The Role of Intermediate Inputs in a Multisectoral Balance-of-Payments-Constrained Growth Model:The case of Mexico

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Outline

1. Introduction
   - The role of intermediate inputs
2. Deriving the MSTL in the presence of intermediate goods
3. Econometric Analysis and Numerical Simulations
4. Concluding Remarks

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- Amit and Konings (2007) and Goldberg et al. (2010): it allows for quality improvement and increase the participation of a country in international trade;
- Blecker and Ibarra (2013), Moreno-Brid (1999, 2002) and Pacheco-López and Thirlwall (2004) : it may result in an increase in the income elasticity of demand for imports without a compensating effect on the income elasticity of exports.

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The Role of Intermediate Inputs

- In order to assess the outcome of such strategy, we follow two contributions to a disagreggated view of the balance-of-payment constrained growth hypothesis.
- Araujo and Lima (2007): The multisectoral Thirlwall law (MSTL);
- Blecker and Ibarra (2013): considered explicitly the imports of intermediate goods within a BoP constrained growth approach.
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- By merging the contributions by Araujo and Lima (2007) and Blecker and Ibarra (2013) we present a fully multi-sectoral version of the balance-of-payments constrained growth model in the presence of intermediate inputs;
- In order to illustrate the working of this extended version, we test it to the case of the Mexican economy from 1962 to 2014 by using data from COMTRADE [Gouvea and Lima (2010)];
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Import and export functions of final goods

$$x_i = \bar{x}_i \left(\frac{p_i}{e p_{Fi}} \right)^{-\varepsilon_{Fi}} Y_F^{\eta_{Fi}} \tag{1}$$

$$m_i = \bar{m}_i \left(\frac{e p_{Fi}}{p_i} \right)^{-\varepsilon_{Di}} Y_D^{\eta_{Di}} \tag{2}$$

Y_F : income of the foreign country, denoted by F;
Y_D: income of the domestic country;
p_i: domestic price of the i-th good;
p_{Fi} : foreign price of the i-th good;
η_{Fi}: income elasticities of export for the i-th good;
η_{Di}: income elasticities of import for the i-th good;
ε_{Fi} price elasticities of export for the i-th good;
ε_{Di}: price elasticities of import for the i-th good.

Import function in the presence of intermediate goods

$$m_{k_i} = \bar{m}_{k_i} \left(\frac{e p_{Fk_i}}{p_{k_i}} \right)^{-\varepsilon_{Dk_i}} Y_D^{\eta_{Dk_i}} x_i^{\gamma_{Dk_i}} \tag{3}$$

e: nominal exchange rate;
p_{Fk_i} : foreign price of the i-th intermediate input;
p_{k_i} : domestic price of the i-th intermediate output;
ε_{Dk_i}: price elasticity of the intermediate output;
η_{Dk_i}: the income elasticity of demand;
x_i: export demand for good i;
γ_{Dk_i}: export demand income elasticity of good i.

Equilibrium in the Balance-of-Payments

$$\sum_{i=1}^{n-1} p_i x_i = \sum_{i=1}^{n-1} \left(e p_{Fi} m_i + e p_{Fk_i} m_{k_i} \right) \tag{4}$$

By differentiating expression (4) with respect to time, it yields after some algebraic manipulation the following expression:

$$\sum_{i=1}^{n-1} \left[\frac{p_i x_i \left(\hat{p}_i + \hat{x}_i \right)}{\sum_{i=1}^{n-1} p_i x_i} - \frac{e p_{Fi} m_i \left(\hat{e} + \hat{p}_{Fi} + \hat{m}_i \right) + e p_{Fk_i} m_{k_i} \left(\hat{e} + \hat{p}_{Fk_i} + \hat{m}_{k_i} \right)}{\sum_{i=1}^{n-1} e \left(p_{Fi} m_i + p_{Fk_i} m_{k_i} \right)} \right] = 0 \tag{5}$$

The Intertemporal Equilibrium

$$\sum_{i=1}^{n-1} v_i \hat{x}_i = \sum_{i=1}^{n-1} \mu_i \hat{m}_i + \sum_{i=1}^{n-1} \omega_{k_i} \hat{m}_{k_i} \tag{6}$$

$v_i \equiv \frac{p_i x_i}{\sum_{i=1}^{n-1} p_i x_i}$: share of the i-th sector in total exports;

$\mu_i \equiv \frac{e p_{Fi} m_i}{\sum_{i=1}^{n-1} e\left(p_{Fi} m_i + p_{Fk_i} m_{k_i}\right)}$: share of the i-th sector in total imports;

$\omega_{k_i} \equiv \frac{e p_{Fk_i} m_{k_i}}{\sum_{i=1}^{n-1} e\left(p_{Fi} m_i + p_{Fk_i} m_{k_i}\right)}$: share of the k_i-th intermediate sector in total imports.

