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Positive Natural Resource Shocks and Domestic Adjustments in a Semi-Industrialized Economy:
Argentina in the 2004-2007 period

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Abstract

This paper evaluates the domestic adjustment to recent positive external shocks in Argentina's natural resource sectors. Although there is no single, exclusive determinant of Argentina's fast economic growth in the period 2003-2007, the paper illustrates the favourable contribution of certain economic policies to this outcome. According to counterfactual simulations performed with a dynamic Computable General Equilibrium (CGE) model especially designed to capture structural features of the Argentine economy, export taxes on natural resource products and Argentina's competitive exchange rate policy have counteracted Dutch disease adjustments associated the positive terms of trade shock (which may be contractionary in the medium-term if no economic policies are implemented) contributing to productive and export diversification and to bring about output growth. The analysis also shows that in a context of strong demand impulses spending the income collected with export taxes may not be beneficial for the overall competitiveness of the economy, hence counteracting one of the purposes of the tax policy. This implies, first, that subsidies to producers of wage-goods may be ineffective to control overall price increases, and second, that optimizing the contribution of public investment in infrastructure to improve the competitiveness of the economy requires special attention to the timing of public investment.

Keywords

TERMS OF TRADE, DUTCH DISEASE, ARGENTINA, EXCHANGE RATE POLICY, PRODUCTIVE DIVERSIFICATION

Positive Natural Resource Shocks and Domestic Adjustments in a Semi-Industrialized Economy[1]
Argentina in the 2004-2007 period

1 Introduction

For the first time in many decades output in Argentina has grown for five years in a row. Since 2003, the economy has expanded steadily, with GDP growing at over 8% on average in the period 2002-2007. This economic expansion has come about in part through the recovery from the 2001-2002 economic crisis and the deflationary years which preceded the collapse of the previous macroeconomic regime. Yet, real GDP in 2005 surpassed the previous peak (1998) and in 2007 was almost 25% larger than in 1998. Table 1 describes the evolution of the main components of aggregate demand. It shows that investment (although starting from low levels) and exports expanded faster than output during this period, and private consumption grew at a similar rate of output between 2004 and 2007 and has accelerated since 2006.

Although Argentina's recent growth has surpassed even the most optimistic expectations, the question that emerges is whether the country has been able to promote a competitive and diversified tradable sector, a necessary condition to encourage sustained economic development in Argentina (Porta, 2005, Serino, 2007).

In Argentina, which is a country richly endowed with natural resources, productive and export diversification requires the development of industry and service sectors able to compete internationally. The enlargement and diversification of the tradable sector is indispensable for reducing the country's falling but still high unemployment, poverty and inequality levels in the second place, and for ensuring that output growth is not undermined by Argentina's historical external imbalances in the first place (Bianco, et al. 2008).

Although both socio-economic conditions and the external accounts have improved significantly since 2002, further progress is still required. Internally, productive diversification is desirable to improve socio-economic conditions since most industry and modern service sectors tend to create formal employment and make intensive use of skilled workers and, thus, may contribute to reducing unemployment and improving real wages.[2] [3]

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[1] This paper presents some of the results of the PHD project entitled "Productive Diversification in Natural Resource Abundant Countries.Limitations, Policies and the Experience of Argentina in the 2000s". The paper has benefited from comments from Professors Rob Vos, Mansoob Murshed and Roberto Frenkel. Possible mistakes are responsibility of the author.

[2] As shown in CENDA's 2007 labour market report, the recovery of employment was particularly significant in Argentina's industrial sector and, at least in these sectors, real wages and employment conditions also improved (see CENDA, 2007).

[3] Table 2 shows that unemployment, poverty and inequality have all been falling in Argentina's urban areas, and especially the first two socio-economic measures, which in 2007 fell to less than half their values in 2003. Nevertheless, in 2007, unemployment was affecting 9% of the labour force and real wages were still below 1998 figures.

Table 1
Growth in output and aggregate demand and external and government balances.
Selected years and periods

	billions of ARG $ at 1993 prices							% GDP		
	GDP	CONSUMPTION		INVESTMENT		EXP	IMP	TRADE BCE/a	CC AA /a	GOV ACC PRIM /a
		Private	Public	Private	Public					
1993	236,5	163,7	32,0	41,1	4,0	16,3	22,0	-1.0	-3.5	1.42
1998	288,1	197,6	35,2	56,1	4,7	30,8	38,9	-1.04	-4.84	0.22
2001	263,9	181,3	35,6	38,8	2,9	32,1	29,7	2.7	-1.41	-1.96
2002	235,2	155,3	33,8	24,8	1,7	33,1	14,8	16.1	8.20	1.84
2003	256,1	168,0	34,3	33,6	3,1	35,1	20,4	13.2	6.41	2.3
2004	279,1	183,9	35,2	44,5	4,7	38,0	28,6	8.7	2.11	3.9
2005	304,7	200,3	37,4	53,2	7,2	43,1	34,3	7.2	2.80	3.3
2006	330,6	215,9	39,4	61,0	10,4	46,2	39,6	6.5	3.61	3.51
2007	359,2	235,3	42,3	n.a.	n.a.	50,4	47,8	5.1	2.77	3.21
	Annual average percentage change									
1993-1998	4.03	3.83	1.98	6.43	3.21	13.54	12.05	-0.05	-3.36	-0.29
1998-2002	-4.94	-5.84	-1.03	-18.45	-22.16	1.80	21.45	3.67	-1.08	-0.05
2002-2004	8.93	8.83	2.09	33.97	66.06	7.05	38.84	12.67	5.57	2.68
2004-2007	8.77	8.56	6.24	17.07(b)	48.02(b)	9.88	18.70	6.89	2.82	3.48

Source: Secretary of Economic Policy, MECON (Ministry of Economy and Production)

Notes: EXP= exports; IMP= imports; TRADE BCE = Trade Balance CC AA = Current Account; GOV ACC PRIM = Government Primary Surplus; (a) Positive (negative) values stand for surplus (deficit) (b) Final year is 2006; n.a. = not available

In the external front, progress is necessary because the trade and current account surpluses of recent years –which as shown in Table 1 amounted respectively to 6.9% and 2.8% of GDP during the 2004-2007 period, but are falling– may deteriorate as a consequence of future external debt payments, or Argentina's high income elasticity of imports[4] , or due to changes in favourable international conditions (see Table 3 for information regarding the evolution of Argentina's external terms of trade and the evolution of export prices and quantities of Argentina's main export commodity groups).

Favourable international conditions and Argentina's recent macroeconomic performance can be seen as a unique opportunity to promote productive diversification. The expansion in external demand, improvements in the external terms of trade and the presence of government and current account surpluses (see Table 1) have encouraged capital accumulation and generated a favourable environment for investment in the tradable sectors.

[4] Recent estimations by Nicolini-Llosa (2007b) show that imports in Argentina have expanded more than three times faster than output and are not responsive to changes in relative prices.

Table 2
Changes in prices and labour market conditions and socio-economic indicators in Argentina

	RER (1)	CPI (2)	UN R (3)	RW (3)	POVERTY (1)	INEQUALTY (1)
	2001=100	1999=100		Oct 01= 100	Headcount ratio	Gini Coefficient
1993	100.5	93.19	9.90	n.a	20,20	n.a.
1998	118.59	101.98	13.20	105.21	30,90	0,497
2001	100.00	98.78	16.40	100.00	54,60	0,522
2002	241.9	124.34	15.60	70.60	53,00	0,518
2003	215.71	141.05	19.10	76.23	47,70	0,5
2004	218.23	147.26	14.60	77.16	39,90	0,495
2005	222.08	161.48	12.50	85.78	33,80	0,485
2006	228.08	179.08	10.90	98.05	26,90	0,485
2007	234.5	194.89	9.20	101.98	20,60	0,490
	Annual Average Percentage Change		**Period Average**			
1993-1998	3.4	1.8				
1998-2002	19.5	5.1	15.07	91.94	46.17	0.51
2002-2004	-5.0	8.8	16.43	74.66	46.87	0.50
2004-2007	2.27	9.8	11.80	90.74	30.30	0.49

Note: RER = Real Exchange Rage (multilateral); CPI = Consumer Price Index; UN R= unemployment rate; RW = real wages; all figures refer to Argentina's urban areas. Urban areas in Argentina stand for 90% of total population and the household survey covers approximately 70% of urban population.

Source: (1) Secretary of Economic Policy, MECON (Ministry of Economy and Production); (2) INDEC (National Bureau of Statistics); (3) CENDA, *El Trabajo en Argentina: Condiciones y Perspectivas*, No. 8, 11 and 13

However, there is need for caution in predicting the prospects of productive and export diversification. As the experiences of many developing countries show, positive external shocks may be a blessing, but can also turn out to be a curse. The literature on the so-called natural resource curse provides abundant evidence of the experiences of different countries where increases in primary commodity prices, similar to those benefiting Argentina (see Table 3)[5], can hinder economic development.[6]

[5] As shown in Table 3, both the terms of trade and the prices of all Argentina's exports, but especially those of resource-intensive products (PP, MOA and FUEL), have grown fast since 2002, and particularly fast in 2007.

[6] See Brunnschweiler and Bulte (2008); Murshed (2004), Sachs and Warner (1999), Serino (2008, 2009, chapter 2) and Van der Ploeg (2008) for a discussion and an empirical investigation of the so-called resource curse.

Table 3
Export growth in Argentina. Price and quantity indexes for the main commodity groups. Selected years and periods (1993=100)

	TOT INDEX	EXPORT PRICE INDEX				EXPORT QUANTITY INDEX			
		PP	MOA	MOI	FUEL	PP	MOA	MOI	FUEL
1998	102	106	101	105	76	191	176	224	260
2002	105	88	80	91	129	185	207	229	291
2004	116	108	97	96	201	194	249	271	250
2005	114	99	91	108	271	251	292	303	214
2006	121	110	99	115	327	240	314	350	192
2007	125	133	123	119	361	286	318	399	154
		Annual Average Percentage Change							
1998-2002	0.7	-3.7	-4.6	-2.8	11.2	-0.6	3.3	0.4	2.3
2002-2007	5.1	8.78	8.87	5.47	22.92	9.15	9.00	11.79	-11.98
2004-2007	2.53	7.23	7.98	7.31	21.59	13.92	8.51	13.79	-14.98

Source: (1) Secretary of Economic Policy, MECON (Ministry of Economy and Production)

Note: TOT = Terms of Trade; PP = primary products; MOA = manufactures of agricultural origin; MOI = manufactures of industrial origin;

The positive natural resource shock raises a critical question in relation to the possibility of sustained economic development in Argentina, which as claimed above requires the diversification of Argentina's tradable sector. This is the possibility of Dutch disease type adjustments associated with the improvements in primary commodity prices. Positive natural resource shocks, as shown in dependent economy models (see Murshed 1997 and Sachs 1999, among many others), can set in motion price adjustments that reduce the competitiveness of the non-traditional tradable sector and, thus, limit rather than promote economic diversification.

But Dutch disease adjustments are not unavoidable. As discussed (and hypothesised) in Serino (2007 and 2009, chapters 3, 4 and 5) and explored in this paper, the adjustment to a positive natural resource shock depends on economic policies, in particular the exchange rate regime, export taxes and the characteristics of government expenditure. The first two because they affect price adjustments, preventing revaluations through the exchange rate or increases in domestic prices –something particularly relevant in wage-goods exporting countries like Argentina–, and the third one because, as shown in Ros (2001) and Serino (2009, chapter 3), the government can channel part of the increased income associated to the shock to expand the provision of infrastructure (and other productive linkages), increasing the overall competitiveness of the economy.

The implications of the positive natural resource shock benefiting Argentina in recent years and how the abovementioned policies influenced the domestic adjustment, in particular that of the non-natural resource tradable sectors, are analysed in this paper through counterfactual simulations that are performed using a dynamic structuralist CGE model.

The analysis constitutes one of the few attempts to make an applied evaluation of the recent transformations in the Argentine economy.[7] The analysis shows that Argentina's economic performance in the period 2003-2007 has been positively affected by government policies, in contrast to the propositions linking Argentina's growth record almost exclusively to positive exogenous impulses coming from the international economy.[8] The paper does not deny the presence of these impulses but rather suggests that, unless complemented with economic policies – e.g. export taxes and the exchange rate–, the positive terms of trade shock could not bring about output growth and the expansion of non-traditional exports, as observed in the analysed period.

The paper is organised as follows. Section 2 presents the main features of the structuralist CGE model and associated Social Accounting Matrix (SAM) for Argentina. Section 3 is entirely devoted to the counterfactual simulations. The section first analyses the general implications of positive terms of trade shocks and the particular implications these shocks can have in wage-good exporting countries, as Argentina is; the section secondly studies economic-policy issues related to shock management, in particular the role of export taxes, exchange rate regimes and the implication of increases in government expenditure financed with export taxes.

2 A STRUCTURALIST CGE MODEL FOR ARGENTINA

2.1 Some General Remarks

To analyze the effects of positive natural resource shocks to Argentina's traditional exporting sectors and economic policies this paper uses a dynamic CGE and a small SAM of Argentina updated for 2004. They were designed to capture some structural features of the Argentine economy. The SAM and model distinguishes: (i) five commodities and

[7] The papers by Cicowiez, Díaz-Bonilla C. and E. Díaz (2008) and Nogués et al. (2007) are among the few studies that deal with these issues using modelling techniques. They use general equilibrium and partial equilibrium approaches to study the impact of demand shocks and export tax policies on poverty and income distribution. Serino (2008b) uses a Walrasian general equilibrium model developed by Argentina's economic authorities to study the macro and socio-economic implications of changes in terms of trade shocks and export taxes. Finally, Visintini and Salto (2004, 2005) focus on the macroeconomic impact of improvements in Argentina's external sector. None of them, however, discusses how natural resource shocks can affect the structure of production and exports in Argentina.

[8] The papers by Bastourre, Carrera and Ibarlucia (2007), studying the impact of the recent reversion in Argentina's trend terms of trade, and Argentina's exports elastic response to income growth in the country's trading partners and more limited response to price changes, as estimated by Streb (2005), can be associated to this position. Bianco et al. (2008), on the other hand, emphasize improvements in Argentina's terms of trade as a mechanism permitting a historically unique combination of fast economic growth without foreign exchange constraints; although they do not consider international price dynamics to be the main driving force of Argentina's recent development process.

economic sectors; (ii) nine labour categories [9]; (iii) five households, classified according to per capita income; (iv) indirect, factor, trade and direct taxes, and (v) public and private sectoral investment.

The dynamic CGE model draws on existing applied models. Although the model defines the behaviour of the natural resource tradable sectors following the so-called standard trade model[10], most features of the model are embedded in the structuralist tradition. These have many points in common with the models developed in Gibson (2005), Gibson and van Seventer (2000a, 2000b) and Taylor (1990) [11], and concern: the assumption of mark-up prices and quantity adjustment in the industrial sector and the inclusion of wage, trade and investment equations, and the definition of macroeconomic closure rules.

2.2 Classification of economic activities, commodities and productive diversification in Argentina

The classification of economic sectors and definition of their characteristics are of particular importance for the analysis of economic diversification; they are summarised in Table 4. As shown in Table 4, the SAM identifies five commodity groups and the five economic sectors that produce them[12]: (i) primary products (PP); (ii) resource intensive manufacturing products (MR); (iii) other manufacturing products (MO); (iv) producer services (PS); and (v) consumer services (OS). Products and sectors PP, MR and MO are the standard tradable sectors and are the ones defined according to the CTP-DATA classification.

