positive and large increase in domestic BL is lower than that  
23 of imported origin. But it started with a high domestic share in total BL and FL, so this can  
24 actually be welcome if these imported intermediates are necessary and currently not produced  
25 home or are more efficiently imported. Chart 2 below visually summarize this for both  
26 backward and forward linkages.  
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44 **Chart 2**            **About Here**  
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49 The large increase in forward imported inputs (240%) is simply due to the very small imported  
50 content in the base year. It can be shown that such an increase contributed with less than half  
51 of the increase in total forward linkages of 52%. In the forward linkage panel especially, every  
52 time that Table No.1 shows a very large IMP it should be interpreted as an imported  
53 contribution that starts from a very low imported base (e.g. notably industry 28: Real estate  
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1 activities with a 1758% increase). The primary sector then shows a slight relative import  
2 penetration in its BL pull and a more significant one in the FL push, but the latter is still at a  
3 very low import content base. And given that its output share has become significantly smaller,  
4 it has a significantly lower relative influence in the economy. Chart 3 shows the case for the  
5 secondary sector over the period.  
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### 11 **Chart 3**      **About Here**

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19 In contrast to the previous case, the secondary sector shows a clear case of absolute import  
20 substitution over the period ( $DOM > 0$  and  $IMP < 0$ ), both for backward (BL) and forward  
21 linkages (FL). But this is almost fully concentrated in its light industry for both BL and FL.  
22 This is especially the case for industries 4 (textiles plus), 5 (leather plus) and 6 (wood plus).  
23 Other things being equal, this means that this subsector has become less dependent on imports  
24 both upstream (BL) and downstream (FL) over the period, so it exerts a greater domestic pull  
25 and push over the economy. Medium industry, on the other hand, shows a mixed case of  
26 relative import penetration for BL and absolute import substitution for FL. For the former, this  
27 is especially the case for industries 8 (coke, petroleum refineries and nuclear fuel) and 9  
28 (chemicals plus). But industry 10 (rubber and plastics) shows an absolute import substitution,  
29 notably for industries 9 and 10. So it is mixed here too. For FL there is a more clear case of  
30 absolute import substitution. There appears to be a tendency towards the use domestic  
31 intermediates in general at the expense of imported ones, but key industries for energy sources  
32 and chemicals appear as a relative counter trend. Of course, an increase in the relative use of  
33 imported intermediates is not a problem in itself, as this may be more efficient. The issue  
34 however is about useful domestic linkages. A relative increase in imported inputs also  
35 represents a relative weakening of domestic integration (especially the BL pull of the  
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1 economy), which may have consequences for a more balanced growth if these are large (Stiglitz  
2 1996).  
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7 Heavy industry, in turn, which is the one that has grown significantly faster than the rest of the  
8 economy, exhibits a pretty mixed case. There is a small relative import substitution for BL,  
9 mostly on account of industries 15 (transport plus) and 16 (manufacturing plus), but at the same  
10 time an absolute import penetration in industries 13 (machinery) and 14 (electrical plus). As  
11 shown in Table No.1, the latter is the industry that shows the fastest growth in gross output  
12 share over the period, but also the one that exerts the largest domestic pull weight. But for FL  
13 its domestic linkage significantly increased while its import linkage significantly decreased  
14 (IMP < 0), so there is here a clear case of import substitution. This means, others things being  
15 equal, that while the pull of this industry has weakened, its push has increased<sup>(9)</sup>.  
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31 For FL, save for industry 14 (electricals plus) as indicated above, there is a relative import  
32 penetration in general on account of all of its industries, with an absolute import penetration in  
33 the case of industry 16 (non-electrical manufacturing). Finally, construction shows a mixed of  
34 relative import substitution for BL and absolute import penetration for FL. Given that the latter  
35 shows that DOM < 0, then it can be interpreted as a general fall in the domestic provision of  
36 construction intermediates to using industries over the period. Chart 4 shows the change rates  
37 of backward and forward linkages for the tertiary sector.  
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#### 51 **Chart 4      About Here**

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56 The tertiary sector also increased its BL (24%), with an increase in its relative domestic pull or  
57 relative import substitution (DOM>IMP), and an increase in its relative import supply push or  
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1 relative import penetration, but with a decreased share in gross output. So again, this is a sector  
2 that becomes better domestically integrated, especially in BL, but with a smaller but still  
3 significant relative influence pull on the whole economy.  
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9 The meagre increase of the BL rate of change in the domestic trade subsector (5%) is fully due  
10 to industry 21 (hotels and restaurants); and that of the finance plus subsector (28%) is due to  
11 real estate activities (industry 28) and renting machinery and equipment plus other business  
12 activities (industry 29). Transport, especially air one (industry 24), and social sectors, notably  
13 education, health and other services (industries 31-33), show both a strong BL increase and  
14 domestic pull. All this contributes to a more mutually dependent and integrated national  
15 economy.  
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30 As a general summary of section 3.2, we can conclude as follows. First, the primary sector  
31 shows the largest increase in domestic BL and FL, but the largest loss in output share, so while  
32 it becomes better integrated into the domestic economy has a relatively less influence in it.  
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34 There has also been some import penetration, especially in FL, which is due to mining and  
35 quarrying, but from a low import base. Second, the secondary sector shows a small increase in  
36 especially domestic BL, but the largest gain in its share of output. So it has both become better  
37 integrated into the economy and has by far the largest influence in it. This sector also shows an  
38 absolute import substitution over the last track of our period, but almost fully concentrated in  
39 its light industry for both BL and FL. Heavy industry shows on average a relative import  
40 substitution in BL, with small import penetration in its two largest industries (nos.13 and 14 in  
41 Table No.1). The other subsectors are on average mixed in this respect. Finally, the tertiary  
42 sector shows an increase in both domestic BL and FL and a secondary loss in its share of output  
43 over the period. So it has become better integrated and has an important but lower relative  
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1 influence in the economy than in 1995. This sector shows both absolute and relative import  
2 substitution for all its constituent subsectors on average. At the same time there is clear  
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4 indication of import penetration in FL for all constituent subsectors and industries, except  
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6 social sectors. So while the domestic BL pull has increased its traction, the domestic FL push  
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8 has lost some of its strength. The latter means that in general the economy depends on more  
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10 imported input supply coming to this sector than before. But this represents a small imported  
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12 FL proportion.  
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### 16 17 18 *3.3 Growth Rate Trajectory over 1995-2010* 19 20 21 22

23 We now look at the trajectory of backward and forward linkage growth rates over the period  
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25 in question, at the level of each sector and accounting for the domestic and imported linkage  
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27 growth rate changes via a collection of charts grouped in Charts 5-12. These show the evolution  
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29 of the linkage growth rates that made up the total linkage growth rate changes over the period  
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31 as shown in Table No.1.  
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#### 38 **Charts 5-12                      About Here** 39 40 41

