Incorporating Import Coefficients into a Structural Decomposition Analysis

An Empirical Investigation on Brazilian Growth Sources

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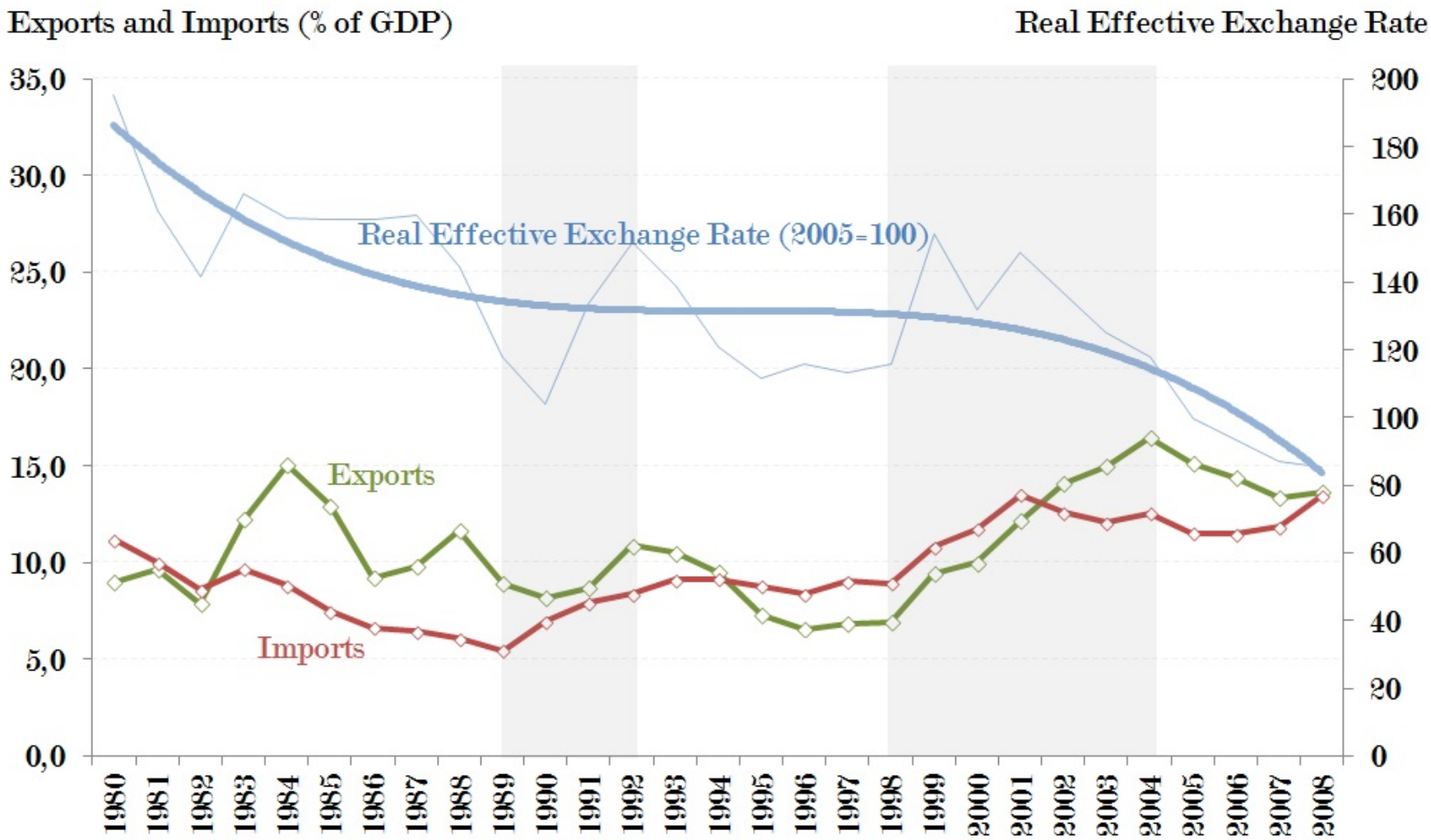
Outline

Introduction
Structural Changes in Brazil

- Last decades: some macro regimes had effects on the Brazilian production chains, e.g.:
  - Economic openness in the 1990s
  - Exchange rate appreciation in the 2000s
- From a global perspective they have been integrated into global supply chains, and this has permitted an increase in exports not witnessed in decades
- On the other hand: substitution of imported inputs for domestic suppliers - the potential for growth in demand to precipitate economic growth have declined

Introduction

Economic openness and Real Exchange Rate



Introduction

Why a multi-sectoral perspective?