Sectors PP and MR are the sectors linked to Argentina's abundant and highly productive natural resource endowments, which in the SAM and CGE model are distinguished according to the degree to which they process natural resources. Although

[9] Labour categories are classified according to the skills of the labour force, which is defined in relation to the level of education and the workers' labour relationships: self-employed and formal or informal wage labour, depending on whether they are covered or not by the social security system.
[10] The standard trade model was first developed by Dervis, de Melo and Robinson (1982) and extended by Löfgren, Lee Harris and Robinson (2001).
[11] Diao, Rattsø and Stokke (2006, 2005) construct a Ramsey growth model to simulate Thailand's long-term economic growth record and show that structural change has been the fundamental vehicle of growth. Although their research questions and findings have some similarities with the present research, I opted for a different modelling strategy. This is because the Ramsey model these authors use does not adequately identify the propositions put forward in the analytical chapters of the current research.
[12] Primary and industrial products are classified using the CTP-DATA taxonomy proposed by Peirano and Porta (2000) and follows the taxonomy proposed by Pavitt (1984), adapted by Gurrieri (1989, 1992, quoted in Porta and Peirano, 2000), and used in the SELA study (1994, quoted in Porta and Peirano, 2000) to analyse the pattern of trade specialization in Latin American countries. The classification distinguishes products and sectors according to their main competitiveness factors (endowments, economies of scale, economies of specialization, technological intensity, etc.) and their reliance on price and non-price competitiveness advantages.

the country has a price competitiveness advantage in these two sectors and products, in the paper I refer to sector PP as the traditional sector and consider that diversification of Argentina's tradable sector can take place in two ways: in sectors MR, by industrializing Argentina's natural resources, and/or in sectors MO and PS, through the development of industries intensive in scale, science and technology and exportable services.

Table 4
Commodity and sector classification

Commodities and Sectors		Observations
TRADABLE TRADITIONAL	PP – Primary	Price competition; flexible prices and supply determined exports, according to Constant Elasticity of Transformation function.
TRADABLE NON-TRADITIONAL	MR – Manufacturing Resource Intensive	Price competition; flexible prices and supply determined exports, according to Constant Elasticity of Transformation function.
	MO – Manufacturing Other	Non-price competition; excess capacity and mark-up pricing
	PS – Producer Services	Non-price competition; excess capacity and mark-up pricing
NON - TRADABLE	OS – Other Services	Price adjustment

Source: Author's classification, based on CTP-DATA taxonomy for tradable products and sectors.

Table 4 presents some key characteristics of the different economic sectors. Following the tradition for multisectoral models of the Argentine economy[13], the sectors linked to Argentina's natural resources (PP and MR) are assumed to: (i) have a price competitiveness advantage; (ii) operate at full-capacity; and (iii) sell to the domestic or international market depending on the relative profitability of one or the other product destination. Excess capacity and quantity adjustments, on the other hand, are the norm in the non-natural resource manufacturing sector MO and in sector PS. As discussed in Serino (2007 and 2009, chapter 4), this implies that output in these sectors is demand-determined. Hence, it depends on domestic and world income and the price and non-price competitiveness (and the events affecting them) of these sectors.

Two types of services and the sectors providing them are identified in the SAM and the CGE model, following the sectoral classifications in Serino (2009, chapter 3): sector PS, principally making and providing producer-oriented services, as for example public utilities, construction, and communication, finance, transportation and other specialized producer services, and sector OS providing services, e.g. commerce, restaurants, tourism, leisure and informal services. The main difference between the two sectors is that the services provided by sector OS are principally for consumption, a difference captured in 1997 Argentina's input-output table, which was employed to update the SAM. Although many

[13] For different analytical specifications of Argentina's agricultural sector as the main exporting sector operating at full-capacity, see papers by Diamand, (1972), Canitrot (1975), Kostzer (1994). Nicolini-Llosa (2007a ,2007b), Porto (1975), Serino (2007) and Visintini and Calvo (2000).

services from sector PS are inputs from other domestic activities, services as for instance software, transportation and financial services can also be exported, which is why they are also considered as a tradable sector.

The reason for this particular classification of Argentina's service sector is to distinguish between two adjustments to a positive resource shock with opposite effects for the competitiveness of sectors MO and PS, an important distinction often omitted from multi-sectoral models. A positive resource shock can encourage an expansion in the demand of consumer services (OS) which leads to higher non-tradable prices and Dutch disease type adjustments; alternatively, it may, at the same time, promote the expansion of sector PS. This second adjustment may occur because the natural resource sector makes intensive use of producer services, or it may be the result of public policies to promote investment in the sector providing producer and infrastructure-type services. Most importantly, expansion of sector PS –to the extent that it implies improvements in the provision of commercial, scientific and transportation services, for example– can augment the competitiveness of the non-traditional tradable sectors and thus encourage economic diversification, as in Ros (2001) and Serino (2009, chapter 3).

2.3 The CGE Model

The material balance equation and demand components

A synthetic description of the model is provided in this section, which highlights the features of the model that are relevant for the applied analysis; its full specification is provided in the appendix to this paper.

Together with the commodities and economic sectors (denoted with supraindex *c* and *a*), the model distinguishes ten factors of production (one capital and nine labour categories, characterized with supraindices *k* and *l*), and identifies three types of institutions: households (H), government (G) and rest of the world (W).

Equation (1) shows the material balance equation

$$XC_{c,t} = AINTD_{c,t} + \sum_{h} CDH_{c,h,t} + IO_{c,t}^{priv} + IO_{c,t}^{gov} + CDG_{c,t} + E_{c,t} - M_{c,t} \qquad 1$$

In the equation, XC_c is commodity c demand, $AINTD_c$ is domestic intermediate inputs, $CDH_{c,h}$ refers to household consumption, IO_c^{priv} and IO_c^{gov} to private and public investment, CDG_c to government current expenditure, E_c stands for exports and M_c for imports.

The external sector: exports supply and demand, and the competitiveness of the non-natural resource tradable sectors

The economic rationale for exporting natural resource products is different from that for other exports and therefore they are modelled differently. Exports of natural resource-related products (PP or MR) are supply-determined and producers decide the destination of production according to relative profitabilities. The decision between exporting or selling to the domestic market is modelled using a Constant Elasticity of Transformation (CET) function that links exports and domestic supply to the relative price prevailing in the external and domestic market. This function is defined in equation (2)

$$\frac{E_{c,t}}{QDDA_{c,t}} = \left(\frac{PE_{c,t}}{PDC_{c,t}} \cdot \frac{\left(1-\psi_c^{cet}\right)}{\psi_c^{cet}} \right)^{1/\rho_c^{cet}-1} \qquad 2$$

where $E_{c,t}$ and $QDDA_{c,t}$ are exports and domestic sales respectively, $PE_{c,t}$ and $PDC_{c,t}$ are export and domestic prices respectively, and ψ_c^{cet} and ρ_c^{cet} respectively are the share and exponent parameter of the CET function. The exponent parameter depends on the elasticity of transformation between the domestic and export supply, which captures the ability of producers to shift from one market to another. To reproduce the capacity of Argentina's natural resource sector to export its surpluses, the model assumes high elasticity of transformation. This permits an easy reallocation of production between the domestic and external markets and increases the pass-through of international to domestic prices and, thus, serves to evaluate the adjustment to positive terms of trade shocks in wage-goods exporting countries.[14]

Output in sectors MO and PS is assumed to be demand-determined. It depends, among other things, on the demand for exports and the competitiveness of production in these sectors. Equation (3) defines the export demand equation for MO and PS products.

$$E_{c,t} = E_{c,t-1} \cdot (RERE_{c,t})^{\xi_{EP}} \cdot (y^W)^{\xi_{EY}} \cdot \left(\frac{ID_{a,t}^{priv}}{ID_{a,t-1}^{priv}} \right)^{\xi_{E_{NP1_c}}} \cdot \left(\frac{QA_{APS,t}}{QA_{APS,t-1}} \right)^{\xi_{E_{NP2_c}}} \qquad 3$$

The export demand equation goes beyond traditional specifications.[15] Exports are function of conventional factors, as changes in world income (y^W) and the price competitiveness of the products concerned, as captured by the sector-specific real exchange rate (RER_c). Yet, in this CGE model, the competitiveness of exports depends on factors other than prices.

Following Leon-Ledesma's (2002) Kaldorian growth model, the equation incorporates two non-price determinants of competitiveness. The first links the competitiveness of production to sector-specific private investment $\left(\frac{ID_{a,t}^{priv}}{ID_{a,t-1}^{priv}} \right)$, which enters the equation to account for factors facilitating access to foreign markets, as embodied technical progress and investment in machinery and equipment. The second associates export competitiveness with output increases in sector PS $\left(\frac{QA_{APS,t}}{QA_{APS,t-1}} \right)$. This is included to capture the contribution of productive linkages and different types of infrastructure to the

[14] The CGE model specification differs from the specification in Serino (2007). In that model sectors producing natural resource base products are indifferent as to the destination of production since they can charge the international price in the domestic market and export their surpluses. Modelling-wise this specification implies fixed price and quantity adjustments for the natural resource sectors. This specification, however, is not included in the CGE model since it would reduce its flexibility –with four out of five sectors adjusting through quantities to excess demand.

[15] See e.g. Dervis et al. (1982: Ch. 7).

competitiveness of exports, an effect emphasized in Ros (2000, 2001) and the analytical model developed in Serino (2009, chapter 3).

The price competitiveness of non-traditional exports is defined by the sector-specific real exchange rate

$$RERE_{c,t} = \frac{NER_t \cdot pwe_c}{PDC_{c,t}} \qquad 4$$

with pwe_c denoting world prices, NER the nominal exchange rate and PDC_c denoting the domestic price of goods produced in sectors MO and PS and depending on domestic production costs as indicated in equation (5)

$$PDA_{a,t} = (1 + TAUV_{a,t})VC_{a,t} \qquad 5$$

Production costs, in turn, depend on the mark up rate $TAUV_a$,, which changes according to sectoral output, and variable production costs (VC_a), which are a function of intermediate input prices and unitary labour costs, as defined by nominal wages W_l and labour productivity.

The model also assumes that the price of labour is institutionally determined, depending on labour productivity growth (*LPRODG*), the evolution of consumer prices (*CPI*), changes in the rate of unemployment (*UN*) and an exogenous policy variable (*wpol*), to account for and/or simulate changes in government wage policy.

$$WL_{fl,t} = WL_{fl,t-1} \cdot \left[\begin{array}{l} 1 + \omega_1 \cdot \dfrac{\sum_a LPRODG_{fl,a,t}}{a} \\ + \omega_2 \cdot \hat{CPI}_t - \omega_3 \hat{UN}_{fl,t} + \omega_4 wpol \end{array} \right] \qquad 6$$

Other particular feature of the model is the endogeneity of the labour output coefficient and labour productivity, as defined in equations (7) and (8).

$$LOCF_{fl,a,t} = LOCF_{fl,a,t-1} \cdot (1 - LPRODG_{fl,a,t}) \qquad 7$$

$$LPRODG_{fl,a,t} = lstc_{fl,a} + \alpha_{1fl,a} \cdot \hat{UAV}_t \qquad 8$$

As discussed in Serino (2007), labour productivity growth is determined by demand and supply factors. Demand-determined productivity growth is referred to in the literature as the Kaldor-Verdoorn effect and links productivity growth to learning and specialization economies that arise with expansion in demand. These are captured by α_1 in equation (8), which links productivity to changes in the economy-wide capacity utilization. Supply-side determinants of productivity growth (i.e. human capital accumulation) are captured by the exogenous term *lstc*, which stands for labour saving technical change, and is assumed to be exogenous in the model.

The specification of imports resembles the export demand equation.

$$M_{c,t} = M_{c,t-1} \cdot \left(\frac{YAGR_t}{YAGR_{t-1}} \right)^{\xi_{MY}} \cdot \left(\frac{1}{RERM_{c,t}} \right)^{\xi_{MP}} \cdot \left(\frac{ID^{priv}_{a,t-1}}{ID^{priv}_{a,t}} \right)^{\xi_{MNP1}} \cdot \left(\frac{QA_{APS,t-1}}{QA_{APS,t}} \right)^{\xi_{MNP2}} \qquad 9$$

In equation (9) *YAGR* is real GDP, $RERM_c$ is sector-specific exchange rates and the last two ratios account for the non-price competitiveness determinants discussed above.

Domestic demand

The specification of domestic demand, to a large extent, follows the traditional structuralist CGE models. Demand for intermediate inputs is based on a Leontief function and consumption demand is defined according to a linear expenditure system (LES), as defined in equations (10) and (11) below[16] ,

$$INTD_{c,a,t} = iocf_{c,a} \cdot XA_{a,t} \qquad 10$$

$$CDH_{c,h,t} = \theta_{c,h} + \frac{\mu_{c,h}}{PINDEX_{c,t}} \cdot \left[EXPH_{h,t} - \sum_c PINDEX_{c,t} \cdot \theta_{c,h} \right] \qquad 11$$

In structuralist-type models, output also responds to changes in investment and government expenditure, which thus are determined according to particular behavioural equations or are defined as exogenous and determined by economic policies.

Private investment is defined in equation (12) below

$$ID^{priv}_{a,t} = ID^{priv}_{a,t-1} \cdot \begin{bmatrix} 1 + \gamma_{1a} \hat{UAV}_t + \gamma_{2a} \hat{ID}^{gov}_t \\ + \gamma_{3a} \hat{PRFR}_{a,t} - \gamma_{5a} \hat{RIR}_t \end{bmatrix} \cdot IADJ_t \qquad 12$$

The model defines an investment equation for each economic sector; each equation incorporates an accelerator parameter γ_1, linking capital accumulation to changes in economy-wide capacity utilization, and a crowding-in parameter γ_2 that relates private investment to changes in public investment. Investment is also a positive function of the profit rate $\hat{PRFR}_{a,t}$ and is negatively linked to the real interest rate $\hat{RIR}_t$, which accounts for the cost of borrowing.[17]

Government consumption and public investment are the remaining components of aggregate demand. The benchmark specification of the model assumes that *government expenditure (consumption and investment)* are exogenous and evolve according to a pre-defined rule (*cdgrule* and *idgrule* in equations (13) and (14)) -a rule that is calibrated to reproduce the evolution of government expenditure in recent years, although it can be modified so as to simulate the impact of alternative government expenditure policies. As shown in equations

[16] In equation (11), θc,h is 'basic needs' of household H, □ c,h denotes the marginal propensities to consume and the term in brackets represents household expenditure after satisfying "basic needs".
[17] Variable IADJ is included to allow for alternative saving-investment closure rules: it is endogenous under the neoclassical closure and exogenous with alternative closure rules.

(13) and (14), the model allows for alternative specifications of government consumption, for this also can be endogenous and adjust to balance government accounts (*GCADJ*), or can be a function of government income from export taxes ($CDGTC_{c,t}$) and ($IGTI_{c,t}$).[18]

$$CDG_{c,t} = \left[CDG_{c,t-1} \cdot (1 + cdgrule) + CDGTC_{c,t} \right] \cdot GCADJ_t \qquad 13$$

$$ID_t^{gov} = ID_{t-1}^{gov} \cdot \left[(1 + igrule) + IGTI_t \right] \cdot GIADJ_t \qquad 14$$

In the model, public income is invested exclusively to improve the provision of infrastructure. It occurs, therefore, in sector *PS* and represents the type of public expenditure that could increase the overall competitiveness of Argentina's non-natural resource tradable sector (see equations (3) and (9)).[19]

This characterization of public expenditure enables the analysis of the implications of alternative government policies for economic development, since public investment not only increases domestic demand, but also can have positive externalities that benefit the non-traditional tradable sectors. Also important is that the government equations include a variables $CDGTC_{c,t}$ and $IGTI_t$ to study the impact of alternative uses of the income provided by export taxes, the "extraordinary" source of finance that Argentina's government has enjoyed since 2002.