42 Charts 5 and 6, which present this for the economy as a whole, show a similar pattern for both  
43  
44 total backward (BL) and forward (FL) linkages and their domestic (DOM) and imported (IMP)  
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46 components. There are three distinctive crossing points between the domestic and the imported  
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48 growth rates. First, for both BL and FL, from the beginning of our period in 1995 the charts  
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50 show that negative import rates were moving fast to positive territory, while positive domestic  
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52 rates were doing the opposite, producing a crossing by 1998. There is here a significant  
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54 decrease of both total backward and forward linkages, dragged down by linkages of domestic  
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56 origin, which only start to recover by 2001. This seems to correspond to the East-Asian crisis  
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1 of 1997-98. Second, from 2003, there is reversion where negative domestic rates move to  
2 positive territory, while import rates move to negative territory, producing a crossing in the  
3  
4 opposite direction by 2004. There is here a sustained increase in BL and FL that reaches its  
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6 maximum by 2006, almost fully on account of domestic linkages, as imported ones have now  
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8 become negative. And there is a third crossing, where BL and FL rapidly decrease, reaching  
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10 about zero by 2008-09, with imported linkages moving towards positive values while domestic  
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12 ones towards negative ones, which seems to correspond to the onset of the 2008 world crisis.  
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14 In general, the pattern for the whole is pretty similar to that for the three economic sectors.  
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16 There are only some minor differences in the timing of the crossings and in their levels, as can  
17  
18 be seen in the sectoral charts above.  
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27 Following the categorization of our Table No.3, this shows that between 1995 and 1998 there  
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29 mostly seems to be an absolute import substitution, then between 1998 and 2005 there appears  
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31 to be both an absolute and relative import penetration, and from 2005 until 2010 it shows an  
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33 absolute import substitution. That is, from 2004, domestic backward and forward linkages take  
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35 the largest contribution to total linkages, meaning that the use of domestically produced  
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37 intermediates, which otherwise would have been imported, significantly increased, making the  
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39 economy more domestically integrated over the last tract of our period. The latter seems to be  
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41 due to both policies towards the domestic market and the shock from the 2007-08 international  
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43 credit crunch, as further illustrated below.  
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### 50 *3.4 Some Policies behind the above Patterns*

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54 We know that the secondary sector underwent a massive growth over the period, increasing its  
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56 share of gross output to over 75%, especially for heavy and medium industries (Table No.1).  
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58 And also that the contribution of export demand to the total growth of the secondary sector  
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1 gross output was by far the most important demand source between 1997 and 2005. From about  
2 then, domestic demand became more prominent, replacing eventually export demand as the  
3 most important growth source of the period. This is seen to be related to important domestic  
4 policies and the credit crunch, which this tallies with the above observation that the growth  
5 rates of domestic BL became positive and significant after 2004<sup>(10)</sup>.  
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14 Over the period 1994-96 some deep reforms were introduced with the aim at both developing  
15 private domestic business and attracting foreign direct investment via among others policies a  
16 widespread liberalization of capital flows (Prasad and Wei 2005). The 1997 East-Asian crisis  
17 plus other accumulated domestic economic problems, like sluggish rural income growth and  
18 general industrial inefficiency, impinged on both a slowdown of positive growth rates and a  
19 significant fall in the total factor productivity of the economy (Albala-Bertrand 2013, Yueh  
20 2013, Zhen, Bigsten and Hu 2009). Apart from some short-term crisis-induced counteracting  
21 policies, which aimed at stimulating domestic demand, especially in the areas of construction  
22 and services over 1997-2001, some deeper reforms were introduced and implemented. Notably,  
23 a law that let the markets to guide prices with outside intervention by the government. In  
24 addition, in 2001 China became a member of the WTO, which eliminated direct price controls  
25 and export subsidies on agricultural products (Yueh 2010, 2013; Zhang and Tan 2007, OECD  
26 2002). On top of this, open market agreements with the US and Southeast Asian countries, set  
27 a strong foundation on which total factor productivity and capital intensity could contribute to  
28 the very high growth rates of the economy, especially between 2001 and 2007 (Albala-Bertrand  
29 2013). This especially relied upon heavy industry and exports (Yueh 2010, 2011; Lardy 2006),  
30 which accumulated some large imbalances in the economy to the point that by 2007 China  
31 officially acknowledged that its economic growth was “unsteady, unbalanced, uncoordinated  
32 and unsustainable” (Wen Jiabao-Annual Meeting of China’s legislature, 2007). This reality  
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1 check referred to the situation of the whole economy: imbalance between domestic and foreign  
2 demand, imbalance between the secondary and the other economic sectors, disparities between  
3 regions, increasing income inequalities, and market and product fragmentation, among others  
4 problems (Goodman and Parker 2014, Yueh 2010, Zhang and Tan 2007, World Bank 2005, Fu  
5 2004, Chow and Li 2002).

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14 This official admission coincided with the onset of the 2008 international financial crisis, which  
15 brought new policies to counteract it. A major stimulus package for agriculture, construction  
16 and services came about. There was here, sets of policies that focused on particular areas, like  
17 housing and rural infrastructure, education and health, environment and disaster reconstruction,  
18 industry and transportation, tax cuts and finance, and so on (Wong 2011). All this, appeared to  
19 have produced a strong structural change reversal, especially from 2007, between the  
20 contribution of final domestic demand and that of foreign demand to total gross output (Albala-  
21 Bertrand, 2016). This was also reflected in an important domestic substitution of previously  
22 imported intermediaries and in an increase of domestic backward and forward linkages, as  
23 shown in the charts above.

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41 It then seems that over the period 1995-2010, world external shocks together with counter and  
42 strategic policy packages as well as the overall structural change of economy and society, can  
43 be partly illustrated with the help of the above type of analysis, which can complement and  
44 serve as the basis for other approaches and aims (e.g. Albala-Bertrand, 2013, 2016; He and  
45 Zhang 2010, Cai and Wang 2010, Zheng, Wang and Shi 2008).

