The Impact of China's Import Demand Growth on Sectoral Specialization in Brazil: A CGE Assessment

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1. Motivation

Brazil's trade with China has expanded at a tremendous pace over the past few years. Between 1999 and 2004, its exports to China have grown by 800 percent in value terms while the value of its imports from China has more than tripled. China is now Brazil's third most important export destination and its fourth most important import source. At the same time, there are growing concerns that the intensifying bilateral trade links with China adversely affect the sectoral production and employment structure, given that Brazilian exports to China consist primarily of primary commodities commonly associated with negligible dynamic spillover effects, while imports from China increasingly compete with domestic manufacturing output in home and third-country markets. While the Brazilian government under Lula actively pursues closer trade and investment links with China, critics fear that potential resulting shifts in sectoral specialization patterns towards low-value-added activities with low human capital and technology intensity may adversely affect Brazil's long-run growth prospects.[1]

To which extent is the underlying fear that China's emergence as a global player in international trade pushes Brazil back into raw material corner warranted? This paper aims to provide a partial answer to this question by focussing on the impact of China's growth in demand for Brazilian exports from 2001 to 2006 on the sectoral structure of the Brazilian economy. The analytical framework is a 34-sector computable general equilibrium (CGE) model for Brazil and its trade relations with the rest of the world. The model is calibrated to a 2001 dataset and then shocked with the growth in Brazilian exports to China by sector over the period 2001 to 2006. Conditional on the validity of the underlying model, the simulation results are meant to provide us with an indication of the strength of the resource pull effects due to this shock in isolation from all other exogenous influences on the Brazilian economy.

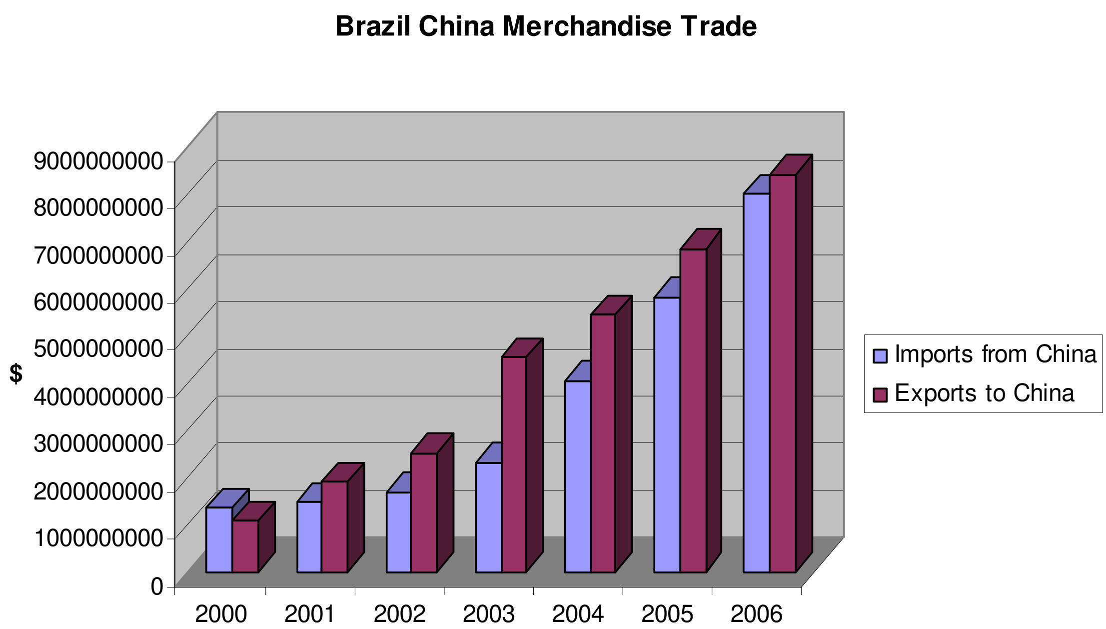
The remainder of the paper is organized as follows: Section 2 provides necessary information on the evolution of Brazil-China aggregate trade flows over the period under consideration and on the commodity composition of these trade flows. Section 3 outlines the analytical framework, explains the numerical calibration process and presents the main features of the benchmark data set. Section 5 discusses simulation results and section 6 draws conclusions.

[1] See Mesquita Moreira (2006), de Paiva Abreu (2005), The Economist (2005).

2. Brazil's Emerging Trade Relations with China

Figure 1 shows the evolution of bilateral trade in goods between Brazil and China from 2000 to 2006. While the Dollar value of Brazil's exports to all destinations has roughly doubled over this period, its exports to China have grown by nearly 700 percent and its imports from China have risen by nearly 500%. As shown in Figure 2, the share of China in Brazil's total merchandise exports has more than tripled from less than two percent to six percent yet seems to have reached a plateau at this level in 2003, while the market share of China in Brazil's total merchandise imports has been steadily climbing and has moved close to nine percent in 2006. China is now Brazil's third largest export destination after the United States and Argentina.

