Looking for virtuous structural change in Uruguay: Linkages of medium and high technological sectors

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Abstract

Structural change has been suggested as a tool for reaching equity. To this end, increasing the export shares of more knowledge-intensive sectors has been put forward as a policy. However, structural change through these sectors induces genuine welfare improvements only if they are strongly linked with the rest of the economy (in terms of output, value added, and labor) while also their total environmental impact should be consideredand the environment). This study analyzes whether the development of medium and high tech (MHT) sectors can lead to a virtuous structural change in Uruguay.

We consider three areas of analysis: (i) the characterization of direct and indirect linkages of MHT sectors, (ii) the domestic value added content of Uruguayan MHT exports, and (iii) the total impact of MHT sectors in terms of greenhouse gas emissions. The results show that a final demand increase for MHT products affects very few sectors in the rest of the economy, MHT sectors are linked upstream mainly to transport activities. From a downstream perspective, however, is a significant share of the MHT outputs employed as input by the rest of the economy, suggesting the possibility of a virtuous development through MHT's downstream linkages. Also, MHT sectors depend heavily on imported inputs. This means that any value chain in which MHT sectors participate generates a considerable amount of foreign value added and jobs. As a consequence, Uruguay is sensitive to variations in import prices, which may affect its competitiveness and the effects of exchange rate policies.

1. Motivation

Structuralism, a line of thinking historically developed by the Economic Commission for Latin America and the Caribbean (ECLAC), has taken a new impulse during the last two decades (ECLAC, 2012). The latest proposals recover the of *neo-structuralism* emerged in the early 90´s considering the structural change as a tool for reaching equity, focusing mainly in two issues: i) to increase the share of more knowledge-intensive sectors in both, total production and trade, and ii) to diversify production, expanding to more dynamic sectors in terms of internal and external demand. By attending this demand with internal supply would allow to avoid balance of payment pressures. Also, competitiveness is pure if it emerges from the introduction of new technologies with a constant and increasing trend, and human capital and equity are enhanced. On the other hand, competitiveness is understood as spurious if it is supported by exchange rate, wage, and natural resources advantages (ECLAC, 1990).

Productive structures with higher technological intensities offer better prospects for future growth because their products tend to grow faster in trade, being highly income elastic, creating new demand, and substituting older products faster (Lall, 2000). Development can be delayed by coordination failures because of divergences of individual and social optimums, which can be corrected through vertical policies (Hausmann et al., 2005b). Nonetheless, for vertical policies to be beneficial for the economy as a whole, these sectors must satisfy certain conditions. According to Hirschman (1958), an unbalanced push by the government on these key industries can create supply bottlenecks in them, which generate profit opportunities in upstream sectors, and hence induce private investment.

There are three key elements in regards to the concept above. First, for unbalanced push to create profits in upstream sectors, they must be highly linked, and not act as an enclave. Second, for inducing private investment, there must be competitiveness stability. Despite the fact that exchange rate is identified as spurious competitiveness by early *neo-structuralism*, the later ECLAC's developments recognize the importance of real exchange rate (RER) for exports diversification. The gains from globalization depend on the ability of the countries to appropriately position themselves along the exports product spectrum (Hausmann et al., 2005a).

Also, by stimulating exports diversification, lower volatility of exports income and positive impacts over the Gross Domestic Product and the employment could be attained (Iglesias, 2005). In contexts where foreign investment is needed for complementing government stimulus, competitiveness stability plays a salient role. However, the share of domestic content plays a very important role because the effect of a currency appreciation on a country's exports depends crucially on the share of domestic content in the exports. Other things being equal, the lower the share of domestic content in exports, the smaller the effect on trade volume a given exchange rate appreciation would have (Koopman et al., 2008). Third, the scope of vertical policies is bounded by market size (Murphy et al., 1989). In this sense, trade plays a very important role in small economies, by the time that RER turns into a very important tool.

Empirical studies in line with ECLAC's thought for Uruguay show that it has lower capacities for developing a deep structural change to a productive structure with higher technological content in their products than other countries with similar productive structure (Brunini et al., 2009). This is explained because of two facts: lower exports diversification and lower technological content of the productive capacity already acquired. The sectors that show better potential are forestry and automotive industry. Following a similar strategy, Isabella (2012) suggests that a gradual transition should be developed starting through sectors with lower technological content but with a higher transversal component. Moreover, Mordecki and Piaggio (2012) show that this kind of exports, that are mainly destined to boundary countries, are the only driven by external demand, without giving place to RER for improving their performance.

However, these studies only consider final Uruguayan exports, without paying attention to inter-sectoral linkages within the economy, as well as the foreign content of these products. Uruguay is a small open economy, and its future development will be based on its capacity to diversify its export to more products with more technological content. Structural change through these sectors is going to mean genuine welfare improvements only if they are strongly linked with the rest of the economy in different relevant dimensions (output, value added, labor, and environment). Also, competitiveness improvements through exchange policies are going to be effective for supporting these sectors exports and increasing exports product diversification only if the domestic content of these products is significant. ECLAC (2012) also include sustainability and environment as relevant dimensions for structural change. But it does not give any clue about how structural change increasing the share of products with medium and high (M&H) technological content would impact on natural resource use, pollution and waste generation. M&H subsystem (M&Hss) sectors require inputs from the rest of the economy with a strong material base, as well as the pollution from input processing. Thus, whether or not M&Hss sectors are able to lead to a virtuous path through structural change is not obvious.

The general objective of this paper is to analyze if M&Hss sectors development in Uruguay leads to a virtuous structural change. The specific objectives are threefold. First, to characterize the direct and indirect linkages of M&Hss sectors, in terms of output, value added, and employment. This characterization identifies whether these sectors have been developed under an enclave structure or if they are linked with the rest of the economy. Second, to analyze the domestic value added content of Uruguayan M&Hss exports, and exports price elasticities in reference to imports value increases. This step helps to determine if exchange rate policies are going to be effective for increasing external competitiveness of M&Hss exports, and impulse exports diversification. Third, to analyze the total impact of M&Hss sectors in reference to greenhouse gas emissions. This incorporates the total environmental impact of the M&Hss into the analysis, determining if this way of development is virtuous in terms of its relationship with the environment.