- Some aspects cannot be observed in one-sector analysis:
  - Which chains have changed more substantially?
  - What are the implications in the long-run, considering that sectors have different income-elasticies of demand, increasing returns to scale, etc...
- Global supply chains - Asian x Latin American countries:
  - high-tech or low-tech products;
  - commodities, labour-intensive products, etc...
- Therefore, it is important to decompose changes in industrial chains to determine the sectors in which the substitution of imported inputs was more intense

Introduction
Changes in SDA methods

- SDA method considers that total output depends on:
  1. final demand: affects production directly
  2. intermediate consumption: depends on I-O coefficients
- Purpose: a method to decompose these changes in intermediate consumption into two:
  1. changes in input-output coefficients (technological change)
  2. substitution of imported inputs for domestic suppliers
- The aim of this decomposition is to identify to what extent output growth across sectors is affected by the substitution between domestic and imported inputs

Structural Decomposition Analysis

What is the method?

- Based on two I-O tables, it disaggregates the total amount of change into various components
- The contribution of each component may be analysed separately
- Some examples of SDA application
  - McClain & Palmer (1987): decomposed output in final demand and I-O coefficients
  - Skolka (1989): decomposition of net output into the contributions of technological shifts, domestic final demand, foreign trade, and labour productivity

Structural Decomposition Analysis

Applications of SDA to Brazil

- Messa (2012): declines in the intermediate consumption of domestic industrial output is the most important determinant of the growth differential between services and industry
- Moreira & Ribeiro (2012): output growth was primarily explained by changes in final demand, while technical progress had less of an impact
- However, they did not take into account the effect of substitution between domestic suppliers and imports:
  - has Brazil been achieving low growth rates due to substitution between imported and domestic inputs in sectors that have the potential to increase the country's growth rate?

Structural Decomposition Analysis

Basic SDA method (Miller & Blair, 2009)

Leontief model for years 0 and 1: $x^1 = L^1 f^1$ and $x^0 = L^0 f^0$, so, the observed change in gross output is:

$$\Delta x = x^1 - x^0 = L^1 f^1 - L^0 f^0$$

Some re-arrangements may be employed to decompose this change:

$$\Delta x = L^1(f^0 + \Delta f) - (L^1 - \Delta L)f^0 = (\Delta L)f^0 + L^1(\Delta f)$$
$$\Delta x = (L^0 + \Delta L)f^1 - L^1(f^1 - \Delta f) = (\Delta L)f^1 + L^0(\Delta f)$$

According to Dietzenbacher & Los (1998) the the average approach is often an acceptable method for SDA:

$$\Delta x = \underbrace{\frac{1}{2}(\Delta L)(f^0 + f^1)}_{(i)} + \underbrace{\frac{1}{2}(L^0 + L^1)(\Delta f)}_{(ii)}$$

(i) change in Leontief coefficients; (ii) change in final demand.

Incorporating import coefficients into a SDA (1)

1) Changes in Leontief coefficients have to be partitioned into technological changes and substitution between national and imported inputs: $L^1 = (I - A_n^1)$ and $L^0 = (I - A_n^0)$

2) Doing some algebra we have:

$$\Delta L = L^1 A_n^1 L^0 - L^1 A_n^0 L^0 = L^1(\Delta A_n)L^0 = L^1(A_n^1 - A_n^0)L^0$$

3) Since A_n^t is the difference between total direct coefficient matrix (A^t) and direct coefficient matrix of imported goods (A_m^t), the change in Leontief matrix can be written alternatively as:

$$\Delta L = L^1[(A^1 - A_m^1) - (A^0 - A_m^0)]L^0$$

Incorporating import coefficients into a SDA (2)