#### 4 Conclusions

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1 We started by setting up the input-output model and its derivation for total backward and  
2 forward linkages the economy. We then produced a decomposition of both type of linkages  
3 into domestic and imported ones. This was essential for our aims, which where to learn about  
4 the changes of domestic industrial/sectoral backward and forward linkages (i.e. the pull and  
5 push of the economy) as well as the changes in their domestic and imported linkages (i.e. via  
6 import substitution - import penetration changes) over the 1995-2010 period. To such aims we  
7 produced a disaggregation of 33 industries and a re-aggregation of the standard three economic  
8 sectors and their main subsectors of grouped industries, as presented in Table No.1. Then with  
9 the help of a couple of additional tables and a series of charts we presented the results in terms  
10 of rates of change for the period as a whole and for their yearly evolution or trajectories over  
11 such a period.  
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28 *(a) Whole period changes*  
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31 The first conclusion is that over the period, the secondary sector massively grew its share in  
32 total (gross) output via heavy industry (especially its electrical and optical equipment  
33 component), notably at the expense of the primary sector and secondarily the tertiary one. This  
34 is the result of the different speeds of positive growth rates of sectors and industries, given that  
35 as a rule none of them exhibited yearly negative growth rates of gross output over the period.  
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45 Total backward (BL) and forward linkages (FL) significantly increased for all sectors, with  
46 their highest increases in the primary and tertiary sectors. This should have made the primary  
47 sector as having the strongest pull and push over the economy, but this is a case of a sector that  
48 while becoming better domestically integrated, it shows also a significant share loss in gross  
49 output and a slight relative import penetration, making it a sector with significant less relative  
50 weight in the economy (Table No.2). Still, this sector started with a pretty high share of  
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1 domestic linkages, so this can actually be welcome if these imported intermediates are currently  
2 not produced home or are more efficiently imported. The tertiary sector is more mixed. Its  
3 domestic BL pull has become significantly more important (notably for trade and finance with  
4 an absolute import substitution), but with a lower share of total output, with the two factors  
5 partly compensating with each other, so this sector seems to have slightly reduced its relative  
6 domestic pull weight over the period. Its domestic FL push shows a similar picture.  
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17 The secondary sector shows a small positive increase in both backward and forward linkages,  
18 but it also shows on the whole an absolute import substitution. This is especially the case for  
19 the pull of light and heavy industry on the economy. In other words, these industries exert a  
20 demand pull on the whole economy that requires relatively less imported intermediates to  
21 satisfy it. Given the huge increase in output share, this sector on the whole has significantly  
22 increased its domestic weight on the economy. However, its electrical and optical equipment  
23 industry (no. 14), which also exhibits the largest share in output among all 33 industries, show  
24 a small absolute import penetration in backward linkages and an important import substitution  
25 in forward ones. This can be interpreted as follows. Any time that this industry initiates an  
26 increase in its domestic final output, all industries upstream (pull) will slightly increase their  
27 share of imported intermediates on average to satisfy the input requirement of this initial  
28 industry. But any time this industry increases its total supply of intermediates (domestic plus  
29 imported), all industries downstream (push) will be on average acquiring a lower share of  
30 imported intermediates to satisfy their own outputs (and not only that of the industry 14 alone).  
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53 *(b) Trajectories of changes over period*  
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56 Both for the total economy and for its constituent sectors the pattern of the trajectories are  
57 similar, although the levels and timing may slightly differ. There appear to be three distinctive  
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period, which correspond to the crossing points between the domestic and the imported linkage growth rates in the charts (Charts 5-15). First, around 1997-98 there appears to be a significant decrease of both backward (BL) and forward linkages (FL), dragged by a fall of linkages of domestic origin, which start to recover by 2001. For both BL and FL, import growth rates grow faster than declining domestic ones, the latter becoming negative by 1999. This seems to correspond to the East-Asian crisis of 1997-98 and policies that gave privilege to exports of especially heavy industry and market deregulation. Second, from 2003, there appears to be a sustained increase in both BL and FL, producing the opposite picture, where domestic linkages grow faster than imported ones, with the latter now becoming negative, producing a crossing by 2004. This departure reaches its maximum by 2006, and then this gap rapidly decreases. By 2007 China officially acknowledged that its economic growth was “unsteady, unbalanced, uncoordinated and unsustainable”, coinciding with the onset of the 2007-8 world financial crisis, which brought a major short-term stimulus package and longer-term reforms, giving more importance to the domestic market. Third, by 2008-09 the growth of BL and FL move towards zero, with the gap between the two then closing around it, where it seems that again imported linkages moves towards positive territory while domestic ones seem to go the other way round. So between 1995 and 1998 the economy shows an absolute import substitution, between 1998 and 2005 it shows both an absolute and relative import penetration, and from 2005 until 2010, it shows an absolute import substitution. The latter seems to be due to both policies towards the domestic market and the shock from the 2007-08 international credit crunch.

## **Appendix: Backward and Forward Linkages**

### *1. Backward Linkages (economic pull)*



Using equation (3) and recalling that  $A$  is a matrix of input demand coefficients, then solving for  $X$ :

$$X = (I - A)^{-1}(F + E - M) \quad (\text{gross output: demand viewpoint}) \quad (5)$$

Let  $C = (I - A)^{-1}$  be the Leontief inverse. Each element of this matrix contains the total (direct and indirect) input demand per unit of final demand ( $F + E - M$ ) of a particular industry with respect to any other industry (including itself). The column sum of  $C$  represents the total intermediate demand for domestic and imported inputs in all the economy, derived from the increase of one unit of output for final demand by a particular industry. This coefficient will be normally be larger than one, as for each unit of final demand, an addition of intermediate inputs is required to satisfy it, which is why sometimes the Leontief matrix is called a matrix of multipliers, i.e. multiplies each unit of final demand into a larger number of gross output units. The larger this is, the stronger the total upstream backward linkage between a particular industry and the overall economy. This represents the total industrial/sectoral pull of the economy. In matrix notation, backward linkages ( $BL$ ) are expressed as follows:

$$BL = i' C \quad (\text{backward linkage, row vector}) \quad (6)$$

This vector correspond to the vertical sum of the  $C$  matrix. In addition, these sectoral  $BL$  values should be weighted by the sectoral gross output shares in total gross output to assess their pull influence in the economy, as shown in Tables No. 1 and No. 2.

## 2. Forward Linkages (economic push)

The procedure we adopt here to calculate  $FL$  is fully analogous to that for  $BL$ , but instead of using a matrix of *input-demand* coefficients ( $A$ ), we use a matrix of *input-supply* coefficients ( $A^*$ )<sup>(11)</sup>. That is, letting  $i'W = X' A^*$ , substituting this in (4), and solving for  $X'$  we get:

$$X' = (V' - M^{W'}) (I - A^*)^{-1} \quad (\text{gross output: supply or production cost viewpoint}) \quad (7)$$

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Let us define the Leontief inverse as:  $C^* = (I - A^*)^{-1}$ , where each cell in this matrix contains the total (direct and indirect) intermediate supply per unit of net value added ( $V' - M^W$ ). Hence, a row sum of  $C^*$  accounts for the overall intermediate supply from a particular industry to all other industries in the economy, which derives from the initial increase of one unit of intermediate output supply by this particular industry (under the *ex-ante* assumption that it is acquired by all other industries that use it for their now increased production). This represents the total downstream industrial/sectoral push of the economy. Then, in matrix notation, forward linkages ( $FL$ ) are expressed as follows:

$$FL = C^*i \quad (\text{forward linkage column vector}) \quad (8)$$

This vector corresponds to the horizontal sum of the  $C^*$  matrix. In addition, these sectoral FL values should be weighted by the sectoral gross output shares in total gross output to assess their push influence in the economy, as shown in Tables No. 1 and No. 2.