Next section describes the methodology employed. Section 3 shows data and results, and the last sections concludes.

2. Methodology

Backward linkages (BL) measure sector *j*'s dependence on inputs from any sector *i*. From the Leontief quantity model $\mathbf{x} = \mathbf{Ax} + \mathbf{y}$, where vector $\mathbf{x}_{\mathrm{n}\times 1}$ depicts sectoral gross output, matrix $\mathbf{A}_{\mathrm{n}\times\mathrm{n}}$ is the Leontief domestic input coefficients matrix, whose elements, a_{ij}, depict the weight of how much sector *j* purchases to sector *i* in relation to total sector *j* production, and while $\mathbf{y}_{\mathrm{n}\times 1}$ represents sectoral final demand vector.[1] In this way, $\sum_{\mathrm{i}} \mathrm{a}_{\mathrm{ij}}$ reflects the direct dependence of sector *j* from all the sectors *i*. The Leontief's model identity, $\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-\mathbf{1}}\mathbf{y}$ denotes the relation

[1] In this paper, elements in **bold** denote vectors and matrices (lowercase and uppercase, respectively), while the scalars will be expressed in plain text. In turn, the ^ symbol over a vector element refers to a diagonal matrix composed of the specified vector.

between total output levels (**x**) required in an economy to hold a final demand vector (**y**) through the inverse Leontief matrix (or matrix of coefficients of direct and indirect requirements per unit of final demand $\mathbf{L} = (\mathbf{I} - \mathbf{A})^{-1}$). The particular elements of Leontief inverse, l_{ij}, represents the total (direct plus indirect) additional amount of gross output of sector i that is needed for increasing in one unit the final demand of sector j. Departing from this, we can define:

$$(1) \qquad \mathbf{C} = (\hat{\mathbf{v}} + \widehat{\mathbf{m}})\mathbf{L}(\hat{\mathbf{d}} + \hat{\mathbf{e}})$$

Here **v** and **m** are vectors of sectoral value added and import per output coefficients respectively, **d** the domestic final demands, and **e** the exports. Matrix **C** can be split into four sub-parts: $(\hat{\mathbf{v}})\mathbf{L}(\hat{\mathbf{d}})$, $(\hat{\mathbf{v}})\mathbf{L}(\hat{\mathbf{e}})$, $(\widehat{\mathbf{m}})\mathbf{L}(\hat{\mathbf{d}})$ and $(\widehat{\mathbf{m}})\mathbf{L}(\hat{\mathbf{e}})$. The element c_{ij} is interpreted as the domestic value added generated in sector *i* (or the imports by sector *i*) that is necessary for the domestic final demand of product *j* (or the exports of product *j*). These matrices are complementary. Their columnsums for any final demand vector **y** indicate:

$$(2) \qquad \mathbf{u}'(\hat{\mathbf{v}} + \widehat{\mathbf{m}})\mathbf{L}(\hat{\mathbf{y}}) = \mathbf{u}'(\mathbf{I} - \mathbf{A})\mathbf{L}(\hat{\mathbf{y}}) = \mathbf{u}'(\hat{\mathbf{y}}) = \mathbf{y}'$$

Element **u** denotes a summation vector. Intuitively this makes sense, the value y_j of final demand for product *j* equals the sum of all values added that were necessary to produce it plus the sum of all imports that were necessary to produce it. This holds for any vector **y** and thus also for domestic final demands (take **y** = **d**), exports (take **y** = **e**), or at the individual level (take **y** the j^{th} unit vector for example).

Extensions are easily obtained by replacing the value added coefficients **v**, in for example $(\hat{\mathbf{v}})\mathbf{L}(\hat{\mathbf{e}})$, by other input coefficients. For instance, emission coefficients (emissions in sector *i* per unit of this sector's output) implies that element (*i*, *j*) of $(\hat{\mathbf{v}})\mathbf{L}(\hat{\mathbf{e}})$ gives the total emissions generated in sector *i* that are necessary to produce the exports of product *j*. The same holds when using employment coefficients (the number of workers or number of hours worked in sector *i* per unit of output in this sector). A special case arises when we replace **v** by the summation vector **u**. In that case, we get the ordinary output multipliers. That is, element (*i*, *j*) of $\mathbf{L}(\hat{\mathbf{e}})$ gives the total output in sector *i* that is necessary to produce the exports of product *j*.

Subsystem backward linkages decompositions

An economic system can be subdivided into as many *subsystems* as there are commodities in its net products (Sraffa, 1960). Input Output (IO) framework assumes that each sector produce only one product. In this sense, a *subsystem* can be defined as one, or a group of sectors. Total linkages can be split between the effect of a sector demand increase has on itself, on the rest of a wider subsystem it belongs, and on the rest of the economy. For the purpose of this paper, we are going to consider the sectors that export goods with medium and high technological content as a subsystem of the economy.

Lets define $\mathbf{C^m} = (\hat{\mathbf{m}})\mathbf{L}(\hat{\mathbf{e}})$. Let us also define S as the cluster of high- and medium-tech sectors. Then, from the backward perspective, for any $j \in S$ we have that the total amount of imports required for its exports e_j is given by $\sum_i c_{ij}^m$. We may split this into three parts:

$$(3) \qquad \sum_i c_{ij}^m = \underbrace{c_{jj}^m}_{own\ component} + \underbrace{\left(\sum_{k\in S} c_{kj}^m - c_{jj}^m\right)}_{internal\ spillover\ component} + \underbrace{\sum_{k\notin S} c_{kj}^m}_{external\ spillover\ compoent}$$

Where the first term reflects the own component (i.e. how much itself must import), the second term the internal spillover component (i.e. how much the other medium- and high-tech sectors must import) and the last term gives the external spillover component (i.e. how much the imports in the rest of the economy must import). Again, the analysis can be extended to any relevant dimension (value added, labor and GHGs emissions).