Export and Import functions in growth rates

$$\hat{m}_{k_i} = \varepsilon_{Dk_i}\left(\hat{p}_{k_i} - \hat{e} - \hat{p}_{Fk_i}\right) + \eta_{Dk_i}\hat{Y}_D + \gamma_{Dk_i}\hat{x}_i \tag{7}$$

$$\hat{x}_i = -\varepsilon_{Fi}\left(\hat{p}_i - \hat{e} - \hat{p}_{Fi}\right) + \eta_{Fi}\hat{Y}_F \tag{8}$$

$$\hat{m}_i = \varepsilon_{Di}\left(\hat{p}_i - \hat{e} - \hat{p}_{Fi}\right) + \eta_{Di}\hat{Y}_D \tag{9}$$

Under the irrelevance of price competitiveness in the long run

$$\hat{m}_{k_i} = \eta_{Dk_i}\hat{Y}_D + \gamma_{Dk_i}\eta_{Fi}\hat{Y}_F \tag{10}$$

$$\hat{x}_i = \eta_{Fi}\hat{Y}_F \tag{11}$$

$$\hat{m}_i = \eta_{Di}\hat{Y}_D \tag{12}$$

Multi-sectoral Thirlwall's Law in the Presence of Intermediate Inputs

$$\hat{Y}_D = \frac{\sum_{i=1}^{n-1} \left(v_i - \omega_{k_i} \gamma_{Dk_i}\right) \eta_{Fi}}{\sum_{i=1}^{n-1} \left(\mu_i \eta_{Di} + \omega_{k_i} \eta_{Dk_i}\right)} \hat{Y}_F \tag{13}$$

Note that if $\omega_{k_i} = 0 \ \forall i = 1, ..., n-1$ we obtain the result derived by Araujo and Lima (2007);

Numerator: the income elasticity of exports are decreasing in those sectors where intermediate inputs are imported.

Denominator: it is just a matter of decomposition of the imports between final and intermediate goods;

The growth rate consistent with intertemporal equilibrium in the balance-of-payments is lower in the presence of intermediate goods.

Mexican Economy from 1962 to 2014

- Mexico average per capita economic growth in the first 25 years (2.86% a.p.) was higher than the average of the last 30 years (0.88% a.p.);
- Other factors such as the fierce competition of the Chinese producers in the U.S. market after China entry in the WTO in 2001 and repeated economic crisis may help to explain such performance;
- This shows evidence that had Mexico succeeded in performing a complete structural change, then it would keep growth rates consistent with those in the first years.

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Structural Change in the Mexican Economy from 1962 to 2014

- More technology-intensive products hold a stake of approximately 65% in the exports against 2% in 1962;
- Primary products, that once held 37.5% share in the exports, now have only 5.5%.
- Imports of hi-tech products decreased by 4 percentage points while the the share of intermediate goods in the imports has increased by approximately 4 percentage points.

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Table 1: Results of Unit Roots Tests.

Series\Tests	ADF		PP		KPSS		Concl.	
	Level	Diff.	Level	Diff.	Level	Diff.	Level	Diff.
LN(realexch)	-3.13**	-7.28***	-3.12**	-9.85***	0.12	0.18	I(0)	I(0)
LN(xprim)	-0.49	-7.86***	-0.41	-9.24***	0.87 △ △ △	0.11	I(1)	I(0)
LN(xcrudem)	-0.13	-7.40***	-3.29*	-7.74***	0.85 △ △ △	0.11	I(1)	I(0)
LN(xlowm)	-1.49	-4.42***	-1.45	-4.45***	0.71 △ △	0.17	I(1)	I(0)
LN(xmidm)	-1.00	-7.37***	-0.76	-9.22***	0.86 △ △ △	0.12	I(1)	I(0)
LN(xhighm)	-2.10	-7.09***	-2.15	-7.09***	0.86 △ △ △	0.37 △	I(1)	I(0)
LN(xotherm)	-1.37	-7.30***	-1.38	-7.30***	0.85 △ △ △	0.18	I(1)	I(0)
LN(mprim)	-1.24	-7.54***	-1.31	-8.19***	0.17 △ △	0.09	I(1)	I(0)
LN(mcrudem)	-2.01	-8.08***	-3.31**	-7.83***	0.22 △ △ △	0.38 △	I(1)	I(0)
LN(mlowm)	-0.71	-7.76***	-0.63	-8.42***	0.86 △ △ △	0.07	I(1)	I(0)
LN(mmidm)	-1.02	-6.06***	-1.10	-6.39***	0.85 △ △ △	0.15	I(1)	I(0)
LN(mhighm)	-0.77	-6.46***	-0.80	-6.97***	0.86 △ △ △	0.12	I(1)	I(0)
LN(motherm)	-1.01	-5.92***	-1.04	-5.83***	0.86 △ △ △	0.14	I(1)	I(0)

