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"Commercial Integration and Vulnerability to Regional Trade: An Application to Mercosur"

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Commercial Integration and Vulnerability to Regional Trade: An application to Mercosur*

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Abstract

Commercial integration among the Mercosur countries has increased dramatically ever since the trade block was established in 1991. This fact has raised concerns among policy makers about the macro economic vulnerability of the smaller Mercosur countries to macroeconomic disturbances in Brazil, specially with respect to changes in bilateral exchange rates within the region.

We asses the macro-economic vulnerability of Argentina, Paraguay and Uruguay to real devaluations in Brazil by introducing the concept of regional goods, i.e. goods which are tradable with Brazil but largely non-tradable with the rest of the world. We argue that the extent of trade in regional goods with Brazil - irrespective of the amount of total trade - is the relevant one to asses the macro-economic vulnerability of the smaller Mercosur partners to changes in Brazil's real exchange rate.

The first part of the paper measures the extent of trade in regional goods between each of the Mercosur partners and Brazil. The second part develops an inter–temporal open economy model which is used to evaluate the qualitative and quantitative impact of a real devaluation in Brazil on the macro variables - output, employment and sectoral allocation of resources, the current account and the trade balance.

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1 Introduction

Countries in the Mercosur region have strong links which have grown very rapidly since the Treaty of Asunción was signed in March of 1991, formally establishing Mercosur. In 1990, about 15% of Argentina's exports went to Mercosur countries. This share went up 33% in1996. For Brazil, although the 1990 level was lower (4%), the Mercosur share increased by almost four times, to 15 percent in 1996. For Paraguay and Uruguay, the increases in the Mercosur share in total trade were less dramatic, but in both cases, the level of total exports to Mercosur countries almost doubled between 1990 and 1996 reaching 57% and 48% respectively.

In addition, Mercosur differs from other trade arrangements such as the European Union and NAFTA by the fact that it is a trade block characterized by a very large and very volatile dominant trade partner, with which there´s a large concentration of trade for the smaller countries. Although for the European Union members in general the shares of intra–regional exports in total exports and the shares of intra-regional imports in total imports are substantially larger than the corresponding shares in Mercosur, countries in the European Union buy from (sell to) their **main** intra–regional supplier (customer) a smaller share of their total imports (exports) than Argentina, Paraguay and Uruguay buy from (sell to) Brazil as shown in Tables 1.1 and 1.2.

For NAFTA, however, this concentration pattern is even more extreme[1]. Consequently, this is not enough to make Mercosur different. What furthre differentiates Mercosur is the uncertainty regarding macroeconomic developments in the largest economy since, ceteribus paribus, the more uncertain the macroeconomic enviroment in the largest economy, the higher the risk of macroeconomic shocks for the smaller economies. In fact, both the mean and the standard deviation of the volatility of real exchange rates are, on average, much higher for Brazil than for Germany and the US. Brazil's mean real exchange rate volatility during 1985–1997 corresponds to six times Germany's volatility and about five times United States' volatility as shown in Table 1.3.

The combination of all these facts (the growth in Mercosu trade, the relatively high exposure of the smaller Mercosur to Brazil and the volatility of Brazil's economy) have raised concerns among policy makers about the macro economic vulnerability of the smaller Mercosur countries to macroeconomic disturbances in Brazil, specially with respect to changes in bilateral exchange rates within the region. The concerns have become so widespread that the media in Argentina regularly makes references to the dangers of "Brazil–Dependence". In Uruguay the same phenomenon is referred to as "Merco–dependence" highligting the fact that it is not only the direct effects of Brazil that matter for Uruguay, but also the indirect effects through the Argentine economy.

Given these basic facts about Mercosur, should we then be concerned about the possibility of excessive dependence of the smaller economies with respect to macroeconomic developments in Brazil? Not necessarily. Suppose Argentina exports oil to Brazil (which it does and in substantial amounts since 42 percent of Argentina's oil exports go to Brazil). What would happen if Brazilian demand for Argentinian oil were suddenly to shrink? Oil is a relatively homogenous commodity whose price is quoted in international spot and futures

[1] See Tables 1.1 and 1.2.

TABLE 1.1
MERCOSUR: TOTAL EXPORTS, 1990-1997
(IN MILLIONS OF US DOLLARS)

	1990	1991	1992	1993	1994	1995	1996	1997	Avg. Growth Rate 1990-97
Argentina	12,353	11,975	12,234	13,118	16,531	18,603	23,794	25,375	11%
Brazil	31,414	31,620	37,046	38,783	43,623	46,605	47,747	52,993	8%
Paraguay	959	737	657	725	817	1.180	1.282	1.410	6%
Uruguay	1,730	1,588	1,620	1,678	1,914	2,121	2,397	2,730	7%
MERCOSUR	46,456	45,920	51,557	54,304	62,885	68,509	75,220	82,508	9%

Source: IMF. Direction of Trade Statistics. Yearbook, 1997.

TABLE 1.2
MERCOSUR: TOTAL IMPORTS, 1990-1997
(IN MILLIONS OF US DOLLARS)

	1990	1991	1992	1993	1994	1995	1996	1997	Avg. Growth Rates 1990-97
Argentina	4,078	8,304	14,862	16,773	22,869	18,352	23,762	30,272	33%
Brazil	22,707	23,210	20,554	28,168	33,079	49,498	58,907	67,583	17%
Paraguay	1,193	1,275	1,237	1,478	2,140	5,156	3,489	4,016	19%
Uruguay	1,317	1,552	2,010	2,344	2,785	2,867	3,323	2,730	11%
MERCOSUR	29,295	34,341	38,663	48,763	60,873	75,873	89,481	104,600	20%

Source: IMF. Direction of Trade Statistics. Yearbook, 1997.

TABLE 1.3
BRAZIL, GERMANY AND UNITED STATES:
REAL EXCHANGE VOLATILITY, 1985-97

	1985-90	1991-97	1985-97
MEAN			
Brazil	0.0148	0.0093	0.0121
Germany	0.0018	0.0023	0.0020
United States	0.0024	0.0026	0.0025
STANDARD DEVIATION			
Brazil	0.0027	0.0031	0.0029
Germany	0.0004	0.0006	0.0005
United States	0.0007	0.0006	0.0006

markets. Therefore, oil exports to Brazil should be relatively easy to relocate –probably after an adjustment period and at lower prices and higher transportation costs– in other markets. Hence, nothing very substantial should happen to oil production in Argentina.

Suppose now that Argentina exports cars to Brazil (which it does and in substantial amounts since 90 percent of Argentina's car exports go to Brazil) based on a special regime which governs automobile trade between Argentina and Brazil. What would happen in this case if Brazilian demand for Argentinian cars were suddenly to shrink? Since cars are exported to Brazil – and only to Brazil – based on a special regime, the Argentinian auto industry is not competitive in other markets. Hence, the decline in Brazilian demand should translate into larger inventories, production cuts and worker layoffs since it would be very difficult to relocate to other markets.

The present paper asseses the macro-economic vulnerability of Argentina, Paraguay and Uruguay to real devaluations in Brazil by formalizing the concept of regional goods both at the empirical and theoretical level. We argue that the extent of trade in regional goods with Brazil - irrespective of the amount of total trade - is the relevant one to asses the macro-economic vulnerability of the smaller Mercosur partners to changes in Brazil's real exchange rate.

The paper procceeds as follows. Section 2 measures the extent of trade in regional goods. To that end we first estimate intraregional trade in services and then identify the commodity items that can relatively easily find alternative markets. When trade in regional goods is taken as the relevant measure of macroeconomic exposure we find that overall exposure of Argentina, Paraguay and Uruguay to Brazil declines very significantly when compared to standard measures of exposure. On the contrary, we find that Paraguay and Uruguay's exposure to Argentina increases relative to that of Brazil when standard measures of exposure are replaced by ours. According to our measure, for example, Uruguay is more exposed to macroeconomic shocks in Argentina than in Brazil even though Uruguay's

exports of goods to Brazil are three times larger than to Argentina!

Section 3 develops an inter-temporal open economy model that formally incorporates the concept of regional goods. This model is used to evaluate the qualitative and quantitative impact of a real devaluation in Brazil on the main macro-variables —output of tradable and regional goods, employment, real wages, aggregate demand, the current account, the trade balance and the regional composition of the trade balance– of the smaller trade partners. We find that for reasonable configurations of parameter values of the model, a real devaluation in Brazil –as represented by a change in the price of regional goods– can have potentially large macroeconomic effects on Brazil's trade partners. Interestingly, we find that macroeconomic vulnerability –as measured by the required changes in supply and demand side variables in response to changes in the price of regional goods– of Brazil's partners in Mercosur does not only depend on the extent of net trade in regional goods. It depends *independently* on the share of regional goods in total output, the share of regional goods in total consumption as well as the net trade position in regional goods, i.e., whether the country is a net exporter or importer of regional goods.

Finally, in Section 4 we conclude by summarizing the main results of this paper, discussing the policy implications and suggesting avenues for future research.

2 Why Should we Care About Brazil Dependence? Trade in Regional Goods

As argued in the introduction, not only has intra–regional Mercosur trade grown very rapidly in recent years but the smaller economies in Mercosur conduct a significant share of their trade with a large partner which has been subject to more volatile macroeconomic conditions than dominant trade partners in other trade arrangements around the world.

We have argued however, that this dependence is only relevant as long as intra-regional trade is sufficiently concentrated in regional goods. Since the relative importance of trade in regional goods is a key factor in determining the real effects on the smaller economies of shocks originating in Brazil, this chapter will attempt to measure the extent of trade in regional goods of Argentina with Brazil, and of Paraguay and Uruguay with both Argentina and Brazil. We use both Argentina and Brazil to measure the extent of trade in regional goods for Paraguay and Uruguay because shocks originating in Brazil potentially impact these two economies both directly and indirectly (through the impact coming from Argentina in response to a shock in Brazil).

In order to measure trade in regional goods for a given country with a certain degree of accuracy, it is necessary to start by estimating the extent of intraregional trade in services. This is necessary because, as Table 2.1 indicates, the relative importance of services in total trade is different for the four countries and it is our presumption that trade in services has a larger regional component than trade in goods, especially for the smallest economies (Paraguay and Uruguay).

2.1 Evolution of Trade in Services

TABLE 2.1
MERCOSUR: SHARE OF EXPORTS OF SERVICES IN
TOTAL EXPORTS OF GOODS AND SERVICES, 1990-97:
(IN PERCENT)

	1990	1991	1992	1993	1994	1995	1996	1997
Argentina	17	17	17	16	14	13	12	11
Brazil	11	10	10	9	10	12	–	–
Paraguay	30	38	39	40	38	32	31	26
Uruguay	21	27	34	38	41	40	37	35
MERCOSUR	13	13	13	13	13	14	–	–

Source: IMF. Direction of Trade Statistics.Yearbook,1997

TABLE 2.2
MERCOSUR: TOTAL EXPORTS OF SERVICES,1990–1997
(IN MILLIONS OF US DOLLARS)

	1990	1991	1992	1993	1994	1995	1996	1997	Average Growth Rate 1990-97
Argentina	2,446	2,408	2,454	2,454	2,599	2,860	3,226	3,271	4%
Brazil	3,762	3,319	4,088	3,965	4,908	6,135	–	–	10%
Paraguay	403	453	426	485	502	548	567	503	3%
Uruguay	466	596	830	1,015	1,335	1,359	1,399	1,475	18%
MERCOSUR	7,076	6,776	7,798	7,919	9,344	10,902	–	–	9%

Source: IMF. Direction of Trade Statistics.Yearbook,1997

Total exports of services from Mercosur countries increased from some US$7 billions in 1990 to almost US$11 billions in 1995, or at an average rate of growth of about 9 percent a year (Table 2.2). The fastest rate of growth is associated with Uruguay, where exports of services in 1995 had almost three times their 1990 value. Between 1995 and 1997 Uruguay's exports of services increased even more, reaching at the end of the period about US$1.5 billions, or some 35 percent of total exports of goods and services (Tables 3.1 and 3.2).

Table 2.3 presents the intraregional exports of services, estimated with the use of the methodology described in Appendix A. The estimation involved the bilateral assignation of total services exports for the different Mercosur countries following some basic criteria established for each of the services accounts. In some cases, such as "transportation services" and "other services", for example, the criterion was simple as the use of the same structure of total merchandise exports to distribute services exports among different trade partners.