Prices elasticities

Another interesting interpretation arises when we consider the Leontief price model

(4) $$\mathbf{p}' = \mathbf{p}'\mathbf{A} + \boldsymbol{\pi}'\hat{\mathbf{v}} + \boldsymbol{\rho}'\hat{\mathbf{m}}$$

Where π_i gives the "price" for value added in sector *i* and ρ_i the price of the imports. The solution of the price model is given by $\mathbf{p}' = (\boldsymbol{\pi}'\hat{\mathbf{v}} + \boldsymbol{\rho}'\hat{\mathbf{m}})\mathbf{L}$. Suppose now that the price of the imports in sector *i* increases by 1%. In that case, $0.01\mathbf{u}_i{}'\hat{\mathbf{m}}\mathbf{L}$ (where $\mathbf{u}_i$ indicates the *i*th unit vector with a one in element *i* and zeros elsewhere) gives the *i*th row of $\hat{\mathbf{m}}\mathbf{L}$ (divided by 100) and indicates the price increases of the products. Multiplying this with, for example, the export vector $\mathbf{e}$ gives $0.01\mathbf{u}_i{}'\hat{\mathbf{m}}\mathbf{L}\mathbf{e}$ which expresses the value increase in the export bundle. In other words, the element (*i*,*j*) of $(\hat{\mathbf{m}})\mathbf{L}(\hat{\mathbf{e}})$ gives us (100 times) the increase in the value of the export of product *j* due to a 1% increase in the imports of sector *i*. Dividing by the original value of the export bundle (i.e. e_j) yields the elasticity of the value of the exports of product *j* with respect to an increase in the value of the imports in sector *i*.

3. Data

There is no official input–output matrix for Uruguay. However, in the benchmark of an agreement between RED Mercosur – FAO for technical assistance to the Agriculture, Livestock and Fishing Ministry, an input–output table for the year 2005 was constructed under direct supervision of the Central Bank of Uruguay (BCU), institution that publishes the national account information (Terra et al., 2009). There is a consensus on its validity, and it is the main reference for both public and private analysis. It is split in 56 activities at 2005 basic prices.

Table 1: Total Output and exports’ technological content – Uruguay 2005 (basic prices)

Nº	Sector name	Total Output (U$S :)		Exports (U$S :)[1]						Exports technological content (Lall, 2002)					
										Primary products	Manufactured products				Other trans.[2]
		Total	%	Total	%	Brazil	%	Arg.	%		Resource-based	Low Tech	Medium Tech	High Tech	
34	Pesticides and other agro-chemical products	117.51	0.4%	14.4	0.3%	1.19	7.9%	7.07	46.8%	0%	0%	0%	100%	0%	0%
35	Pharmaceuticals	180.87	0.6%	46.7	1.0%	8.36	15.9%	6.62	12.6%	0%	0.9%	0%	0%	99.1%	0%
36	Basic chemicals	363.65	1.2%	122.9	2.6%	46.00	43.0%	31.10	29.1%	0%	33.4%	0.2%	66.4%	0%	0%
39	Basic metals	620.06	2.1%	130.1	2.7%	30.50	23.0%	20.50	15.5%	0%	11.9%	12.7%	37.2%	5.9%	32.3%
40	Motor vehicles	171.69	0.6%	75.7	1.6%	6.36	9.0%	50.50	71.9%	0%	0%	0%	99.9%	0.1%	0%
Totat H&T subsystem		**1,453.79**	**5.0%**	**389.8**	**8.1%**	**92.41**	**20.1%**	**115.79**	**43.4%**	**0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Total economy		**29,229.48**	**100%**	**4,819**	**100%**	**460.50**	**13.5%**	**266.97**	**7.8%**	**48.0%**	**17.7%**	**19.8%**	**6.8%**	**1.8%**	**6.0%**

[1] Allocation of exports destiny is based in Uruguayan trade national statistics provided by the Uruguayan Central Bank for good, while for services ins based in Leznen (2012).
[2] Other transactions include products related to Electricity, cinema film, printed matter, ‘special’ transactions, gold, art, coins, pets

Source: own elaboration based in in Terra et al. (2009).

Exports vector is split by destiny to Brazil and Argentina. For goods, this procedure is based in Uruguayan trade national statistics provided by the Uruguayan Central Bank for good, while for services is based in Lenzen (2012). Exports are also classified in reference to the technological content following Lall (2002). This is the criteria for defining the subsystem of analysis. There are only seven sectors that export goods with medium and/or high technological content: Pesticides and other agro-chemical products (34); Pharmaceuticals (35); Basic chemicals (36); Rubber and plastics products (37); Other non-metallic mineral products (38); Basic metals (39); and Motor vehicles (40). The relatively aggregate data from the input output table implies that not all sectors’ exports have the same kind of products. In this way, a sector can export products with different technological content. Only 14.8% and 8.4% of total exports of sectors 37 and 38 respectively are classified as products with medium technological content, while they don’t produce products with high technological content. From above, they are not considered as part of the subsystem of sectors that produce goods with medium and/or high technological content. Despite the share of products with medium and/or high technological content the other considered sectors exports, the heterogeneity of technological content of goods is also present in them. Close attention must be paid when analyzing results for sectors 36 and 39, whose medium and/or high technological content exports are 66.6% and 43.1% respectively. 67.2% of the subsystem’ exports are goods with medium and/or high technological content. This kind of products represents 8.5% of the total economy exports (Table 1).