Figure 1: Brazil – China Merchandise Trade 2000 - 2006



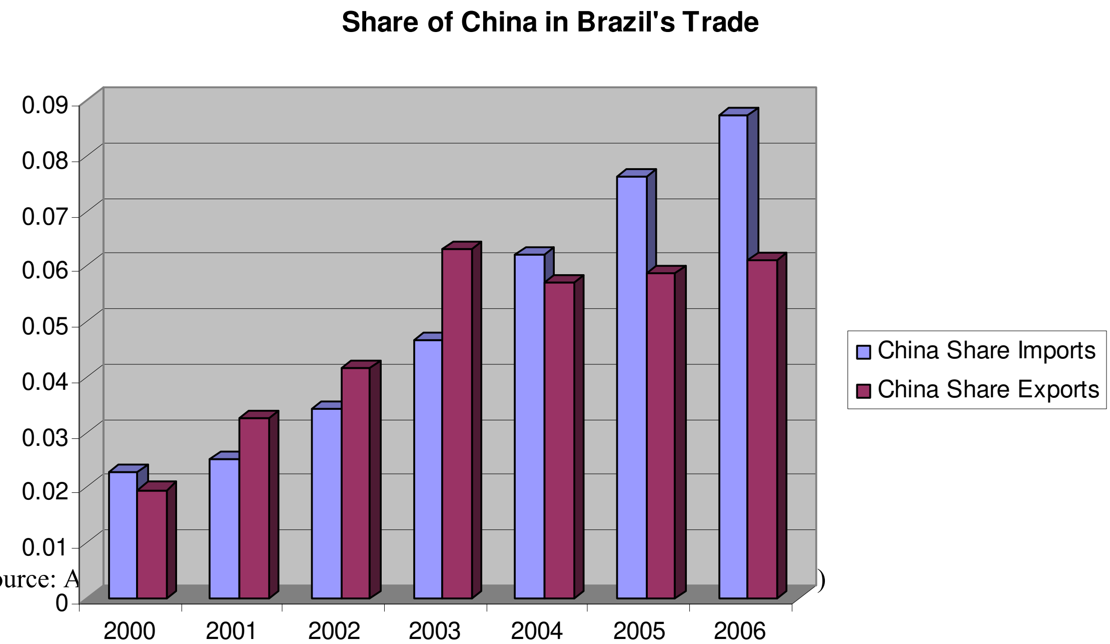
Source: Author's calculation based on UN Comtrad Data (Accessed June 2007)

The commodity composition of Brazil's exports to China is depicted in Figure 3. Evidently, China's demand for Brazilian goods concentrates heavily on a narrow range of primary commodities. Two HS 4-digit commodities – iron ore and soya beans[2] – alone account for 60 percent of the total in 2006, and the five top 4-digit export commodities including crude oil, wood pulp and bovine leather make up over 80 percent of China's merchandise import bill from Brazil. This pattern contrasts

[2] For different views concerning the environmental impact of China's demand for Brazilian soya beans on deforestation in the Amazon region, see Watts (2005)

sharply with the far more diversified structure of Brazil's total world exports shown in Figure 4.

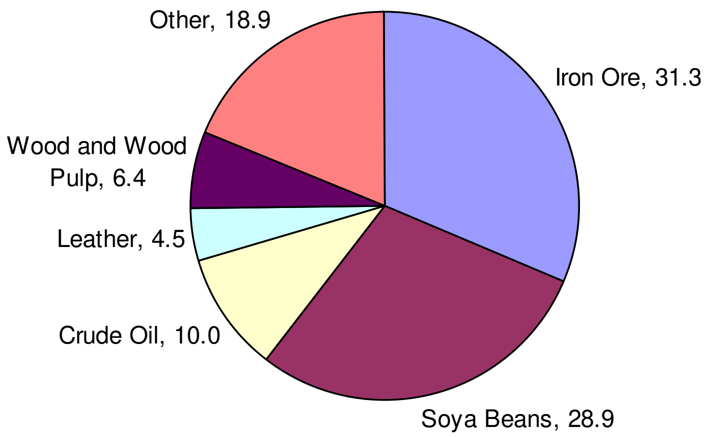
Figure 2: Share of China in Brazil's Total Merchandise Trade 2000-2006



Source: A)