## Notes

- (1) There are no input-output tables that directly include the import content of exports at sectoral/industrial level, so in our paper this is treated by means of imported input substitution of the whole economy, which does not allow to distinguish between intermediate imports used for domestic demand (consumption and investment) and those for export demand, let alone processed exports and non-processed ones. Given the highly globalized fragmentation of some industrial structures, the import content of exports and their supply chains, which relates to vertical specialization and derived value chains, are important research efforts, which have so far shown only relative success. Given the insufficiency of direct information from the standard tables, this issue has been tried indirectly either via the use of some strong

assumptions (e.g. Hummels et al. 2001), which produce some significant biases, or by means of focussing only on a couple of years by using complementary data that comes from custom and tax rules, which are peculiar to China alone (Yang, Dietzenbacher et al. 2015). This also require some convenient assumptions on these data, so the results may not be devoid enough of biases. The research attention paid to this issue is an important endeavour, which will surely see more robust results in due course.

(2) Notice that gross output includes both intermediate and final output, so from the viewpoint of GDP it would be double counting, as GDP already contains all the value-added additions to final output from all the intermediate inputs required for its production. But from the viewpoint of each industry (or firm), it represents the actual productive effort to supply both intermediate inputs to other industries (or firms) and goods/services for final demands. So what the input-output model does is to show the total productive effort made, directly and indirectly, by all sectors of the economy.

$$(3) \quad \Delta BL = i'[\Delta B^{-1}] = i'[B_1^{-1}B_0^{-1}B_0 - B_0^{-1}B_1^{-1}B_1] = i'[B_0^{-1}(B_0 - B_1) B^{-1}_1]$$

$$= i'B_0^{-1}\{[I - (A^d + A^m)_0] - [I - (A^d + A^m)_1]\}B^{-1}_1 = i'[B_0^{-1}\Delta A^d B^{-1}_1] + i'[B_0^{-1}\Delta A^m B^{-1}_1].$$

$$(4) \quad \Delta FL = [\Delta B^{*-1}]i = [B^*_{1^{-1}}B^*_{0^{-1}}B^*_0 - B^*_{0^{-1}}B^*_{1^{-1}}B^*_1]i = [B^*_{0^{-1}}(B^*_0 - B^*_1) B^*_{1^{-1}}]i$$

$$= B^*_{0^{-1}}\{[I - (A^{*d} + A^{*m})_0] - [I - (A^{*d} + A^{*m})_1]\}B^*_{1^{-1}}i$$

$$= [B^*_{0^{-1}}\Delta A^{*d} B^*_{1^{-1}}]i + [B^*_{0^{-1}}\Delta A^{*m} B^*_{1^{-1}}]i$$

(5) As the OECD defines it: “the basic price is the amount receivable by the producer from the purchaser for a unit of a good or service produced as output minus any tax

1 payable, and plus any subsidy receivable, on that unit as a consequence of its  
2 production or sale. It excludes any transport charges invoiced separately by the  
3 producer as well as suppliers' retail and wholesale margins". This is considered a  
4 better measure of industrial efforts than market (final) prices.  
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12 (6) It is to be noticed that over this period the growth rate of gross output ( $\Delta X/X_{1995}$ )  
13 was around 385%. For an input-output analysis of structural change in industrial  
14 output over this period, see Albala-Bertrand (2016), which is a good complement  
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24 (7) Other things being equal, the backward-pull demand contribution (BL) is normally  
25 the most important *ex-ante*, as it represents a direct demand stimulus to supplying  
26 firms to increase their output to satisfy such a new market demand, while the  
27 forward-push supply contribution (FL) represents only an opportunity for  
28 purchasing firms to increase their output, as more inputs are now available from  
29 their suppliers, but that does not guarantees its market sale. However, *ex post*, FL  
30 reflects what actually happened by giving an indication of the importance of the  
31 input supply of a particular sector/industry on all sectors/industries of the economy,  
32 which is what we do in this paper.  
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48 (8) Other things being equal, if newly available imports are taken up by firms to  
49 increase their output (whether for an expected demand or for inventories), this will  
50 necessarily increase the demand for domestic and other imported intermediates to  
51 satisfy such a new output, so there will be an indirect backward pull effect, which  
52 was originated by an imported forward push effect. However, *ex post*, this effect is  
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already counted when measuring backward linkages, which is what we do in this paper.

(9) A simple visualization would be to imagine that this industry makes the economy to require (directly and indirectly) relatively more imports to satisfy its output, but the increased availability of domestic intermediate supply from this industry to the rest of the economic sectors seems to require less imported inputs for their own productions.

(10) Had we kept adding charts, we would have seen that the pattern for domestic BL and FL for the three main components of the secondary sector was similar to that for the whole, confirming the prominence of heavy and medium industry after 2004.

(11) The standard procedure to calculate FL is based in the matrix  $A$ , rather than  $A^*$ , but this has serious shortcomings (Bulmer-Thomas, 1982). This still has shortcomings, but they are less relevant for our *ex-post* or actual linkage analysis.

## Bibliography

Albala-Bertrand, J.M. (2016) "Structural Change in Industrial Output: China 1995-2010", *Journal of Chinese and Foreign Trade Studies*, Vol 9, No. 2, pp.146-170.

Albala-Bertrand, J.M. (2013) "Evolution of structural indicators: China and its regions 1981-2010", *Journal of Chinese and Foreign Trade Studies*, Vol.6, No.3, pp.100-18.

Albala-Bertrand, J.M. (1999), 'Structural Change in Chile: 1960-1990,' *Economic Systems Research*, 11, 301-319.

Amiti, M. and Freund, C. (2010), "The Anatomy of China's Export Growth" in R.C. Feenstra and S.-J. Wei (Eds) (2010), *China's Growing Role in World Trade* (Chicago: University of Chicago Press), Chap2, pp.35-56.

Bulmer-Thomas, V. (1982), *Input-Output Analysis in Developing Countries*, John Wiley, New York.