In reference to the greenhouse gas emissions, a sectoral vector of emissions is constructed. The Third National Communication to the Conference of the Parties in the United Nations Framework

Convention on Climate Change (MVOTMA, 2010) provides detail on the 2004 GHGs inventory split by processes. We have constructed GHGs emissions accounts following the Eurostat (2009) methodology. Secondary sources, like the reports of the National Energy and Nuclear Technology Direction (DNETN, 2008), which details the structure of net and used energy consumption for the year 2006 are used. Methane and nitrous oxide are the main polluters (56.6% and 30.8% of total emissions respectively), while carbon dioxide represents the remaining emissions. In this paper, only methane and carbon dioxide are considered separate from total emissions, because methane and nitrous oxide coincide in almost all their direct sources, so conclusions apply for both.

4. Results

4.1 Who pulls?

From eq. (1), Table 2 shows direct and total value added, GHGs emissions and labor requirements, as well as which part of them is generated for attending their external demand. This is also computed separately for exports to Brazil and to Argentina, because of the importance of regional trade in M&Hss exports. Only total jobs are shown in Table 2, because skilled and non-skilled jobs follow a similar pattern. For similar reasons, only total GHGs emissions are shown.

Table 2: Value Added, GHGs and Labor (direct, total, and related to exports)

Value Added (U$S:)											
Nº	**Sector name**	**Direct** $\mathbf{u'\hat{v}A\hat{y}}$	**%[a]**	**Total** $\mathbf{u'\hat{v}L\hat{y}}$	**%[a]**	**Exports** $\mathbf{u'\hat{v}L\hat{e}}$					
						Total	**%[b]**	**Brazil**	**%[c]**	**Arg.**	**%[c]**
34	Pesticides and other agro-chemical products	11,8	2,4%	6,2	1,7%	3,8	60,9%	0,3	7,9%	1,8	46,8%
35	Pharmaceuticals	63,2	12,8%	49,1	13,2%	26,0	53,0%	4,1	15,9%	3,3	12,6%
36	Basic chemicals	99,2	20,0%	93,7	25,2%	73,1	78,0%	31,4	43,0%	21,2	29,1%
39	Basic metals	270,2	54,5%	164,7	44,2%	94,7	57,5%	21,8	23,0%	14,7	15,5%
40	Motor vehicles	51,0	10,3%	58,8	15,8%	38,6	65,7%	3,5	9,0%	27,8	71,9%
Total H&M technological content subsystem		**495,4**	**3,1%**	**372,5**	**2,3%**	**236,2**	**63,4%**	**61,2**	**25,9%**	**68,7**	**29,1%**
Total		**15.985**		**15.985**		**3.479**		**513**		**461**	

GHG (CO_2e Ktons)											
Nº	Sector name	Direct $u'(\widehat{ghg})A\hat{y}$	%[a]	Total $u'(\widehat{ghg})L\hat{y}$	%[a]	Exports $u'(\widehat{ghg})L\hat{e}$					
						Total	%[b]	Brazil	%[c]	Arg.	%[c]
34	Pesticides and other agro-chemical products	0,5	1,1%	3,5	2,4%	2,1	60,9%	0,2	7,9%	1,0	46,8%
35	Pharmaceuticals	5,3	10,3%	22,0	15,2%	11,7	53,0%	1,9	15,9%	1,5	12,6%
36	Basic chemicals	21,2	41,1%	60,3	41,8%	47,0	78,0%	20,2	43,0%	13,7	29,1%
39	Basic metals	24,3	47,2%	40,0	27,7%	23,0	57,5%	5,3	23,0%	3,6	15,5%
40	Motor vehicles	0,2	0,4%	18,6	12,9%	12,2	65,7%	1,1	9,0%	8,8	71,9%
Total H&M technological content subsystem		**51,6**	**0,14%**	**144,4**	**0,39%**	**96,1**	**66,5%**	**28,6**	**29,8%**	**28,5**	**29,7%**
Total		**36.773**	**100%**	**36.773**	**100%**	**19.916**		**961,9**		**1.274,3**	

Total labour (Nº jobs)											
Nº	Sector name	Direct $u'(\widehat{job})A\hat{y}$	%[a]	Total $u'(\widehat{job})L\hat{y}$	%[a]	Exports $u'(\widehat{job})L\hat{e}$					
						Total	%[b]	Brazil	%[c]	Arg.	%[c]
34	Pesticides and other agro-chemical products	784	2,2%	445	1,6%	270,9	60,9%	21	7,9%	127	46,8%
35	Pharmaceuticals	4.043	11,4%	3.469	12,4%	1.839,5	53,0%	292	15,9%	232	12,6%
36	Basic chemicals	5.409	15,2%	6.286	22,4%	4.902,0	78,0%	2.107	43,0%	1.425	29,1%
39	Basic metals	20.493	57,7%	12.685	45,2%	7.292,5	57,5%	1.680	23,0%	1.129	15,5%
40	Motor vehicles	4.810	13,5%	5.190	18,5%	3.409,8	65,7%	309	9,0%	2.451	71,9%
Total H&M technological content subsystem		**35.539**	**2,4%**	**28.075,0**	**1,9%**	**17.714,6**	**63,1%**	**4.409,6**	**24,9%**	**5.362,9**	**30,3%**
Total		**1.463.190**	**100%**	**1.463.190**	**100%**	**262.330**		**36.578**		**30.822**	

[a] % for Total H&M technological content subsystem is in relationship to the total economy
[b] % (exports/total) by branch
[c] % (exports to the region/total exports) by branch
Source: own elaboration based in Terra et al. (2009), MVOTMA (2010a) and DNTEN (2008)

First, around 60% of M&Hss total value added, GHGs and jobs are produced for satisfying their exports. Between 50-60% of them is consequence of regional trade. This clearly reflects the importance of regional demand for this kind of exports. It is worth noting that total value added employed for producing export products is coincident with Hummels et al. (2001) definition of *domestic value added of exports*. This helps to interpret the importance of exports in domestic value added generation in these sectors.