Figure 3: Composition of Brazil's Exports to China 2006

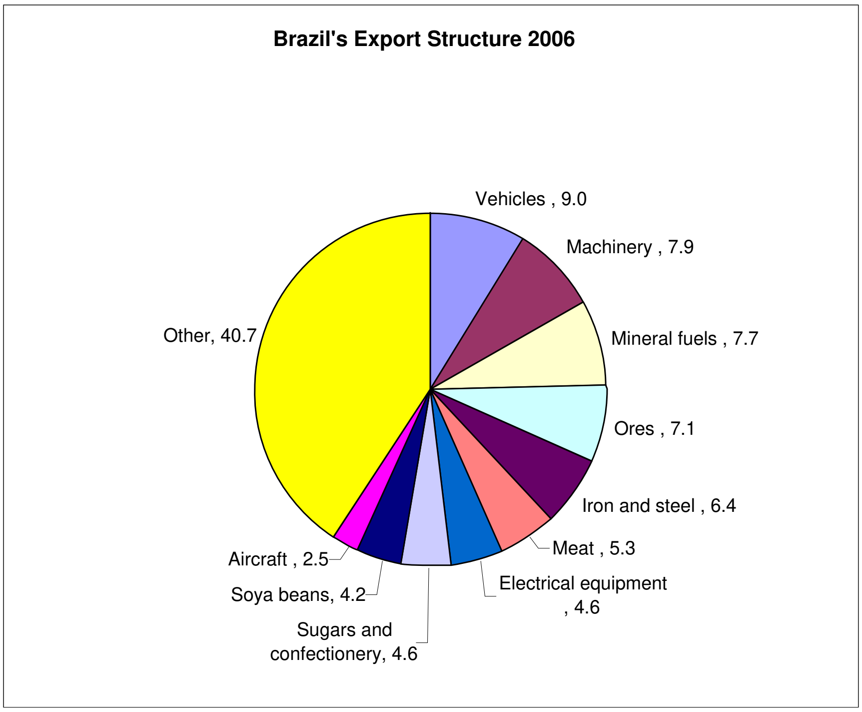
Figures in percent



Source: Author's calculation based on UN Comtrad Data (Accessed June 2007). The graph shows the five HS four digit commodity groups with the highest 2006 export values.

Figure 4: Commodity Composition of Brazil's Total Exports 2006

Figures in percent



Source: Author's calculation based on UN Comtrad Data (Accessed June 2007). The graph shows the 10 HS two digit commodity groups with the highest 2006 export values.

Brazil's imports from China, on the other hand, consist primarily of manufactures including, in order of importance, electronic equipment (39.5% of total Chinese exports to Brazil in 2006), computers and parts (17.3%), organic chemicals (5.9%), optical instruments (5.7%), manmade filaments (2.5%), iron and steel articles (2.1%), plastics (2.0%), toys and games (1.9%), vehicle parts (1.7%), and apparel (1.6%).

Table 1 reports the growth in Brazil's exports to China for the 12 most important commodity groups over the period 2001 to 2006 along with a decomposition into price (i.e. unit value) and quantity changes. The "China Share" column shows the 2001 share of China in Brazil's total exports of each commodity. The next two columns of the Table map these commodities to the sectors of the CGE model presented in the following section and express the growth in exports to China as a percentage of 2001 benchmark exports of the corresponding model sectors, taking into account the China share and the share of the HS commodity group exports under consideration in total exports of the associated model sectors. The final column corresponds with Figure 3 and shows the 2006 shares of the listed HS commodity groups in total Brazilian exports to China. Thus, the twelve commodity groups included in the simulation analysis below account for 91.6 percent of Brazil's total China exports in 2006.

Table 1: Growth of Brazil's Exports to China by Commodity 2001 -2006

HS	*Description*	*ΔEx Value %*	*ΔP %*	*ΔQ %*	*China Share 2001*	*Model Sector*	*Export Demand Shock%*	*% of China Exports*
2601	Iron Ores	445	88	190	16	MINEXT	+68.2	31.3
1201	Soya Beans	352	34	237	20	AGRICU	+50.1	28.9
2709	Crude Oil	1998	138	781	6	OILGAS	+107.5	9.9
4104	Leather	586	-33	927	6	FOOTWL	+13.2	4.5
4703	Wood Pulp	184	30	118	10	PAPERP	+10.5	4.5
84	Machinery	213	-	-	2	MECENG	+4.3	3.3
						OTMETL	+4.3	
						NFMETL	+3.5	
4407	Wood sawn	306	13	260	7	WOODFU	+6.1	1.9
72	Iron and Steel	207	-	-	2	IRONST	+4.0	2.0
39	Man-made fib	1308	-	-	1	REFOIL	+3.1	1.7
1507	Soya oil	2207	67	1280	1	VEGOIL	+3.4	1.4
85	Electrical gds	102	-	-	2	ELECMT	+0.7	1.2
						ELEQUIP	+1.5	
2401	Tobacco	38	45	-5	6	AGRICU	+0.6	0.9
							Sum	91.6

Explanations in text.

3. The Analytical Framework

The Model in Overview

The analytic framework is a highly stylised comparative-static computable general equilibrium model of Brazil's economy and its trade relations with the rest of the world. The model distinguishes 34 industries and synonymous commodity groups as listed in Table 2 and the two sectorally mobile primary production factors labour and capital. On the domestic supply side, firms are price takers in output and input markets. Technologies in all sectors are characterized by constant returns to scale, constant sectoral elasticities of substitution between primary factors and Leontief technologies for intermediate consumption with imperfect substitutability between domestic and imported intermediate inputs in the same commodity group. The domestic final demand specification takes the form of a linear expenditure system with a constant elasticity of substitution between domestic output and imports in each commodity group. From the viewpoint of the domestic economy the structure of world market import prices is given exogenously, while the demand for Brazilian exports by the rest of the world is finitely elastic, and hence the terms of trade are endogenously determined. The model incorporates trade and transport margins as well as a stylised indirect tax and tariff system.