Similarly to what happened with goods, most of the increase in the exports of services has occurred within the Mercosur region. The average rates of increase of intraregional exports of services presented in Table 2.3 were higher than the rates of growth of total

TABLE 2.3
MERCOSUR: INTRAREGIONAL EXPORTS OF SERVICES, 1990-97
(IN MILLIONS OF US DOLLARS)

	1990	1991	1992	1993	1994	1995	1996	1997	Average Growth Rate 1990-97
Argentina	843	804	868	935	1,015	1,152	1,318	1,384	7%
Brazil	563	523	1,102	1,232	1,174	1,335	–	–	19%
Paraguay	298	337	311	329	336	387	399	438	6%
Uruguay	254	315	407	550	724	728	849	953	21%
MERCOSUR	1,958	1,979	2,688	3,046	3,249	3,601	–	–	13%

TABLE 2.4
MERCOSUR: SHARE OF INTRAREGIONAL EXPORTS OF SERVICES
IN TOTAL EXPORTS OF SERVICES, 1990-97
(IN PERCENT)

	1990	1991	1992	1993	1994	1995	1996	1997
Argentina	34	33	35	38	39	40	41	42
Brazil	15	16	27	31	24	22	–	–
Paraguay	74	74	73	68	67	71	70	87
Uruguay	54	53	49	54	54	54	61	65
MERCOSUR	28	29	34	38	33	33	–	–

Source: author's estimates (See Appendix A).

services exports during the period under consideration, particularly for Brazil and Uruguay. Alternatively, Table 2.4 shows that the shares of intraregional exports of services in total exports of services have increased during the 1990s. In 1990 a estimated 28 percent of the exports of services of Mercosur countries were intraregional, yet this value increased to 33 percent in 1995.

As with goods, the figures in Table 2.4 show that the increase in the relative importance of intraregional exports of services has been different for the four Mercosur countries. Proportionally, the largest increase is associated with Argentina, where the share of intraregional exports of services has increased from 34 percent in 1990 to 40 percent in 1995 and 42 percent in 1997. For Brazil, the Mercosur share of services increased from 15 percent in 1990 to 31 percent in 1993, but declined to 17 percent in 1995. Paraguay and Uruguay already had very large shares of intraregional exports of services in 1990, but in both cases this share increased even further during the following years.

The information on intraregional services exports is separated according to its bilateral

components in Table 2.5. Argentina and Brazil have been the most dynamic intra-Mercosur importers of each other services. The main source of growth for Argentina's intraregional exports of service during 1990-1997 was the Brazilian market, with an average growth rate of about 11 percent a year. For Brazil, the most dynamic market within Mercosur was Argentina, with an average rate of growth of about 16 percent a year. As Table 2.4 shows, the average rate of growth of exports from Brazil to Argentina during 1990-1997 is dominated by the very high rate of growth during the sub-period 1990-1993. For Paraguay, the fastest growth is also associated with exports to Argentina, especially from 1994 to 1997. Finally, Uruguay's exports of services to the other Mercosur countries increased at very high rates during the entire period. When the sub-periods are taken into consideration, the most dynamic market for Uruguay's exports has been Argentina during 1990-1993 with an average rate of growth of 30 percent a year.

The final Table in this section presents bilateral data on the shares of intra-Mercosur exports of services in total exports of services (Table 3.5). Brazil is the most important export market for the services coming from Argentina and Paraguay. For Argentina, the increase in the relative importance of Mercosur on its exports of services was driven mainly by Brazil, which became the destination of more than a fifth of its services exports in 1997. For Paraguay, Brazil was already the destination of 50 percent of its exports of services in 1990, yet this share increased to 57 percent in 1997. Finally, Argentina continued to be the most important market for Uruguay's exports of services during the 1990s, but the relative importance of Brazil as a partner for this type of trade increased significantly during the period.

Therefore, most of the evidence presented in this section confirms the findings from Section 2.1, which described the evolution of merchandise trade for the Mercosur countries during the 1990s. However, there are some important results which are specific to the present analysis and which deserve to be highlighted. First, trade in services cannot be simply considered a given fraction of total trade for the entire region. For both Paraguay and Uruguay the share of services in total exports of goods and services is substantially higher than in Argentina and Brazil.

The second important result of this section is that the shares of intraregional trade in services for Argentina, Paraguay and Uruguay are higher than the respective shares of intraregional trade in goods. For Argentina the increase in this share reflects the importance of Uruguay as a destination for its exports of services. For Paraguay, the increase in the share with respect to its counterpart for goods is explained entirely by Brazil, which was already a major export market in the case of goods. The most interesting case, however, is Uruguay. When services are considered, the most important market for this country's exports is Argentina and not Brazil as in the case of goods. Finally, for Brazil whether we deal with goods or with services, we find basically the same relative importance of intraregional trade flows.

2.2 The Extent of Trade in Regional Goods

Having estimated the extent of intraregional trade in services in the previous section, we now proceed to measure the share of trade in regional goods as a percentage of total trade in goods and services for Argentina, Paraguay and Uruguay, the three Mercosur economies

TABLE 2.5
MERCOSUR: INTRAREGIONAL SERVICES EXPORTS, 1990–97
(US$ MILLIONS)

	1990	1991	1992	1993	1994	1995	1996	1997	Avg. Growth Rate 1990 –1993	Avg. Growth Rate 1994 –1997	Avg. Growth Rate 1990 –1997
Argentina	843	804	868	935	1015	1152	1318	1384	3%	11%	7%
Brazil	325	332	376	445	491	573	657	681	11%	12%	11%
Paraguay	174	143	124	138	151	156	180	191	-7%	8%	1%
Uruguay	345	329	368	352	373	423	481	512	1%	11%	6%
Brazil	563	523	1102	1232	1174	1335	–	–	30%	7%	19%
Argentina	320	314	802	921	894	1006	–	–	42%	6%	26%
Paraguay	89	82	110	131	131	154	–	–	14%	9%	12%
Uruguay	154	126	190	180	149	175	–	–	5%	8%	3%
Paraguay	298	337	311	329	336	387	399	438	3%	9%	6%
Argentina	87	96	73	93	83	114	129	141	2%	19%	7%
Brazil	202	230	277	223	240	260	262	287	3%	6%	5%
Uruguay	9	12	10	13	13	12	9	10	15%	-8%	2%
Uruguay	254	315	407	550	724	728	849	953	29%	10%	21%
Argentina	207	262	347	452	579	531	605	694	30%	6%	19%
Brazil	43	48	55	92	135	184	224	237	29%	21%	28%
Paraguay	3	4	5	6	11	13	20	22	20%	28%	31%

TABLE 2.6
MERCOSUR: SHARE OF INTRAREGIONAL SERVICES EXPORTS IN TOTAL SERVICES EXPORTS, 1990-97
(IN PERCENT)

	1990	1991	1992	1993	1994	1995	1996	1997
Argentina	34%	33%	35%	38%	39%	40%	41%	42%
Brazil	13%	14%	15%	18%	19%	20%	20%	21%
Paraguay	7%	6%	5%	6%	6%	5%	6%	6%
Uruguay	14%	14%	15%	14%	14%	15%	15%	16%
Brazil	15%	16%	27%	31%	24%	22%	–	–
Argentina	8%	9%	20%	23%	18%	16%	–	–
Paraguay	2%	2%	3%	3%	3%	3%	–	–
Uruguay	4%	4%	5%	5%	3%	3%	–	–
Paraguay	74%	74%	73%	68%	67%	71%	70%	87%
Argentina	22%	21%	17%	19%	16%	21%	23%	28%
Brazil	50%	51%	53%	46%	48%	48%	46%	57%
Uruguay	2%	3%	2%	3%	2%	2%	2%	2%
Uruguay	54%	53%	49%	54%	54%	54%	61%	65%
Argentina	45%	44%	42%	45%	43%	39%	43%	47%
Brazil	9%	8%	7%	9%	10%	14%	16%	16%
Paraguay	1%	1%	1%	1%	1%	1%	1%	1%

potentially exposed to macroeconomic developments in Brazil.

The first step in our analysis is the construction of three alternative indicators of the share of regional goods in total exports of goods and services which will be used for the assessment of the relative exposure of the smaller economies. As a starting point, "Indicator 1" defines regional goods as the sum of intraregional exports of goods and intraregional exports of services. Except for the inclusion of intraregional exports of services in the numerator and total exports of services in the denominator, this indicator resembles the "Pedestrian Indicators" of exposure to Brazil which are the simple shares of intraregional trade in goods calculated in the previous chapter.

For the construction of the "Indicator 2", we narrowed down the list of goods and services that should be included in the definition of regional goods. For goods, we considered total intraregional merchandise exports excluding commodity exports.[2] For services, we used the total amount of intraregional exports of travel services plus a proportion of the remaining intraregional services exports ("transportation services" and "other services") which follows the share of non-commodity exports in total intraregional merchandise exports.[3] The definition of trade in regional goods in this case is therefore the sum of this two components and the share of intraregional goods in total trade is calculated by dividing this sum by the total exports of goods and services..

Finally, "Indicator 3" makes our definition of regional goods even more narrow. For goods, we considered again total intraregional merchandise exports excluding commodity exports, but we also excluded any other export item for which less than 50 percent of exports were intraregional. The 50 percent cut off point is necessarily arbitrary, but changing it to 40 or 60 percent does not significantly alter the results. For services, the definition matched the definition for Indicator 2 with the corresponding adjustment for the amount of "transportation services" and "other services". Again, the share of trade in regional goods in total trade is calculated by dividing the amount of trade in regional goods by the total amount of exports of goods and services.

Table 2.7 presents the results for the three alternative exposure indicators, along with the so called "pedestrian indicator" (share of intraregional trade in goods) calculated in the previous chapter, for Argentina and Paraguay in 1996, and Uruguay in 1997.

The introduction of trade in services does not increase Argentina's exposure to Brazil in a significant way. As we see in the top portion of Table 2.7, there is almost no difference between the exposure measured as the simple share of intraregional merchandise exports in total merchandise exports and the equivalent share including services (Indicator 1). In fact, for the bilateral trade between Argentina and Brazil the inclusion of services seems to affect both the numerator and the denominator of the exposure indicator in the same proportion. Table 2.8 identifies the ten most important items in Argentina's exports of goods and services to Brazil according to the three indicators. The largest export item from Argentina to Brazil in 1996 were vehicles. They represented 5.6 percent of Argentina's total exports of goods and services and almost 90 percent of their exports were directed to the Brazilian market. The second and third largest items, however, refer largely to

[2]The list of commodities excluded from intraregional exports is presented in Appendix A.

[3]For Paraguay, however, since the bilateral exports of "other services" to Brazil include mainly exports from the Itaipú power plant, the total amount of this item is considered a regional good.

TABLE 2.7
MERCOSUR: EXPOSURE INDICATORS
(IN PERCENT)

ARGENTINA, 1996	
	Brazil
Share of intraregional exports in goods	27.8
Indicator 1	26.9
Indicator 2	15.4
Indicator 3	9.5

PARAGUAY, 1996			
	Argentina	Brazil	Total
Share of intraregional exports in goods	9.2	50.0	59.2
Indicator 1	14.0	48.6	62.6
Indicator 2	11.9	24.3	36.2
Indicator 3	11.3	21.8	33.1

URUGUAY, 1996			
	Argentina	Brazil	Total
Share of intraregional exports in goods	13.0	34.0	47.0
Indicator 1	24.9	28.0	52.9
Indicator 2	22.8	17.1	39.9
Indicator 3	21.7	16.1	37.8

commodity exports.

Given the list of most important items in Table 2.8, it is not surprising that the exposure of Argentina to Brazil declines significantly when commodities are excluded from total intraregional exports in Indicator 2. As we see again in Table 2.7, the share of regional goods in the total exports from Argentina to Brazil declines from 27 to 15 percent. As the middle part of Table 2.8 indicates, the list of the ten most important export items changes considerably when commodities are excluded. The exposure is reduced even further, to only 9.5 percent, when we eliminate all items for which less than 50 percent of total exports are intraregional in Indicator 3. Therefore, when commodities and goods for which Brazil is not a dramatically important export market are excluded from the computations, Argentina's exposure to Brazil declines substantially.

For Paraguay and Uruguay we reach different conclusions. As Table 2.7 shows, the relative exposure of Paraguay to Argentina and Brazil in regional goods is very different than what would be shown by the simple share of intraregional exports in total exports. This is due to the fact that trade in services is concentrated with Argentina, while trade with Brazil is intensive in commodities. When both goods and services are considered, the total exposure of Paraguay increases from 59 percent to 62 percent. However, when commodities and goods for which intraregional exports are less than 50 percent of total exports are excluded, the exposure drops dramatically. As we see in the table, when we go from Indicator 1 to Indicators 2 and 3 the drop in total exposure is explained by the decline in exposure to Brazil. While Paraguay continues to be more exposed to Brazil in absolute terms, the relative exposure to Argentina increases substantially. As Table 2.9 shows, the most important regional good export for Paraguay refers to "other services", which are dominated by the payments related to the Itaipú power plant.