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- Cai, F. and Wang, M. (2010) “Growth and structural changes in employment in transition China”, *Journal of Comparative Economics* Vol. 38, pp. 71–81.
- Chow, G. and Li, K.W. (2002) “China’s Economic Growth: 1952-2010”, *Economic Development and Cultural Change*, Vol. 51, No. 1, pp. 247-56.
- Dean, J.M., Fung, K.C. and Wang Z. (2011) “Measuring Vertical Specialization: The Case of China”, *Review of International Economics*, Vol.19, No.2, pp. 609-625.
- Evans, P. and Stavetieg, S. (2009).“The Changing Structure of Employment in Contemporary China.” *IRLE Working Paper No. 190-09*. <http://irle.berkeley.edu/workingpapers/190-09.pdf>.
- Fu X., (2004), “Limited linkages from growth engines and regional disparities in China”, *Journal of Comparative Economics*, No. 32, 148-64.
- Goodman, M. and Parker, D. (2014) “China’s Economic Policymaking at a Time of Transition”, *Center for Strategic and International Studies* (April).
- He, D. and Zhang, W. (2010) “How Dependent Is the Chinese Economy on Exports and in What Sense Has its Growth Been Export-Led?” *Journal of Asian Economics*, Vol. 1, No.21, pp. 87-104.
- Hirschman, A. (1958): *The Strategy of Economic Development* (New Haven, Yale University Press).
- Hirschman, A. (1977): “Enfoque generalizado del desarrollo por medio de enlaces, con referencia general a los productos básicos”, *El trimestre económico*, vol. 44(1), No. 173, Mexico City, Fondo de Cultura Económica, January-March.
- Hummels, D., J. Ishii and K.-M. Yi (2001) “The Nature and Growth of Vertical Specialization in World Trade”. *Journal of International Economics*, No. 54, pp. 75–96.
- Ichimura, S. and Wang, H.-J. (2003) *Interregional Input-output Analysis of the Chinese Economy* (London: World Scientific Publication).
- Lardy, N. (2006) “China: Toward a Consumption-Driven Growth Path”, *Institute for International Economics, Policy Brief* 06-6 (October).
- NBS (National Bureau of Statistics of China): <http://www.stats.gov.cn/english>.
- Pan, W., Yang, D. and Lin, M. (2012) “Inter-industry Technology Spillover Effects in China: Evidence from 35 Industrial Sectors”, *China & World Economy*, vol. 20, Issue 2, pp. 23–40.
- Pei, J., Dietzenbacher, E., Oosterhaven, J. and Yang, C. (2011), "Accounting for China’s import growth: a structural decomposition for 1997 – 2005," *Environment and Planning*, vol. 43 (12), pp. 2971-299.
- Prasad, E. and Wei, S. (2005) “The Chinese Approach to Capital Inflows: Patterns and possible explanations”, *NBER Working Paper* No. 11306.

- 1 Stiglitz, J. (1996), 'Some Lessons from the East Asian Miracle', *World Bank Research Observer*, 11,  
2 151-177.
- 3 Syrquin, M. (1992): "Linkages and the strategy of development", in S. Teitel (ed.), *Towards*  
4 *a New Development Strategy for Latin America*, Washington, D.C, Inter-American  
5 Development Bank (IDB).
- 6
- 7 WIOD (World Input-Output Database 2015): [http://www.wiod.org/new\\_site/home.htm](http://www.wiod.org/new_site/home.htm).
- 8
- 9
- 10 Wong, Christine (2011), "The Fiscal Stimulus Programme and Public Governance Issues in  
11 China", *OECD Journal on Budgeting*, Vol. 11/3.
- 12
- 13 World Bank (2005) "China Integration of National Product and Factor Markets Economic  
14 Benefits and Policy Recommendations", *World Bank Report* No. 31973-CHA.
- 15
- 16
- 17 Yang, C., Dietzenbacher, E., Pei, J., Chen, X., Zhu K. & Tang Z. (2015) "Processing Trade  
18 Biases. The Measurement of Vertical Specialization in China", *Economic Systems*  
19 *Research*, Vol. 27, No 1, pp. 60-76.
- 20
- 21
- 22 Yueh, L. (2010) *The Economy of China* (Cheltenham, E.Elgar).
- 23
- 24 Yueh, L. (2011) *Enterprising China. Business, Economic, and Legal Developments since*  
25 *1979* (Oxford, Oxford University Press).
- 26
- 27
- 28 Yueh, L. (2013) *China's Growth: The Making of an Economic Power* (Oxford, Oxford  
29 Scholarship Online).
- 30
- 31 Zhang, X. and Tan, K. (2007) "Incremental Reform and Distortions in China's Product and  
32 Factor Markets", *The World Bank Economic Review*, Vol. 21, No. 2, pp. 279-99.
- 33
- 34
- 35 Zhen, J., Bigsten, A. and Hu, A. (2009) "Can China's Growth be Sustained? A  
36 Productivity Perspective" *World Development*, Vol. 37, No. 4, pp 874-88.
- 37
- 38 Zheng, J., Wang, Z. and Shi, J (2008) "Industrial Productivity Performance in Chinese  
39 Regions (1987-2002): A Decomposition Approach", *Journal of Chinese Economic*  
40 *and Business Studies*, Vol. 6, No. 2, 157-75.
- 41
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TABLE No.1: Backward and Forward Linkages 1995-2010 (BP Yuans 10m, 1995 prices).