Second, total value added and total jobs are lower than their direct value. This means that a part of these factors that the M&Hss produces or employs is destined to satisfy other sectors demand, instead of their own final demand. Motor vehicles (40) is an exception, which total value added is higher than its direct value added. This is explained because this sector is more linked to final consumers than the other sectors of the M&Hss. Also, the same is shown in reference to total jobs for Motor vehicles (40) and Basic chemicals (36). This means that they require inputs from more labor intensive sectors for attending their final demand.

Third, the opposite happens when looking at GHG. M&Hss sectors require others sectors to pollute when producing inputs for attending their final demand. Looking at the input-output matrix, this is explained mainly because of the transport requirements.

Consequently, the M&Hss final demand is mainly pulled by regional exports. However, the intermediate inputs demand from the rest of the economy to this subsystem is also important. This gives insights that M&Hss are not an enclave. The opposite happens in reference to GHG emissions, where the M&Hss sectors pull the rest of the economy to pollute more than the pollution they directly produce for satisfying their final demand. This analysis is extended in next section.

4.2 Who is pulled?

When a sector satisfies its final demand, the product that it sells not only contains or requires the value added, jobs, or pollution produced by it. It also embodies the ones produced or required by other sectors when supplying inputs to it. This explains the differences between direct and total employed factors or pollution produced in previous section. It is an important distinction, because a sector can contain high value added in its products, but require inputs from the rest of the economy that are not value added intensive. In this case, the sector is going to concentrate the produced wealth. Moreover, if the indirect value added produced by that sector is significant it will be redistributed between other sectors of the economy. In terms of policy implications, when looking for virtuous development, it would be important to stimulate a sector not only with high own value added per unit of output, but also those sectors that significantly pull other sectors through their relation. Similar interpretation can be given in reference to jobs demand. This would be virtuous in particular when looking to skilled jobs.

In regards to pollution, it is important to consider a sector’s responsibility on the pollution that it directly generates for producing the output to satisfy its final demand (own), as well as the pollution that it embodies from the rest of the economy. Mitigation policies are going to be different if a sector is a direct or indirect polluter. Technical improvements and best practices are going to be only effective in direct polluters, while indirect polluters can only be tackled by demand policies.

Figure 1 summarizes the own, internal spillover and external spillover components concept depicted in the methodology. The own component depicts how much of a factor (value added, labor, or pollution) is employed or produced by a sector of the subsystem itself (directly or indirectly) for satisfying its final demand. The internal spillover component accounts the factors that a sector requires from the rest of the M&Hss to satisfy its final demand. Finally, the external spillover component reflects how much of these factors are required from the rest of the economy by a M&Hss sector for satisfying its final demand. A high share of the own component in sectors total factors employed or produced would mean that sectors production process is made isolated (in terms of value added, jobs or emissions) from the rest of the economy. Moreover, the spillover components denote the level of vertical integration among the subsystem and the rest of the economy.

Figure 1: Own, internal spillover, and external spillover component

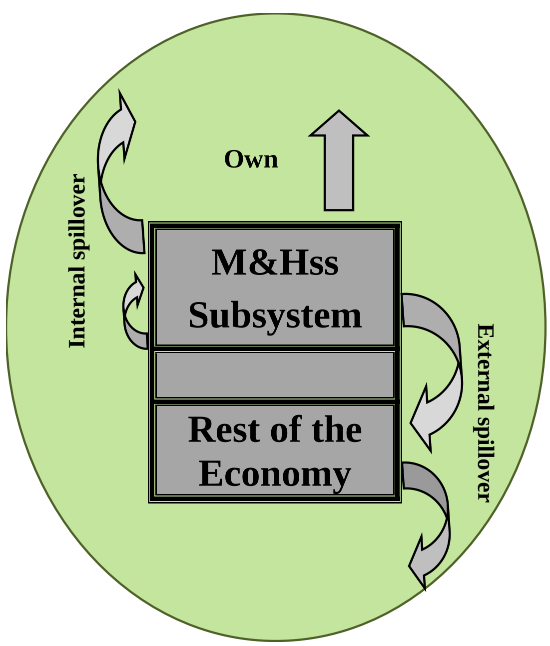

Table 3 show the results computed from eq. (3). First, the own component represents around 65% of total value added and total jobs of M&Hss. Also, for both cases, 33% of their value is produced by sectors outside the subsystem, while only 2% is explained by the internal-spillover component. Almost all M&Hss sectors show a similar pattern, except Pesticides and other agro-chemical products (34), whose own component is significantly lower than the subsystem average.

Despite the fact that the own component is the most important for all subsystem sectors, the previous analysis reflects that there exists an important interrelationship between M&Hss and the rest of the economy. However, when looking in detail to which sectors of the rest of the economy demands its inputs, they are concentrated in sectors that develop transport related activities, like Motor vehicles and oil retail trade; Land transport and transport via pipelines; and Water and air transport. This fact gives insights that for satisfying their final demand, these sectors work as enclaves that import and produce their own inputs just demanding transport related activities. Table A1 in the Appendix shows the total and spillover component for value added, and skilled and non-skilled jobs for the RoE, which is split in primary, industrial and services sectors, as well for M&Hss. Notwithstanding the fact that the spillover component of M&Hss sectors is concentrated in few sectors, its interlinkages with the rest of the economy is higher than the one of primary and services sectors', while it is lower than the other industrial sectors of the economy. This indicates that interrelationship of the M&Hss with the rest of the economy is not much different than the once of the big categories of sectors.