Finally, the results for Uruguay are similar to the results for Paraguay in one respect: the relative exposure to Argentina and Brazil in regional goods is different than what is suggested by simple intraregional export shares. However, when we consider regional goods, we see that Uruguay is still highly exposed to the region even when commodities are excluded. This is due to the large importance of trade in services with Argentina. While Argentina only represents 28 percent of intraregional merchandise trade for Uruguay, it represents almost 60 percent of trade in regional goods when both Indicators 2 and 3 are considered. As Table 2.10 shows, the largest export item for Uruguay are travel services, which represented in 1997 about 18 percent of its total exports. Of the corresponding amount, 71 percent were exports to Argentina and 9 percent were exports to Brazil.

2.3 Summary of Main Findings

This chapter argues that in order to assess exposure of the smaller trade partners to Brazil we have to go beyond simple trade shares. For this purpose we introduced the concept of a regional good, defined in the chapter as a good which is tradable within the region but is largely nontradable with the rest of the world.

In order to measure in a meaningful way trade in regional goods we first estimated bilateral services exports for the four Mercosur countries. Trade in services cannot be considered a simple fraction of total trade for the entire region. For both Paraguay and Uruguay the share of services in total exports of goods and services is substantially higher

than in Argentina and Brazil. In addition, the shares of intraregional trade in services for Argentina, Paraguay and Uruguay are higher than the respective shares of intraregional trade in goods. In fact, when services are considered, the most important export market for Uruguay is Argentina and not Brazil as in the case of goods. For Brazil, whether we consider goods or services, we find basically the same relative importance of intraregional trade flows.

When the extent of trade in regional goods is estimated, the findings are as follows. First, when trade in services is taken into account (Indicator 1), the overall exposure to Brazil declines for Argentina and increases for Paraguay and Uruguay. Second, when the appropriate share of trade in regional goods is used as a measure of exposure (Indicators 2 and 3), the overall exposure declines for Argentina, Paraguay and Uruguay when compared to simple intraregional export shares. Third, in relative terms, the share of Argentina in total trade in regional goods increases both for Paraguay and Uruguay. Fourth, in absolute terms, when exposure is measured appropriately, Uruguay's exposure to Argentina is larger than to Brazil (according to simple intraregional export shares, Uruguay's exposure is 3 times larger with respect to Brazil than with respect to Argentina). Therefore, it is not Brazil dependence what the smallest economies should care about, but Merco-dependence.

TABLE 2.8.1
ARGENTINA: TRADE IN GOODS AND SERVICES

INDICATOR 1: MOST IMPORTANT ITEMS OF TRADE IN GOODS AND SERVICES

	Exports (in millions)		%. of Total Exports		% of. Each Item
Chapter	Brazil	Total	Brazil	Total	Total
Vehicles	1,360	1,519	5.0	5.6	89.6
Mineral fuels, oils, etc.	1,287	3,089	4.8	11.4	41.7
Cereals	912	2,560	3.4	9.5	35.6
Machinery and appliances	385	765	1.4	2.8	50.4
Transportation services	272	1,276	1.0	4.7	21.3
Cotton	233	580	0.9	2.1	40.2
Dairy products	205	371	0.8	1.4	55.1
Travel services	196	1,269	0.7	4.7	15.4
Other services	189	681	0.7	2.5	27.8
Fruits and nuts	172	509	0.6	1.9	33.9

TABLE 2.8.2
ARGENTINA: TRADE IN GOODS AND SERVICES

INDICATOR 2: MOST IMPORTANT ITEMS OF TRADE IN NON COMMODITY–GOODS AND SERVICES

Chapter	Exports (in millions)		% of Total Exports		% of Each Item
	Brazil	Total	Brazil	Total	Total
Vehicles	1,361	1,519	5.0	5.6	89.6
Machinery and appliances	385	7659	1.4	2.8	50.4
Transportation Services	272	1,276	1.0	4.7	21.3
Dairy products	205	371	0.8	1.4	55.1
Travel services	196	1,269	0.7	4.7	15.4
Other services	189	681	0.7	2.5	27.8
Plastics	164	340	0.6	1.3	48.2
Vegetables	128	271	0.5	1.0	47.2
Mill products	103	166	0.4	0.6	64.0
Preparation of vegetables and fruits	100	399	0.4	1.5	24.9

TABLE 2.8.3
ARGENTINA: TRADE IN GOODS AND SERVICES

INDICATOR 3: MOST IMPORTANT ITEMS OF REGIONAL TRADE IN NON COMMODITY–GOODS AND SERVICES

Chapter	Exports (in millions)		% of Total Exports		% of Each Item
	Brazil	Total	Brazil	Total	Total
Vehicles	1,361	1,519	5.03	5.6	89.6
Machinery and appliances	385	765	1.43	2.8	50.4
Dairy products	205	371	0.76	1.4	55.1
Mill products	106	166	0.39	0.6	64.0
Man-made filaments	84	95	0.31	0.4	88.4
Wadding, felt & nonwoven; yarns, twine, cordage, etc	24	46	0.09	0.2	52.2
Photographic goods	17	33	0.06	0.1	53.3
Man-made staple fibres	13	18	0.05	0.07	69.4
Toys, games and sports goods	12	23	0.04	0.09	51.8
Carpets and other textile floor coverings	4	6	0.02	0.02	69.0

TABLE 2.9.1
PARAGUAY: TRADE IN GOODS AND SERVICES

INDICATOR 1: MOST IMPORTANT ITEMS IN TRADE OF GOODS AND SERVICES

Chapter	Exports (In millions)				% of Total Exports				% of Each item		
	Arg	Bra	Arg + Bra	Tot	Arg	Bra	Arg + Bra	Tot	Arg	Bra	Arg + Bra
Other services	30	173	203	256	1.9	10.7	12.6	16.1	12	67	78
Cotton	21	159	179	216	1.3	9.8	11.1	13.4	10	73	83
Oil Seeds, oleagi fruits	0	152	153	326	0.0	9.5	9.5	20.3	0.1	47	47
Travel services	68	48	116	203	4.2	2.9	7.2	12.6	34	23	57
Transportation services	30	42	72	105	1.9	2.6	4.5	6.5	29	39	68
Animal/veg. fats	4	63	67	74	0.2	3.9	4.1	4.6	5	84	89
Wood and articles	28	20	48	93	1.7	1.2	3.0	5.8	30	22	51
Residues & wax	2	34	36	91	0.1	2.1	2.3	5.7	3	37	40
Cereals	0	26	26	26	0.0	1.6	1.6	1.6	1	99	100
Meat	1	18	19	46	0.1	1.1	1.2	2.8	2	40	42

TABLE 2.9.2
PARAGUAY: TRADE IN GOODS AND SERVICES

INDICATOR 2: MOST IMPORTANT ITEMS OF TRADE
IN NON COMMODITY-GOODS AND SERVICES

	Exports (in millions)				% of Total Exports				% of each item		
Chapter	Arg	Bra	Arg + Bra	Tot	Arg	Bra	Arg + Bra	Tot	Arg	Bra	Arg + Bra
Other services	30	173	203	259	1.9	10.7	12.6	16.1	11.7	66.7	78.4
Travel services	68	48	116	203	4.2	2.9	7.2	12.6	33.6	23.4	57.0
Transportation services	30	42	72	105	1.9	2.6	4.5	6.5	28.8	39.4	68.3
Animal/veg. fats	4	63	67	74	0.2	3.9	4.1	4.6	4.9	84.4	89.3
Wood	28	20	48	93	1.7	1.2	3.0	5.8	29.8	21.6	51.4
Residues & waste	2	34	36	91	0.1	2.1	2.3	5.7	2.6	37.3	39.9
Rubber	2	11	12	12	0.1	0.7	0.8	0.8	14.6	85.4	100.0
Live animals	0	11	11	11	0.0	0.7	0.7	0.7	0.2	99.4	99.6
Apparel	5	5	10	12	0.3	0.3	0.6	0.7	47.5	40.7	88.1
Iron and steel	7	1	8	9	0.4	0.1	0.5	0.5	74.6	16.5	91.0

TABLE 2.9.3
PARAGUAY: TRADE IN GOODS AND SERVICES

INDICATOR 3: MOST IMPORTANT ITEMS OF REGIONAL TRADE IN NON COMMODITY-GOODS AND SERVICES

Chapter	Exports (in millions)				% of Total Exports				% of each item		
	Arg	Bra	Arg + Bra	Tot	Arg	Bra	Arg + Bra	Tot	Arg	Bra	Arg + Bra
Other services	30	173	203	259	1.9	10.7	12.6	16.1	11.7	66.7	78.4
Travel services	68	48	116	203	4.2	2.9	7.2	12.6	33.6	23.4	57.0
Transportation services	30	42	72	105	1.9	2.6	4.5	6.5	28.8	39.4	68.3
Animal/veg. fats	4	63	67	74	0.2	3.9	4.1	4.6	4.9	84.4	89.3
Wood	28	20	48	93	1.7	1.2	3.0	5.8	29.8	21.6	51.4
Rubber	2	11	12	12	0.1	0.7	0.8	0.8	14.6	85.4	100.0
Live animals	0	11	11	11	0.0	0.7	0.7	0.7	0.2	99.4	99.6
Apparel	5	5	10	12	0.3	0.3	0.6	0.7	47.5	40.7	88.1
Iron and steel	7	1	8	9	0.4	0.1	0.5	0.5	74.6	16.5	91.0
Prep of vegetables and fruit	4	0	4	6	0.3	0.0	0.3	0.3	76.8	4.1	80.9

TABLE 2.10.1
URUGUAY: TRADE IN GOODS AND SERVICES

INDICATOR 1: MOST IMPORTANT ITEMS OF TRADE IN GOODS AND SERVICES

Chapter	Exports (in millions)				% of Total Exports				% of each item		
	Arg	Bra	Arg + Bra	Tot	Arg	Bra	Arg + Bra	Tot	Arg	Bra	Arg + Bra
Travel services	539	67	606	759	12.8	1.6	14.4	18.1	71.0	8.9	79.8
Cereals	11	215	226	323	0.2	5.1	5.4	7.7	3.2	66.5	69.8
Transportation services	112	67	184	419	2.8	1.6	4.4	10.0	27.8	16.0	43.8
Other services	39	102	141	297	0.9	2.4	3.4	7.1	13.0	34.4	47.7
Meet	14	101	115	421	0.3	2.4	2.7	10.0	3.3	24.0	27.3
Dairy products	12	89	101	150	0.3	2.1	2.4	3.6	8.2	59.1	67.3
Vehicles	58	18	76	78	1.4	0.4	1.8	1.8	74.7	23.4	98.1
Apparel	20	52	72	77	0.5	1.2	1.7	1.8	25.7	67.6	93.3
Mill Products	10	52	62	69	0.2	1.2	1.5	1.7	14.8	75.0	89.8
Paper & paperboard	27	21	48	52	0.6	0.5	1.1	1.2	52.7	39.7	92.4

TABLE 2.10.2
URUGUAY: TRADE IN GOODS AND SERVICES

INDICATOR 2: MOST IMPORTANT ITEMS OF TRADE
IN NON COMMODITY-GOODS AND SERVICES

Chapter	Exports (in millions)				% of Total Exports				% of each item		
	Arg	Bra	Arg + Bra	Tot	Arg	Bra	Arg + Bra	Tot	Arg	Bra	Arg + Bra
Travel services	539	67	606	759	12.8	1.6	14.4	18.1	71.0	8.9	79.8
Transportation services	117	67	184	419	2.8	1.6	4.4	10.0	27.8	16.0	43.8
Other services	39	102	141	297	0.9	2.4	3.4	7.1	13.0	34.4	47.4
Dairy products	12	89	101	150	0.3	2.1	2.4	3.6	8.2	59.1	67.3
Vehicles	58	18	76	78	1.4	0.4	1.8	1.8	74.7	23.4	98.1
Apparel	20	52	72	77	0.5	1.2	1.7	1.8	25.7	67.6	93.3
Mill products	10	52	62	69	0.2	1.2	1.5	1.7	14.8	75.0	89.8
Paper & paperboard	27	21	48	52	0.6	0.5	1.1	1.2	52.7	39.7	92.4
Rubber	9	34	42	45	0.2	0.8	1.0	1.1	18.9	74.2	93.1
Plastics	12	30	41	46	0.3	0.7	1.0	1.1	25.1	64.9	90.1

TABLE 2.10.3
URUGUAY: TRADE IN GOODS AND SERVICES

INDICATOR 3: MOST IMPORTANT ITEMS OF REGIONAL TRADE IN NON COMMODITY-GOODS AND SERVICES

Chapter	Exports (in millions)				% of Total Exports				% of each item		
	Arg	Bra	Arg + Bra	Tot	Arg	Bra	Arg + Bra	Tot	Arg	Bra	Arg + Bra
Travel services	539	67	606	759	12.8	1.6	14.4	18.1	71.0	8.9	79.8
Dairy products	12	89	101	150	0.3	2.1	2.4	3.6	8.2	59.1	67.3
Vehicles	58	18	76	78	1.4	0.4	1.8	1.8	74.7	23.4	98.1
Apparel	20	52	72	77	0.5	1.2	1.7	1.8	25.7	67.6	93.3
Mill products	10	52	62	69	0.2	1.2	1.5	1.7	14.8	75.0	89.8
Paper & paperboard	27	21	48	52	0.6	0.5	1.1	1.2	52.7	39.7	92.4
Plastics	12	30	41	46	0.3	0.7	1.0	1.1	25.1	64.9	90.1
Rubber	9	34	42	45	0.2	0.8	1.0	1.1	18.9	74.2	93.1
Electrical machinery	10	31	41	43	0.2	0.7	1.0	1.0	22.2	72.3	94.5
Live animals	5	27	32	38	0.1	0.6	0.8	0.9	12.0	71.6	83.6

3 Transmission Channels and Quantitative Impact of Shocks within Mercosur: A Model of Trade Linkages

Following Talvi (1995) this chapter constructs a model that captures the essential characteristics of Mercosur described in Chapter 2, i.e., a very large and volatile trade partner (Brazil) with which the smaller partners of the trade agreement (Argentina, Paraguay and Uruguay) have a large concentration of trade. In addition, the model formally incorporates the concept of regional goods described in Chapter 3, i.e., goods which are tradable with the regional partner but largely non-tradable with the rest of the world.