Production and labour demand

In the model, supply depends on capital accumulation and, thus, on investment, as defined in Gibson (2000a) and equation (15). Based on the assumption of price adjustment in sectors PP, MR and OS, equation (15) determines effective output in these sectors. In sectors MO and PS, where output is demand-determined, the equation defines potential output.

$$QA_{a,t} = \left(\kappa_a \cdot K_{a,t-1} + QA_{a,t-1} \right) \qquad 15$$

In (15) κ_a is the sector-specific incremental capital-capacity ratio, and $K_{a,t-1}$ and $QA_{a,t-1}$ respectively denote capital stock and output in the previous period. The rate of capacity utilization ($U_{a,t}$) equals

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[18] Variable $CDGTC_c$ is defined as

$CDGTC_{c,t} = strcdg_c \cdot (taxcon \cdot \frac{TTEX_t}{TTEX_{t-1}}) \cdot \frac{1}{CPI_t}$, where TTEX stands for total export tax and *taxcon* denotes the percentage of this income that finances government current consumption. A similar specification is defined for $IGTI_t$ where as with current government expenditure, *TTEX* stands for total export taxes and *taxinv* denotes the proportion of this income that is invested

[19] Larraín, Sachs and Warner (2000) emphasize the importance of public investment in infrastructure in Chile to prevent Dutch disease adjustments. Their argument also is applicable to the Argentine case.

$$U_{a,t} = \frac{XA_{a,t}}{QA_{a,t}} \qquad 16$$

Capacity utilization equals 1 in sectors PP, MR and CS, the sectors for which the model assumes full-employment and price adjustment, and is defined as the ratio of demand-determined ($XA_{a,t}$) to potential output ($QA_{a,t}$) in the other two sectors.

Sectoral labour demand depends on the endogenous labour output coefficients and output, as shown in equation (17).[20]

$$LD_{fl,a,t} = LOCF_{fl,a,t} \cdot XA_{a,t} \qquad 17$$

Macroeconomic Balances, System Constraints and Closure Rules

The final elements of the CGE model are macroeconomic balances. These concern government and external balances, which define public and external savings, and the macro equilibrium relation between savings and investment. These are defined in equations (18), (19), (20) and (21) below.[21]

$$SG_t = YG_t - EXPG_t \qquad 18$$

$$GBR_t = EXPG_t + \sum_c PINDEX_{c,t} \cdot IO^{gov}_{c,t} - YG_t \qquad 19$$

$$SW_t = \frac{\sum_c PM_{c,t} \cdot M_{c,t}}{(1+tm_c)} + \sum_h TRHWV_{h,t} + TRGWV_t - \sum_{ctp} \frac{PE_{c,t} \cdot E_{c,t}}{(1-te_c)} - \sum_{cmup} PDC_{c,t} \cdot E_{c,t} - \sum_h TRWHV_{h,t} - TRWGV_t \qquad 20$$

$$\sum_h MPS_{h,t}(1-ty_h)Y^H_{h,t} + SG_t + SW_t = \sum_c PINDEX_{c,t}(IO^{priv}_{c,t} + IO^{gov}_{c,t}) \qquad 21$$

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[20] The labour supply is defined in equation A.28 in the appendix. It grows according to an exogenous growth rate and responds to wage differential among labour categories. Because labour categories differ in terms of the skills of the labour force, which are acquired through working experience or participation in the education system, the response to wage differentials is assumed to be slow.

[21] Equation (18) and (19) define government savings SG_t – the difference between current income (YG_t) and current expenditure ($EXPG_t$) – and government borrowing requirements GBR_t, which take account of public investment and represent the effective final needs of the government to cover its expenses. In equation (20) – the external macroeconomic balance – the first three terms on the RHS of equation indicate payments to the rest of the world and the last three terms are payments from abroad. Equation (21) expresses the remaining macroeconomic balance capturing the equilibrium between saving and investment.

Table 5 summarises the main characteristic of the CGE model: the numeraire to express relative prices and the closure rules[22] defining how the factor and commodity markets adjust to excess demand and how the economy achieves the various macroeconomic balances.

As shown in the table, the nominal wage for unskilled and informal labour is defined as the *numeraire,* and a fix-flex closure rule characterizes the commodity market, with mark-up sectors MO and PS showing quantity adjustments, as in the model developed in Serino (2007 and 2009, chapter 4), and sectors PS, MR and OS adjusting to excess demand via price adjustments. Consistent with the still high (though falling) unemployment levels observed in Argentina, quantity adjustments are the regulating mechanism in the labour market –in 2004 the starting year of the simulations unemployment affected 14% of Argentina's labour force.

Table 5
Main features of the dynamic CGE model

MICRO CLOSURE		
MARKET	**ADJUSTMENT MECHANISM**	**OTHER PROPERTIES**
Commodity markets		
PP & MR	Price adjustment to excess demand	Price competition; full capacity utilization and CET function
MO & PS	Quantity adjustment	Non-price competition; excess capacity and mark-up pricing
OS	Price adjustment to excess demand	
Labour Market	Quantity adjustment	Institutionally determined wages
MACRO CLOSURE		
Foreign Exchange Market	Fixed / Flex exchange rate regime	
Saving-Investment Balance	Investment driven / Saving driven	
NUMERAIRE		
FWLNP1	Nominal wage of unskilled and informal wage labour	

In the case of macroeconomic balances, the benchmark specification of the model assumes a fixed exchange rate, exogenous government expenditure and Keynesian closure rule for the saving-investment balance. The assumption concerning the adjustment in the external balance is consistent with the managed exchange rate regime implemented in Argentina and the model is calibrated so as to reproduce observed changes in the nominal exchange rate. In relation to the savings-investment balance, the assumption of a Keynesian closure rule, where output adjusts to ensure the savings required to finance the exogenously determined investment, is compatible with the presence of excess capacity and the fast response of output to changes in demand conditions that has been observed in Argentina.

[22] See Robinson (1989) and Sánchez Cantillo (2004) for a general and complete discussion of closure rules, and Taylor (1990) for an exposition of fix-flex closure rules.

2.4 The Model Parameters

The model is calibrated to reproduce the initial equilibrium of the SAM using different parameter values, as shown in Table A.1 and Table A.2. Average and distribution parameters are calibrated to the SAM[23] , values for exogenous variables are obtained from different official sources, as shown in Table A.2, and parameters for behavioural equations and exogenous or policy variables are calibrated using available information, borrowed estimations or are defined according to guesstimates. This section makes a short description of the calibration and the reader is referred to Serino (2009, chapter 6) for a comprehensive discussion of the calibration and validation of the CGE model used in this paper.

The model assumes a high elasticity of transformation (sigma = 5) to capture the ability of the natural resource producers to sell their surplus in the international market. Although high parameter values may overestimate the economic or sectoral response to changes in international conditions or trade policy (Vos, 2007), a high elasticity of transformation is a realistic and relevant assumption to describe the behaviour of sectors PP and MR in Argentina.

Demand for exports from sectors MO and PS is assumed to have unitary price elasticity, in line with figures from Catao and Falcetti (2002). The income elasticity of exports for these sectors equals 0.94, which is the short run elasticity for Argentina's exports estimated by Senhadji and Montenegro (1999). The parameter capturing the elasticity of exports to capital accumulation is assumed to have a value of 0.25 (0.2 for sector PS) and elasticity of productive linkages and provision of infrastructure is assumed to equal 0.15.[24]

Price and income import elasticities are calibrated taking into account Catao and Falcetti's (2002) estimations. The short term price elasticity of imports is 0.25 and the income elasticity of imports has the value 2.25. These values illustrate the strong connection between Argentina's imports and the economic cycle and their unresponsiveness to changes in relative prices, especially in the short-term. Due to a lack of empirical estimations, and to reflect Argentina's structurally high import dependency, the elasticity of imports to the determinants of non-price competitiveness is assumed to have very low values (equal to 0.025).

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[23] Average and distribution parameters represent the largest group of parameters, and include household saving rates, household income and expenditure structure, input-output coefficients and tax rates, among others.

[24] Low parameter values are consistent with Catao and Falcetti's findings that capital accumulation influences exports in the long-run but not in the short-run. It should also be noted that two factors justify the differences in the non-price elasticity parameters. First, the model calibration assumes a higher elasticity to capital accumulation because the bulk of Argentina's non-natural resource exports are capital intensive and, thus, tied to the dynamism of investment. Second, the calibration assumes lower export elasticity to the expansion of productive linkages and infrastructure to reflect that their development is a lengthy process, which does not have an immediate effect but rather an effect that unfolds over time.

Labour productivity grows due to labour-saving technical change, which is assumed to be exogenous and increases by 2% per year, but also varies according to changes in aggregate demand. The Kaldor-Verdoorn parameter capturing this relationship equals 0.8, lower than recent estimations for Argentina (see Narodowski and Panigo, 2008, which estimate that the Kaldor-Verdoorn parameter is equal to 0.92) but higher than standard figures, which are said to fluctuate around 0.6 (see e.g. Ros, 2000; Leon-Ledesma, 2002; Rada and Taylor, 2004).

Price and income elasticities of household demand are taken from Berges and Casellas (2002) and are employed to calibrate the intercept and marginal propensities of the household linear expenditure system according to the Frisch methodology.

The parameters of the wage and investment equation were defined in collaboration with people from Argentina's Ministry of Economy and Production (MECON), considering estimations from a structural macroeconometric model for the period 2003-2006 (see Panigo et al. 2009). The calibration of the wage equation considers: (i) an intermediate response of wages to labour productivity growth, with the respective coefficient taking a value equal to 0.5; (ii) an indexation parameter equal to 0.8; and (iii) a moderate elasticity to the situation of the labour market, since the coefficient linking wage growth to changes in unemployment equals 0.28.[25] Parameters for the investment equation suggest a weak response of total investment to output growth, public investment and increases in the cost of capital, and that profits are the main driving force behind investment (see Table A.1).

Together with parameter values and sources, Table A.1 shows the range of values for which the dynamic CGE model works. None of the model's parameters, as shown in columns 2 and 3 of Table A.1 is at bound, but rather is distant from the values that make the dynamic CGE model unstable. This suggests that the functioning and stability of the dynamic CGE model do not depend on any particular parameter value and that the model works for values close to those defined in this calibration.

3 AN APPLIED ANALYSIS OF POSITIVE TERMS OF TRADE SHOCKS IN ARGENTINA

This section studies the impact of a positive natural resource shock, simulated as an increase in the international prices of Argentina's natural resource exports. The analysis first discusses the dynamic economic adjustments to the shock and the implications of this positive terms of trade shocks in wage-goods exporting countries. It secondly addresses economic-policy issues related to shock management. The purpose of the analysis is to evaluate: if terms of trade shocks tend to constrain productive and export diversification, to what extent economic policies have contributed to counteract Dutch disease effects in Argentina and thus facilitated the economic recovery and fast economic growth observed

[25] This value is larger than the 0.1 estimated by Damill, Frenkel and Maurizio (2002) for the 1990s, when, in contrast to the period after the 2001-2002 economic crisis, unemployment exerted downward pressure on nominal wages.

in the country in recent years, and how do the effects of a positive terms of trade shock in a wage-goods exporting countries differ from a similar shock in countries producing other resource based products. Before turning to these issues, however, the paper compares the trends observed in key macroeconomic variables to simulated trends with the dynamic CGE model.

Simulations are performed for the medium-term period 2004-2007 and, unless otherwise stated, the simulations in this paper assume the benchmark closure rules: quantity adjustments in factor markets, exogenous government expenditure, a fixed nominal exchange rate and Keynesian adjustment to the savings-investment balance. Although the CGE model capture many dimensions of an economy, the analysis in this paper focuses on changes in output, the main components of aggregate demand and the evolution of the external sector, especially changes in output, exports and the competitiveness of the tradable sectors. The tables in the appendix, however, display the effects of the shocks in a broader set of variables.

Table 6 below displays information of the average growth rate observed in key macroeconomic variables (real GDP growth, the main components of aggregate demand, consumption, investment, exports and imports, and other relevant macroeconomic data such as total employment, the CPI and average real wages) and the model baseline simulations for the period 2004-2007 (see columns 1 and 2). Although inaccuracies in the model specification, missing information and "unobservable" factors (or factors not considered by the model) influence the simulations, Table 6 shows that, in the case of most variables, the baseline simulation projects growth rates similar to those reported in official statistics. The model shows rapid real output, consumption and exports growth, and even faster growth in total investment and imports, which in all cases differ from official trends by less than 10% (see Table 6, columns 1 and 2, rows 1 to 5). However, the figures for employment and real wages exceed or fall short of observed trends by higher margins (see Table 6, columns 1 and 2, rows 6 and 11). [26]

The model simulations also display observed increases in consumer prices. According to official data and the model's base run simulation, the CPI grew at an annual average rate of 10% between 2004 and 2007; yet inflation accelerated in 2007 and 2008 –a period not analysed here (see Table 6 columns 1 and 2, row 7). It should be noted that the model identifies only two sources of overall price increases: wage-goods inflation associated with changes in the prices of natural resource products, and inflation due to differences in the composition of domestic supply and demand, linked to the economic cycle.[27]

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[26] Whereas the presence of significant excess capacity contributes to explain the model's overestimation of total employment growth, the main factor that explains the models underestimation of real wage growth is the moderate wage response of nominal wages to improvements in labour market conditions.

[27] Price increases associated with changes in agents' expectations or due to monetary factors are not taken into account since the dynamic CGE model considers only the real side of the economy. For a discussion of the various causes of inflation in Argentina see the analyses in CENDA (2008) and Frenkel (2006).

Table 6

Positive terms of trade shocks. A 10% increase in the price of exported goods. Dynamic simulations for the period 2004-2007 *a/*

		Observed	Base Run (BR)	Positive Terms of Trade Shock 10% inc. PWE_{PP} & PWE_{MR}
		Annual Av. growth		% change from BR
		(1)	(2)	(3)
	Macroeconomic Variables			
1	Real GDP	8,8	7,93	-2,2
2	Tot. Consumption	8,2	8,20	5,5
3	Tot. Investment	18,4	16,98	3,8
4	Tot. Exports	9,9	10,18	-10,2
5	Tot. Imports	18,7	19,56	7,9
6	Tot. Employment	3,2	5,29	3,8
7	Consumer Price Index (CPI)	9,8	9,93	18,6
8	Dom. Price PP	13,4	9,83	32,1
9	Dom. Price MR	11,4	8,77	28,2
10	Dom. Price OS	8,6	10,76	14,9
11	Av. Real Wage	9,7	4,86	-3,4
	Variables External Sector			
12	Real Exchange Rate CMO		-0,74	159,3
13	Real Exchange Rate CPS		-2,06	77,8
14	Output APP		8,06	3,7
15	Output AMR		7,26	5,0
16	Output M-up Sectors (MO + PS)		7,48	-16,4
17	Domestic supply PP		7,91	-7,6
18	Domestic supply MR		6,34	-7,0
19	Imports PP		9,93	21,5
20	Imports MR		19,19	11,6
21	Exports PP		9,00	11,3
22	Exports MR		11,30	25,0
23	Exports MO		10,61	-67,6
24	Exports PS		9,59	-73,7

Source: model computations. % change from base run

a/ The base run simulation assumes a Keynesian closure rule for the saving-investment balance; PP= primary products; MR= resource intensive manufacturing; MO=other manufacturing products; PS= producer and exportable services; OS= other (consumer) services

Wage-goods inflation is linked to developments in the international market for primary and other natural resource products and to Argentina's exchange regime. Increases in the international price of Argentina's natural resource exports, especially in 2006 and 2007, and the implementation of a stable and competitive exchange rate since 2002, have been pushing prices upwards. In terms of the CGE model, this occurs because higher

international prices and a competitive exchange rate –read devalued exchange rate– increase the profitability of exporting and, thus, reduces the number of goods offered in the domestic market.[28] Increases in the demand for non-tradable goods, in excess of available supply, associated to the (observed and) simulated increases in demand, employment and real wages are the other cause of overall price increases identified in the model (see Table 6 columns 1 and 2, rows 7 to 10).