Table 3: Backward linkages decomposition - Value added, GHGs and Labor

Value Added (U$S:)									
Sector	Name	Own	%	Spillover component				Total VA	% Total VA H&M
				H&M ss.	%	RoE	%		
34	Pesticides and other agro-chemical products	2,5	40,9%	0,6	9,6%	3,1	49,5%	6,2	1,7%
35	Pharmaceuticals	32,0	65,3%	0,5	1,0%	16,5	33,7%	49,1	13,2%
36	Basic chemicals	49,7	53,1%	1,2	1,2%	42,8	45,7%	93,7	25,2%
39	Basic metals	122,0	74,1%	1,6	1,0%	41,1	25,0%	164,7	44,2%
40	Motor vehicles	35,4	60,2%	4,1	7,0%	19,3	32,8%	58,8	15,8%
Total H&M technological content subsystem		**241,7**	**64,9%**	**8,0**	**2,1%**	**122,8**	**33,0%**	**372,5**	**100%**
% of total Value Added		**1,5%**		**0,0%**		**0,8%**		**2,3%**	

GHG (CO_2e Ktons)									
Sector	**Name**	**Own**	**%**	**Spillover component**				**Total**	**% Total GHGs H&M ss.**
				H&M ss.	**%**	**RoE**	**%**	**GHGs**	
34	Pesticides and other agro-chemical products	0,1	3,4%	0,092	2,6%	3,3	94,0%	3,5	0,4%
35	Pharmaceuticals	2,7	12,2%	0,078	0,4%	19,2	87,4%	22,0	2,3%
36	Basic chemicals	10,6	17,6%	0,095	0,2%	49,6	82,2%	60,3	6,4%
39	Basic metals	11,0	27,5%	0,315	0,8%	28,6	71,7%	40,0	4,3%
40	Motor vehicles	0,2	0,8%	0,426	2,3%	18,1	96,9%	18,6	2,0%
Total H&M technological content subsystem		**24,6**	**17,0%**	**1,01**	**0,70%**	**118,8**	**82,3%**	**144,4**	**100%**
% of total GHG emissions		**0,07%**		**0,0027%**		**0,32%**		**0,39%**	

Total labour (Nº jobs)									
Sector	**Name**	**Own**	**%**	**Spillover component**				**Total labor**	**% Total labor**
				H&M ss.	**%**	**RoE**	**%**		
34	Pesticides and other agro-chemical products	168	37,9%	38	8,4%	239	53,7%	445	243,4%
35	Pharmaceuticals	2.051	59,1%	32	0,9%	1.386	40,0%	3.469	1899,0%
36	Basic chemicals	2.712	43,1%	86	1,4%	3.488	55,5%	6.286	3440,6%
39	Basic metals	9.250	72,9%	90	0,7%	3.345	26,4%	12.685	6943,7%
40	Motor vehicles	3.341	64,4%	302	5,8%	1.547	29,8%	5.190	2840,8%
Total H&M technological content subsystem		**17.522**	**62,4%**	**548**	**2,0%**	**10.005**	**35,6%**	**28.075**	**100%**
% of total labor		**1,2%**		**0,037%**		**0,7%**		**1,9%**	

When looking at GHGs emissions, almost all of them are produced outside the M&Hss. Own emissions are explained mainly by Pharmaceuticals (35), Basic chemicals (36), and Basic metals (39). The RoE spillover component is consequence of transport services demand by the M&Hss sectors.

For analyzing if the M&Hss is an enclave or not, it is important to evaluate not only if the subsystem pulls the rest of the economy by demanding inputs, but also if its participation is relevant as inputs provider for satisfying the RoE final demand. This can be approached by looking at the RoE external spillover. This is a simple measure of how much of a factor (value added, jobs, or pollution) that the M&Hss sectors employ or produce is consequence of the input provision to the rest of the economy when satisfying its final demand. If the external spillover of the rest of the economy on the M&Hss is significant, it would mean that these sectors development can be reached by the impulse of other sectors linked to them. The rest of the economy spillover on the M&Hss can be straightly computed extracting the own and internal spillover component from the M&Hss direct factors employment or production.

Despite the fact that M&Hss external spillover component is not widely spread among the RoE sectors, their input provision to the rest of the economy plays an important role. Half of their direct value added, number of jobs and greenhouse emissions (first column in Table 2) are consequence of its own (direct plus indirect) production for satisfying its final demand (own plus M&Hss spillover in Table 3). Because the internal spillover component is very small we can ignore it when analyzing the role of the individual sectors of the subsystem as inputs providers, and just extract the own component to the direct factor employment or production. Looking for the individual sectors, the above idea is reinforced for Pesticides and other agro-chemical products (34), for which its own (direct plus indirect) value added and jobs represent only around 21.5% of its direct provision of each factor. The remaining is consequence of other sectors inputs demand. This sector mainly provides inputs to the Other cereals and crops sector. Other examples of M&Hss inputs provision to the rest of the economy are Basic metals to the Building sector; the Pharmaceutical and the Basic metals inputs provision to the Sewage and refuse disposal sector; the Basic chemicals, the Basic metals, and the Motor vehicles inputs provision to the Motor vehicles and oil retail trade sector; and the Pharmaceutical inputs provision to the Wines sector.

4.3 Backward multipliers

By looking only to backward multipliers, it is possible to distinguish the impact on the economy when increasing a sector's final demand because of its domestic technology from impact because of the scale of this sector. This is important, because despite the fact that some sectors can be not very important in the whole economy because of their size, their interrelationships with the rest of the economy can still be virtuous because of the kind of inputs that they demand.

Table 4 shows the backward multipliers for each relevant dimension, computed as the columnsum of matrix $= (\mathbf{f}')\mathbf{L}$, where $\mathbf{f}$ is the vector of coefficients per unit of output for every relevant dimension (value added, imports, jobs, and GHGs emissions). The i^{th} element of vector $\boldsymbol{\mu}$ indicates the total amount of each dimension per unit of final demand for sector *i*. When referred to value added, total domestic value added per unit of final demand is computed. By definition, this is complementary to the interpretation of total imports per final demand. Computing import multipliers is useful to shed light on the weight of this kind of inputs in sectors output. This is important for a guidance of the possible effects of a devaluation on sectors output. A complementary analysis is going to be developed in next section.