The model is then used to evaluate the qualitative and quantitative impact of trade related shocks in the regional partner –as represented by changes in the price of regional goods– on the main macro-variables —output, employment, sectoral allocation of production and productive resources, aggregate spending, the current account, the trade balance and the composition of the trade balance vis a vis the regional partner and the rest of the world– and to identify the main channels of transmission of those shocks.

The rest of the chapter proceeds as follows. In Section 3.1 we consider an endowment economy with regional goods and evaluate the qualitative and quantitative impact of shocks to the price of regional goods on the demand-side macro-variables. Section 3.2 introduces production and evaluates the impact of shocks to the price of regional goods on supply

side macro-variables. Finally, Section 3.3 summarizes the main findings of this Chapter.

3.1 An Endowment Economy with Regional Goods

3.1.1 Model

Consider a small open economy with a representative consumer that derives utility from the consumption of a traded good and a regional good, i.e., a good which is traded only with the region but non-traded with the rest of the world and whose price the small open economy takes as given.

The consumer's life–time utility (i.e. present discounted utility) is given by:

$$\int_0^\infty u(c_t^*, c_t) \exp(-\beta t) dt, \tag{1}$$

where c_t^* and c_t denote consumption of tradable and regional goods, respectively, and β is the subjective discount factor. The instantaneous utility function $u(\cdot)$ is continuous, increasing, concave and satisfies the Inada conditions:

$$u'(z) > 0,\ u''(z) < 0 \text{ and } \lim_{z \to 0} u'(z) = +\infty \tag{2}$$

where z is an index of real consumption which is a function of c^* and c :

$$z = v(c^*, c) \tag{3}$$

The intra–temporal utility function v is linearly homogeneous, increasing in both arguments and quasiconcave.

The consumer can hold only one asset, an internationally traded bond: k_t. We can thus write the flow constraint of the consumer as:

$$\dot{k}_t = r k_t + y_t^* + p_t y_t - c_t^* - p_t c_t. \tag{4}$$

where y_t and y_t^* are the endowments of the tradable and regional good respectively and we have normalized the price of the traded good to 1.

In order to obtain the intertemporal budget constraint we need to impose the Non–Ponzi game conditions that $\lim_{t \to \infty} k_t \exp(-rt) \geq 0$. Intuitively, if $lim_{t \to \infty} k_t \exp(-rt) < 0$, the present discounted value of life–time consumption would exceed intertemporal wealth. But this could only occur at the expense of creditors who would be providing the local economy with free resources. Clearly, creditors would prefer to consume those resources themselves. Imposing this constraint and integrating the flow constraint, eq. (4), we obtain the intertemporal budget constraint:

$$\int_0^\infty (c_t^* + p_t c_t) \exp(-rt) dt \leq k_0 + \int_0^\infty (y_t^* + p_t y_t) \exp(-rt) dt. \tag{5}$$

which says that the present discounted value of consumption cannot exceed wealth (i.e. the present discounted value of income and financial wealth.)

With these preferences, the solution to the problem can be decomposed in two stages.[4] In the first stage, the consumer chooses the allocation of consumption between the two goods for a given sub-utility level, z,

$$\min_{c^*,c} c^* + pc \text{ s.t. } v(c^*, c) \geq z.$$

Proposition 1 *Under the assumptions of this section, total (minimized) expenditure of the two goods Z is a separable function of real consumption and a price index which depends on the price of regional goods:*

$$Z \equiv c^* + pc = zP_z \tag{6}$$

where:

$$\begin{aligned} P_z &= P(p) \\ \partial P(\cdot)/\partial p &> 0 \text{ and } \partial^2 P(\cdot)/\partial p^2 < 0 \end{aligned} \tag{7}$$

In addition, expenditures on the two goods are also separable functions of the relative price of regional goods and real consumption:

$$c^* = \psi^*(p)z, \tag{8}$$

$$c = \psi(p)z. \tag{9}$$

where:

$$\begin{aligned} \psi^*(p) &= P(p) - p\frac{\partial P(p)}{\partial p} \\ \psi(p) &= \frac{\partial P(p)}{\partial p} \end{aligned}$$

Proof. See the Mathematical Appendix.

Using these results, we can rewrite the consumer's intertemporal budget constraint as:

$$\int_0^\infty z_t P_{zt} \exp(-rt)dt = k_0 + \int_0^\infty (y_t^* + p_t y_t) \exp(-rt)dt. \tag{10}$$

In the second stage, the consumer chooses the path of real spending z to maximize lifetime utility (1) subject to the intertemporal budget constraint (10). It can be shown that the first order conditions are:

$$u'(z_t) = z_t^{-\frac{1}{\eta}} = \lambda P_{zt} \tag{11}$$

$$\lim_{t\to\infty} u'(z_t)\frac{b_t}{P_{zt}}e^{-\beta t} \leq 0 \tag{12}$$

where we have assumed that $\beta = r$ to avoid inessential dynamics and λ is the lagrange multiplier associated with (10), the marginal utility of wealth. Intuitively, the first condition

[4] See Deaton and Muelbauer (1980).

implies that along a perfect foresight equilibrium path (with a constant λ), the consumer equates the marginal utility of real consumption, $u'(z)$, with its marginal cost, λP_z. The second condition is the transversality condition. To understand it consider a finite horizon with terminal time T. In that case, if $u'(z_T)b_T P_{zT}^{-1} e^{-\beta T} > 0$ it would not be optimal to end up at T with positive net foreign assets because they could be consumed. Equation (12) carries that intuition over to the infinite horizon problem.

Before we continue, a few definitions are in order. We define as gross domestic product in terms of tradable goods (or GDP for short), the overall trade balance, the trade balance with the rest of the world and the region, respectively, as:

$$\begin{aligned} g &\equiv y^* + py \\ TB &\equiv y^* + py - c^* - pc = g - P_z z, \\ tb^* &\equiv y^* - c^*, \\ tb &\equiv p(y - c). \end{aligned}$$

Hence, we can rewrite the current account as:

$$\dot{k}_t = rk_t + TB_t.$$

In addition, inter–temporal and intra–temporal utility will be characterized in terms of their elasticities:

Definition 2 (Inter–temporal and Intra–temporal elasticities of substitution) *The intratemporal elasticity of substitution is given by:*

$$\eta(z) = -\frac{u'(z)}{zu''(z)} \tag{13}$$

The intertemporal elasticity of substitution is given by:

$$\varepsilon = -\frac{d\log(c/c^*)}{d\log(p)} \tag{14}$$

3.1.2 Qualitative Dynamics

In this section we will perform two simple exercises with the two–fold aim of understanding the model and studying the dynamic adjustment of our model economy to different temporal paths of regional prices. For future reference, we will define a **permanent** change of p as one which implies changes in wealth (i.e. the present discounted value of income) and a **temporary** change as one which does not change wealth.

Before performing those exercises, we will characterize the paths of the endogenous variables for perfectly anticipated changes in p.

Perfect foresight equilibrium paths The following Proposition will prove very useful when considering perfectly anticipated changes in the relative price of the regional good:

Proposition 3 *Assume that*

1. *The inter–temporal elasticity of substitution exceeds the intra–temporal one (i.e.* $\eta < \varepsilon$*),*

2. *the intra-temporal elasticity of substitution is below* 1*,*

3. *the country is a net exporter of the regional good (i.e.* $tb = p(y - c) > 0$*) ,and,*

4. *that the real interest rate* (r) *equals the rate of time preference* (β) *for all* t*.*

Then, along any perfect foresight equilibrium path, if p *rises,*

1. *The price index* (P_z)*, aggregate consumption expenditures* (Z)*, consumption of traded goods* (c^*) *also rise and the overall trade balance* (TB) *and the regional balance* (tb) *both improve (the latter more than the former).*

2. *Real consumption* (z) *and consumption of regional goods* (c) *fall and the balance with the rest of the world* (tb^*) *worsens.*

In the special case of a perfect foresight equilibrium where the path of p *is constant (i.e. when* $p_t = \bar{p}$ *for all* $t \in [0, \infty)$*),*

- P_z*,* z*,* c^**,* c*,* TB*,* tb^* *and* tb *are all constant.*

- *In addition,*

$$\bar{P}_z \bar{z} = rk_0 + y^* + \bar{p}y \tag{15}$$

  where an upper–bar denotes the constant level of a variable and k_0 *are the net assets of the economy at time* 0*.*

- *The current account remains balanced throughout (i.e.* $\dot{k}_t = 0$ *for all* t*).*

Proof. See Mathematical Appendix.

Intuitively, since the price of aggregate consumption (P_z) is a geometric weighted average of the prices of the components of the basket, it is increasing in the price of the regional good: (p). Given that along a perfect foresight equilibrium path λ is constant, an increase in p will lead to a higher price for real consumption so that z will fall. Furthermore, having assumed an inter–temporal elasticity of aggregate consumption lower than one, an increase in P_z will result in higher aggregate consumption expenditures $(P_z z)$ of that good.

With respect to the two consumption sub–accounts, there are two effects. On the one hand, as we have seen, the inter–temporal effect dictates that real consumption decreases with p. On the other hand, the (intra-temporal) substitution effect implies that when the relative price of a good rises, the consumer substitutes away from it. In the case of regional goods, both effects reinforce each other so that regional goods consumption fall. In the case of tradable goods, both effects offset each other. In the particular case in which $\eta = \varepsilon$ both effects exactly cancel each other. Consequently, if $\eta < \varepsilon$, the intertemporal effect is relatively less important and the substitution effect dominates so that c^* is increasing in p.

With respect to the two consumption sub–accounts, there are two effects. On the one hand, as we have seen, the intertemporal effect dictates that real consumption decreases with p. On the other hand, the (intra-temporal) substitution effect implies that when the relative price of a good rises, the consumer substitutes away from it. In the case of regional goods consumption (c), the two effects reinforce each other so that c falls. In the case of tradable goods consumption (c^*), they offset each other. In the particular case in which $\eta = \varepsilon$ both effects exactly cancel each other. Consequently, if $\eta < \varepsilon$, the intertemporal effect is relatively less important and the substitution effect dominates so that c^* is increasing in p.

The improvement of the overall trade balance (TB) is due to two effects. An increase in regional prices leads, to a positive terms of trade shock (since the regional good is exported). In addition, with constant prices, the fall in aggregate consumption leads to a fall in aggregate consumption. Both effects reinforce each other. With respect to the trade balance (tb^*) with the rest of the world, since production of tradables (y^*) is fixed and c^* rises with p, tb^* falls with p. Since the regional trade balance (tb) is the difference between TB and tb^* it must be increasing in p.

With respect to the special case in the proposition, the constancy of the endogenous variables follows trivially from the first part. To obtain the constant level of real consumption ($\bar{z}$), note that with a constant p aggregate consumption expenditures and GDP are constant at $\bar{z}\bar{P}_z$ and $y^* + \bar{p}y$ respectively. If the current account shows a surplus for some t (i.e. if the sum of the trade balance surplus and net income receipts is positive) it will grow without bound ever after at the rate of r, violating the transversality condition. On the other hand, if it shows a deficit for some t, it will decline without bound hence violating the intertemporal resource constraint.[5] Consequently, aggregate consumption expenditures in every period must equal to GDP plus net income receipts ($r\bar{k}$). In other words, the trade balance is identical to net income payments.

Permanent Increase in regional prices In this and the exercises that follow we will assume an initial situation in which the economy is traveling along a perfect foresight equilibrium path in which p is expected to be constant at $\bar{p}$ forever.

Assume, then, that at time 0 there is an unanticipated **permanent** increase in p from p_h to $\bar{p}$.