The Model in Detail

Let J denote an index set over commodity groups. Total domestic demand for each commodity group i $\in$ J is modeled as demand for an Armington composite commodity

$$Q_i = [\delta_i D_i^{(\sigma_i - 1)/\sigma_i} + (1-\delta_i) M_i^{(\sigma_i - 1)/\sigma_i}]^{\sigma_i/(\sigma_i - 1)}, \qquad (1)$$

where D_i denotes domestic demand for domestic output, M_i denotes imports, and σ_i is the elasticity of substitution between domestic and imported goods. Demand for Q_i is the sum of domestic final demand and intermediate input demand:

$$Q_i = C_i + \sum_{j \in J} x_{ij} \quad . \qquad (2)$$

Let PP_i denote domestic producer prices and let $P_i = PP_i(1+tt_i)$ denote the prices of domestically produced output including trade and transport margins at ad valorem rates tt_i but excluding domestic indirect taxes on products. Similarly, let PMW_i denote world market prices of imports in terms of an import numeraire commodity and let $PM_i = PMW_i(1+tt_i+tm_i)$ denote import prices inclusive of trade and transport margins and import tariffs at ad valorem rate tm_i but excluding other domestic indirect taxes on products.

Given P_i and PM_i , optimizing domestic final and intermediate users of composite commodity i allocate their spending between home goods and imports such that

$$D_i = \delta_i^{\sigma_i} \left[\frac{P_i}{\theta_i} \right]^{-\sigma} Q_i \quad , \quad M_i = (1-\delta)_i^{\sigma_i} \left[\frac{PM_i}{\theta_i} \right]^{-\sigma} Q_i \quad , \qquad (3)$$

where

$$\theta_i = [\delta_i^{\sigma_i} P_i^{1-\sigma_i} + (1-\delta_i)^{\sigma_i} PM_i^{1-\sigma_i}]^{1/(1-\sigma_i)} \qquad (4)$$

is the true price index dual to the Armington quantity index (1).

Sectoral final demand functions are derived from a nested Stone-Geary-Armington utility function

$$U = \sum_{i\in J}(C_i - \beta_i)^{\alpha_i} \quad , \quad \alpha_i \geq 0, \sum_{i\in J}\alpha_i = 1 \,, \tag{5}$$

and take the LES (linear expenditure system) form

$$C_i = \beta_i + \frac{\alpha_i}{\theta_i(1+tf_i)}(CH - \sum_{i\in J}\beta_i\theta_i(1+tf_i)) \,, \tag{6}$$

where CH denotes total domestic final expenditure and tf_i is an ad valorem tax on final sales of domestic and imported goods.

On the domestic supply side, firms are price takers in output and input markets. Technologies in all sectors are characterized by constant returns to scale, imperfect primary factor substitutability, and imperfect substitutability between domestic and imported intermediate inputs in the same commodity group. Sectoral production functions take the Leontief-CES form

$$X_i = \min\left[V_i(K_i, L_i), \frac{x_{ji}}{a_{ji}} |_{\forall j\in I} \right], \tag{8}$$

where X_i denotes gross output, x_{ji} denotes intermediate input consumption of commodity type j by industry i, and

$$V_i = \gamma_i\left[\phi_{L,i}L_i^{-\rho} + \phi_{K,i}K_i^{-\rho}\right]^{-1/\rho}, \quad \rho \geq -1 \tag{9}$$

is the value-added production function, where L_i and K_i represent labour and capital inputs respectively. Cost minimization yields the unit factor demand functions

$$\begin{aligned} L_i / X_i &= \gamma_i^{-1}\phi_{L,i}^{\varepsilon_i}w_L^{-\varepsilon_i} \cdot \left[\sum_{j\in\{L,K\}}\phi_j^{\varepsilon}w_j^{1-\varepsilon}\right]^{1/\rho} \\ K_i / X_i &= \gamma_i^{-1}\phi_{K,i}^{\varepsilon_i}w_K^{-\varepsilon_i} \cdot \left[\sum_{j\in\{L,K\}}\phi_j^{\varepsilon}w_j^{1-\varepsilon}\right]^{1/\rho} \end{aligned} \,, \tag{10}$$

where ε = 1/(1+ρ)≥0 denotes the factor elasticity of substitution and the w_j are factor prices.

In analogy to the domestic demand side, Brazil's exports to the rest of the world (RoW) are treated as imperfect substitutes for goods of RoW origin in RoW demand. In each commodity group, RoW demand for an Armington composite defined over goods of Brazilian and RoW origin is assumed to be unitary-elastic. The optimal allocation of expenditure within each commodity group yields export demand functions for goods of Brazilian origin of the form

$$E_i = \kappa_i\delta_{R,i}^{\sigma_{R,i}}PE_i^{-\sigma_{r,i}}\theta_{R,i}^{\sigma_{R,i}-1} \,, \tag{11}$$

where κ_i is RoW's total expenditure on type-i goods

$$PE_i = P_i(1+\tau_{R,i}), \tag{12}$$

is the price of Brazil's exports faced by users in the rest of the world inclusive of ad valorem trade barriers τ_R imposed on Brazil's exports by the rest of the world, and

$$\theta_{R,i} = [\delta_{R,i}^{\sigma_{R,i}} PE_i^{1-\sigma_{R,i}} + (1-\delta_{R,i})^{\sigma_{R,i}} PMW_i^{1-\sigma_{R,i}}]^{1/(1-\sigma_R)} \tag{13}$$

are the price indices dual to the RoW Armington composites.