First, it is worth to note the great dependency of M&Hss on imports (for every 1 million dollar increase in their final demand, their imports increases in 0.47 million dollar). However, M&Hss sectors' behavior is heterogeneous. While Pesticides and other agro-chemical products (34) draws heavily on imported inputs, Basic metals (39) shows multipliers similar to total economy average. The heavy dependence on imports means, by definition, lower domestic value added per unit of final demand of the M&Hss sectors. The share of exports in total final demand is much higher in the subsystem sectors (63.8%) than for the rest of the economy (23.8%). Also, 63.4% of their domestic value added is produced for satisfying their exports (Table 2). Joint these facts, the great share of imported inputs for satisfying this subsystem final demand, and the significance of exports pulling their domestic value added make these sectors to be especially sensitive to exchange rate policies. A devaluation of the nominal exchange rate is going to increase the cost of their inputs greater than for the rest of the economy. The effect on the price of the exports is going to be analyzed in next section.

Second, M&Hss subsystem sectors' pollute much less (direct plus indirectly) per unit of final demand than the rest of the economy. This is because they neither are high direct polluters or demand inputs to polluting sectors. However, while multipliers in reference to methane emissions are insignificant in reference to total economy average, carbon dioxide multipliers are around one third of it.

Table 4: Backward linkages – Value added, imports, GHGs, and jobs

Sector	Name	BL							
		Value Added [1]	Imports [2]	GHG			Labor		
				Total [3]	CH_4 [4]	CO_2 [5]	Total [6]	Skilled [7]	Non-skilled [8]
34	Pesticides and other agro-chemical products	0,26	0,74	0,15	0,02	0,12	18,8	12,9	5,9
35	Pharmaceuticals	0,56	0,44	0,25	0,07	0,14	39,4	21,5	17,9
36	Basic chemicals	0,59	0,41	0,38	0,10	0,22	39,9	25,8	14,1
39	Basic metals	0,73	0,27	0,18	0,02	0,15	56,0	40,2	15,8
40	Motor vehicles	0,51	0,49	0,16	0,01	0,14	45,1	34,5	10,6
Average									
H&M technological content subsystem		0,53	0,47	0,22	0,04	0,16	39,8	27,0	12,9
Total economy		0,75	0,25	1,90	0,95	0,46	76,0	57,6	18,4

Third, M&Hss sectors pulls less jobs than the total economy when it final demands increases. This difference is mainly consequence because of the number of skilled jobs created when this subsystem demand increases. The subsystem and the whole economy multipliers are similar in reference to skilled jobs. Moreover, M&Hss sectors behavior is again very heterogeneous. While Basic Metals (39) creates more skilled jobs than the rest of the M&Hss sectors, Pesticides and other agro-chemical products (34) shows much lower multipliers than the rest of the subsystem in reference to both kind of jobs.

The above means that when leaving the scale aside, and looking at the domestic technological coefficients, the M&Hss sectors show many differences in reference to the rest of the economy. Increasing their final demand in one unit would mean an increase of the domestic value added and jobs lower than in the rest of the economy. However, their pollution per unit of final demand is also much lower than the rest of the economy.

It was already shown above that M&Hss sectors greenhouse gas emissions, total jobs and value added multipliers are smaller than the once of the whole economy. However, while M&Hss value added and jobs multiplier where around 50-70% of total economy average, GHGs multiplier is only 12%. Furthermore, M&Hss imports' average multipliers almost double the one of the rest of the economy. As a consequence, it is noteworthy to look at the ratio between GHGs emissions, jobs, and imports per million dollars of value added generation respectively. This is computed as the ratio of columns [2] to [8], respectively over column [1] in Table 4. This expresses how much imports, or emissions, or jobs are required or produced per unit of value added, corresponding to the final demand of sector *i*. Similar analysis has been previous done by Muller et al. (2011) in reference to gross external environmental damage by US sector, and by Dietzenbacher et al. (2012) in reference to carbon dioxide emissions in domestic demand, processing and non-processing exports for China.

Results are shown in Table 5. First, the GHG and total jobs ratio are similar across all the M&Hss sectors. While the total GHGs emissions over value added ratio is only 16% of the RoE multiplier, it is 41% of it when looking only to carbon dioxide emissions. The above means that each 1: dollar due to the value added generated by the M&Hss final demand yields more than five times less emissions (more than half time less in reference to carbon dioxide only), as 1: dollar generated by the final demand of the RoE. Similar interpretation can be done in reference to skilled labor. Furthermore, while the total jobs relation with value added of the M&Hss is 74% of the one of the whole economy, the M&Hss skilled jobs ratio is 65% of the whole economy. This share is higher than multipliers in reference to output. Also, skilled jobs ratio is two times higher than the one of the RoE economy. This fact is mainly driven by Basic metals (39) and Motor vehicles (40).