Differentiating (15),

$$\bar{P}_z d\bar{z} = y d\bar{p} - \bar{z}\frac{\partial \bar{P}_z}{\partial \bar{p}} d\bar{p}$$

The first term on the right hand side corresponds to the income effect (measured in units of traded goods) brought about by the increase in regional prices. The second term represents the increase in the cost of real consumption. Given the fact that $P_z z$ can be interpreted as an expenditure function, however, $\frac{\partial \bar{P}_z}{\partial \bar{p}}$ equals consumption of the regional good. Consequently,

$$\bar{P}_z d\bar{z} = (\bar{y} - \bar{c}) d\bar{p}.$$

[5] Or, equivalently, the Non–Ponzi game condition.

Intuitively, on the margin, the increase in the price of the regional good improves the income perceived by the domestic economy in terms of the traded good by $\bar{y}dp$ (the first term in the above expression). On the other hand, the increase in p increases the cost of the consumption basket in terms of traded goods by $\bar{c}dp$. If the country is a net exporter of the regional good, the first effect dominates, the "net income" of the consumer rises and the consumer can increase real consumption. In the parlance of international trade, the increase in the relative price of the exportable, leads to a positive terms of trade shock which improves its welfare.

Since the increase in the price of the regional good leads to an increase in income in terms of the tradable good, wealth (i.e. rk_0+y^*+py which is also measured in terms of the tradable good) increases so that aggregate consumption expenditures ($Z = P_z z$) increase. Tradable consumption (c^*) increases not only because wealth increases but because its relative price falls. In the case of regional goods (c), on the other hand, these two effects, offset each other (since its relative price increases). As will be made explicit when we perform the quantitative analysis in Section 3.1.3, however, when the country is a net exporter of the regional good, the first effect dominates as long as initial net external debt is not too large.

Inspection of equation (15) shows that along any perfect foresight equilibrium path with a constant p, the overall trade balance surplus (TB) must equal net income payments ($-rk_0$). Since rk_0 has not changed, TB does not change either. Since production of tradable goods is fixed, the increase in tradable consumption leads to a fall in the tradable goods balance (tb^*). The only way that the economy can accommodate the increase in tradable goods imports given that the overall trade balance has not changed, is through an increase in the regional trade balance (tb). Finally, from Proposition 3, neither the current account nor net external assets change.

Temporary increase in regional prices Consider now a temporary unanticipated increase in the price of the regional good such that wealth remains unchanged. Formally:

- The path of p is given by: $p_t = \begin{cases} p_0 & \text{for} \quad t < 0, \\ p_h > p_0 & \text{for} \quad 0 \leq t < T, \\ p_l & \text{for} \quad t \geq T \end{cases}$.
- Wealth is unchanged which implies:

$$\int_0^\infty [y^* + p_t y] \exp(-rt)dt = (y^* + \bar{p}y)/r \tag{16}$$

In what follows, we will denote the interval $[0, T)$ as period 1 (or the transition) and $[T, \infty)$ as period 2.

To solve for the path of the endogenous variables we need to determine first how p_l compares to p_h. Since we have assumed that $p_h > p_0$, the present value of production during the transition is higher under p_h that under p_0. This implies that during period 2, the present value of production must be lower under p_l that under p_0. Hence, $p_l < p_0 < p_h$.

Since the fall in p at time T is perfectly anticipated, from Proposition 3 we know that aggregate consumption expenditures must fall at T. This implies $z_1 P_{z1} > z_2 P_{z2}$ where

the subscripts 1 and 2 denote the respective periods. Moreover, since (by assumption) wealth has not changed, $z_1 P_{z1} > z_0 P_{z0} = rk_0 + y^* + py > z_2 P_{z2}$. This implies that we observe a boom in aggregate consumption expenditures at time 0 and a bust at time T. Since, by equation (8), tradable consumption is proportional to aggregate consumption expenditures, it exhibits the same behavior. Using Proposition (3) it is clear that both real consumption and consumption of the regional good will rise at T. It is not so clear what happens on impact and how their levels during period 2 (i.e. for $t \geq T$) compare to the their original levels at time T. Fortunately, one can show:

Proposition 4 *Given the path of regional prices assumed in this sub-section,*

- *When $\eta = 1$ (log utility), real consumption falls on impact. When $\eta \to 0$, real consumption jumps on impact (at time 0). The higher η, the less likely that real consumption will jump on impact.*
- *Consumption of regional goods falls on impact for any η lying in the unit interval.*
- *At time T, real consumption and consumption of regional goods both jump above their originals level for any intertemporal substitution lying in the unit interval.*

Proof. See Mathematical Appendix.

Intuitively, the larger η, the more distorted the path of real consumption. Consequently, the larger η, larger the increase in real consumption at time T and the more likely that real consumption during the transition will be smaller than its original level. In the case where $\eta = 1$ (log utility), aggregate consumption expenditures (Z) are independent of p. Consequently, since the price index increases at time 0 and falls at time T, real consumption ($z = Z/P_z$) must fall at $t = 0$ and increases at $t = T$. Consumption of regional goods falls at $t = 0$ due to the combined effect of the inter–temporal effect (the fall in z) and the intra–temporal effect (the increase in p). For an analogous reason it must be higher at $t = T$ than in the original steady state situation. In the case where $\eta = 0$ (i.e. perfect real consumption smoothing) along any perfect foresight equilibrium path, real consumption is independent of the price index (P_z).

We now study the effect on the external accounts. From Proposition (3) we know that the overall trade balance will worsen at time T. Consequently, it has to improve on impact lest the intertemporal budget constraint be violated.[6] Since tradable consumption jumps on impact, the R.O.W. trade balance worsens on impact and improves at time T. As a consequence the regional balance must improve on impact and worsen at time T. Finally, with respect to the current account, since the trade balance will improve on impact and net foreign assets are predetermined, at time 0,

$$\dot{k}_0 = r\bar{k} + TB_0 > r\bar{k} + \overline{TB} = 0.$$

Since the trade balance is unchanged for $t \in (0, T)$, this implies that the current account continues to improve during this interval. At time T, however, when the trade balance

[6] The present discounted value of the trade balance is equal to $-k_0$.

worsens, it will become nil otherwise k will grow or decline without bound at rate r, violating either the transversality or Non–Ponzi game condition. This implies that the initial improvement in the current account is smaller than the final deterioration.

This path for net external assets has an intuitive interpretation. The consumer knows that the increase in prices is only temporary. Consequently, in order to smooth consumption, the economy accumulates assets during the "boom" years that will enable him to obtain higher net income receipts when the boom ends. This asset accumulation can only be achieved by running a current account surplus during the boom years.

3.1.3 Numerical Examples

The objective of this section is to evaluate the demand-side vulnerability of the small economy to shocks originating in the large regional partner, as represented by permanent and temporary shocks to regional prices, p. For our purposes demand side vulnerability is defined in a very precise sense: a country is said to be more vulnerable to shocks originating in the large trade partner, the larger the required adjustment in aggregate consumption expenditures and the larger the required adjustment in the composition of the trade balance, for a shock of any given size.

To evaluate the vulnerability of the small economy we will assume specific forms for the utility functions in order to obtain closed form solutions for the endogenous variables under different parameter configurations and different unanticipated (at time $t = 0$) paths for regional prices. The section proceeds as follows. First we will characterize a benchmark, steady state situation and present the benchmark parameter configuration. Also, to avoid unnecessary repetitions in latter subsections, we will derive the closed form solution for real consumption (z) and collect the (already derived) closed form solutions for (almost all) the rest of the endogenous variables in our system. The objective of the rest of the section is to quantify the effects of regional price fluctuations and to identify the channels by which these fluctuations are transmitted throughout the economy.

Benchmark Case We will assume that the inter–temporal and intra–temporal utility functions are:

$$\begin{aligned} u(z) &= \frac{z^{1-\frac{1}{\eta}}}{1-\frac{1}{\eta}} \\ v(c, c^*) &= c^q \left(c^*\right)^{1-q} \end{aligned}$$

where q is the share of tradables goods consumption in aggregate consumption expenditures:

$$q \equiv \frac{c}{zP_z} \tag{17}$$

The first functional form implies a constant intra–temporal elasticiy of substitution of η and the second a constant inter–temporal elasticity of substitution of 1 (i.e. $\varepsilon = 1$)

Using these specific functional forms it can be shown that the path of real consumption

is given by:[7]

$$z_t = \frac{k_0 + \int_0^\infty (y^* + p_t y) e^{-rt} dt}{\int_0^\infty p_s^{(1-q)(1-\eta)} e^{-rs} ds} p_t^{(1-q)(1-\eta)}. \tag{18}$$

The rest of the endogenous variables are simple functions of z and p :

$$\begin{aligned}
P_z &= q^{-q}(1-q)^{q-1}p^{1-q}, && \text{(19a)}\\
Z &= P_z z, && \text{(19b)}\\
c^* &= qZ, && \text{(19c)}\\
c &= (1-q)Z/p, && \text{(19d)}\\
tb^w &= y^* - c^*, && \text{(19e)}\\
tb^r &= p(y-c), && \text{(19f)}\\
TB &= y^* - c^* + p(y-c), && \text{(19g)}\\
\dot{k}_t &= rk_t + TB_t. && \text{(19h)}
\end{aligned}$$

In the benchmark situation we will assume that the economy is travelling along a perfect foresight equilibrium path in which regional prices are anticipated to be constant forever at $\bar{p}$. In this case, by Proposition 3, benchmark aggregate consumption is given by equation (15):

$$\bar{z} = \frac{rk_0 + y^* + \bar{p}y}{\bar{P}}.$$

The benchmark parameter values we assume are given in Table 4.1. The values for q and Ψ were chosen in order to mimic the exposure to trade in regional goods as measured by the three Indicators of the previous chapter. The implied assumption is that the structure of production, as measured by Ψ, is similar to the structure of trade, i.e., if trade in regional goods represents 30% of total trade, the production of regional goods represents 30% of total output. Given Ψ, the value of q, follows directly from the assumption of the regional trade balance. For example, if $\Psi = q$, regional trade is balanced in the initial situation.

The interest rate was set equal to the prevailing world real interest rate. The intertemporal elasticity parameter is consistent with the estimates of Ostry and Reinhart (1992) and Reinhart and Vegh (1995). The estimates reported in Ostry and Reinhart (1992) for the intra–temporal elasticity parameter are consistent with the our assumption that this elasticity equals 1. Finally, we normalize the benchmark value of regional prices ($\bar{p}$) to be equal to 1.

Permanent decline in regional prices The first experiment we perform is an unanticipated (sudden) permanent decline in the price of regional goods from $\bar{p}$ to p_l (i.e. the same permanent experiment described qualitatively in Section 3.1.2). Consequently, using (15),

$$z_l P_{lh} = rk_0 + y^* + p_l y.$$

[7] See Talvi and Bevilaqua (forthcoming).

TABLE 3.1: BENCHMARK PARAMETERS

Description	Symbol	Value
Share of tradable goods in aggregate consumption expenditures	q	0.90
Share of tradable goods in output	Ψ_y	0.85
Real interest rate	r	0.03
Inter–temporal elasticity of substitution	η	0.5
Intra–temporal elasticity of substitution	–	1
Net external assets as percentage of output	w_0	0
Relative price of regional good	p	1
Duration of Temporary Shocks (in years)	T	3

In the first simulation we reduce p by 20%. This shock could be thought of as a real devaluation in Brazil or alternatively as a contraction in the demand of Brazilian imports, i.e., the small country's exports, due to a recession. Table 3.2 measures the impact of this shock on the endogenous variables of the model for alternative parameter configurations

The results in Table 3.2 indicate that permanent shocks to the price of regional goods have potentially large quantitative effects on aggregate consumption expenditures and on the composition of the trade balance. In the case in which $\Psi = q = 0.7$, aggregate consumption falls by 6% and although the overall trade balance remains in equilibrium, the required adjustment in the regional trade balance is 4.2% of GDP. Put differently, 20% decline in the price of regional goods implies that the smaller country should run a huge trade deficit vis a vis the larger trade partner. In a more realistic setting, this kind of quantitative adjustment in the regional balance in response to shocks in the large regional partner, will certainly produce strains within the trade agreement, inviting retaliatory trade measures.

To check for the sensitivity of our results we performed the same exercise for different parameter configurations. In the upper part of Table 3.2 we can see that the larger the share or regional goods in both production and consumption, the larger the required adjustment in aggregate consumption expenditures and in the composition of the trade balance for any given size of the shock. For example, when $\Psi = q = 0.5$ aggregate consumption expenditures fall by 10% in response to a permanent 20% reduction in the price of regional goods. Finally, if the small country is a net supplier of the regional good, i.e., $\Psi > q$, aggregate consumption expenditures still fall by the same amount as before but the required adjustment in the regional trade balance is larger than in the case in which $\Psi = q$. Furthermore since real consumption (z) declines by a larger amount than in the case in which $\Psi = q$, there is and adverse welfare impact which was absent in the case in which $\Psi = q$.