Domestic final spending CH is constrained by

$$CH = w_L \sum_{i\in J} L_i + w_K K + T - TB_o, \tag{14}$$

where T is total model tax revenue from indirect taxes on production, intermediate and final sales taxes, and tariff revenue, and TB_o is the trade balance in terms of the numeraire, which is kept fixed at benchmark equilibrium level in all simulations.[3]

The product market clearing conditions are[4]

$$X_i = D_i + E_i \tag{15}$$

and the factor market equilibrium conditions are

$$\overline{K} = \sum_{i\in J} K_i \quad , \tag{16}$$

$$L = \sum_{i\in J} L_i \tag{17}$$

where L and K denote the given factor endowments. The simulation exercises below also allow for the case of unlimited supplies of labour. In this case, the nominal wage is indexed to the model's price index of final goods (CPI) so that the real wage w_L/CPI is fixed, and L is endogenized.

Benchmark Data Set and Calibration

The model is calibrated to a benchmark data set that reflects the structure of the Brazilian economy in 2001. The main data sources for the construction of the model-consistent benchmark data set are the semidefinite supply and use tables for 2001 reported in IBGE (2003). The raw data from this source distinguish 44 activities and 80 commodities. For purposes of the present study, these tables have been aggregated into 34 activities and commodities as listed in Table 2, and the intermediate input-

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[3] In view of ongoing confusions in parts of the CGE literature concerning the external sector closure of single-region trade models, it should be pointed out that it is not necessary to impose the trade balance condition as a separate independent model constraint in addition to the budget constraint (14). Given that agents obey (14), trade balance equilibrium is implied by Walras' Law in the context of the model.

[4] For the Services sector, the RHS of (15) includes the total of trade and transport margins.

output and value-added matrices have been transformed into symmetric commodity-by-commodity tables using a commodity technology assumption.[5]

insert section on elasticity sources

Table 2 provides summary information on the sectoral distribution of employment and exports as well as on the shares of exports in total output by sector and the share of imports in total domestic demand by commodity.

Extraneous values for the Armington elasticities and the factor elasticities of substitution are drawn from the GTAP behavioural parameter data base (Dimaranan et al., 2002). The α parameters in (6) are calibrated to extraneous information on sectoral income elasticities of demand ε drawn from the same source:

$$\mu_i = \frac{\alpha_i CH}{\theta_i(1+tf_i)C_i} = \alpha_i / s_i \;\Rightarrow \alpha_i = \mu_i s_i,\; s_i \equiv \frac{\theta_i(1+tf_i)C_i}{CH}.$$

The extraneous income elasticity have been re-scaled prior to calibration to enforce the Engel aggregation condition $\sum s_i \mu_i = 1$. The β parameters are determined by choosing a value for the Frisch parameter $\Omega = -CH/(CH - \sum \beta_i \theta_i (1+tf_i)) < 0$ which represents the elasticity of the marginal utility of income with respect to income. (6) entails the calibration rule

$$\beta_i = C_i + \frac{\alpha_i CH}{\theta_i(1+tf_i)\Omega}.$$

Note that for given α, the choice of Ω determines the whole set of benchmark own- and cross-price elasticities of consumer demand which are given by

$$\frac{\partial \ln C_i}{\partial \ln[\theta_i(1+tf_i)]} = -1 + \frac{\beta_i(1-\alpha_i)}{C_i},\; \frac{\partial \ln C_i}{\partial \ln[\theta_{j\neq i}(1+tf_j)]} = -\alpha_i \frac{\theta_j(1+tf_j)\beta_j}{\theta_i(1+tf_i)C_i}.$$

The Armington elasticities, income elasticities and labour-capital substitution elasticities are reported in Table 3.

[5] See Willenbockel (1994: Appendix) for technical details of this transformation step. For an axiomatic argument in favor of the choice of the commodity technology model over alternative approaches such as the industry technology model and mixed technology models see Jansen and Ten Raa (1990). A familiar feature of the commodity technology approach is that it can yield negative entries in the input-output matrix. In the present application, very small negative numbers occurred in a small number of cases and have been set to zero and an RAS algorithm has been applied to preserve row and column totals.