This brief introduction to the model baseline simulations concludes by referring to simulated dynamics of the non-natural resource tradable sectors (MO and PS). According to the baseline simulation, production and exports from sectors MO and PS expand at rates similar to those in other sectors (see Table 6, column 2, rows 14 to 24). Although sectoral exchange rates appreciate by a small amount due to domestic inflation, reducing the competitiveness of sectors MO and PS, the expansion of domestic and international demand, rising international prices, Argentina's exchange rate policy and the recovery of public and private investment has encouraged production and exports in the non-traditional sectors (see Table 6 column 2, rows 14 to 24).

3.1 Positive natural resource shocks: increases in the price of Argentina's Natural Resource Exports

The paper now turns to the analysis of Argentina's economic response to positive natural resource shocks. The first simulation provides a general overview of the effects of positive terms of trade shocks in Argentina. The simulations assume that the world price of Argentina's natural resource exports (PP and MR) increases by 10% over all the simulated period, an expansion in international prices slightly larger than the average expansion for 2004-2007, but smaller than 2007 price changes, which expanded at around 8% and 20% respectively (see Table 3).

Simulation results for a selected group of variables are summarized in Table 6 above. Column 2 presents the baseline simulation and column 3 displays the adjustment to the terms of trade shock. The former are annual average growth rates over the simulated periods and the results for the terms of trade shock are presented as percentage changes from the baseline.

According to the simulations, *a sustained increase in the international price of natural resource products, as the one observed in recent years, is not expansionary but contractionary*, slowing GDP growth by 2.2% vis-à-vis the base run simulation in period 2004-2007. This result, which

[28] However, there are other mechanisms linking domestic and international prices, all of them valid to a certain extent. Domestic prices may increase because the price of primary commodities and many processed natural resources goods are determined in the international market. Or they can augment because the increased profitability of some exportable crops, e.g. soybeans in Argentina, reduces the supply of other products that are consumed in the domestic market, with a subsequent impact on prices and inflation. The latter explanation cannot be explored with this model because the natural resource sector is not sufficiently disaggregated. And the former explanation is not accounted for because, as explained in the previous section, the natural resource sector in the CGE model is defined using a flexible price formulation.

initially may appear "counterintuitive", does not imply that Argentina's recent expansion has been independent of improvements in the external terms of trade. As is shown later in this paper, it suggests that, unless complemented by economic policies – e.g. export taxes and the exchange rate– the positive terms of trade shock could not bring about output growth.

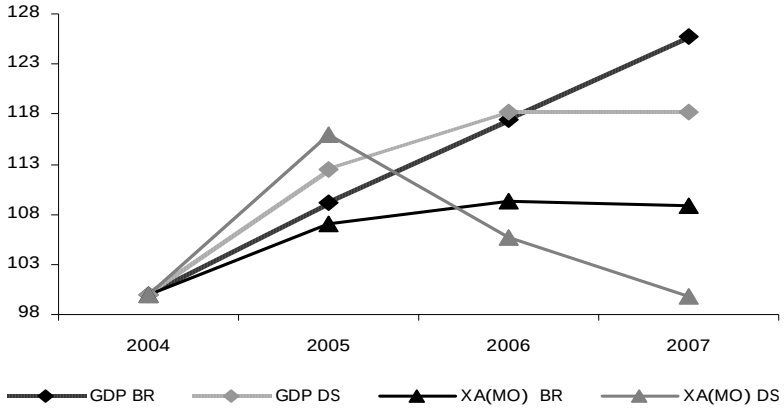
Dutch disease effects are the fundamental explanation for the adjustment, although the reduction in real wages also slows aggregate demand and thus contributes to making the terms of trade shock contractionary in this demand-driven model.[29] Although the positive terms of trade shock increases consumption and investment, the shock also reduces net exports, as growth in international prices prompts increases in domestic prices reducing the competitiveness of Argentina's non-natural resources sectors (see rows 2 to 5). The contraction in output occurs not only because total exports decrease –as the contraction in export growth in sectors MO and PS more than compensates the expansion of natural resource exports– but also because, as domestic products become less competitive, they are substituted by imports, and output growth in mark-up sectors slows down (see rows 16 to 24). Indeed, as Figure 1.a and Figure 1.b show, the shock leads to an absolute reduction in output from sector –which is not compensated by the positive impact of the shock on other sectors.

In Argentina's managed exchange regime, where the government aims at maintaining a competitive exchange rate, the revaluation occurs via increases in domestic prices, which expand at close to 20% overall in relation to the baseline (Table 6, column 3, row 7). Prices expand due to rising costs (of wages and intermediate inputs) in mark-up sectors, both because the demand for non-tradables grows faster than supply, but fundamentally because the shock increases the profitability of exporting and reduces the fraction of total production of natural resource products offered in the domestic market, thus increasing the price of primary products and wage-goods.[30] Because the model assumes a high elasticity of

[29] Without the reduction in real wages, consumption might have expanded further than the 5% resulting from the simulation. The reduction in foreign savings following the improvement in the current account surplus associated with the shock diminishes disposable income and could reduce aggregate demand. The link between the availability of foreign savings and output growth, however, is not straightforward and depends very much on exchange rate adjustments. As the Argentine experience in the 1990s shows, increases in foreign savings can also be contractionary, whenever inflows are associated with exchange rate appreciations and engender a process of de-industrialization. The reverse applies to reductions in foreign savings, in Argentina as in many other developing countries during the 2000s, and Japan and Germany before that, have often been linked to the experiences of fast economic growth pulled by tradable production and investment. Indeed, what most developing countries (including Argentina) are in need of is foreign exchange rather than foreign savings. This can be obtained from abroad in the form of loans and increases in foreign savings, or can be obtained by developing a competitive economy, which takes place in a context of falling foreign savings but rising domestic ones.

[30] Table 6 shows that in a context of growing natural resource production, domestic supply of products from sectors PP and MR falls by 7%, but PP exports expand by 11% and MR exports grow by around 25% vis-à-vis the baseline (Table 6, column 3, rows 14, 15, 17, 18, 21, 22).

Figure 1.a
Evolution of aggregate and sectoral output (2004-2007). Base run simulation and demand shocks (10% Increase in the international price of natural resource exports (PP & MR))



Source: model simulation

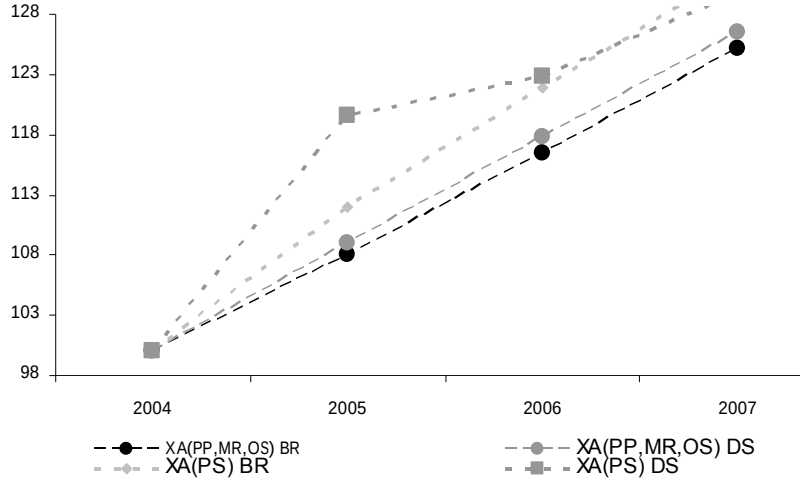
Note: BR = Base Run; DS = Demand Shock (10% Increase in the International Price of Natural Resource Exports (PP & MR)); XA (MO) = output sector MO; XA (PP, MR, OS) = output in sectors PP, MR, OS

transformation[31] and does not allow for substitution among natural resource products, price changes may overestimate the effect of the terms of trade shock, although the adjustment is consistent with the behaviour of the Argentine economy.

The first simulation illustrates *that positive terms of trade shocks can be contractionary when analysed through a dynamic lens because they crowd-out the industrial sector and hinder productive and export diversification. Unless they are managed adequately to avoid a currency revaluation, positive terms of trade shocks may fail to convert current wealth into future and sustainable rewards.*

[31] Alternative simulations assuming an elasticity of transformation equal to 1.8, not reported in the table, but available on request, lead to lower price increases; nevertheless, the overall impact of the shock remains contractionary.

Figure 1.b
Evolution of aggregate and sectoral output (2004-2007). Base run simulation and demand shocks (10% Increase in the international price of natural resource exports (PP & MR))



Source: model simulation

Note: BR = Base Run; DS = Demand Shock (10% Increase in the International Price of Natural Resource Exports (PP & MR)); XA (MO) = output sector MO; XA (PP, MR, OS) = output in sectors PP, MR, OS

3.1.1 Terms of trade shocks in wage-goods exporting countries. Is the adjustment in Argentina different from that in other Latin American countries with different natural resource endowments?

In addition to analysing the general effects of positive natural resource shocks and the response of other tradable sectors, this research also aims to analyse how the characteristics of the sectors linked to Argentina's natural resource endowments influence the economic adjustment to these shocks, a point that has been discussed in Serino (2007) in relation to the effects of nominal exchange rate devaluations. Does a positive price shock to agricultural and food products, Argentina's traditional exports, differ from a price shock affecting other type of natural resource products, as for instance mineral products?

To investigate whether being an exporter of wage-goods has implications for the adjustment to a positive terms of trade shock, this section compares the simulation results for a 10% increase in international prices affecting the products from sector PP with a similar shock in sector MR. Although Argentina's natural resource exports include mineral, fuel and agricultural products, the analysis assumes that the price shock to PP products represents an increase in mineral prices and the price shock affecting MR products

represents an increase in wage-goods prices, because processed natural resource exports in Argentina to a large extent consist of food-products.[32]

Table 7 and Table A.3 in the appendix to this paper show the results of simulations using the dynamic model for the period 2004-2007. As shown in columns 1, 2 and 3, the medium-term contractionary effects of a positive price shock to MR products are larger than the effects of a similar shock affecting primary products (PP). A key factor explaining this difference is the response of domestic prices to each shock: whereas the price shock to "mineral" products increases consumer prices by 5% vis-à-vis the base run, these prices expand by more than 10% when the shock affects "food" products (see Table 7, columns 1, 2 and 3, row 4).[33]

Two particular effects of the shock in wage-goods exporting countries are worth noting. The first one is that the positive shock to natural resource-intensive manufacturing products increases exports from sector MR and therefore diversifies Argentina's natural resource exports, one of the two export diversification possibilities identified in previous sections, because higher export prices encourage natural resource processing and greater supply of MR products, and also in part because higher prices reduce domestic demand. Yet, "export diversification" occurs in a context of falling total exports, because Dutch disease adjustments reduce exports from sectors MO and PS (see Table 7, columns 2 and 3, rows 2, 13 to 15).

The second one relates to an important difference between the two shocks: in the medium-term positive terms of trade benefiting "mineral" products improve real wages, but constrain household purchasing power when the price shock affects wage-goods. A similar external shock, therefore, may have different implications for Argentina and Chile (one exporting wage-goods and the other copper), in both aggregate and sectoral terms and also in terms of changes in socio-economic conditions (see Table 7 columns 2 and 3, row 8, and Table A.3, columns 2 and 3, rows 32 to 36).

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[32] Indeed, it would be incorrect to assume that wage-goods are only processed products. Most crops produced in Argentina should also be considered wage-goods as they are the inputs to sector MR and increases in their prices will be reflected in food prices. This relationship, however, cannot be taken into account because, to gain flexibility, the model assumes that prices in sector MR are determined according to market conditions and not in relation to production costs.

[33] There are two factors underlying the differences observed in the increase in consumer prices. First, food prices have a higher weight than primary commodity prices in the consumption basket; therefore, increases in the former have a larger impact on the overall price index. Second, non-tradable prices (OS) increase more when the shock affects food products than when it is related to primary products. This is because, as the shock is more contractionary in wage-goods exporting countries, the expansion in the supply of non-tradable goods is smaller than when the shock affects primary or "mineral" exporters (see Table A.3, columns 2 and 3, rows 13 and 19).

3.2 Managing positive terms of trade shocks

3.2.1 Increases in export taxes

The previous simulations show that positive terms of trade shocks, in a fixed or managed exchange rate regime, increase domestic prices and constrain export diversification, an adjustment that is larger when the shock is in a country that is a wage-goods exporter, as Argentina. To counteract these effects the Argentine government has implemented various policies, and others have been suggested by analysts and policymakers.[34]

One such policy is export taxation. The impact of export taxes was discussed in Serino (2007) and others[35], and are studied in this paper simulating a 100% increase in export taxes (i.e. from 10% to 20%) in addition to the price shock affecting the products from sectors PP and MR.

The simulation results are presented in Table 7 (and Table A.3 in the appendix to this chapter), in columns 4 (5) and 5 (6), depending on the sector concerned, whether PP or MR. As expected, export taxes contribute to reducing consumer prices, especially as they are applied to wage-goods –growth in annual consumer prices is 8%(1%) lower than in the base run simulation and 20%(5%) lower than if the terms of trade shock to sector MR (PP) is not accompanied by higher export taxes (see Table 7 columns 1 to 7, rows 4 to 7). Yet, for this policy to foster an increase in domestic supply sufficiently large to reduce domestic prices and offset the Dutch disease effects of the shock, export taxes will have to be substantially increased.[36]

According to Table 7, annual export growth from sectors MO and PS is larger than in the base run simulations and significantly larger than when the terms of trade shock is not accompanied by increases in export taxes; the same applies to total exports (see Table 7 columns 1 to 5, rows 2, 12 to 15). In addition, as taxes on primary commodity exports (PP) reduce the domestic price of these products, the policy increases the profitability of natural resource processing and encourages all types of export diversification: diversification within

[34] A number of policies to control inflation, in addition to export taxes, have been discussed, recommended and, in some cases, already implemented in Argentina. Among these: contractionary fiscal policies to slowdown the fast expansion in aggregate demand, the development of institutions to channel and control the conflict between firms and workers (which has increased with economic activity), exchange rate appreciations and price controls. See Albrieu and Corso (2008), CENDA (2008), Frenkel (2008), Plan Fenix (2007), Olivera (2006) for recent contributions to and perspectives on this debate.