Temporary decline in regional prices Here we reexamine the "temporary" experiment of Section 3.1.2. We will first derive the closed form solutions for this case and then discuss the numerical results. Specifically, assume that the economy faces a temporary unanticipated increase in the price of the regional good such that intertemporal wealth is unchanged. Formally, this can be expressed as:

TABLE 3.2
SUDDEN PERMANENT DECLINE IN THE PRICE OF REGIONAL GOODS

STEADY STATE VALUES					
PANEL A: REGIONAL TRADE BALANCE EQUILIBRIUM					
Parameters		$\Psi = 0.95$	$\Psi = 0.85$	$\Psi = 0.70$	$\Psi = 0.50$
		$q = 0.95$	$q = 0.85$	$q = 0.70$	$q = 0.50$
Aggregate Consumption Expenditures[a]	Z	-1.0	-3.0	-6.0	-10.0
Overall Trade Balance[b]	TB	0.0	0.0	0.0	0.0
Regional Trade Balance[b]	tb	-0.45	-2.6	-4.2	-5.0
Current Account[b]	$\dot{k}$	0.0	0.0	0.0	0.0
Net Extermal Debt[b]	$-k$	0.0	0.0	0.0	0.0
PANEL B: REGIONAL TRADE BALANCE SURPLUS					
Parameters		$\Psi = 0.95$	$\Psi = 0.85$	$\Psi = 0.70$	$\Psi = 0.50$
		$q = 0.98$	$q = 0.88$	$q = 0.73$	$q = 0.53$
Aggregate Consumption Expenditures[a]	Z	-1.0	-3.0	-6.0	-10.0
Overall Trade Balance[b]	TB	0.0	0.0	0.0	0.0
Regional Trade Balance[b]	tb	-0.97	-2.64	-4.4	-5.3
Current Account[b]	$\dot{k}$	0.0	0.0	0.0	0.0
Net Extermal Debt[b]	$-k$	0.0	0.0	0.0	0.0

[a]Percentage change with respect to the initial level.[b]Change in percentage of GDP.

- The path of p is given by:

$$p_t = \begin{cases} p_0 & \text{for} \quad t < 0, \\ p_l < p_0 & \text{for} \quad 0 \leq t < T, \\ p_h & \text{for} \quad t \geq T \end{cases} . \tag{20}$$

- Wealth is unchanged:

$$\int_0^{\infty} [y^* + p_t y] \exp(-rt) dt = (y^* + \bar{p}y)/r$$

To determine the value of p_h, inserting (20) into the last equation yields:

$$p_h = (\bar{p} - p_l)e^{rT} + p_l$$

Substituting this last result into (18) we find that:

$$z_t = P_{zt}^{-\eta} \frac{r\bar{w} + y^* + \bar{p}y}{(1 - e^{-rT})P_L^{1-\eta} + e^{-rT}P_H^{1-\eta}}.$$

With respect to the current account, we know that for $t \in [0, T)$ it will be given by:

$$\dot{k}_t = rk_t + TB_1$$

where TB_1 is the (constant) trade balance during the transition. Since k is continuous (predetermined), the solution to this differential equation has the form:

$$k_t = \left(k_0 + \frac{TB_1}{r}\right) e^{rt} - \frac{TB_1}{r},$$

so that:

$$\dot{k}_t = (rk_0 + TB_1)e^{rt}.$$

for any $t \in [0, T)$. It will be balanced thereafter.

We are now in position to evaluate the quantitative importance of a temporary shock. The price of the regional good temporarily declines by 20% for a period of 3 years. This implies that after three years the price of regional goods will be permanently higher at 1,02 in order for wealth to remain constant at its initial level. Table 4.3 measures the impact of this shock on the endogenous variables of the model for alternative parameter configurations presents the paths of selected variables.

The results in Table 3.3 indicate that temporary shocks to the price of regional goods have potentially large quantitative effects on aggregate consumption expenditures, on the current account, on the trade balance and on the composition of the trade balance. In the case in which $\eta = 0.5$ and $\Psi = q = 0.7$, aggregate consumption expenditures fall by 3.3%, the current account deteriorates by 3% of GDP and the overall trade balance by 2.7% of GDP. Furthermore, the required change in the composition of the trade balance is temporary but large: the trade balance of the small country vis a vis its regional trade partner deteriorates by 5% of GDP. The intuition behind these results is the following: as

TABLE 3.3

SUDDEN TEMPORARY DECLINE IN THE PRICE OF REGIONAL GOODS

PANEL A: IMPACT EFFECTS FOR $\eta = 0.5$ AND $T = 3$

Parameters		$\Psi = 0.95$ $q = 0.95$	$\Psi = 0.85$ $q = 0.85$	$\Psi = 0.70$ $q = 0.70$	$\Psi = 0.50$ $q = 0.50$
Aggregate Consumption Expenditures[a]	Z	-0.6	-1.7	-3.3	-5.8
Overall Trade Balance[b]	TB	-0.45	-1.4	-2.7	-4.6
Regional Trade Balance[b]	tb	-1.0	-2.8	-5.0	-7.3
Current Account[c]	$\dot{k}$	-0.5	-1.5	-3.0	-5.0
Net Extermal Debt[c]	$-k$	-1.4	-4.3	-8.6	-14.5

PANEL B: IMPACT EFFECTS FOR $\eta = 0.9$ AND $T = 3$

Parameters		$\Psi = 0.95$ $q = 0.95$	$\Psi = 0.85$ $q = 0.85$	$\Psi = 0.70$ $q = 0.70$	$\Psi = 0.50$ $q = 0.50$
Aggregate Consumption Expenditures[a]	Z	-0.1	-0.3	-0.7	-1.1
Overall Trade Balance[b]	TB	-0.9	-2.7	-5.3	-8.9
Regional Trade Balance[b]	tb	-1.0	-3.0	-5.8	-9.5
Current Account[c]	$\dot{k}$	1.0	-2.9	-5.8	9.7
Net Extermal Debt[c]	$-k$	-2.8	-8.4	-16.8	-28.0

[a]Percentage change with respect to the initial level.[b]Change in percentage of GDP.
[c]Change in percent of GDP (end of transition).

a result of the decline in p, which can be thought of as a temporary deterioration of the terms of trade, the consumer runs a current account deficit and accumulates debt that he will repay in the years in which the price of regional goods is higher, in order to smooth real consumption (z). In addition, due to the temporary decline in the price of regional goods, the consumer substitutes consumption away from regional goods and in favor of world goods, changing the composition of the trade balance.

To check for the sensitivity of our results we performed the same exercise for different parameter configurations. For any given value of η, the larger the share of regional goods in both production and consumption the larger the required adjustment in aggregate consumption expenditures, the current account, the trade account and the regional trade balance for any given size of the shock. For example, when $\Psi = q = 0.5$ aggregate consumption expenditures fall by 5.8%, the current account deteriorates by 5% of GDP and trade account by 4.6% of GDP in response to a temporary 20% reduction in the price of regional goods. Finally, when $\eta = 0.9$, aggregate consumption expenditures still fall but by less than in the case when $\eta = 0.5$, while the current account and the trade account deteriorate by more, for any value of $\Psi = q$. The reason is that a higher η produces a larger change in real consumption (z) for any given change in the price of the consumption basket, P_z. Since aggregate consumption expenditures declines by a smaller amount in response to an adverse terms of trade shock, the current account and the trade balance deficit must deteriorate by a larger amount.

3.2 Supply Side Effects

In this section we extend the model to allow for production and thus study the supply side effects of changes in the price of regional goods.

3.2.1 Model

Consumers There are almost no changes with respect to the consumer. The only difference is that instead of owning the rights to the endowments of both goods, the consumer now owns the rights to the firms. This implies that the flow constraint now reads:

$$\dot{k}_t = rk_t + \Omega_t^f - c_t^* - p_t c_t \tag{21}$$

where Ω_t^f are the dividends payed by the firms.

Similarly, the intertemporal budget constraint is:

$$\int_0^\infty (c_t^* + p_t c_t) \exp(-rt)dt = k_0 + \int_0^\infty \Omega_t^f \exp(-rt)dt \tag{22}$$

which says that the present discounted value of consumption expenditures equals initial financial wealth plus the present discounted value of dividends (i.e. the value of the firm).

The problem faced by the consumer is to maximize lifetime utility – given by equations (1), (2) and (3) – subject to (22). It is easy to see that none of the first order conditions for the consumer in section 3.1.1 are modified. In particular, (19a) – (19d) still continue to hold in the new equilibrium.

Firms and Production The representative firm in our economy owns the factors of production and maximizes the value of sales which he rebates to consumers.[8]

In agreement with the rest of the model we will assume that the firms produce both the tradable and non-tradable goods (y^* and y respectively). We will assume that there are two sector specific factors, capital in the regional sector (K^*) and capital in the regional sector (K), and one mobile factor, labor. In equilibrium, the latter will be endogenously allocated to the tradable sector in the amount (L^*) and to the regional sector in the amount (L). Consequently, the firm solves:

$$g(p;\bar{K}^*,\bar{K},\bar{L}) = \max_{L^*,K^*,L,K} F^*(K^*,L^*) + pF(K,L) \tag{23}$$

subject to:

$$\begin{aligned} y^* &= F^*(K^*,L^*) && (24)\\ y &= F(K,L) && (25)\\ K^* &\leq \bar{K}^* && (26)\\ K &\leq \bar{K} && (27)\\ L^*+L &\leq \bar{L} && (28) \end{aligned}$$

where an upper-bar over a variable represents the total endowment of the corresponding factor.

In Section 3.1, g was, by definition, equal to $y^* + py$ and was called gross domestic product in terms of tradable goods where y^* and y were fixed. The only difference here is that the firm is now free to allocate resources to the production of tradables and regional goods. Consequently, we need not modify this definition. For this reason we will call g the GDP function.

The Lagrangian can be written as:

$$\begin{aligned} \mathcal{L}(p;\bar{K}^*,\bar{K},\bar{L}) = \max_{L^*,K^*,L,K} & F^*(K^*,L^*) + pF(K,L) + w(\bar{L}-L^*-L) \\ & +\rho^*(\bar{K}^*-K^*) + \rho(\bar{K}-K) \end{aligned}$$

where w, ρ^* and ρ are the lagrange multipliers on the resource constraints and can be interpreted, respectively, as the wage rate, the rate of return on capital employed on the tradable sector and the rate of return on capital employed in the regional sector.

The first order conditions can be expressed, after some manipulation, as:

$$MP_L^* = pMP_L \tag{29a}$$

[8] This contrasts with the usual assumptions whereby the consumer owns both the factors of production which he supplies inelastically and the firm maximizes profits. However, it can be shown these two dual problems yield the same optimized values for input demands and final product outputs. We choose to let firms own the factors of production because in this approach, called the dual approach to trade theory, the maximized value of sales has several important features that will be useful when performing comparative dynamics. Furthermore, it is quite standard in the trade literature. See, for example, Dixit and Norman (1980) and Wong (1997).

$$w = MP_L \tag{29b}$$
$$\rho = MP_K \tag{29c}$$
$$\rho^* = MP^*_{K^*} \tag{29d}$$

where MP denotes marginal products, and the subscripts denote the input with respect to which the marginal product is taken.

Equilibrium The equilibrium conditions of the basic model continue to hold. Now, in addition to the condition that markets for inputs clear – i.e. equations (26), (27) and (28) – the only difference is that the aggregate flow and resource constraint are:

$$\dot{k}_t = rk_t + g(p_t) - P_{zt}z_t \tag{30}$$
$$\int_0^\infty P_{zt}z_t \exp(-rt)dt = k_0 + \int_0^\infty g(p_t)\exp(-rt)dt \tag{31}$$

3.2.2 Qualitative Analysis

A convenient feature of this model is that the supply side variables are only functions of the relative price of regional goods. Consequently, even without knowing how the consumer's problem is modified, we can derive the supply side effects of a change in relative prices which are gathered in the following Proposition.

Proposition 5 *Suppose that regional prices increase by dp. Then,*

- *y and L increase, y* and L* fall.*
- $d\rho/\rho > dp/p > dw/w > 0$,
- $d\rho^*/\rho^* < 0$.

Proof. This is a standard proof for the specific factors model. See, for example, James R. Markusen and Maskus (1995) pp. 127–141.

Intuitively, the increase in p increases the demand for labor in the regional sector which drives up wages and draws labor towards the regional sector so that production of the regional good increases at the expense of production in the tradable sector. At the same time the increase in p increases the marginal product of capital in the regional sector driving up its rental rate. Finally, the decrease in the supply of labor to the tradable sector diminishes the marginal product of capital in that sector and the corresponding real rate of return falls.