NACE	1995-2010 No INDUSTRY	BACKWARD LINKAGES (BL)								FORWARD LINKAGES (FL)											
		SX <sub>1995</sub>	SX <sub>2010</sub>	BL <sub>1995</sub>	DOM BL	ABL/BL <sub>1995</sub>	DOM IMP	DBL <sub>1995</sub>	DBL <sub>2010</sub>	DBLW <sub>1995</sub>	DBLW <sub>2010</sub>	FL <sub>1995</sub>	DOM FL	ΔFL/FL <sub>1995</sub>	DOM IMP	DFL <sub>1995</sub>	DFL <sub>2010</sub>	DFLW <sub>1995</sub>	DFLW <sub>2010</sub>		
A65	1 Agriculture, hunting, forestry and fishing	12.5	3.9	1.9	92	27	28	15	1.8	2.3	9	3	2.2	95	41	41	57	2.1	3.1	11	4
C	2 Mining and quarrying	3.1	1.5	2.3	91	85	82	108	2.1	3.8	3	2	4.4	87	58	27	273	3.8	5.5	5	3
1516	3 Food, beverages and tobacco	6.4	5.5	2.6	94	-1	-1	-3	2.4	2.4	7	5	1.8	96	41	42	11	1.8	2.6	5	5
1713	4 Textiles and textile	5.8	5.3	3.0	89	4	17	-104	2.6	3.1	6	6	2.3	83	23	46	-90	1.9	3.4	5	5
19	5 Leather, leather and footwear	1.4	1.0	3.1	89	2	14	-96	2.8	3.1	2	1	1.9	84	20	34	-53	1.6	2.6	1	1
20	6 Wood and of wood and cork	1.1	1.5	2.8	90	0	9	-74	2.5	2.7	1	1	3.1	87	21	34	-68	2.7	4.1	1	2
2122	7 Pulp, paper, printing and publishing	1.9	2.0	2.8	91	1	4	-27	2.6	2.7	2	2	3.7	89	21	31	-58	3.3	4.8	3	3
23	8 Coke, refined petroleum and nuclear fuel	1.7	1.2	2.8	87	24	14	86	2.4	2.8	2	1	3.9	92	22	19	48	3.6	4.6	3	2
24	9 Chemicals and chemical	4.5	4.1	2.9	90	32	32	36	2.6	3.4	5	5	3.9	83	15	25	-33	3.2	4.8	6	6
25	10 Rubber and plastics	2.3	2.8	3.1	90	1	4	-31	2.7	2.9	3	3	3.3	92	20	23	-22	3.0	4.0	3	4
26	11 Other non-metallic mineral	4.4	3.1	2.8	93	-1	-2	10	2.6	2.5	5	3	2.6	100	3	1	1306	2.6	2.7	5	3
2728	12 Basic metals and fabricated metal	8.1	9.2	3.1	91	3	1	26	2.9	2.9	10	10	3.7	91	7	10	-24	3.3	4.0	11	12
29	13 Machinery, nec	4.0	6.6	3.0	91	-3	-4	4	2.7	2.6	5	6	2.7	93	9	5	63	2.5	2.8	4	6
3033	14 Electrical and optical equipment	5.0	16.1	3.2	88	-6	-7	3	2.8	2.6	6	15	2.6	68	16	31	-14	1.8	3.4	4	13
3435	15 Transport equipment	2.6	6.0	3.2	91	-6	-5	-12	2.9	2.7	3	6	2.5	90	6	6	7	2.2	2.6	2	5
3637	16 Manufacturing nec; recycling	0.7	0.8	2.9	90	-17	-13	-56	2.6	2.3	1	1	2.3	95	1	-13	240	2.1	2.0	1	1
E	17 Electricity, gas and water supply	1.9	2.4	2.4	92	55	52	86	2.2	3.3	2	3	3.8	100	28	26	1106	3.8	4.7	3	4
F	18 Construction	8.1	7.5	3.0	92	36	37	26	2.7	3.7	9	10	1.1	98	-3	-4	30	1.1	1.1	4	3
51	19 Wholesale trade and commission trade, ex motor vehicles	5.2	3.4	2.3	92	-5	-4	-17	2.1	2.0	5	2	2.9	99	-5	-7	229	2.9	2.7	6	3
52	20 Retail trade, ex motor vehicles; repair of household goods	1.1	0.7	2.3	92	-5	-4	-17	2.1	2.0	1	1	2.9	99	-7	-7	-12	2.9	2.7	1	1
H	21 Hotels and restaurants	1.8	1.5	2.4	94	23	24	7	2.2	2.8	2	1	2.2	88	25	33	-29	1.9	2.9	1	1
60	22 Inland transport	2.4	1.6	2.1	91	17	18	4	1.9	2.3	2	1	3.1	98	15	10	341	3.1	3.5	3	2
61	23 Water transport	0.3	0.6	2.6	90	8	8	1	2.3	2.5	0	1	2.7	97	22	23	-15	2.6	3.4	0	1
62	24 Air transport	0.3	0.3	2.6	91	37	36	43	2.3	3.2	0	0	2.6	83	19	6	81	2.1	2.7	0	0
63	25 Other Supporting and auxiliary transport activities; travel agencies	0.7	0.7	2.2	92	23	24	10	2.0	2.5	1	1	2.6	80	0	14	-59	2.1	3.0	1	1
64	26 Post and telecommunications	0.5	1.2	2.1	89	19	18	20	1.8	2.2	0	1	3.0	95	-12	-14	35	2.8	2.5	1	1
7	27 Financial intermediation	3.1	2.0	2.0	92	-5	-3	-24	1.8	1.7	2	1	3.4	99	5	5	44	3.3	3.5	4	3
28	28 Real estate activities	2.0	1.1	1.6	93	16	15	35	1.5	1.7	1	1	2.1	100	-15	-16	1758	2.1	1.8	2	1
717	29 Renting of m&eq and other business activities	1.8	1.9	2.5	87	62	72	-11	2.2	3.8	2	3	2.5	93	38	34	91	2.3	3.4	2	2
L	30 Public admin and defence; compulsory social security	1.9	1.4	2.4	92	25	28	-11	2.2	2.8	2	1	1.0	93	13	4	9	0.9	1.1	1	1
M	31 Education	1.3	1.2	2.0	91	43	42	54	1.9	2.6	1	1	1.2	100	13	11	535	1.2	1.3	1	1
N	32 Health and social work	1.0	1.0	2.7	90	45	48	18	2.5	3.6	1	1	1.1	86	29	35	-4	0.9	1.5	0	0
O	33 Other community, social and personal services	1.1	1.1	2.4	91	48	50	29	2.2	3.2	1	1	1.8	93	47	49	20	1.7	2.7	1	1
I	PRIMARY SECTOR (1,2)	15.6	5.4	2.1	92	59	58	69	1.9	3.1	12	5	3.3	94	52	32	240	3.1	4.3	16	7
II	SECONDARY SECTOR (3-18)	59.9	75.1	2.9	91	7	9	-11	2.6	2.9	67	77	2.8	90	16	20	-17	2.5	3.4	60	75
	Light Industry (3-7)	16.5	15.3	2.9	91	1	9	-69	2.6	2.8	18	15	2.6	89	24	37	-65	2.3	3.5	14	16
	Medium Industry (8-12)	21.0	20.4	2.9	91	11	10	28	2.7	2.9	34	22	3.5	91	14	16	-10	3.2	4.0	28	27
	Heavy Industry (13-17)	14.2	31.8	2.9	90	2	3	0	2.6	2.7	16	30	2.7	84	14	12	29	2.3	3.1	14	29
	Construction (18)	8.1	7.5	3.0	92	36	37	26	2.7	3.7	9	10	1.1	98	-3	-4	30	1.1	1.1	4	3
III	TERTIARY SECTOR (19-33)	24.4	19.5	2.3	92	24	26	9	2.1	2.6	21	18	2.3	94	10	10	18	2.2	2.6	24	18
	Domestic Trade (19-21)	8.1	5.5	2.3	93	5	6	-11	2.1	2.3	7	4	2.7	97	3	3	-11	2.6	2.7	9	5
	Transport plus (22-26)	4.2	4.4	2.3	91	21	21	16	2.1	2.5	4	4	2.8	94	9	8	20	2.6	3.0	5	5
	Finance plus (27-29)	6.9	5.0	2.0	91	28	32	-6	1.8	2.4	5	4	2.7	98	10	8	90	2.6	2.9	8	5
	Social sectors (30-33)	5.2	4.6	2.4	91	40	42	21	2.2	3.1	5	5	1.3	92	28	35	10	1.2	1.7	3	3
	Average/Total	100.0	100	2.6	91	17	19	0.23	2.3	2.8	100	100	2.6	90	17	17	16	2.4	3.1	100	100