[35] Export taxes were implemented in 2002 in Argentina to moderate the impact of the large devaluation that followed the collapse of the convertibility regime, but have been raised in recent years to ameliorate the impact of escalating international prices.

[36] E.g. a 50% increase in export taxes to wage-goods, not reported in the table, reduces the inflationary impact of the terms of trade shock, but is not sufficient to reduce Dutch disease effects making the shock contractionary, nor does it impede a reduction in real wages. The increase in export taxes, however, may be overestimated since in this model export taxes affect domestic prices through increases in domestic supply.

the natural resource sector, for it promotes natural resource processing, and diversification in other industrial products and services (see Table 7, columns 2 and 4, rows 12 to 15).

Table 7
Positive demand shocks and export taxes.
Annual Av. growth 2004-2007 and percentage change to base run simulation a/

		Base Run (BR)	10% Inc. PWE_{PP}	10% inc. PWE_{MR}	10% inc. PWE_{PP} & 100% inc. EXP_T PP	10% inc. PWE_{MR} & 100% inc. EXP_T MR
			% change BR b/			
		(1)	(2)	(3)	(4)	(5)
1	Real GDP	7,93	-0,73	-2,58	0,21	2,01
2	Tot. Exports	10,18	-6,36	-5,24	1,55	4,02
3	Tot. Employment	5,29	2,01	1,75	-0,53	-1,35
4	Consumer Price Index	9,9	4,69	13,46	-1,01	-8,07
5	Dom. Price CPP	9,8	30,22	1,71	-6,97	-1,01
6	Dom. Price CMR	8,8	1,60	26,57	-0,34	-16,93
7	Dom. Price COS	10,8	2,89	10,89	-0,54	-5,88
8	Real Wage	4,9	1,79	-5,33	-0,66	2,69
9	Real Exchange Rate CMO	-0,7	50,21	110,21	-11,96	-71,24
10	Real Exchange Rate CPS	-2,1	31,65	47,07	-7,58	-30,79
11	Output Mark-up sectors (MO + PS)	7,48	-7,05	-11,91	1,76	8,91
12	Exports CPP	9,00	18,94	-7,67	-4,57	4,76
13	Exports CMR	11,30	-5,79	30,45	1,23	-22,57
14	Exports CMO	10,61	-25,84	-43,70	6,13	30,00
15	Exports CPS	9,59	-32,44	-44,02	7,85	30,58

Source: model computations;

a/ All the simulations are run using the benchmark closure rule: quantity adjustment the labour market; fixed exchange rate regime; exogenous government expenditure and Keynesian closure rule for the saving-investment balance; b/ Macroeconomic balances are presented as annual average growth rather than % change from base run

$PWE_{PP(MR)}$ = export price primary products (resource-intensive products); inc. = increase; EXP_T.=export tax

It has been shown that export taxes contribute to mitigating domestic inflation by increasing the domestic supply of natural resources products. But export taxes also help to reduce domestic prices as they take money out of the economy, preventing further increases in the demand for non-tradable goods. This mechanism, however, depends on government expenditure decisions: on the government not spending the additional income it collects via export taxes, as in the previous simulations, and on how the government spends these resources, which is discussed in the next section.

3.2.2 Tax and Spend: production subsidies, government consumption and public investment

Analysis of export taxes draw attention to government expenditure since if government spends the income derived from export taxation its policy for controlling inflation and offsetting Dutch disease adjustments will be less effective. Yet, the characteristics of government expenditure decisions also determine domestic adjustments and can contribute to preventing or counteracting Dutch disease adjustments through alternative channels.

In relation to the medium-term responses of sectors MO and PS –the non-natural resource tradable sectors–, three different uses of income from export taxes are worth analysing. The first is subsidising production in sector MR, a policy designed by the Argentine government to reduce inflation. The other two policies refer to changes in government investment and consumption because, as mentioned in the previous section, public investment in infrastructure can contribute to productive and export diversification, but increases in government consumption may have the opposite effect because they can increase domestic prices.

To simplify the exposition, I define an *alternative base run simulation* considering the simulation of a 10% increase in the international price of wage-goods (MR) accompanied by a 100% increase in export taxes. Therefore, the simulations compare alternative public expenditures decisions financed by the annual increase in government tax income against this alternative base run.

Production subsidies for natural resource-intensive industries

In addition to export taxes, the Argentine government has been subsidizing the natural resource-intensive industries to deal with the terms of trade shock. Subsidies have been allocated to sector MR to promote increases in the domestic supply of wage-goods and to reduce inflationary pressures.

Column 2 in Table 8 and Table A.4 simulates annual changes in export tax income devoted to expanding production subsidies, which is used to increase the price received by domestic producers in sector MR. Comparison with column 1 –the alternative base run simulating of higher international prices for MR products and the higher export taxes– suggests that *production subsidies do increase the domestic supply of wage-goods, but are ineffective in reducing increases in domestic prices* (the CPI is close to 3% higher than in the simulation with no subsidies). This is because subsidies are an injection of income into the economy, which increases demand more than supply, increasing the prices of wage-goods and (especially) non-tradables[37] (see Table 8 columns 1 and 2, and rows 4 to 7 and 11).

Tax and spend: increases in public consumption and investment

A particular feature of Argentina during the period analysed is the sharp contrast observed between rapidly growing public investment and government consumption, which have

[37] As expected, increases in domestic prices reduce the competitiveness of exports from sectors MO and PS, and also slows down exports from these sectors (see Table 8 columns 1 and 2, and rows 15, 16).

expanded at average annual rates of more than 45% and 6% respectively between 2004 and 2007 (see Table 1). To extend the discussion on the consequences of different government expenditure decisions, this section simulates that annual changes in export tax income are alternatively used to finance government consumption or investment.

First, I simulate that changes in export tax income finance higher government consumption. As Table 8 and Table A.4., columns 1 and 3 show, higher government consumption has some positive real effects: it further increases total consumption and employment vis-à-vis the *alternative base run scenario* used in these simulations (see Table 8 columns 1 and 3, row 3, and Table A.4, columns 1 and 3, rows 2, 6). However, higher government consumption increases domestic prices and reduce the price competitiveness of industry and services exports vis-à-vis the *alternative base run*, leading to a slowdown in

Table 8
Managing positive demand shocks. dynamic simulations.
Annual average growth 2004-2007 and percentage change to base run simulation a/

		ALT BR	(1) & prod. subsidies b/	(1) & Gov. Cons.c/	(1) & Pub. Inv. d/	(1) & Exp. Elasticity e/
			% change to Alternative Base Run f/			
		(1)	(2)	(3)	(4)	(5)
1	Real GDP	8.09	0,7	-0,1	4,1	3,1
2	Tot. Exports	10.58	-3,7	-3,9	-4,5	-8,0
3	Tot. Employment	5.22	1,1	0,9	4,8	4,0
4	Consumer Price Index	9.12	2,7	3,7	3,6	3,0
5	Dom. Price CPP	9.73	0,5	0,2	0,7	0,6
6	Dom. Price CMR	7.28	1,3	1,2	1,4	1,2
7	Dom. Price COS	10.13	4,2	6,4	4,6	3,9
8	Real Wage	4,9	1,6	0	12,4	9,7
9	Real Exchange Rate CMO	-0.21	69,0	77,0	147,9	116,3
10	Real Exchange Rate CPS	-1.43	15,8	18,5	39,1	32,6
11	Output in MR	7.03	1,2	0,2	2,5	1,8
12	Output Mark-up sectors (MO + PS)	8.14	0,3	-1,4	4,7	3,2
13	Exports CPP	9.43	-1,4	-0,8	-0,2	-0,4
14	Exports CMR	8.75	-4,1	-4,3	-3,4	-3,0
15	Exports CMO	13.79	-4,3	-5,2	-8,0	-15,9
16	Exports CPS	12.52	-5,5	-6,5	-7,4	-14,8

Source: model computations;

a/ All the simulations are run using the benchmark closure rule: quantity adjustment the labour market; fixed exchange rate regime; exogenous government expenditure and Keynesian closure rule for the saving-investment balance; b/ annual increases in export tax used to subsidize producers in sector MR; c/ annual increases in export tax finances increases in government consumption; d/ annual increases in export tax finances increases in government investment; e/ annual increases in export tax finances increases in government investment and export elasticity to sector PS (capital accumulation and productive linkages) = 0

ALT BR= alternative Base Run (10% inc. PWE_{MR} & 100% inc. exp tax MR); $PWE_{PP(MR)}$ = export price primary products (resource-intensive products); inc. = increase; prod-= production; Gov.= government; Cons-= consumption; Pub.= public; Inv.= investment; Exp.=exports

total exports[38] and investment (see Table 8, columns 1 and 3, rows 2 and 13 to 16, and Table A.4 columns 1 and 3, and rows 1, 3, 4 and 20 to 23).

The next simulation explores the adjustment in Argentina would public investment further expand with changes in export tax income. Table A.4 shows that, in contrast to the medium-term effect of larger government consumption, higher public investment is expansionary, increasing the annual growth rate of output and consumption by more than 4% and further expanding total investment, vis-à-vis the *alternative base run scenario* (see Table A.4, columns 1 and 4, rows 1 to 3). Total employment and domestic prices, especially of non-tradable goods, also expands with economic activity, as shown in Table A.4 (see columns 1 and 4, rows 6 and 10 to 13).

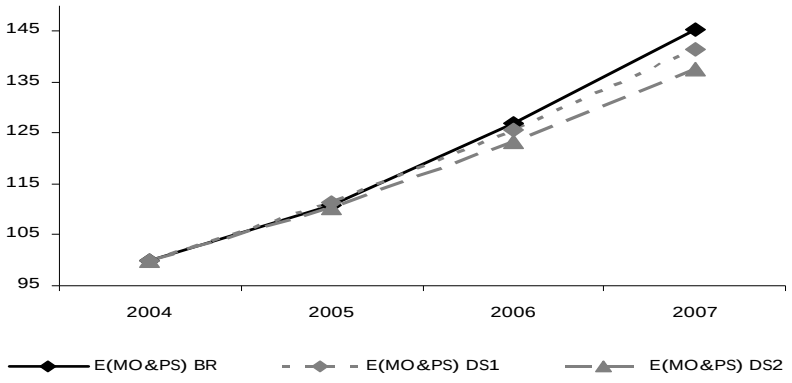
Exports undergo a particular adjustment and grow slower than if income from export taxes were not used to finance public investment. Total exports decelerate because public investment is an expansionary impulse that increases domestic demand and prices. As a consequence, first, total exports growth slow down as more natural resource products are allocated to the domestic market, and second because domestic inflation jeopardizes the price competitiveness of non-natural resource exports (see Table 8, columns 1 and 4, rows 13 to 16).

The slowdown in non-natural resource exports at first sight may seem surprising if one considers that these results suggest that the development of productive linkages associated with public (and private) investment in infrastructure are not relevant to export diversification. The situation is somewhat different, as Table 8, Table A.4 and Figure 2 show in comparing the abovementioned simulation to an alternative simulation that assumes that non-natural resource exports are absolutely independent of output changes in sector PS. The results in both Table 8 and Figure 2 show that non-natural resource exports would have grown slower were they irresponsive to non-price competitive determinants (see Table 8, columns 4 and 5, rows 15 and 16 and Figure 2, lines E(MO&PS) DS1 and E(MO&PS) DS2).

The simulation results do not question the importance of public investment policies, a hypothesis explored in this paper following Serino (2009, chapter 3), but do call the attention to the timing of these policies. In the context of a positive shock, public investment is pro-cyclical and engenders price adjustments that counteract their positive (non-price) effects for export competitiveness. Indeed, to increase the effectiveness of public policies it may be preferable –and recommended– to take advantage of times of abundance to create a countercyclical fund (Ocampo, 2005a). This fund could be used finance public investment, but in a continuous, smooth and sustainable manner.

[38] The slowdown in total exports occurs because growth in all kinds of exports falls. Natural resources exports fall because with higher prices encourage producers to sell a larger percentage of their production in the domestic market, and exports from MO and PS because they are less competitive.

Figure 2
Terms of trade shocks, export tax and non-natural resource exports



Source: model simulation

E(MO&PS) BR = Non-natural resource exports in the alternative base run (10% inc. PWEMR & 100% inc. in export tax MR); E(MO&PS) DS1 = Non-natural resource exports in the alternative base run and increases in export tax revenue finance public investment; E(MO&PS) DS2 = E(MO&PS) DS1 and export elasticity to sector PS (capital accumulation and productive linkages) = 0

Despite the effects on aggregate demand, the results of the simulations are interesting in terms of medium-term economic adjustment to different types of government expenditure. Alternative allocations of export tax income suggest that:

production subsidies seem to be ineffective to control overall domestic price increases;

expansion in government consumption creates additional inflationary pressures that engender Dutch disease adjustments in the medium-term;

public investment promotes two opposite types of adjustments: increases in the non-price competitiveness of the non-natural resource sector on the one hand, and reductions in the price-competitiveness of these sectors on the other, when public investment projects are promoted in a context of positive terms of trade shocks.

3.2.3 An alternative response to the positive terms of trade shocks: a nominal exchange rate revaluation

Although the Argentine government is at present deliberately preventing changes to the nominal exchange rate, it is worth investigating how the Argentine economy would adjust if economic authorities accompany positive terms of trade changes with a nominal exchange rate revaluation. The simulation results are presented in Table A.5 in the appendix to this chapter and assume a 10% increase in the international prices of wage-goods (PWE_{MR}), and that the nominal exchange rate falls, or revalues, by 10%, as a response to higher export prices.

The exchange rate adjustment manages to curve down increase in domestic prices in relation to the simulation of increases in export prices with no changes in the nominal exchange rate (see Table A.5, columns 2 and 3, and rows 9 to 12).[39] According to the simulation, real exchange rate revaluation has negative real effects: the rate of growth of aggregate output and investment falls by 8% and export growth decreases by more than 12% vis-à-vis the baseline simulation (see Table A.5, columns 3 and 4, and rows 1 to 4).[40] Therefore, the simulation results suggest that, together with export taxes, Argentina's exchange rate policy has been contributing to the economic expansion observed in recent years, as it prevented Dutch disease effects associated with domestic prices and nominal exchange rate adjustments, and through increases in the profitability of tradable production.

The simulations also show why exchange rate revaluations tend to be accepted by households in the short and medium terms. Despite their negative impact on aggregate demand and employment (larger for formal and skilled workers employed in the industrial sector), exchange rate revaluations improve real wages, which expand at an annual rate 15% higher than in the base run simulation (see Table A.5, column 3, and rows 19 to 26). Over the longer term, however, the contraction of aggregate variables and employment linked to the real exchange rate revaluation can offset the benefits of lower domestic inflation rather leading to deflation, as happened in Argentina during the 1990s.

4 FINAL THOUGHTS

This paper has provided an applied evaluation of recent positive external shocks in Argentina's natural resource sectors and some of the policies implemented to cope with them. The analysis has shown that impulses associated to growing primary commodity prices have been adequately managed by economic authorities and that, although there is no single, exclusive determinant of Argentina's fast economic growth in recent years, some of the policies analysed in this paper have positively contributed to it. The findings from this paper call into question the positions claiming that economic growth in Argentina has been principally (if not only) the consequence of unique, favourable international conditions.

Evaluation of the positive external terms of trade shock has shown that they limit the competitiveness of the non-natural resource sector and that they can be contractionary in

[39] The reduction in domestic prices is associated not only to the reduction of tradable prices, but also to the slowdown verified for non-tradable prices, an adjustment that is directly related to the evolution of aggregate variables.