With respect to the consumer's problem, note that his optimal choices depend only on p and his wealth (i.e. his initial bond holdings plus the present discounted value of profits). This implies that the existence of a non–trivial supply–side structure only complicates the problem insofar as it brings about changes in the present value of GDP. Fortunately, however, it is easy to show that Proposition 3 still holds. Moreover, since the qualitative and quantitative exercises performed in the previous section only relied on this Proposition

and the inter–temporal budget balance to derive the path of the endogenous variables, it is also easy to prove that the respective qualitative responses are not altered with the introduction of production. The only difference is that when p changes not only does the valuation of endowments change but also the amount of production in the regional sector. For this reason, for the same change in p, GDP will change more in a production economy than in an endowment one.

3.2.3 Numerical Examples

The objective of this section is to evaluate the supply-side vulnerability of the small economy to shocks orginating in the large regional partner, as represented by permanent and temporary shocks to regional prices, p. For our purposes supply side vulnerability is defined in a very precise sense: a country is said to be more vulnerable to shocks originating in the large trade partner, the larger the required adjustment of output, employment and rates of return on capital in the regional goods sector and the larger the required adjustment of real wages for a shock of any given size.

This sub–section proceeds as follows. First we find the closed form solutions and establish the benchmark parameters. Next, we the discuss the supply side effects of changes in p. Finally, we discuss how the demand side results of Section 3.1 are modified by the existence of production.

Closed Form Solutions For our numerical simulations we will assume the following Cobb-Douglas technology:

$$F^*(K^*, L^*) = A^* (L^*)^{\alpha} (K^*)^{1-\alpha} \text{ and } F(K^*, L^*) = A (L)^{\beta} (K)^{1-\beta} \tag{32}$$

where A^*, α are total factor productivity and the labor share in the tradable sector and A and β are total factor productivity and labor shares in the regional sectors.

Given the production technology we have assumed, the conditions that wages are equal in both sectors (29a) coupled with full employment of labor implies:

$$\alpha A^* \left(\bar{L} - L\right)^{\alpha-1} (K^*)^{1-\alpha} = \beta p A (L)^{\beta-1} (K)^{1-\beta}. \tag{33}$$

which, after solving for L we can write $L^* = L^*(\theta)$ and $L = L(\theta)$ where θ is a vector of exogenous parameters ($\alpha, \beta, A^*, A, p, \bar{L}, K^*$ and K). Given this optimal labor allocation, the functional assumed in (32), the definition of g and (29b) – (29d) we obtain:

$$\begin{aligned}
y^*(p) &= A^* (K^*)^{1-\alpha} [L(\theta)]^{\alpha} && (34a)\\
y(p) &= A K^{1-\beta} [L(\theta)]^{\beta} && (34b)\\
g(p) &= y^* + py = A^* (K^*)^{1-\alpha} [L^*(\theta)]^{\alpha} + pA K^{1-\beta} [L(\theta)]^{\beta} && (34c)\\
w &= (1-\alpha) A^* (K^*)^{1-\alpha} [L^*(\theta)]^{\alpha-1} && (34d)\\
\rho^* &= \alpha A^* (K^*)^{-\alpha} [L^*(\theta)]^{\alpha} && (34e)\\
\rho &= p\beta A (K)^{-\beta} [L(\theta)]^{\beta} && (34f)
\end{aligned}$$

TABLE 3.4
BENCHMARK PRODUCTIVITY PARAMETERS

Description	Symbol	Value
Share of Labor in tradable good production	α	.4
Share of Labor in regional good production	β	.4
Gross Domestic Product	g	1
Contribution of Tradable Production to GDP	Ψ	.85
Rate of return in tradable sector	ρ^*	0.03
Rate of return in regional sector	ρ	1

In addition, since we will want to match the share of tradables and regional goods in total GDP one can also calculate:

$$\Psi \equiv \frac{y^*(p)}{g(p)} = \frac{A^* (K^*)^{1-\alpha} [L^*(\theta)]^{\alpha}}{A^* (K^*)^{1-\alpha} [L^*(\theta)]^{\alpha} + pAK^{1-\beta} [L(\theta)]^{\beta}}. \tag{35}$$

In the case where $\alpha = \beta$, (33) can be solved explicitly to yield:

$$L = \bar{L} \left[1 + (pA/A^*)^{\frac{1}{\alpha-1}} (K^*/K) \right]^{-1} \tag{36}$$

otherwise, L^* and L must be found numerically.

Benchmark Case The parameters that we will employ for our simulations are presented in Table 4.4. Labor shares in the two sectors were both set equal to 40% To be consistent with the endowment model, we will assume GDP is still equal to 1 and the share of tradable production in GDP will vary from 0.95 to 0.50. Since we want our initial situation to be consistent with a long run equilibrium we will assume that the returns to capital are equal to the real interest rate which we assumed was equal to 3%. The rest of the parameters ($\bar{L}$, K^*, K, A^* and A) were chosen to be consistent with the above assumptions. [13]

Quantitative Impact of Changes in p In this subsection we quantify the supply side effects of changes in relative prices. In the our example we reduce p by 20%. This shock could be thought of as a real devaluation in Brazil or alternatively as a contraction in the demand of Brazilian imports, i.e., the small country's exports, due to a recession in Brazil. Table 3.5 measures the impact of this shock on the endogenous variables of the model for alternative parameter configurations.

The results in Table 3.5 indicate that permanent shocks to the price of regional goods have potentially large quantitative effects on output, employment and the real return on capital in the regional goods sector and the real wages . In the case in which $\Psi = 0.7$, output in the regional goods sector declines 10.4% and employment in the regional goods

[13] The exact procedure by which these parameters were calculated is described in Talvi and Bevilaqua (forthcoming).

TABLE 3.5
SUPPLY SIDE EFFECTS OF A DECLINE
IN THE RELATIVE PRICE OF REGIONAL GOODS

		Ψ			
		0.95	0.85	0.7	0.5
Output of Regional Goods[a]	y	-13.2	-12.1	-10.4	-7.8
Employment in Regional Goods Sector[a]	L	-30.0	-27.7	-24.0	-18.4
Potential Change in Unemployment[b]	$L + L^*$	1.5	4.2	7.2	9.2
Wages[a]	w	-0.9	-2.8	-5.7	-9.6
Return to capital in Regional Goods Sector[b]	ρ	-0.9	-0.9	-0.8	-0.8
Real Exchange Rate with respect to[a]					
Rest of the world[c]	$1/w$	1.0	2.9	6.0	10.7
Regional trade partners[d]	p/w	-19.2	-17.7	-15.2	-11.5

[a]Percentage change with respect to the initial level.
[b]Absolute change in percentage points with respect to initial level.
[c]The real exchange rate with respect to the rest of the world is defined as the price of world goods in terms of wages.
[c]The real exchange rate with respect to the regional partner is defined as the price of regional goods in terms of wages.

sector declines by 24%. In equilibrium, the absorption by the tradable goods sector of the workers laid out from the regional goods sector requires a fall in real wages of 5.7%. In a more realistic setting where frictions are present, e.g., nominal wage rigidities or adjustment costs to shift workers from one sector to the other, unemployment could increase on impact as much as 7 percentage points if laid out workers cannot be immediately absorbed by the other sector in the economy. Finally, the adverse impact on the return on capital is close to 1% per year. This change implies – for an initial return on capital of 3%– a decline in the value the assets of the firms involved in the production of regional goods of 30%.

To check for the sensitivity of our results we performed the same exercise for different parameter configurations. The larger the share of regional goods in the productive structure of the small country, the larger the required reduction in real wages and the larger the potential impact on unemployment. For example, when $\Psi = 0.5$ real wages must fall in equilibrium by 9.5% and unemployment can potentially rise up to 9 percentage points. However, the impact on the return to capital invested in the regional goods sector appears to be insensitive to the share of regional goods in total output, only depending on the size of the reduction in p.

Finally, it is interesting to highlight the direction and size of the realignment in the equilibrium real exchange rate vis a vis the rest of the world and vis a vis the large regional partner in response to a 20 percent decline in the price of regional goods. The bilateral real exchange rate with respect to the regional partner appreciates, i.e., the price of regional goods declines in terms of wages, but by less than the full amount of the reduction in p, since labor costs also decline as a result of the shock. The real exchange rate vis a vis the

rest of the world depreciates, i.e., the price of world goods increase in terms of wages, due to the decline in labor costs. As a result, the competitiveness of the tradable goods sector improves while that of the regional goods sector deteriorates when regional prices decline. The equilibrium change in the real exchange rate with respect to the rest of the world is larger the larger the share of regional goods in total production and naturally, the larger the size of the shock to the price of regional goods.

Intertemporal Effects We mentioned earlier than when production is constant a change in p will change GDP relatively more than in the endowment economy because firms will reallocate production in response to relative price changes. We will show that the quantitative results of Section 3.1 are not modified substantially.

Suppose for example, that the relative price of the regional good declines permanently from 1 to 0.8. In the endowment economy of Section 3.1, when the share of tradable production in GDP was (initially) equal to 85%, GDP declined by 3.0%. With variable production GDP declines by 2.8%. If we increase the initial share of tradable production in GDP to 70%, the respective declines (with fixed and variable production) would have been 6.0% and 5.7% respectively. The differences are therefore not significant in terms of their effects on wealth, and therefore the introduction of production does not modify the quantitative demand side results of Section 3.1 in any meaningful way.

3.3 Summary of Main Findings

For our purposes we have defined the vulnerability of the smaller regional partners in Mercosur vis a vis larger partners, i.e., Argentina vis a vis Brazil and Paraguay and Uruguay vis a vis Argentina and Brazil, as follows: a country is said to be more vulnerable to shocks in the larger regional trade partners i) the larger the required adjustment in output, employment and the rate of return on capital in the regional goods sector, ii) the larger the adjustment in real wages, iii)the larger the required adjustment in aggregate demand and the current account and iv) the larger the required adjustment in the composition of the trade balance (regional balance vis a vis the balance with the rest of the world), for any given shock to the price of regional goods.

With this definition in mind we now proceed to summarize the main findings of this chapter:

i) Shocks to the price of regional goods –whether permanent or temporary– have potentially large quantitative effects on output, employment and the return to capital in the regional goods sector, real wages, aggregate demand, the current account, the trade balance and the composition of the trade balance. The main channels of transmission of these shocks are wealth effects, intertemporal substitution effects and intra-temporal substitution effects in production and consumption. For example, for a reasonable configuration of parameters our model predicts that a permanent decline of 20% in the price of regional goods generates a reduction of output in the regional goods sector of 10.4%, a decline of 30% in the rate of return on capital and the value of the assets invested in the regional goods sector, a decline in real wages of 5.7% and a potential increase in unemployment of 7 pecentage points. Furthermore, aggregate consumption expenditures decline by 6% and

trade balance vis a vis the regional partner deteriorates by 4 percentage points of GDP.

ii) The larger the share of regional goods in total production the larger the impact of any given shock to the price of regional goods on the supply side (for any given share of regional goods in consumption).

iii) The larger the share of regional goods in total consumption the larger the impact of any given shock to the price of regional goods on the demand side (for any given share of regional goods in production).

iv) The larger the net export position in regional goods, the larger the impact of any given shock to the price of regional goods.

v) The vulnerability –as measured by the required changes in supply and demand side variables– of smaller economies to shocks in the large regional partner does not only depend on the extent of **net trade** in regional goods. *It depends* **independently** *on the share of regional goods in total output, the share of regional goods in total consumption as well as the net trade position in regional goods,* i.e., whether the country is a net exporter or importer of regional goods.

4 Conclusion

In the previous section we have shown that sharp and discontinuous changes in Brazil's real exchange rate –as represented in our model by changes the price of regional goods– have potentially large macroeconomic effects on the smaller trade partners of Mercosur, Argentina, Paraguay and Uruguay. A large change in the price of regional goods results in correspondingly large movements in output, employment, sectoral allocation of productive resources, real wages, aggregate spending, the current account, the trade balance and the regional composition of the trade balance. We have argued that it is not total trade with Brazil that matters in order to assess the degree of exposure to changes in Brazil's real exchange rate, but trade in regional goods, i.e., goods or services which are tradable vis a vis Brazil but largely non-tradable with respect to the rest of the world.

Let us recall that for our purposes the vulnerability of each of the smaller Mercosur partners with respect to changes in Brazil's real exchange rate, is defined in a very precise sense: a country is said to be more vulnerable to shocks originating in Brazil i) the larger the required adjustment of output, employment and rates of return on capital in the regional goods sector, ii) the larger the required adjustment in equilibrium real wages, iii) the larger the required adjustment in aggregate consumption and iv) the larger the required adjustment in the composition of the trade balance, for a shock of any given size.