Table 2: Result of Chow Breakpoint Test For Specific Years

Equations	F-statistic					
	1973	1979	1987	1994	2001	2008
$\hat{x}_1 = \varepsilon_{F1}\hat{R}_1 + \eta_{F1}\hat{Y}_F$	9.25***	1.69	2.48*	3.36**	0.03	0.44
$\hat{x}_2 = \varepsilon_{F2}\hat{R}_2 + \eta_{F2}\hat{Y}_F$	2.59*	3.53**	5.21***	6.44***	2.04	2.04
$\hat{x}_3 = \varepsilon_{F3}\hat{R}_3 + \eta_{F3}\hat{Y}_F$	1.78	10.10***	5.40***	2.53*	1.27	0.53
$\hat{x}_4 = \varepsilon_{F4}\hat{R}_4 + \eta_{F4}\hat{Y}_F$	2.22	1.86	0.69	0.76	0.36	0.25
$\hat{x}_5 = \varepsilon_{F5}\hat{R}_5 + \eta_{F5}\hat{Y}_F$	0.81	0.65	1.61	0.26	0.47	0.05
$\hat{x}_6 = \varepsilon_{F6}\hat{R}_6 + \eta_{F6}\hat{Y}_F$	0.13	0.18	0.60	0.41	0.17	0.01
$\hat{m}_1 = \varepsilon_{D1}\hat{R}_1 + \eta_{D1}\hat{Y}_D$	0.28	0.69	1.53	1.15	0.10	0.05
$\hat{m}_2 = \varepsilon_{D2}\hat{R}_2 + \eta_{D2}\hat{Y}_D$	0.42	3.42**	2.86*	0.51	0.74	0.53
$\hat{m}_3 = \varepsilon_{D3}\hat{R}_3 + \eta_{D3}\hat{Y}_D$	0.51	0.71	1.32	1.58	3.09*	1.33
$\hat{m}_4 = \varepsilon_{D4}\hat{R}_4 + \eta_{D4}\hat{Y}_D$	0.21	1.98	1.74	3.99**	0.10	0.04
$\hat{m}_5 = \varepsilon_{D5}\hat{R}_5 + \eta_{D5}\hat{Y}_D$	0.12	0.44	4.25**	3.01*	0.46	0.26
$\hat{m}_6 = \varepsilon_{D6}\hat{R}_6 + \eta_{D6}\hat{Y}_D$	0.03	0.00	2.73*	5.93***	1.01	0.28
$\hat{m}_{k_2} = \varepsilon_{Dk_2}\hat{R}_{k_2} + \eta_{Dk_2}\hat{Y}_D + \gamma_{Dk_2}\hat{x}_2$	0.03	0.73	0.94	0.65	0.50	0.59

Table 3: Estimated Parameters for the Mexican Economy without Intermediate Inputs (1962-2014).

Sectors/Param.	η_{Fi}	ε_{Fi}	ε_{Di}	η_{Di}
prim	0.82***	1.18**	3.46***	1.15***
crudem	0.75***	0.74	1.36***	0.94***
lowm	0.83***	1.14	5.43***	1.32***

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Sectors/Param.	η_{Fi}	ε_{Fi}	ε_{Di}	η_{Di}
midm	0.93***	2.49**	4.67***	1.29***
highm	1.25***	6.06*	4.18***	1.29***
others	1.21***	6.04**	5.00***	1.31***