[40] The reduction in export growth occurs because real exchange rate revaluation works to reduce all types of exports. Growth in primary commodity and resources-intensive manufacturing exports falls because with lower tradable prices the rate of profit, investment and supply of natural resource products falls. Growth in exports and output from sectors MO and PS also slow as changes in exchange rate policy increase labour costs and appreciate the exchange rate relevant for these sectors, a competitiveness loss that is reinforced by the reductions in productivity growth, capital accumulation and domestic productive linkages (see Table A.5, columns 3 and 4, rows 13 to 18).

the medium-term, and may even lead to a reduction in real wages in wage-goods exporting countries, in contrast to other natural resource exporting countries, if no economic policies are implemented to counteract this adjustment. Export taxes on natural resource products and Argentina's competitive exchange rate policy, as shown through counterfactual simulations, have counteracted the negative effects of the terms of trade shock, thereby contributing to productive and export diversification, as suggested in Serino (2007 and 2009, chapter 4).

In addition, the applied analysis has enriched with new findings the understanding of the effects of certain economic policies recently implemented in Argentina. In particular, the counterfactual exercises have shown that in a context of strong demand impulses spending the income collected with export taxes may engender price increases that fuel or reinforce Dutch disease adjustments that the tax originally aimed to counteract. This has two major implications for government spending. First, it implies that subsidies to producers of wage-goods are ineffective to control overall domestic inflation. Second, it implies that optimizing the contribution of public investment in infrastructure to improve the competitiveness of the economy requires special attention to the timing of public investment to avoid overheating the economy.

To conclude it should be noted that, because many factors have determined output dynamics in Argentina in recent years, it is difficult to know how the slowdown in primary commodity prices associated with the 2008 global economic meltdown–if it finally materializes–, will affect economic growth. Although, as shown in this chapter, positive terms of trade shocks under certain circumstances can be contractionary, a negative shock need not be expansionary –nevertheless some simulations, not reported in the paper, point in this direction. First, because domestic prices may not fall; and second, because, unless government makes some provisions via an anti-cyclical fund, some of the expansionary policies implemented in Argentina recent years may not be in place to promote aggregate demand.

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APPENDICES

APPENDIX I
PARAMETER VALUES OF THE CGE MODEL

Table A.1. Behavioural parameter: parameter values, stability ranges and sources

Behavioural Parameters	PV	Range of PV a/		Source
		Max.	Min.	
Elasticity of transformation CET Fn. (c=PP and MR)	**5.00**	0.10	55	Guesstimate
Export Equation (EE) Price Elasticity (c=MO and PS)	**1.00**	0.00	7.00	Guesstimate
EE Income Elasticity (c=MO and PS)	**0.94**	-5.00	5.00	Senhadji and Montenegro (1999)
EE Elasticity to sector specific investment c=MO (c=PS)	**0.25 (0.15)**	0.00	1.00	Guesstimate
EE Elasticity Infrastructure and productive linkages c=MO (c=PS)	**0.2 (0.15)**	0.00	3.00	Guesstimate
Import equation (IM) Price Elasticity (c)	**0.2 (0.15)**	0.00	3.00	Guesstimate
IM Income Elasticity (c)	**0.25**	0.00	4.00	Catao and Falcetti (2002)
IM Elasticity to sector specific investment (c)	**2.25**	0.00	5.00	Catao and Falcetti (2002) b/
IM Elasticity infrastructure and productive linkages (c)	**0.025**	0.00	1.50	Guesstimate
Labour Saving Technical Change	**0.025**	0.00	1.50	Guesstimate
Kaldor-Verdoorn Parameter 2004-07 (2010)	**0.80 (0.5)**	0.00	1.50	Guesstimate c/
Intercept LES Consumption Fn				Based on Berges and Casellas (2002)
Mg. Propensity to Consume LES Fn.				Based on Berges and Casellas (2002)
Wage equation (WE), Productivity	**0.50**	-1.00	5.00	Defined in collaboration with MECON
WE, change in CPI	**0.82**	-0.75	2.00	Defined in collaboration with MECON
WE, change in unemployment	**0.28**	0.10	1.70	Defined in collaboration with MECON
WE, Wage Policy	**1.00**			
Investment equation (IE), response to changes in capacity utilization	**0.03**	-2.00	2.00	Defined in collaboration with MECON
IE, changes in public investment	**0.13**	-0.50	0.85	Defined in collaboration with MECON
IE, changes in the sectoral profit rate	**2.05**	-0.70	3.25	Defined in collaboration with MECON
IE, changes in real interest rate	**0.01**	-2.00	1.25	Defined in collaboration with MECON
Labour supply adj. to wage differentials	**0.05**	0	2	Guesstimate
Mark-up elasticity to changes in total demand for MO (PS) commodities	**0.1 (0.085)**	0	3	Guesstimate

Note: PV = Parameter value; MECON = Ministry of Economy and Production; adj.=adjustment
a/ Range of parameters values giving a stable dynamic solution for the period 2004-2007; b/ Adjusted upwards in line with Nicolini-Llosa (2007) estimations. Catao and Falcetti elasticity parameter equal 1.92; c/ The value of the Kaldor-Verdoorn parameter for the period 2004-2007 is in line with estimations by Narodowski and Panigo (2007), whose estimated coefficient for the period 2002-2005 equals 0.92;

Table A.2
SAM calibrated parameters and exogenous and policy variables.

Exogenous Variables	**Year / Period**				**Source**
	2004	**2005**	**2006**	**2007**	
Export price growth (%) a/					
Primary commodities (PP)		7.2	7.2	7.2	MECON
Resource-based manufactures (MR)		8.0	8.0	8.0	MECON
Non-resource products (MO, PS)		7.3	7.3	7.3	MECON
Import price growth (%) **a/**					
Primary commodities (PP)		24.0	24.0	24.0	MECON
Resource-based manufactures (MR)		4.7	4.7	4.7	MECON
Non-resource products (MO, PS)		5.0	5.0	5.0	MECON
World income growth (%)		5	4.4	3.9	CEPAL
Growth in government (GOV) consumption (%)		6.12	5.25	7.37	MECON
Growth in GOV investment (%)		53.00	44.00	47.50	MECON
Growth in GOV transfers to rest of world (ROW) (%)		-43.4	-31.7	21.8	MECON
Growth in GOV transfers to households (HHLD)		Constant in real terms, adjust with CPI			
Growth in HHLD transfers to GOV		Constant in real terms, adjust with CPI			
Growth in HHLD transfers to ROW (%)		22.37	22.37	22.37	MECON
Growth in transfers from the ROW to GOV (%)		37.19	37.19	37.19	MECON
Growth in transfers from ROW world HHLD (%)		10.35	10.35	10.35	MECON
Growth in subsidy sector MR (%)		100	100	100	Guesstimate
Capacity output ratio 2004 (%)	67				INDEC
Base run unemployment rates (%)	13.6				INDEC
Nominal interest rate	10,8%	10,5%	12,9%	13,4%	BCRA
Nominal exchange rate (2004=1)	1.00	0.99	1.05	1.06	BCRA
Labour force growth (%)	1.92	1.92	1.92	1.92	INDEC
Depreciation rate (%)	8.8	8.8	8.8	8.8	Maia and Nicholson
SAM Calibrated Parameters	household saving-rate; export, import, factor (labour and capital) and direct and indirect taxes; weights (consumer, capital and tradable) price indices; input-output coefficient; output coefficient; incremental capital-capacity ratio; public and private investment demand proportions; export share and shift parameter from CET function; Share factor (labour and capital) income to households; structure government consumption;				

Note: PV = Parameter value; MECON = Ministry of Economy and Production; INDEC = National Bureau of Statistics and Census; GOV=government; ROW=rest of the world; HHLD=household; red.=reduction; inc.=increase
a/ data for PP corresponds to Argentina's primary commodity products; data for MR corresponds to Argentina's MOA (Manufactures of agricultural origin) products and data for MO & PS corresponds to Argentina's MOI (manufactures of industrial origin)

APPENDIX II:
SIMULATION RESULTS

Table A.3
Positive demand shocks and export taxes. Annual Av. growth 2004-2007 and percentage change to base run simulation a/

		Observed values	Base Run (BR)	10% Inc. PWE_{PP}	10% inc. PWE_{MR}	10% inc. PWE_{PP} & 100% inc. in export tax PP	10% inc. PWE_{MR} & 100% inc. in export tax MR
				% change BR b/			
		(1)	(2)	(3)	(4)	(5)	(6)
	Macroeconomic Variables						
1	Real GDP	8.8	7,93	-0,73	-2,58	0,21	2,01
2	Tot. Consumption	8.2	8,20	2,76	2,22	-0,56	-0,88
3	Tot. Investment	18.4	16,98	2,18	-0,05	-0,57	-0,24
4	Tot. Exports	9.9	10,18	-6,36	-5,24	1,55	4,02
5	Tot. Imports	18.7	19,56	2,91	4,01	-0,64	-2,32
6	Tot. Employment	3.2	5,29	2,01	1,75	-0,53	-1,35
7	Current Account (surplus) / GDP		-24,0	-17,90	-10,64	0,08	4,47
8	Trade Balance (surplus) / GDP		-22,2	-21,04	-19,36	-15,12	-13,26
9	Gov. Savings (deficit) / GDP		35,4	37,72	35,73	41,81	44,89
10	Consumer Price Index	9.8	9,9	4,69	13,46	-1,01	-8,07
11	Dom. Price CPP	13.4	9,8	30,22	1,71	-6,97	-1,01
12	Dom. Price CMR	11.4	8,8	1,60	26,57	-0,34	-16,93
13	Dom. Price COS	8.6	10,8	2,89	10,89	-0,54	-5,88
	Variables External Sector						
14	Real Exchange Rate CMO		-0,7	50,21	110,21	-11,96	-71,24
15	Real Exchange Rate CPS		-2,1	31,65	47,07	-7,58	-30,79
16	Output APP		8,06	3,79	-0,35	-0,86	0,35
17	Output AMR		7,26	-0,13	4,63	0,04	-3,13
18	Output Mark-up sectors (MO + PS)		7,48	-7,05	-11,91	1,76	8,91
19	Output AOS		8,06	3,53	2,66	-0,83	-1,82
20	Exports CPP	13.92	9,00	18,94	-7,67	-4,57	4,76
21	Exports CMR	8.51	11,30	-5,79	30,45	1,23	-22,57
22	Exports CMO	13.79	10,61	-25,84	-43,70	6,13	30,00
23	Exports CPS		9,59	-32,44	-44,02	7,85	30,58
24	ULC AMO		12,34	5,39	10,71	-1,36	-8,20
25	ULC APS		12,30	5,63	10,58	-1,26	-6,98

Table A.3 (Continuation)

		Observed values	Base Run (BR)	10% Increase (inc.) PWE_{PP}	10% inc. PWE_{MR}	10% inc. PWE_{PP} & 100% inc. in export tax PP	10% inc. PWE_{MR} & 100% inc. in export tax MR
				% change BR b/			
		(1)	(2)	(3)	(4)	(5)	(6)
	Socio-economic Variables						
26	Total Employment unskilled		5,21	2,23	2,13	-0,58	-1,64
27	Total Employment skilled		5,34	1,87	1,51	-0,49	-1,17
28	WL Employment Informal		5,44	3,66	3,39	-0,92	-2,57
29	WL Employment Formal		5,47	2,75	2,56	-0,70	-1,94
30	WL Employment unskilled		5,22	2,18	2,01	-0,57	-1,55
31	WL Employment skilled		5,40	1,74	1,36	-0,46	-1,06
32	Av. Real Wage	9.7	4,9	1,79	-5,33	-0,66	2,69
33	WL Real Wage unskilled		4,38	2,15	-5,53	-0,74	2,77
34	WL Real Wage skilled		5,28	1,17	-5,78	-0,52	2,98
35	WL Real Wage informal		4,36	6,55	-2,07	-1,70	0,39
36	WL Real Wage formal		5,01	0,70	-6,29	-0,42	3,32

Source: model computations;

a/ All the simulations are run using the benchmark closure rule: quantity adjustment the labour market; fixed exchange rate regime; exogenous government expenditure and Keynesian closure rule for the saving-investment balance; b/ Macroeconomic balances are presented as annual average growth rather than % change from base run

$PWE_{PP(MR)}$ = export price primary products (resource-intensive products); inc. = increase; WL = wage labour; YHQ1(5) household quintile 1 poorest (5 richest); inc.=increase

Table A.4

Managing positive demand shocks. Dynamic simulations. Annual average growth 2004-2007 and percentage change to base run simulation a/

		10% inc. PWE_{MR} & 100% inc. Exp. tax MR	(1) & Subs.AMR b/	(1) & Gov. Cons. c/	(1) & Pub. Inv. d/	(1) & Exp. elasticity e/
		ALT BR	% change to Alternative Base Run f/			
	Macroeconomic Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
1	Real GDP	8.09	0,7	-0,1	4,1	3,1
2	Tot. Consumption	8.13	2,7	2,5	4,6	3,4
3	Tot. Investment	16.94	1,7	-0,4	11,4	11,9
4	Tot. Exports	10.58	-3,7	-3,9	-4,5	-8,0
5	Tot. Imports	19.10	1,5	0,7	5,7	4,2
6	Tot. Employment	5.22	1,1	0,9	4,8	4,0
7	Current Account (surplus) / GDP	4,47	-3,58	-2,01	-14,17	-16,66
8	Trade Balance (surplus) / GDP	-13,26	-16,26	-15,67	-19,61	-20,23
9	Gov. Savings (deficit) / GDP	44,89	41,98	41,78	45,71	46,22
10	Consumer Price Index	9.12	2,7	3,7	3,6	3,0
11	Dom. Price CPP	9.73	0,5	0,2	0,7	0,6
12	Dom. Price CMR	7.28	1,3	1,2	1,4	1,2
13	Dom. Price COS	10.13	4,2	6,4	4,6	3,9
	Variables External Sector					
14	Real Exchange Rate CMO	-0.21	69,0	77,0	147,9	116,3
15	Real Exchange Rate CPS	-1.43	15,8	18,5	39,1	32,6
16	Output APP	8.09	0,5	0,2	2,2	1,6
17	Output AMR	7.03	1,2	0,2	2,5	1,8
18	Output Mark-up sectors (MO + PS)	8.14	0,3	-1,4	4,7	3,2
19	Output AOS	7.92	1,2	1,2	3,4	2,4
20	Exports CPP	9.43	-1,4	-0,8	-0,2	-0,4
21	Exports CMR	8.75	-4,1	-4,3	-3,4	-3,0
22	Exports CMO	13.79	-4,3	-5,2	-8,0	-15,9
23	Exports CPS	12.52	-5,5	-6,5	-7,4	-14,8
24	ULC AMO	11.33	3,0	4,5	8,9	6,0
25	ULC APS	11.45	2,7	2,7	7,5	5,5

Table A.4 (Continuation)

		10% inc. PWEMR & 100% inc. in export tax MR ALT BR	(1) & pro-duction subsidies b/	(1) & Gov. consumption c/	(1) & Public investment d/	(1) & Export elasticity e/
			% change to Alternative Base Run f/			
		(1)	(2)	(3)	(4)	(5)
	Socio-economic indicators					
26	Total Employment unskilled	5.13	1,1	0,9	4,4	3,6
27	Total Employment skilled	5.28	1,1	0,8	5,0	4,2
32	Av. Real Wage	5.00	1,6	0,0	12,4	9,7
33	WL Real Wage unskilled	4.50	1,5	-0,2	11,8	9,1
34	WL Real Wage skilled	5.43	1,7	0,1	13,6	10,8
35	WL Real Wage informal	4.37	1,7	0,4	13,5	11,5
36	WL Real Wage formal	5.18	1,6	-0,1	12,8	10,0