Since the size of the required adjustments to a real devaluation in Brazil, depend on both the size of the real devaluation and the extent of trade in regional goods the two main policy implications of our analysis are the following:

1. **Smaller countries should seek monetary arrangements for Mercosur that reduce the likelihood of sharp and discontinuous changes in the nominal (and real) bilateral exchange rates with respect to Brazil.**

2. **Smaller countries should seek trade arrangements for Mercosur that reduce their trade (and production) exposure in regional goods, i.e., goods**

which are tradable with Brazil but largely non-tradable with respect to the rest of the world.

One way in which the likelihood of sharp and discontinuous changes in Brazil's real bilateral exchange rate with respect to its Mercosur partners could be reduced, is by setting up monetary arrangements that would limit Brazil's ability to change, in a discretionary manner, the nominal (and real) exchange rate. An extreme form of such arrangement would be the establishment of a single currency for Mercosur (perhaps even convertible to the U.S. dollar).

Two ways of reducing exposure to trade in regional goods are to eliminate special regimes (such as those that prevail for automobiles between Argentina and Brazil) and to eliminate the selective imposition, on the part of Brazil, of a higher external tariff for certain categories of goods. Special regimes tend to create artificial trade flows within the region. Selective imposition of higher external tariffs create an umbrella of protection and price differentials vis a vis the rest of the world for certain categories of goods (e.g. diary products). The smaller trade partners, who sell at higher prices in Brazil, have as a consequence very low incentives to become competitive with respect to the rest of the world, therefore transforming an otherwise world good into a regional good. Although special regimes and the selective imposition of differential external tariffs may benefit specific sectors the are socially sub-optimal for two reasons: i) they induce the traditional and well known allocative inefficiencies and ii) by "regionalizing" certain categories of goods and services they increase the macroeconomic vulnerability of the economy as a whole to shocks originating in Brazil.

In this paper we have investigated the trade channel of shock transmission in Mercosur. The impact of a sharp and discontinuous change in Brazil's real exchange rate on its Mercosur partners is not limited, however to trade channels. A real devaluation in Brazil can also change the risk assessment of the smaller trade partners. The change in the risk assessment will most likely translate into an increase in the spread over U.S. Treasuries those countries pay in the international credit markets and a reduction of the availability of international financing that can have potentially large macroeconomic effects. Thus, the financial channel through which shocks in Brazil can affect its smaller trade partners cannot be ignored. Consequently, a promising line of research is to model this financial channel in order to gauge the quantitative effects on the macro–economic variables studied in this paper. We believe that the financial channel of transmission of a real devaluation in Brazil, can have potentially larger quantitative effects on aggregate demand than the trade channel.

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A Appendices to Section 2

A.1 Methodology of Assignation of Services

The methodology used for the assignation of the regional exports of services of each member country in the Mercosur was oriented basically by three types of criteria:

i) the structure of the trade in goods in each country used mainly in categories of air and other (terrestrial) freight as well as other services,

ii) the structure of migration and tourism flows that oriented the assignation for travel and terrestrial transportation of passengers, and,

iii) considerations based on reasonable assumptions such as the participation of the airline companies of each country in the air transportation of passengers and considerations that responded to national particularities such as sea transportation of passengers and freight.

The assignation for each country shares of the different categories included the data for trade in services can be summarized by:

1. Transportation:

For *freights*, the assignation for each of the countries in Mercosur (whenever it was possible) was determined according to the breakdown in transportation: sea, air and others. In this category, due to the lack of information and the absence of specific country considerations, the assignation was defined by the structure of the regional exports.

For *passenger transportation*, the methodology uses, again, the breakdown by transportation means. For air transportation, the relative importance of the air companies in each country (30% for Brazil and Argentina, 5% for Paraguay and Uruguay and 30% for the rest of the world) was considered. For passenger sea transportation, the assignation responded to specific country considerations. The exports of services of passenger terrestrial transportation (others) were estimated considering the structure of the residence or nationality of the travel flow in each of the member countries.

For *other transportation services*, which include port and airport rights and the air space utilization, each country's participation was allocated according to the allocation resulting from the aggregation of freight and passenger transportation.

2. Travel. For this category, each country's participation was estimated with data from the migration agencies which collected information on tourists' nationality.

3. Other services. Due to the fact that most of the services included under this category were associated to international trade, the structure of exports in goods was used for the assignation of country shares in this category.

A.2 Commodities Excluded from Intraregional Trade

TABLE A.1: COMMODITIES EXCLUDED

Code	Goods
2	Meat and edible offal
3	Fish and crustacean, mollusc & other aquatic invertebrate
8	Edible fruit and nuts, peel of citrus fruit or mellons
9	Coffee, tea, malt and spices
10	Cereals
12	Oil Seeds, oleagi fruits, miscellaneous grain, seed, fruit, etc.,
26	Ores, slag and ash
27	Mineral fuels, oils and product of their distillation, etc.,
51	Wool, fine/coarse animal hair, horsehair yarn & fabric
52	Cotton
74	Copper and articles thereof
75	Nickel and articles thereof
76	Aluminium and articles thereof
78	Lead and articles thereof
79	Zinc and articles thereof
80	Tin and articles thereof

B Mathematical Appendix

B.1 Proof of Proposition 1

Proof. Given homothetic utility, it is well known that the expenditure function is multiplicatively separable in prices and utility which in this case corresponds to real consumption z. In the specific case where utility is homogeneous of degree one, it is also well known that the expenditure function is linear in utility. Consequently, we can write: $Z = P(p)z$. In addition, using well known properties of the expenditures function it is easy to prove the rest of the proposition. ■

B.2 Proof of Proposition 2

We first prove the general case (for an arbitrary path of p) and then the particular case were p is constant.

B.2.1 General case

Log–differentiating the price level with respect to p, we find:

$$\hat{P} = \frac{\partial P(p)}{\partial p}\frac{dp}{P} = \frac{c}{z}\frac{dp}{P} = (1-q)\hat{p} \tag{37}$$

where the second equality follows (8) and the third from the definition of q, the share of tradable goods in aggregate concumption expenditures:

$$q \equiv \frac{c^*}{Pz}$$

From (37) it is clear that the price index is increasing in the relative price of regional goods.

Log–differentiating (11), using the fact that λ is constant along a perfect foresight equilibrium path and the definition of intra–temporal elasticity of substitution (eq. 13), we can see that:

$$\hat{P} = -\frac{zu''(z)}{u'(z)}\hat{z} = -\frac{1}{\eta(z)}\hat{z} \tag{38}$$

From the definition of Z, given by equation (6), we have:

$$\hat{Z} = \hat{P} + \hat{z} = \hat{P}\left[1 - \eta(z)\right] \tag{39}$$

Since $\eta(z) < 1$, aggregate consumption expenditures are increasing in P and, hence, increasing in p.

Log–differentiating the equality that $Z = c^* + pc$ it follows that:

$$\hat{Z} = q\hat{c}^* + (1-q)\left(\hat{c} + \hat{p}\right) = q\hat{c}^* + (1-q)\hat{c} + \hat{P}$$

where the second equality follows from (37). Finally, using the first equality in (39) we obtain:

$$\hat{z} = q\hat{c}^* + (1-q)\hat{c} \tag{40}$$

Combining (38) and (40) we find:

$$-\eta(z)(1-q)\hat{p} = q\hat{c}^* + (1-q)\hat{c}$$

Finally, using the definition of intra–temporal elasticity of substitution given by eq. (14), we obtain:

$$\begin{aligned} \hat{c}^* &= (1-q)\left[\varepsilon - \eta\right]\hat{p} \\ \hat{c} &= -\left[q\varepsilon + (1-q)\eta\right]\hat{p} \end{aligned}$$

It is clear from the first expression, that tradable consumption will move in the same direction as the relative price of regional goods if the intra–temporal elasticity of substitution exceeds the inter–temporal elasticity of substitution, an assumption we maintain throughout the paper. In addition, from the second equation it follows that the regional consumption always moves in opposite direction to the price of regional goods.

B.2.2 Special case

If p is constant, so is P_z. In addition, since λ is constant along a perfect foresight equilibrium path, z is constant. Since all the endogenous variables in this model are functions of p and z, they are also constant.

To obtain the constant level of z, say $\bar{z}$, replace the latter in the intertemporal resource constraint (10) so that:

$$\int_0^\infty \bar{P}_z \bar{z} \exp(-rt)dt = k_0 + \int_0^\infty \left[y^* + \bar{p}y\right]\exp(-rt)dt$$

and, consequently,

$$\bar{P}_z \bar{z} = rk_0 + y^* + \bar{p}y.$$

■

B.3 Proof of Proposition 3

We first show the effects on z and then on c.

B.3.1 Effect on z

It can be shown that for simple temporary shock being considered,

$$z_t = P_{zt}^{-\eta} \frac{y^* + p_0 y}{(1-e^{-rT})P_{zh}^{1-\eta} + e^{-rT}P_{zl}^{1-\eta}}.$$

1. Consider first the effect on impact:

$$z_h = \frac{y^* + p_0 y}{(1 - e^{-rT}) + e^{-rT}\left(\frac{P_{zl}}{P_{zh}}\right)^{1-\eta}} \frac{1}{P_{zh}}. \tag{41}$$

so that using (15),

$$\frac{z_h}{\bar{z}} = \frac{1}{(1 - e^{-rT}) + e^{-rT}\left(\frac{P_{zl}}{P_{zh}}\right)^{1-\eta}} \frac{\bar{P}_z}{P_{zh}}$$

This expression is decreasing in η since

$$\frac{\partial \left(\frac{P_{zl}}{P_{zh}}\right)^{1-\eta}}{\partial \eta} = -\ln(\frac{P_{zl}}{P_{zh}})e^{1-\eta} > 0 \Rightarrow \frac{\partial \frac{z_h}{\bar{z}}}{\partial \eta} < 0.$$

(a) When $\eta = 1$, we have:

$$\frac{z_h}{\bar{z}} = \frac{\bar{P}_z}{P_{zh}}. < 1$$

(b) When $\eta = 0$, we have:

$$\frac{z_h}{\bar{z}} = \frac{\bar{P}/P_{zh}}{(1 - e^{-rT}) + e^{-rT}\left(\frac{P_{zl}}{P_{zh}}\right)} > 1$$

if only if

$$\bar{P} > P_{zh}(1 - e^{-rT}) + e^{-rT}P_{zl} \Leftrightarrow \bar{p}^{1-q} > p_h^{1-q}(1 - e^{-rT}) + e^{-rT}p_l^{1-q}$$

which is the case since $\bar{p} = (1 - e^{-rT})p_h + e^{-rT}p_l$ is a convex combination of p_h and p_l and x^{1-q} is a concave function.

2. Similarly, one can show that:

$$\frac{z_l}{\bar{z}} = \frac{1}{(1 - e^{-rT})\left(\frac{P_{zh}}{P_{zl}}\right)^{1-\eta} + e^{-rT}} \frac{\bar{P}_z}{P_{zl}}$$

Arguing as in the previous case, we find that $z_l/\bar{z}$ is increasing on η. Consequently, consider the case where $\eta = 0$. In that case,

$$\frac{z_l}{\bar{z}} = \frac{1}{(1 - e^{-rT})\left(\frac{P_{zh}}{P_{zl}}\right) + e^{-rT}} \frac{\bar{P}_z}{P_{zl}} > 1$$

only if:

$$\bar{P}_z > (1 - e^{-rT})P_{zh} + e^{-rT}P_{zl}$$

which is the case since P is a concave function of p.

Consequently, for any η real consumption in the second period is above the original steady state level.

B.3.2 Effect on c

- Since $\frac{c_h}{\bar{c}} = \frac{z_h P_{zh}/p_h}{\bar{z}\bar{P}_z/\bar{p}}$, using (41),

$$\frac{c_h}{\bar{c}} = \frac{1}{(1-e^{-rT}) + e^{-rT}\left(\frac{P_{zl}}{P_{zh}}\right)^{1-\eta}} \frac{\bar{p}}{p_h}$$

and, for we have seen that the first fraction on the right hand side is increasing in η, positive, $c_h/\bar{c}$ is decreasing on η. Furthermore, when $\eta = 0$,

$$\frac{c_h}{\bar{c}} = \frac{z_h P_{zh}/p_h}{\bar{z}\bar{P}_z/\bar{p}} = \frac{z_h}{\bar{z}} = \frac{\bar{p}}{p_h} < 1$$

Consequently, $c_h/\bar{c} < 1$ for all η.

Similarly,

$$\frac{c_l}{\bar{c}} = \frac{1}{(1-e^{-rT})\left(\frac{P_{zh}}{P_{zl}}\right)^{1-\eta} + e^{-rT}} \frac{\bar{p}}{p_l}$$

which is decreasing in η. When $\eta = 1$ the above expression reduces to:

$$\frac{c_l}{\bar{c}} = \frac{\bar{p}}{p_l} > 1$$

Consequently, $c_l/\bar{c} > 1$ for any η. ■