4) Rearranging, the decomposition of change in Leontief matrix into technological changes and substitution between national and imported goods is given by:

$$\Delta L = L^1(\Delta A)L^0 + L^1(-\Delta A_m)L^0$$

5) Finally, substituting the last equation in the basic SDA, the total output growth can be partitioned:

$$\Delta x = \underbrace{[L^1(\Delta A)L^0]\frac{f^0 + f^1}{2}}_{(i)} + \underbrace{[L^1(-\Delta A_m)L^0]\frac{f^0 + f^1}{2}}_{(ii)} + \underbrace{\frac{L^0 + L^1}{2}(\Delta f)}_{(iii)}$$

(i) technological change,
(ii) substitution between national inputs and imports, and
(iii) final demand growth

Applying this analytical tool to Brazil

Decomposition of Brazilian output growth

Table 1: Decomposition of Brazilian output growth (1995-2008)

	Impacts of technological change ($\Delta\%A$)	**Substitution of imported inputs ($-\Delta\%A_m$)**	**Final demand growth ($\Delta\%f$)**	**Total output growth ($\Delta\%x$)**
Total	**8.3%**	**-7.0%**	**44.7%**	**46.0%**
Agriculture and Mining	**22.1%**	**-13.9%**	**61.6%**	**69.8%**
Manufacturing	**3.6%**	**-11.1%**	**43.4%**	**36.0%**
Low/Med-Low Tech	-1.3%	-7.1%	35.9%	27.6%
High/Med-High Tech	13.1%	-18.1%	57.3%	52.4%
Chemical Products	20.6%	-22.0%	32.5%	31.1%
Machinery	1.3%	-9.4%	85.8%	77.8%
Electrical/Optical	24.7%	-28.9%	33.9%	29.7%
Transport Equip.	3.5%	-10.3%	98.5%	91.6%
Services	**9.0%**	**-3.7%**	**43.6%**	**48.9%**

Source: World Input-Output Database

Applying this analytical tool to Brazil

Impact on output of substitution between imported and domestic inputs

Table 2: Impact on output of substitution between imported and domestic inputs

	1995-99	1999-2003	2003-08	1995-2008
Total	**-0.4%**	**-0.2%**	**-6.5%**	**-7.0%**
Agriculture and Mining	**1.7%**	**-1.5%**	**-14.1%**	**-13.9%**
Manufacturing	**-1.4%**	**-0.1%**	**-9.7%**	**-11.1%**
Low/Med-Low Tech	0.0%	-0.5%	-7.6%	-7.1%
High/Med-High Tech	-4.2%	-1.4%	-13.3%	-18.1%
Chemical Products	-3.5%	-0.2%	-18.9%	-22.0%
Machinery	-1.4%	-1.2%	-7.0%	9.4%
Electrical/Optical	-7.8%	-5.1%	-18.9%	-28.9%
Transport Equip.	-3.5%	0.2%	-7.3%	-10.3%
Services	**-0.1%**	**-0.1%**	**-3.5%**	**-3.7%**

Source: World Input-Output Database

Applying this analytical tool to Brazil

Decomposition of Brazilian output growth sources

- Technological change had a relevant impact on growth (8.3%), but it was compensated by the increase in import coefficients:
  - Primary sectors: the impact of substitution of imported inputs on output is 13.9%
  - High- and medium-high tech : the substitution of imported inputs compensated for technological change effects: it reduced overall output growth by 18.1%
  - It was particularly pronounced in the chemical sector and electrical and optical equipment

- The process of substitution for national inputs picked up between 2003 and 2008
  - It can be seen particularly in the primary sectors
  - But, again, it was significant in Chemical Products and Electrical/Optical Equip.

Conclusion

- Results contrast with other SDA applications for Brazil
  - Messa (2012) and Moreira & Ribeiro (2012) did not consider substitution of imported inputs: other conclusions
  - Relevance of analysing import coefficients in SDA

- Improvements and different applications:
  - comparison between growth of exports and changes in imported coefficients by sector
  - considering consumption as endogenous to analyse the impact of increasing in imported consumption goods on total output