Source: model computations;

a/ All the simulations are run using the benchmark closure rule: quantity adjustment the labour market; fixed exchange rate regime; exogenous government expenditure and Keynesian closure rule for the saving-investment balance;

b/ annual increases in export tax used to subsidize producers in sector MR;

c/ annual increases in export tax finances increases in government consumption;

d/ annual increases in export tax finances increases in government investment;

e/ annual increases in export tax finances increases in government investment and export elasticity to sector PS (capital accumulation and productive linkages) = 0

f/ Macroeconomic balances are presented as annual average growth rather than % change from base run

ALT BR = alternative base run; PWEPP(MR) = export price primary products (resource-intensive products); inc. = increase; WL = wage labour; YHQ1(5) household quintile 1 poorest (5 richest); subs.=subsidies; Gov.=government; Pub.=public; Inv.= investment; Exp.=export

Table A.5

Demand shocks and nominal exchange rate adjustments. Dynamic Simulations 2004-2007. Annual average growth and percentage change to base run a/

		Base Run (BR)	10% inc. PWE_{MR}	(2) & 10% NER app.
			% change to BR b/	
		(1)	(2)	(3)
	Macroeconomic Variables			
1	Real GDP	7,51	2,94	-5,65
2	Tot. Consumption	7,78	7,82	2,77
3	Tot. Investment	14,70	15,48	5,46
4	Tot. Exports	10,49	-8,10	-19,54
5	Tot. Imports	18,26	11,37	4,89
6	Tot. Employment	5,05	6,61	-0,01
7	Current Account (surplus) / GDP	-1,72	-10,6	-11,2
8	Trade Balance (surplus) / GDP	33,88	35,7	32,4
9	Consumer Price Index	9,59	17,44	-39,08
10	Dom. Price CPP	9,74	2,65	-57,06
11	Dom. Price CMR	8,67	28,02	-37,60
12	Dom. Price COS	10,25	16,41	-35,58
	Variables External Sector			
13	Real Exchange Rate CMO	-0,41	279,83	417,35
14	Real Exchange Rate CPS	-1,56	94,47	151,87
15	Exports CPP	9,03	-7,92	-12,87
16	Exports CMR	11,51	28,10	18,15
17	Exports CMO	10,92	-45,31	-61,30
18	Exports CPS	10,83	-50,45	-72,89
	Socio-economic Variables			
19	WL Employment unskilled	4,99	6,68	0,38
20	WL Employment skilled	5,14	6,50	-0,59
21	Av. Real Wage	4,27	7,87	25,12
22	WL Real Wage unskilled	3,84	7,63	29,98
23	WL Real Wage skilled	4,61	7,88	21,51
24	Income (YHQ1) / Income YHQ5	-0,16	-12,72	-55,64

Source: model computations;

a/ All the simulations are run using the benchmark closure rule: quantity adjustment the labour market; fixed exchange rate regime; exogenous government expenditure and Keynesian closure rule for the saving-investment balance; b/ Macroeconomic balances are presented as annual average growth rather than % change from base run

Dyn.=dynamic; Sim.=simulation; $PWE_{PP(MR)}$ = export price primary products (resource-intensive products); inc. = increase; app = appreciation; NER = nominal exchange rate; PP= primary products; MR= resource intensive manufacturing; MO=other manufacturing products; PS= producer and exportable services; OS= other (consumer) services; WL = wage labour; YHQ1(5) household quintile 1 poorest (5 richest)

Table A.6
Positive terms of trade shocks under the Keynesian and Neoclassical closure rules. Dynamic simulation period 2004-2007 a/, b/

			10% inc. PWE_{PP} & PWE_{MR}	
		Base Run (BR)	% change BR Keynesian CR (1)	% change BR Neoclassical CR (2)
	Macroeconomic Variables			
1	Real GDP	7,93	-2,23	-4,58
2	Tot. Consumption	8,20	5,49	3,25
3	Tot. Investment	16,98	3,83	-0,28
4	Tot. Exports	10,18	-10,25	-11,95
5	Tot. Imports	19,56	7,87	4,23
6	Tot. Employment	5,29	3,78	-0,40
7	Current Account (surplus) / GDP	-24,0	-8,22	11,78
8	Trade Balance (surplus) / GDP	-22,2	38,10	34,51
9	Consumer Price Index	9,9	18,57	23,95
10	Dom. Price CPP	9,8	32,10	33,12
11	Dom. Price CMR	8,8	28,21	31,17
12	Dom. Price COS	10,8	14,86	24,86
	External Variables			
13	Real Exchange Rate CMO	-0,7	159,26	300,24
14	Real Exchange Rate CPS	-2,1	77,76	100,05
	Output mark-up sectors (MO & PS)	7,48	-16,39	-13,04
15	Exports CPP	9,00	11,32	5,11
16	Exports CMR	11,30	24,96	13,59
17	Exports CMO	10,61	-67,59	-53,16
18	Exports CPS	9,59	-73,72	-52,44
	Socio-economic variables			
19	Total Employment unskilled	5,21	4,30	-0,14
20	Total Employment skilled	5,34	3,45	-0,56
21	Av. Real Wage	4,9	-3,37	-19,34
22	WL Real Wage unskilled	4,38	-3,26	-21,16
23	WL Real Wage skilled	5,28	-4,40	-18,77

Source: model computations;

a/ % change between annual average growth rate in the base run dynamic solution and annual average growth rates in simulations of demand and/or supply shocks b/ Macroeconomic balances are presented as annual average growth rather than % change from base run

BR = base run; CR = closure rule = PWE = international export price; inc. = increase; $\Delta Y/K$ = incremental capital output ratio; PP= primary products; MR= resource intensive manufacturing; MO=other manufacturing products; PS= producer and exportable services; OS= other (consumer) services; WL = wage labour;

APPENDIX III: MATHEMATICAL STATEMENT OF THE CGE MODEL

Model sets

Symbol	Explanation
T	Time t1 to t5
PRODUCTION: Activities-sectors (a); Commodities (c); Factors of production (F)	
a, c	Activity-sectors and commodities = P (primary), MR (manufacturing resource intensive), MO (manufacturing other), PS (producer services), OS (other services)
Tb	Tradables activity-sectors and commodities = PP, MR, MO, PS
Tbnr	Tradable natural resources activity-sectors and commodities = PP, MR
Mup	Mark-up activity-sectors and commodities = MO, PS
n-mup	Non mark-up activity-sectors and commodities = PP, MR, OS
Fl	Factor labour (6 labour categories) = wage labour skilled (formal / informal); wage labour unskilled (formal / informal); non-wage labour skilled or unskilled
Fk	Factor capital (1 capital)
INSTITIONS	
H	Households (classified by quintile of per capita income)
G	Government
W	Rest of the world
OTHERS	
^	Growth rate or percentage change
UPPERCASE	Endogenous variables
lowercase	Exogenous and policy variables
Greek characters	Model parameters

CGE model equation blocks

COSTS AND PRICE

(A.1) $$VC_{a,t} = \sum_{fl} LOCF_{fl,a,t} \cdot W_{fl,t} + \sum_{c} PINDEX_{c,t} \cdot iocf_{c,a}$$ a

(A.1) $$PM_{c,t} = NER_t \cdot pwm_c \cdot (1 + tm_c)$$ For c ∈ tb

(A.2) $$PE_{c,t} = NER_t \cdot pwe_c \cdot (1 - te_c)$$ For c ∈ tbnr

(A.3) $$PDCBIS_{c,t} \cdot QDC_{c,t} = PDC_{c,t} \cdot QDDA_{c,t} + PE_{c,t} \cdot E_{c,t}$$ For c ∈ tb

(A.4) $$PDCBIS_{c,t} = PDC_{c,t}$$ For c=OS

(A.5) $$PDA_{a,t} = \sum \Xi_{a,c} \cdot PDCBIS_{c,t}$$ For a ∈ n-mup

(A.6) $$PDA_{a,t} = (1 + TAUV_{a,t}) VC_{a,t}$$ For a ∈ mup

(A.7) $$TAUV_{a,t} = TAUV_{a,t-1} \left[\frac{XC_{c,t}}{XC_{c,t-1}} \right]^{\zeta tau_a}$$ For a ∈ mup

(A.8) $$PDC_{c,t} = PDA_{a,t}$$ For c ∈ mup

(A.9) $$PINDEX_{c,t} \cdot QDSC_{c,t} = \left[PDC_{c,t} \cdot (QDDC_{c,t} - M_{c,t}) + PM_{c,t} M_{c,t} \right] \cdot (1 + tind_c)$$ c

(A.10) $$RERM_{c,t} = \frac{PM_{c,t}}{PDC_{c,t}}$$ For c ∈ tb

(A.11) $$RERE_{c,t} = \frac{NER_t \cdot pwe_c}{PDC_{c,t}}$$ For c ∈ mup

(A.12) $$CPI_t = \sum_{c} cwts_c \cdot PINDEX_{c,t}$$

(A.13) $$KPI_t = \sum_{c} kwts_c \cdot PINDEX_{c,t}$$

(A.14) $$RIR_t = nir_t - \hat{CPI}_t$$

(A.15) $$PTI_t = \sum_{c} ptwts_c \cdot PINDEX_{c,t}$$

(A.16) $$RER_t = \frac{PTI_t}{PINDEX_{\cos,t}}$$

PRODUCTION AND FACTOR MARKETS

(A.17) $QA_{a,t} = \left(\kappa_a \cdot KSA_{a,t-1} + QA_{a,t-1}\right) \cdot YADJ$ — For a $\in$ n-mup

(A.18) $QA_{a,t} = \left(\kappa_a \cdot KSA_{a,t-1} + QA_{a,t-1}\right)$ — For a $\in$ mup

(A.19) $XA_{a,t} = QA_{a,t}$ — For a $\in$ n-mup

(A.20) $XA_{a,t} = \left(\sum_a \Xi bis_{a,c} \cdot XC_{c,t}\right) \cdot YADJ_t$ — For a $\in$ mup

(A.21) $QDC_{c,t} = \sum_a \Xi_{a,c} XA_{a,t}$ — For c $\in$ n-mup

(A.22) $QDC_{c,t} = XC_{c,t}$ — For c $\in$ mup

(A.23) $QDC_{c,t} = \lambda_c^{cet}\left[\psi_c^{cet} \cdot E_{c,t}^{\rho_c^{cet}} + \left(1-\psi_c^{cet}\right) \cdot QDDA_{c,t}^{\rho_c^{cet}}\right]^{1/\rho_c^{cet}}$ — For c $\in$ tbnr

(A.24) $\frac{E_{c,t}}{QDDA_{c,t}} = \left(\frac{PE_{c,t}}{PDC_{c,t}} \cdot \frac{\left(1-\psi_c^{cet}\right)}{\psi_c^{cet}}\right)^{1/\rho_c^{cet}-1}$ — For c $\in$ tbnr

(A.25) $U_{a,t} = \frac{XA_{a,t}}{QA_{a,t}}$ — a

(A.26) $UAV_t = \sum_a \frac{XA_{a,t}}{QA_{a,t}}$

(A.27) $LS_{fl,t} = LS_{fl,t-1} \cdot \left(1 + gls_{fl,t}\right) \cdot \left[\frac{WL_{fl,t}}{WL_{fl,t-1}}\right]^{\eta_{fl}}$ — Fl

(A.28) $LD_{fl,a,t} = LOCF_{fl,a,t} \cdot XA_{a,t}$ — Fl, a

(A.29) $LOCF_{fl,a,t} = LOCF_{fl,a,t-1} \cdot (1 - LPRODG_{fl,a,t})$ — Fl, a

(A.30) $LPRODG_{fl,a,t} = lstc_{fl,a} + \alpha_{1\,fl,a} \cdot \hat{UAV}_t$ — Fl,a

(A.31) $WL_{fl,t} = WL_{fl,t-1} \cdot \left[1 + \omega_1 \cdot \frac{\sum_a LPRODG_{fl,a,t}}{a} + \omega_2 \cdot \hat{CPI}_t - \omega_3 \hat{UN}_{fl,t} + \omega_4 wpol\right]$ — Fl

(A.32) $YFL_{fl,t} = \left(WL_{fl,t} \cdot \sum_a LD_{fl,a,t}\right) \cdot (1 - tfl_{fl})$ — Fl

(A.33) $YFK_t = \left[\sum_a ((1+sa_{a,t}) \cdot PDA_{a,t} - VC_{a,t}) \cdot XA_{a,t}\right] \cdot (1 - tfk)$ — Fk

$$PRFR_{a,t} = \frac{\left((1+sa_{a,t})\cdot PDA_{a,t} - VC_{a,t}\right)\cdot XA_{a,t}\cdot\left(1-tfka_a\right)}{KPI_t \cdot KSA_{a,t}} \text{ where}$$

(A.34) $$tfka_a = tfk\cdot\frac{XA_{a,t0}}{\sum_a XA_{a,t0}}$$ a

(A.35) $$KSA_{a,t} = (1-\delta_a)KA_{a,t-1} + ID^{priv}_{a,t}$$ For a=PP, MR,MO,OS

(A.36) $$KSA_{a,t} = (1-\delta_a)KA_{a,t-1} + ID^{priv}_{a,t} + ID^{gov}_t$$ For a= PS

INSTITUTIONS AND DEMAND

(A.37) $$YH_{h,t} = \sum_{fl} shryfl_{h,fl}\cdot YFL_{fl,t} + shryfk_h \cdot YFK_t + TRGHV_{h,t} + TRWHV_{h,t}$$ h

(A.38) $$TRWHV_{h,t} = NER_t \cdot trwh_{h,t}$$ where $trwh_{h,t} = trwh_{h,t-1}\cdot(1+gtrwh_{h,t})$ h

(A.39) $$EXPH_{h,t} = (1-MPS_{h,t})(1-ty_h)YH_{h,t} - TRHGV_{h,t} - TRHWV_{h,t}$$ h

(A.40) $$TRHGV_{h,t} = trhg_{h,t}\cdot CPI_t$$ where $trhg_{h,t} = trhg_{h,t}(1+gtrhg_{h,t})$ h

(A.41) $$TRHWV_{h,t} = trhw_{h,t}\cdot NER_t$$ where $trhw_{h,t} = trhw_{h,t-1}\cdot(1+trhwrule_{h,t})$ h

(A.42) $$CDH_{c,h,t} = \theta_{c,h} + \frac{\mu_{c,h}}{PINDEX_{c,t}}\cdot\left[EXPH_{h,t} - \sum_c PINDEX_{c,t}\cdot\theta_{c,h}\right]$$ c,h

(A.43) $$INTD_{c,a,t} = iocf_{c,a}\cdot XA_{a,t}$$ c,a

(A.44) $$AINTD_{c,t} = \sum_a INTD_{c,a,t}$$ c,a

(A.45) $$CDG_{c,t} = \left[CDG_{c,t-1}\cdot(1+cdgrule) + CDGTC_{c,t}\right]\cdot GCADJ_t$$ c

(A.46) $$CDGTC_{c,t} = strcdg_c\cdot(taxcon\cdot\frac{TTEX_t}{TTEX_{t-1}})\cdot\frac{1}{CPI_t}$$ c