BP: basic prices (10 million Yuans)  
NACE: European Classification of Economic Activities  
SX: gross output share in total gross output in 2010 (%)  
BL<sub>1995</sub>: total backward linkages in 1995  
FL<sub>1995</sub>: total forward linkages in 1995  
DOM/BL<sub>1995</sub>: domestic-to-total 1995 BL (%)  
DOM/FL<sub>1995</sub>: domestic-to-total 1995 FL (%)  
ABL/BL<sub>1995</sub>: backward linkages sectoral/industrial rate of change (%)  
ΔFL/FL<sub>1995</sub>: forward linkages sectoral/industrial rate of change (%)  
DOM: domestic sectoral/industrial rate of change (%)  
IMP: imported sectoral/industrial rate of change (%)  
DBL<sub>2010</sub>: domestic BL in 2010  
DBL<sub>1995</sub>: domestic FL in 2010  
DBLW: domestic sectoral/industrial BL weights (%)  
DFLW: domestic sectoral/industrial FL weights (%)



TABLE No.2: Sectoral BL and FL weights in the economy – 1995 and 2010.

	2010	SX <sub>2010</sub>	SX <sub>1995</sub>	BL <sub>1995</sub>	DBL <sub>1995</sub>	DBL <sub>2010</sub>	DBLW <sub>1995</sub>	DBLW <sub>2010</sub>	DBLW <sub>1995</sub> /SI	DBLW <sub>2010</sub> /SI
<b>BL</b>	<b>SI</b>	5	16	2.1	1.9	3.1	12	5	1	1
<b>BL</b>	<b>SII</b>	75	60	2.9	2.6	2.9	67	77	6	15
<b>BL</b>	<b>SIII</b>	20	24	2.3	2.1	2.6	21	18	2	3
<b>Average/Total</b>				<b>2.6</b>	<b>2.3</b>	<b>2.8</b>	<b>100</b>	<b>100</b>		

	2010	SX <sub>2010</sub>	SX <sub>1995</sub>	FL <sub>1995</sub>	DFL <sub>1995</sub>	DFL <sub>2010</sub>	DFLW <sub>1995</sub>	DFLW <sub>2010</sub>	DFLW <sub>1995</sub> /SI	DFLW <sub>2010</sub> /SI
<b>FL</b>	<b>SI</b>	5	16	3.3	3.1	4.3	16	7	1	1
<b>FL</b>	<b>SII</b>	75	60	2.8	2.5	3.4	60	75	4	11
<b>FL</b>	<b>SIII</b>	20	24	2.3	2.2	2.6	24	18	2	3
<b>Average/Total</b>				<b>2.6</b>	<b>2.4</b>	<b>3.1</b>	<b>100</b>	<b>100</b>		

SI,SII,SIII economic sectors

BL backward linkages

FL forward linkages

SX Sectoral share in total gross output (%)

DBL domestic backward linkages

DFL domestic forward linkages

DBLW domestic BL weight in the economy (%)

DFLW domestic FL weight in the economy (%)

DBLW/SI sectoral DBLW with respect to DBLW of SI (number of times)

DFLW/SI sectoral DFLW with respect to DFLW of SI (number of times)

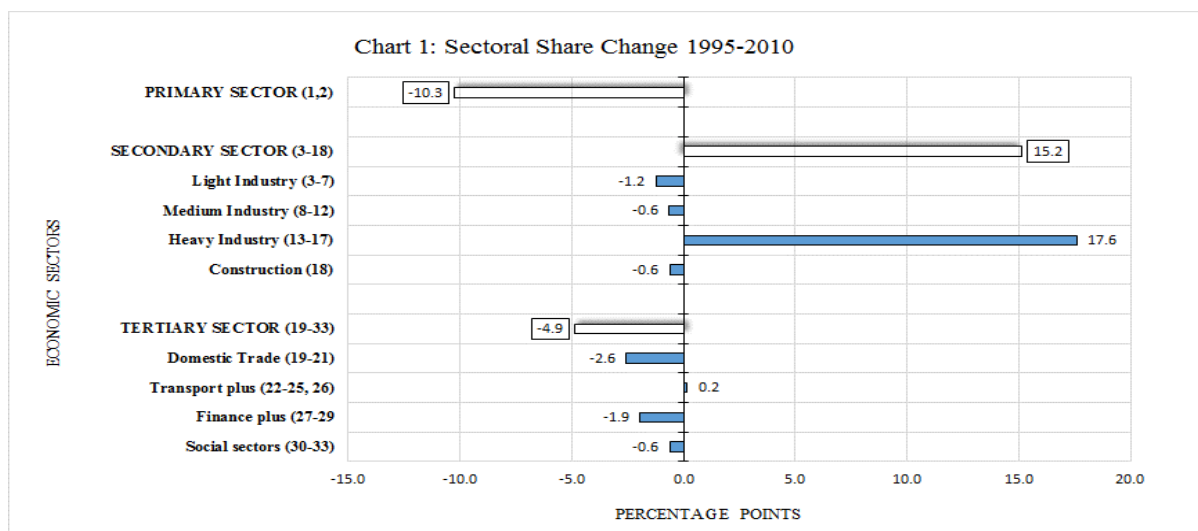
TABLE No.3: Structural Trade Change Interpretation of DOM-IMP Comparison

COMPARISON	SIGNS	STRUCTURAL CHANGE TYPE
DOM = IMP	if both positive or negative or zero	No change
DOM > IMP	if both positive or negative	Relative Import Substitution
DOM > IMP	if DOM positive and IMP negative*	Absolute Import Substitution
DOM < IMP	if both positive or negative	Relative Import Penetration
DOM < IMP	if DOM negative* and IMP positive	Absolute Import Penetration

\* it includes zero

TABLE No.4: Sectors and Subsectors Trade Structural Change (industry averages)

		Relative Imp. Substitution	Absolute Imp. Substitution	Relative Imp. Penetration	Absolute Imp. Penetration	<b>Total Sector Average</b>
PRIMARY	BL	agriculture	x	mining	x	small relative import penetration
	FL	x	x	agriculture and mining	x	strong relative import penetration
SECONDARY	BL	construction	light and heavy	medium	x	medium absolute import substitution
	FL	x	light and medium	heavy	construction	medium absolute import substitution
TERTIARY	BL	transport and social sectors	dom trade and finance	x	x	small relative import substitution
	FL	social sectors	x	transport and finance	dom trade	small relative import penetration