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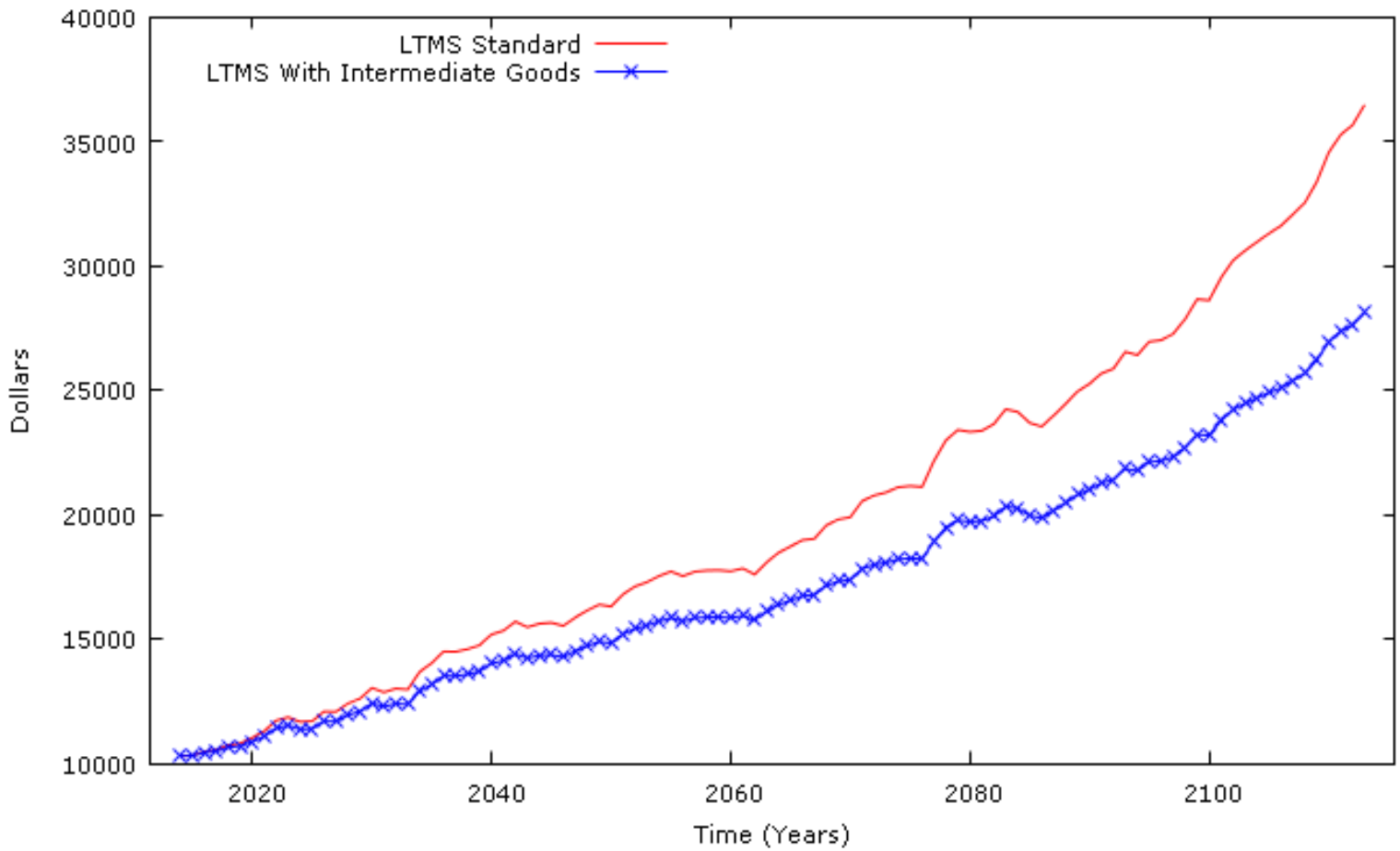
Sectors/Param.	ε_{Dki}	η_{Dki}	γ_{Dk_i}
	J.	J.	J.
prim	1.66**	0.37**	0.72***
crudem	0.55*	0.59***	0.32***
midm	2.08**	0.59***	0.49***

Table 5: Comparison Between the Adjusted Level of Both Estimates

$\hat{Y}_D$	LTMS Standard	LTMS with Intermediate Goods
	Johansen	Johansen
Coefficient	0.2645 ***	0.2739 ***
	(0.0564)	(0.0563)
Intercept	0.0316 ***	0.0336 ***
	(0.0047)	(0.0044)
R-squared	0.3054	0.3209
Adjusted R-squared	0.2915	0.3073

Graph 6: Mexico Output per capita Evolution in Both Versions of LTMS (US$)



Summary

- On the analytical front, we have verified the Blecker and Ibarra's (2013) insight that the imports of intermediate inputs negatively affects the BoP constrained growth rate in a fully disaggregated set up;
- Econometric and simulation approaches for the Mexican economy have confirmed that intermediate inputs lowers the balance-of-payments constrained growth rate .
- Then, a growth strategy with massive imports of intermediate inputs with high-elasticity with respect to exports may give rise to a worse growth performance than that without intermediate inputs.

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