Table 2: Selected Features of the Benchmark Equilibrium: Brazil 2001

Model Code	*Sector*	*Labour Share*	*Employ ment Share*	*Exports / Output*	*Share in Total Exports*	*Imports / Dom. Demand*
AGRICU	Agriculture	2.47%	18.89%	5.94%	5.71%	2.5%
MINEXT	Mineral Extraction	0.43%	0.30%	63.57%	5.04%	13.3%
OILGAS	Oil + Gas Extraction	0.34%	0.09%	5.23%	1.05%	24.8%
NMMINR	Nonmetal Mineral Goods	0.64%	0.70%	6.78%	1.07%	2.6%
IRONST	Iron + Steel	0.19%	0.12%	16.49%	4.38%	4.7%
NFMETL	Nonferrous Metal Goods	0.12%	0.10%	19.95%	2.61%	13.1%
OTMETL	Other Metal Goods	1.29%	1.11%	5.99%	1.30%	5.4%
MECENG	Mechanical Engineering	1.89%	0.79%	10.48%	3.01%	22.1%
MTELEC	Electric Materials	0.44%	0.20%	15.39%	2.30%	25.2%
ELEQUIP	Electronic Equipment	0.32%	0.15%	40.88%	3.62%	52.3%
AUTMOB	Automobiles, Trucks, Bus	0.34%	0.12%	23.36%	4.49%	13.1%
OTVEHC	Other Vehicles	0.97%	0.35%	44.43%	9.88%	28.0%
WOODFU	Wood + Furniture	0.79%	1.43%	24.90%	2.92%	1.9%
PAPERS	Paper Products	1.27%	0.65%	10.99%	3.23%	4.6%
RUBBER	Rubber Products	0.17%	0.09%	12.21%	0.94%	11.4%
CHEALC	Non-Petrol Chemicals	0.21%	0.09%	10.78%	1.48%	20.0%
REFOIL	Oil Refinery Products	0.39%	0.07%	6.65%	5.12%	12.5%
DIVCHE	Paints + Fertilizers	0.66%	0.23%	5.91%	1.21%	14.7%
PHARMA	Pharmaceuticals	0.56%	0.19%	5.25%	0.68%	17.8%
PLASTC	Plastic Products	0.53%	0.33%	5.37%	0.46%	8.9%
TEXTIL	Textiles	0.35%	0.38%	11.11%	1.71%	9.0%
CLOTNG	Clothing	0.59%	2.63%	1.42%	0.18%	1.6%
FOOTWR	Footwear + Leather	0.33%	0.62%	67.58%	3.87%	10.7%
COFFEE	Coffee Products	0.12%	0.12%	27.07%	2.11%	0.0%
VEGPRO	Vegetable Products	0.41%	0.49%	17.59%	3.22%	3.0%
MEATPR	Meat Products	0.38%	0.37%	17.01%	4.43%	0.5%
DAIRYP	Dairy Products	0.12%	0.09%	0.43%	0.04%	2.3%
SUGARP	Sugar Processing	0.19%	0.13%	38.81%	3.50%	0.0%
VEGOIL	Vegetable Oils	0.06%	0.06%	31.30%	3.98%	2.7%
OTFOOD	Beverages + Other Food	0.92%	1.04%	8.38%	2.32%	3.7%
OTMANU	Other Manufacturing	0.42%	0.47%	12.99%	1.54%	18.7%
UTILIT	Utilities	2.67%	0.34%	0.00%	0.00%	2.7%
CONSTR	Construction	2.65%	6.09%	0.03%	0.03%	0.0%
SERVIC	Services	76.76%	61.17%	2.04%	12.56%	3.3%
		100%	100%		100%	

Source: Author's calculation based on IBGE (2003)
Notes: Labour share refers to labour cost. Employment share refers to the number of persons employed.

Table 3: Elasticity Parameters

Code	*Sector*	*σ*	*ε*	*μ*
AGRICU	Agriculture	2.2	0.24	0.19
MINEXT	Mineral Extraction	2.8	0.2	1
OILGAS	Oil + Gas Extraction	2.2	0.24	1.06
NMMINR	Nonmetal Mineral Goods	2.8	0.2	1
IRONST	Iron + Steel	2.8	1.26	1.1
NFMETL	Nonferrous Metal Goods	2.8	1.26	1.1
OTMETL	Other Metal Goods	2.8	1.26	1.1
MECENG	Mechanical Engineering	2.8	1.26	1.1
MTELEC	Electric Materials	2.8	1.26	1.1
ELEQUIP	Electronic Equipment	2.8	1.26	1.1
AUTMOB	Automobiles, Trucks, Bus	5.2	1.26	1.2
OTVEHC	Other Vehicles	5.2	1.26	1.1
WOODFU	Wood + Furniture	2.8	1.26	1.1
PAPERS	Paper Products	1.8	1.26	1.15
RUBBER	Rubber Products	1.9	1.26	1.1
CHEALC	Non-Petrol Chemicals	1.9	1.26	1.1
REFOIL	Oil Refinery Products	1.9	1.26	1.06
DIVCHE	Paints + Fertilizers	1.9	1.26	1.1
PHARMA	Pharmaceuticals	1.9	1.26	1.2
PLASTC	Plastic Products	1.9	1.26	1
TEXTIL	Textiles	2.2	1.26	0.89
CLOTNG	Clothing	4	1.26	0.89
FOOTWR	Footwear + Leather	4.4	1.26	0.9
COFFEE	Coffee Products	2.2	1.12	0.52
VEGPRO	Vegetable Products	2.2	1.12	0.52
MEATPR	Meat Products	2.2	1.12	0.49
DAIRYP	Dairy Products	2.2	1.12	0.4
SUGARP	Sugar Processing	2.2	1.12	0.52
VEGOIL	Vegetable Oils	2.2	1.12	0.52
OTFOOD	Beverages + Other Food	3.1	1.12	0.94
OTMANU	Other Manufacturing	2.2	1.26	1
UTILIT	Utilities	2.8	1.26	1.1
CONSTR	Construction	1.9	1.4	1.24
SERV	Services	1.9	1.47	1.24

σ: Elasticity of substitution between domestic output and imports; ε: Elasticity of substitution between labour and capital; μ: Income elasticity of demand (unscaled).