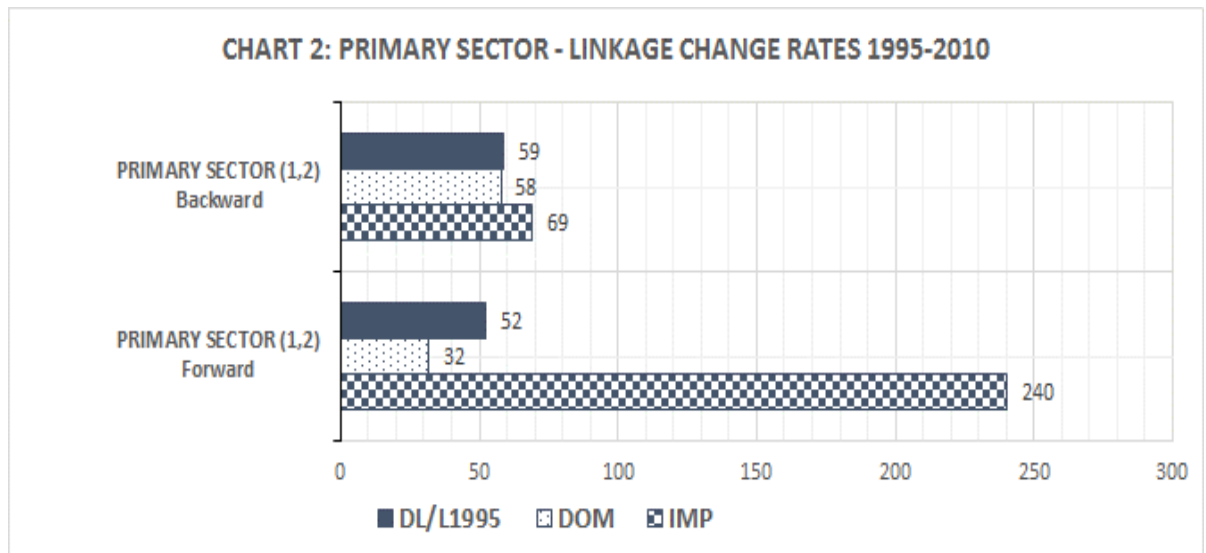
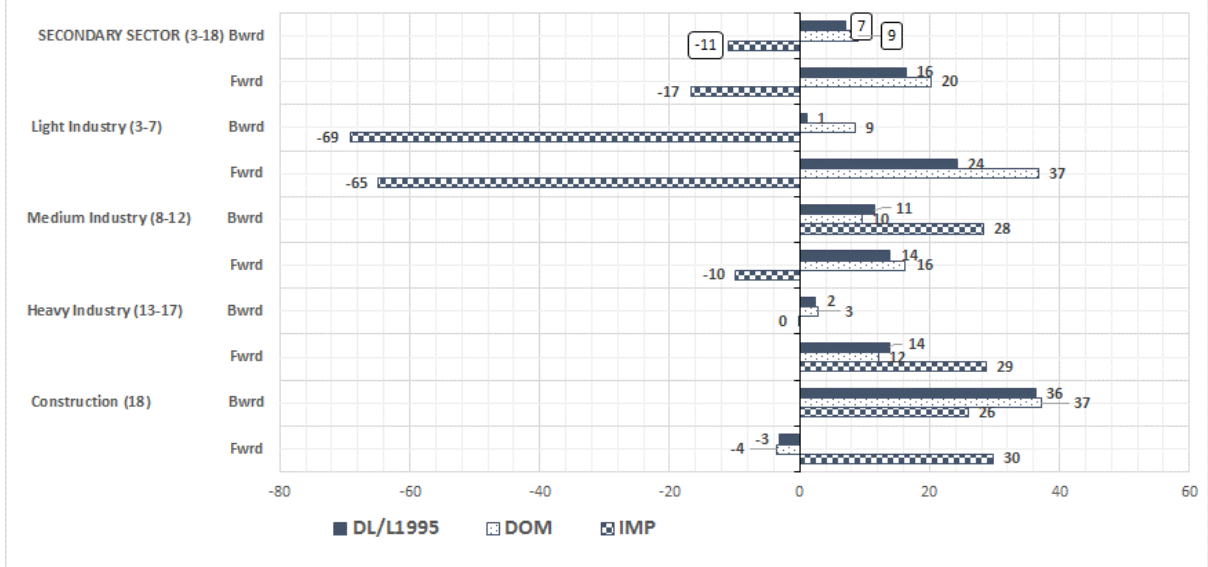


CHART 3: SECONDARY SECTOR - LINKAGE CHANGE RATES 1995-2010



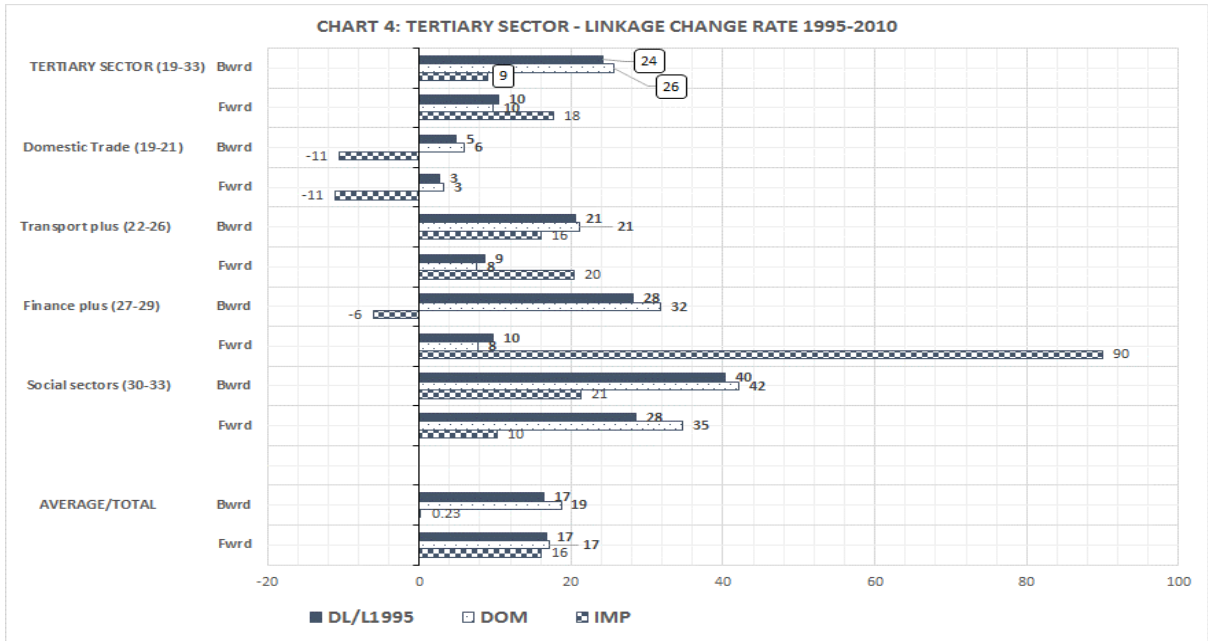


Chart 5 (compound of charts 5-12): BL and FL - Total and Sectoral Growth Rates 2006-2010.