(A.47) $$ID^{priv}_{a,t} = ID^{priv}_{a,t-1}\cdot\begin{bmatrix}1+\gamma_{1a}\hat{UAV}_t + \gamma_{2a}\hat{ID}^{gov}_t \\ +\gamma_{3a}\hat{PRFR}_{a,t} - \gamma_{5a}\hat{RIR}_t\end{bmatrix}\cdot IADJ_t$$ a

(A.48) $$ID^{gov}_t = \left[ID^{gov}_{t-1}\cdot(1+idgrule) + IGTI_t\right]\cdot GIADJ_t$$

(A.49) $$IGTI_t = taxinv \cdot \frac{TTEX_t}{TTEX_{t-1}} \cdot \frac{1}{CPI_t}$$

(A.50) $$IO_{c,t}^{gov} = \Delta_c^{gov} ID_t^{gov}$$ c

(A.51) $$IO_{c,t}^{priv} = \Delta_{ac}^{priv} ID_{a,t}^{priv}$$ c

(A.52) $$IDT_{APS,t} = ID_t^{gov} + ID_{APS,t}^{priv}$$ For a=PS

(A.53) $$E_{c,t} = E_{c,t-1} \cdot (RERE_{c,t})^{\xi_{E_P}} \cdot (y^W)^{\xi_{E_Y}} \cdot \left(\frac{ID_{a,t}^{priv}}{ID_{a,t-1}^{priv}} \right)^{\xi_{E_{NP1_c}}} \cdot \left(\frac{QA_{APS,t}}{QA_{APS,t-1}} \right)^{\xi_{E_{NP2_c}}}$$ For c $\in$ mup

(A.54) $$M_{c,t} = M_{c,t-1} \cdot \left(\frac{YAGR_t}{YAGR_{t-1}} \right)^{\xi_{MY}} \cdot \left(\frac{1}{RERM_{c,t}} \right)^{\xi_{MP}} \cdot \left(\frac{ID_{a,t-1}^{priv}}{ID_{a,t}^{priv}} \right)^{\xi_{MNP1}} \cdot \left(\frac{QA_{APS,t-1}}{QA_{APS,t}} \right)^{\xi_{MNP2}}$$ For c $\in$ tb

MATERIAL BALANCE AND SYSTEM CONSTRAINTS

(A.55) $$XC_{c,t} = AINTD_{c,t} + \sum_h CDH_{c,h,t} + IO_{c,t}^{priv} + IO_{c,t}^{gov} + CDG_{c,t} + E_{c,t} - M_{c,t}$$ c

(A.56) $$MSH_{c,t} = \frac{M_{c,t}}{AINTD_{c,t} + \sum_h CDH_{c,h,t} + CDG_{c,t} + IO_{c,t}^{gov} + IO_{c,t}^{priv}}$$ c

(A.57) $$YAGR_t = \sum_c XC_{c,t} - \sum_c INTD_{c,t}$$

(A.58) $$YAGN_t = \sum_c \left(PDC_{c,t} \cdot XC_{c,t} - PINDEX_{c,t} \cdot AINTD_{c,t} \right)$$

(A.59) $$YG_t = TTHOU + TTFAC + TTIND_t + TRADE_t + \sum_h TRHGV_{h,t} + TRWGV_t$$

(A.60) $$TTIND_t = \sum_c tind_c \cdot \frac{PINDEX_{c,t}}{(1+tind_c)} \left[\sum_h CDH_{c,h,t} + AINTD_{c,t} + CDG_{c,t} + IO_{c,t}^{gov} + IO_{c,t}^{priv} \right]$$

(A.61) $$TTRADE_t = \sum_c \frac{tm_c PM_{c,t} M_{c,t}}{(1+tm_c)} + \sum_{ctp} \frac{te_c PE_{c,t} \cdot E_{c,t}}{(1+te_c)} + \sum_{cmup} \frac{te_c PDC_{c,t} \cdot E_{c,t}}{(1+te_c)}$$

(A.62) $$TTEX_t = \sum_{ctp} \frac{te_c PE_{c,t} \cdot E_{c,t}}{(1+te_c)} + \sum_{cmup} \frac{te_c PDC_{c,t} \cdot E_{c,t}}{(1+te_c)}$$

(A.63) $$TTHOU_t = \sum_h ty_h YH_{h,t}$$

(A.64) $$TTFAC_t = \sum_{fl} \frac{tf_{fl} \cdot YF_{fl,t}}{(1-tf_{fl})} + \frac{tfk \cdot YF_{k,t}}{(1-tfk)}$$

(A.65) $TRWGV_t = trwg_t \cdot NER_t$ where $trwg_t = trwg_{t-1} \cdot (1 + gtrwg_t)$

(A.66) $EXPG_t = \sum_c CDG_{c,t} + \sum_h TRGHV_{h,t} + TRGWV_t + \sum_a SUBSA_{a,t}$

(A.67) $TRGHV_{h,t} = trghr_{h,t} \cdot CPI_t \cdot GTRGHADJ_t$ H
where $trghr_{h,t} = trghr_{h,t-1}(1 + trghrule_{h,t})$

(A.68) $TRGWV_t = trgw_t \cdot NER_t \cdot GTRGWADJ_t$ where
$trgw_t = trgw_{t-1} \cdot (1 + trgwrule_t)$

(A.69) $SUBSA_{a,t} = sa_{a,t} \cdot PDA_{a,t} \cdot XA_{a,t}$ a

Macroeconomic balances: government, external and saving-investment

(A.70) $SG_t = YG_t - EXPG_t$

(A.71) $GBR_t = EXPG_t + \sum_c PINDEX_{c,t} \cdot IO_{c,t}^{gov} - YG_t$

(A.72) $SW_t = \frac{\sum_c PM_{c,t} \cdot M_{c,t}}{(1 + tm_c)} + \sum_h TRHWV_{h,t} + TRGWV_t - \sum_{ctp} \frac{PE_{c,t} \cdot E_{c,t}}{(1 - te_c)} - \sum_{cmup} PDC_{c,t} \cdot E_{c,t} - \sum_h TRWHV_{h,t} - TRWGV_t$

(A.73) $\sum_h MPS_{h,t}(1 - ty_h) Y_{h,t}^H + SG_t + SW_t = \sum_c PINDEX_{c,t}(IO_{c,t}^{priv} + IO_{c,t}^{gov})$

Labour market equilibrium

(A.74) $UNL_{fl,t} = LS_{fl,t} - \sum_a LD_{fl,a,t}$ F

Commodity market equilibrium

(A.75) $QDSC_{c,t} = QDC_{c,t} - E_{c,t} + M_{c,t}$

(A.76) $QDDC_{c,t} = \left[\sum_c INTD_{c,t} + \sum_h CDH_{c,h,t} + IO_{c,t}^{priv} + IO_{c,t}^{gov} + CDG_{c,t} \right]$ c

Saving investment balance

(A.77) $QDSC_{c,t} = QDDC_{c,t}$ c

Model parameters and variables definitions

Endogenous variables

Ψ (endogenous or exogenous according to closure rule)

COST AND PRICES		
$VC_{a,t}$	Variable costs	a
$PINDEX_{c,t}$	Composite commodity prices (including indirect tax) for commodities sold domestically	c
$PDC_{c,t}$	Price for commodity c produced domestically	c
$PDCBIS_{c,t}$	Composite price for commodity c produced domestically	c
$PM_{c,t}$	Domestic import price	tb
$PE_{c,t}$	Domestic export price	tbnr
$PDA_{a,t}$	Producer price	a
NER_t Ψ	Nominal exchange rate	
$RERM_{c,t}$	Real exchange rate imports	tb
$RERE_{c,t}$	Real exchange rate exports	mup
$WL_{fl,t}$ Ψ	Nominal wage by labour type	fl
CPI_t	Consumer price index	
KPI_t	Capital price index	
RIR_t	Real interest rate	
PTI_t	Tradable price index	
RER_t	Ratio tradable to non-tradable prices	
$TAUV_{a,t}$	Mark up	
PRODUCTION AND FOP MARKET		
$QA_{a,t}$	Supply determined output activity-sector	a
$QDC_{c,t}$	Supply commodity c produced domestically	c
$XA_{a,t}$	Demand determined output activity-sector	a
$YADJ_t$ Ψ	Adjustment variable for output, endogenous in Keynesian closure rule	
$U_{a,t}$	Capacity utilization by activity-sector a	a
UAV_t	Aggregate capacity utilization	
$LD_{fl,a,t}$	Labour demand by activity-sector and labour type	fl a
$LS_{fl,t}$	Labour supply by labour type	fl,t
$UNL_{fl,t}$ Ψ	Excess labour supply by labour type	fl
$LOCF_{fl,a,t}$	Labour output coefficient by activity-sector and labour type	fl a
$LPRODG_{fl,a,t}$	Labour productivity	fl a
$YFL_{fl,t}$	Labour income by labour type	fl
YFK_t	Capital income	fk
$PRFR_{a,t}$	Profit rate by activity-sector	a
$KSA_{a,t}$	Capital stock by activity-sector	a

INSTITUTIONS AND DEMAND

$YH_{h,t}$	Household income	h
$TRWHV_{h,t}$	World transfers to households	h
$EXPH_{h,t}$	Households expenditure	h
$TRHWV_{h,t}$	Household transfers to the rest of the world	h
$TRHGV_{h,t}$	Household transfers to the government	h
$MPS_{h,t}$ Ψ	Marginal propensity to save (endogenous in Kaldorian closure rule)	h
$CDH_{c,h,t}$	Household consumption	c,h
$INTD_{ac,t}$	Demand intermediate inputs	c
$AINTD_{c,t}$	Aggregate intermediate input demand	c
$CDG_{c,t}$	Government consumption	c
$CDGTC_{c,t}$	Government consumption out of export tax	c
$GCADJ_{t}$ Ψ	Adjustment variable government consumption	
$ID^{priv}_{a,t}$	Private investment by destination	a
$IADJ_{t}$ Ψ	Adjustment variable for investment (endogenous in saving-driven closure rule)	
ID^{gov}_{t}	Public investment	aps
$IGTI_{t}$	Public Investment out of export tax	
$GIADJ_{t}$ Ψ	Adjustment variable public investment	
$IDT_{aps,t}$	Total investment in sector PS	aps
$IO^{priv}_{c,t}$	Private investment by origin	c
$IO^{gov}_{c,t}$	Public investment by origin	c
$E_{c,t}$	Exports	tb
$M_{c,t}$	Imports	tb
$QDDA_{c,t}$	Quantity of domestic output sold domestically	tbnr

MATERIAL BALANCE AND SYSTEM CONSTRAINT

$XC_{c,t}$	Domestic demand commodity c	c
$MSH_{c,t}$	Import share	ct
$YAGR_{t}$	Real GDP	
$YAGN_{t}$	Nominal GDP	
YG_{t}	Government income	
$TTHOU_{t}$	Total direct tax	h
$TTFAC_{t}$	Total factor tax	fl, fk
$TTEX_{t}$	Total export tax	
$TTRADE_{t}$	Total trade tax	
$TTIND_{t}$	Total indirect tax	
$TRWGV_{t}$	World transference to the government	
$EXPG_{t}$	Government expenditure	
$TRGHV_{h,t}$	Government transfers to households	h

$GTRGHADJ_{h,t}$ Ψ	Adjustment variable government transfers to households	
$TRGWV_t$	Government transfers to the rest of the world	
$GTRGWADJ_t$ Ψ	Adjustment variable government transfers to households	
$SUBSA_{a,t}$	Subsidy by activity-sector	a
SG_t	Government savings	
GBR_t	Government borrowing requirements	
SW_t	Foreign savings	
$QDSC_{c,t}$	Domestic supply composite commodity c	c
$QDDC_{c,t}$	Domestic demand composite commodity c	c

Model parameters and exogenous variables

COST AND PRICES

pwm_c	World price imports
pwe	World price exports
nir_t	Nominal interest rate
ζtau_a	Mark-up elasticity to demand growth
$cwts_c$	Weight consumer price index
$kwts_c$	Weight capital price index
$ptwts_c$	Weight tradable price index

PRODUCTION AND FOP MARKET

κ_a	Incremental capital capacity ratio
$iocf_{c,a}$	Input-output coefficient
$\Xi_{a,c}$	Output coefficient
$\Xi bis_{a,c}$	Demand coefficient
λ_c^{cet}	Shift CET function
ψ_c^{cet}	Export share
ρ_c^{cet}	Exponent CET function
$gls_{fl,t}$	Labour force growth
η_{fl}	Sensibility labour supply to relative wages
$lstc_{fl,a}$	Labour-saving technical change
$\alpha_{1\,fl,a}$	Kaldor-Verdoorn coefficient productivity equation
ω_1	Wage equation, sensibility wages to labour productivity
ω_2	Wage equation, indexation coefficient

ω_3	Wage equation, sensibility to changes in unemployment
ω_4	Wage equation, sensibility to wage policy
$wpol$	Government wage policy
δ_a	Depreciation rate
INSTITUTIONS AND DEMAND	
$shryfl_{h,\,fl}$	Share labour income to household h
$shryfk_h$	Share capital income to household h
$trwh_{h,t}$	Transfers to household from rest of the world
$gtrwh_{h,t}$	Changes in transfers to household from rest of the world
$trhg_{h,t}$	Household transfer to the government
$gtrhg_{h,t}$	Growth in household transfers to the government
$trhw_{h,t}$	Household transfers to the rest of the world
$trhwrule_{h,t}$	Growth in household transfers to the rest of the world
$\theta_{c,h}$	Intercept LES consumption function
$\mu_{c,h}$	Marginal propensity to consume LES fn
$cdgrule$	Exogenous growth government consumption
$strcdg_c$	Structure government consumption
$taxcon$	% of changes in export tax used to finance government consumption
γ_{1a}	Investment equation, coefficient capacity utilization
γ_{2a}	Investment equation, crowd-in parameter
γ_{3a}	Investment equation, coefficient profit rate
γ_{5a}	Investment equation, coefficient real interest rate
$idgrule$	Exogenous growth in public investment
$taxinv$	% of changes in export tax used to finance public investment
Δ_c^{gov}	Public investment coefficient (investment by destination to investment by origin)
Δ_{ac}^{priv}	Private investment coefficient (investment by destination to investment by origin)
y^W	World output
ξ_{E_P}	Price elasticity exports
ξ_{E_Y}	Income elasticity exports
$\xi_{E_{NP1_c}}$	Non-price elasticity exports 1 (sensibility to capital accumulation)

ξ_{ENP2_c}	Non-price elasticity exports 2 (sensibility to infrastructure)
ξ_{MY}	Price elasticity imports
ξ_{MP}	Income elasticity imports
ξ_{MNP1}	Non-price elasticity imports 1 (sensibility to capital accumulation)
ξ_{MNP2}	Non-price elasticity imports 2 (sensibility to infrastructure)
ty_h	Direct income tax
tfl_{fl}	Tax factor labour fl
$tfka_a$	Tax factor capital by activity-sector
tfk	Tax factor capital
tm_c	Import tax
te_c	Export tax
$tind_c$	Indirect tax
$trwg_t$	Transfers to the government from the rest of the world
$gtrwg_t$	Growth in transfers to the government from the rest of the world
$trghr_{h,t}$	Government transfers to households
$trghrule$	Growth in government transfers to households
$trgw_t$	Government transfers to the rest of the world
$trgwrule_t$	Growth in government transfers to the rest of the world
$sa_{a,t}$	Government subsidy to activity-sector