4. Simulation Results

In order to assess the impact of China's booming demand for Brazilian exports from 2001 to 2006 on the sectoral structure of the Brazilian economy in isolation from all other exogenous influences, the shift parameters of the sectoral export demand schedules (11) for the relevant commodity groups identified in Table 1 are shocked in accordance with the reported export growth figures. Two alternative labour market closures are considered. In the first simulation experiment, labour supply is fixed and the real wage adapts endogenously to establish labour market equilibrium, while the second experiment assumes unlimited supplies of surplus labour at a fixed real wage, i.e. the nominal wage is rigidly indexed to the consumer price index and the labour market equilibrium condition (17) is dropped.

Table 4: Aggregate Simulation Results

% Change in	*Fixed Labour Supply*	*Unlimited Labour Supply*
Terms of Trade	+2.6	+2.4
Real Exports	+2.2	+2.6
Real Imports	+4.9	+5.0
EV/GDP	+0.4	+0.8
Wage/rental ratio	-0.3	-1.1
Employment	-	+1.0

Aggregate results for both simulation scenarios are reported in Table 4 and sectoral results are presented in Tables 5 and 6. With an unelastic labour supply, the terms of trade appreciation due to the China export boom is on the order of 2.4 percent and aggregate real exports rise by 2.2 percent, thus allowing for a rise in aggregate real imports by nearly five percent. The aggregate welfare effect as measured by the Hicksian equivalent variation is on the order of 0.4% of benchmark GDP. The relaxation of the labour supply constraint entails an outward shift of the production possibility frontier in response to the external demand boom as previously unemployed workers are drawn into the production process, and hence the terms of trade improvement is slightly lower in this case. The aggregate welfare effect doubles vis-a-vis the standard neoclassical scenario, but overall the aggregate results are not dramatically different, since the net employment effect in the elastic labour supply simulation is only around one percent.

The sectoral results are also closely similar between both scenarios. Not surprisingly, the real export effects are most pronounced in the directly affected primary sectors. and the strongest positive employment effect is in the iron ore producing mineral extraction sector with its high benchmark export/output ratio of 64 percent (see Table 2). In contrast, in agriculture and oil extraction, where benchmark export/output ratios are low, the strong export boost does not translate into dramatic expansionary output and employment effects.

Due to the real exchange appreciation, all manufacturing sectors except those directly benefitting from the China effect – i.e. the wood pulp and leather processing industries – experience a drop in export sales along with a contraction in output and employment. For none of the manufacturing sectors do backward input-output linkages to the expanding primary sectors reverse the contractionary real appreciation effect. Thus, the simulation results exhibit a noticeable Dutch disease pattern induced by the China-driven primary export boom, but from an economy-wide perspective the magnitude of the effect is far from dramatic. In fact, in both simulations the share of manufacturing labour income in total labour income drops by a mere 0.3 to 0.4 percentage points from 14.7 to 14.3 percent while the share of the primary sectors rises from 3.2 to 3.5 percent.

To maintain a proper perspective on these indicative simulation results, the strictly comparative-static nature of the scenarios should be borne in mind. In the flexible wage scenario with its fixed factor endowment, the export demand growth shock necessarily requires an absolute contraction somewhere else in the economy to release the resources needed for the expansion of the booming sectors. While the elastic labour supply scenario relaxes the factor endowment to some extent, the aggregate real capital stock is still fixed. However, in a dynamic analysis, the export boom should be associated with a positive aggregate net investment response, and Brazil's labour force growth and productivity enhancements due to technological progress over the period under consideration would have to be taken into account. Once these dynamic supply factors are included in the analysis, it need by no means be the case that the resource pull effects of the primary export boom entail an absolute contraction of manufacturing even if the manufacturing share declines. Some additional ad hoc simulations of the present model not tabulated here, in which the export shock is combined with moderate exogenous growth of the labour force confirm precisely this conjecture: The relative employment and output share of manufacturing declines slightly like in the reported simulations, yet in these quasi-dynamic scenarios no manufacturing sector suffers an absolute decline in gross output.

Table 5: Sectoral Results: Inelastic Labour Supply Scenario

Percentage changes

Sector	Exports	Output	Labour	Imports
AGRICU	41.9	2.0	2.0	5.8
MINEXT	56.8	36.9	36.9	10.0
OILGAS	94.6	2.5	2.5	4.0
NMMINR	-6.9	-0.9	-0.9	7.1
IRONST	-2.9	-2.9	-2.6	4.2
NFMETL	-2.7	-3.5	-3.2	2.7
OTMETL	-2.5	-1.8	-18	5.3
MECENG	-3.1	-1.8	-1.6	6.1
MTELEC	-5.2	-2.2	-2.1	4.6
ELEQUIP	-4.3	-3.5	-3.2	3.2
AUTMOB	-9.7	-2.9	-2.7	10.4
OTVEHC	-10.3	-8.2	-8.1	4.7
WOODFU	-1.4	-0.6	-0.4	7.5
PAPERS	5.6	0.3	0.4	4.4
RUBBER	-4.4	-2.1	-1.8	2.9
CHEALC	-5.0	-2.1	-1.8	3.6
REFOIL	-1.5	-0.9	-0.6	3.9
DIVCHE	-4.2	-0.3	-0.1	4.5
PHARMA	-4.6	-0.6	-0.4	4.6
PLASTC	-4.4	-1.4	-11.3	3.4
TEXTIL	-4.8	-1.6	-1.5	3.9
CLOTNG	-10.2	-0.2	-0.0	11.8
FOOTWR	1.5	0.5	0.6	10.2
COFFEE	-5.8	-1.9	-1.7	5.8
VEGPRO	-5.6	-1.3	-1.2	5.7
MEATPR	-5.7	-1.0	-0.9	6.1
DAIRYP	-5.6	-0.2	0.0	5.9
SUGARP	-5.7	-2.8	-2.6	5.1
VEGOIL	-2.4	-1.1	-0.8	5.6
OTFOOD	-7.6	-0.7	-0.6	8.4
OTMANU	-5.4	-1.9	-1.7	4.4
UTILIT	-	-0.4	-0.2	7.9
CONSTR	-5.0	0.2	0.5	5.5
SERV	-5.0	-0.2	-0.0	5.4

By design, the preceding analysis focuses exclusively on the implications of China's import demand growth for the structure of the Brazilian economy in order to gauge the quantitative significance of this particular channel in isolation from all other channels through which China's emergence may affect Brazil's economic performance.[6] A corresponding analysis of the structural impacts of the rising China import penetration of Brazil's domestic market and of export competition with China in third-country markets remains a topic for future research.[7]

Table 6: Sectoral Results: Unlimited Labour Supply Scenario
Percentage changes

Sector	Exports	Output	Labour	Imports
AGRICU	42.0	2.2	2.4	5.9
MINEXT	57.6	37.6	37.8	10.0
OILGAS	94.6	2.8	3.1	4.5
NMMINR	-6.5	-0.5	-0.4	7.0
IRONST	-2.7	-2.5	-1.3	4.5
NFMETL	-2.5	-3.0	-1.9	2.9
OTMETL	-1.9	-1.3	-1.1	5.2
MECENG	-2.7	-1.3	-0.5	6.1
MTELEC	-4.7	-1.7	-1.2	4.7
ELEQUIP	-4.0	-3.0	-2.1	3.4
AUTMOB	-9.1	-2.4	-1.4	10.1
OTVEHC	-9.5	-7.4	-6.8	4.7
WOODFU	-0.8	-0.1	0.5	7.3
PAPERS	5.9	0.7	1.5	4.5
RUBBER	-4.2	-1.6	-0.6	3.3
CHEALC	-4.9	-1.7	-0.5	4.0
REFOIL	-1.5	-0.5	0.8	4.3
DIVCHE	-4.0	0.0	0.8	4.6
PHARMA	-4.3	-0.2	0.6	4.7
PLASTC	-4.1	-0.9	-0.5	3.5
TEXTIL	-4.5	-1.3	-0.8	4.0
CLOTNG	-9.4	0.1	0.9	11.2
FOOTWR	2.3	1.2	1.9	10.0
COFFEE	-5.7	-1.8	-0.8	5.8
VEGPRO	-5.4	-1.1	-0.5	5.7
MEATPR	-5.5	-0.9	-0.2	6.1
DAIRYP	-5.4	-0.0	0.8	5.9
SUGARP	-5.5	-2.6	-1.7	5.2
VEGOIL	-2.2	-0.9	0.2	5.7
OTFOOD	-7.2	-0.4	0.2	8.3
OTMANU	-5.1	-1.4	-0.5	4.6
UTILIT	-	0.1	1.0	7.8
CONSTR	-4.8	0.5	1.8	5.7
SERV	-4.5	0.3	1.0	5.4

[6] For systematic comprehensive typologies of the potential impacts of the emergence of China and India on other developing countries see Asian Drivers (2006) and Schmitz (2006).
[7] For some aggregative descriptive evidence on Chinese import penetration of Latin American markets and a rudimentary export similarity analysis between Brazil and China see Mosquita Moreira (2006) and Devlin et al (2006)

5. Concluding Remarks

The analysis suggests that China's import demand growth has non-negligible effects on the sectoral production and employment structure of the Brazilian economy. China's booming demand for goods of Brazilian origin over the period 2001 to 2006 concentrates heavily on a narrow range of primary commodities. Correspondingly, the simulation results exhibit a noticeable "Dutch disease" pattern. However, from an economy-wide perspective the magnitude of this effect is far from dramatic. Under standard elasticity assumptions, the share of manufacturing value added in GDP drops by a mere 0.3 to 0.4 percentage points in favour of the primary sectors. In a static analytic setting, this resource shift is just a rational response to a beneficial shift in the global environment, yet the static perspective ignores the potential implications for long-run growth prospects in the presence of positive dynamic externalities associated with manufactuing activities. Such potential dynamic effects as well as the structural implications of intensifying competition with exports from China in domestic and third-country markets require further research.

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