Table 5: Backward linkages value added ratios

Sector	Name	Imports	GHG			Labor		
			Total	CH_4	CO_2	Total	Skilled	Non-skilled
34	Pesticides and other agro-chemical products	2,81	0,57	0,07	0,47	71,7	49,3	22,4
35	Pharmaceuticals	0,79	0,45	0,13	0,26	70,7	38,5	32,2
36	Basic chemicals	0,68	0,64	0,17	0,38	67,1	43,3	23,8
39	Basic metals	0,37	0,24	0,03	0,21	77,0	55,3	21,8
40	Motor vehicles	0,96	0,32	0,03	0,28	88,3	67,5	20,7
H&M technological content subsystem average		**0,89**	**0,42**	**0,08**	**0,30**	**75,1**	**50,8**	**24,3**
Total economy average		**0,34**	**2,55**	**1,28**	**0,62**	**102**	**77,3**	**24,7**
RoE average		**0,38**	**2,61**	**1,26**	**0,71**	**99,9**	**23,7**	**76,2**

Finally, it is worth to note that per every 1 dollar of value added generated by M&Hss, imports must also increase more than for the RoE. In particular, Pesticides and other agro-chemical products (34) is an outlier, given that almost all it inputs are imported. But this fact keeps for all the other sectors, except Basic metals (39). This sector not only show a lower import – output multiplier than the other of the M&Hss, but also show a higher value added – output multiplier. In this sense, the relevance of imports explains in part why these sectors are as good for the economy in terms of pollution and skilled labor. If the global productive chain allocates the more dirty and low-skilled labor stages in other countries, Uruguay takes profit of this, taking part of the stages that are cleaner and demands more skilled labor.

4.4 Exports prices elasticities to imports

Domestic value added of exports is important because M&Hss sectors development is going to be virtuous only if a significant part of its value added is produced in the country. But also, high share of imported inputs are going to absorb the effect of an exchange rate policy for improving sectors export competitiveness. Export competitiveness is going to be improved by a devaluation of the local currency. This makes local products to be cheaper abroad, consequence of the increase of the local currency earned per dollar exported given that domestic intermediate cost are paid in local currency. Moreover, devaluation is also going to increase the price of imported inputs in local currency, given that buying a dollar is going to be more expensive in local currency terms. Because of this, exchange rate policies for improving exports competitiveness can be not virtuous for sectors that draw heavily on imported inputs. A priori, this would be the case of the M&Hss, which large part of its intermediates inputs are imported.

Table 6 shows the elasticity of the value of the exports of the M&Hss branches regards to an increase in the value of their own imports, and the average elasticity of their exports value in reference to other sector's imports value increase. The prices elasticites of the export value of the M&Hss sectors, in particular Pesticides and other agro-chemical products (34), Motor vehicles (40), and Pharmaceuticals (35), are one of the higher of the whole economy when the price of their own imported inputs increases. Only higher are the ones of Refined petroleum (33) and Rubber and plastics products (37). Uruguay do not extracts petroleum. As a consequence, 75.6% of the total output of sector 33 are imported inputs, that represent 24% of the whole imported inputs in the economy. Because of the same reason, the main inputs to be processed by sector 37 are imported (40% of its total output). This would mean that any increase in competitiveness that could be reached through an exchange rate policy would have softer effect in these sectors than in the rest of the economy (except for those that draws heavily in petroleum and its derivatives).

Table 6: Exports prices elasticities due to an increase in imports prices

Sector	Name	Exports elasticity due to a 1% increase in own imports value		Average exports elasticity due to a 1% increase in other sector's imports value	
		%	Ranking	%	Ranking
34	Pesticides and other agro-chemical products	0,68%	2	0,0011%	39
35	Pharmaceuticals	0,40%	5	0,0009%	45
36	Basic chemicals	0,32%	10	0,0016%	27
39	Basic metals	0,22%	16	0,0011%	40
40	Motor vehicles	0,43%	3	0,0012%	35
H&M technological content subsystem average		**0,41%**		**0,0012%**	
Total economy average[a]		**0,17%**		**0,1018%**	
RoE average[a]		**0,13%**		**0,1063%**	
[a]The average is computed excluding five sectors that do not exports any part of their output					

The M&Hss sectors export prices elasticities due to an increase in other sectors imported inputs is not very important. This would be explained because the backward linkages of these sectors are concentrated in few other sectors, as explained before. It is worth to mention that a cost push on exports consequence of imports prices would mean a response in the final demand that is not considered in this model. A full quantification of this effect would require demand elasticities or a computable general equilibrium (CGE) model. But such analysis escapes to the scope of this paper, where it is intended to give an well supported intuition about why looking for competitiveness improvement through exchange rate policies would not be effective for the M&H tech sectors in Uruguay.

5. Conclusions

Conclusion 1 - Apparently, M&Hss is not an enclave. Despite its small scale, when its demand increases it pulls the rest of the economy both, in reference to value added and jobs. Its spillover component is higher than primary and services sectors, but not higher than the rest of the industrial sectors of the economy (Table A.1). But this subsystem only pulls very few sectors, mostly transport related sectors. This relaxes the idea that it is not an enclave. However, half of its value added and jobs are consequence of the rest of the economy intermediate demand. This may imply virtuous development can be reached through other sectors whose backward linkages are related to the M&H tech sectors.

Conclusion 2 - Domestic content of M&Hss is lower than the rest of the economy. In this sense, these sectors do not produce genuine value added. As a consequence that these sectors draw heavily on imported inputs, the virtuous development mentioned in previous point would be not so virtuous. Moreover, as higher is the share of their output that is sell to the RoE as inputs, lower are the sectors value added and total jobs multipliers (e.g. for Pesticides). Efforts on substituting virtuous (in terms of value added, labor and pollution) stages of imported productive processes should be done.

Also, this fact is very relevant heading to the role of competitiveness improvements through exchange rate policies. Given that a relevant part of the output value is generated abroad, competitiveness policies are not going to be very effective. As Koopmans et al. (2008) remarks, the effect on trade volume of a given exchange rate appreciation are going to be smaller the lower are the share of domestic content in the exports (Koopman et al., 2008). This idea is supported by the prices elasticities analysis, where export value of M&Hss sectors due to an increase in their own imported inputs are one of the higher of the economy (after the ones that draw heavily in petroleum and its derivatives). Also, given that M&H exports are destined mainly to the region, this reinforces the result found by Mordecki and Piaggio (2012), who empirically showed that real exchange rate didn't play any relevant role in M&H exports to the region, and external demand is the main determinant. Given the regional trade policies instability, this makes M&Hss very vulnerable.

Conclusion 3 – M&Hss shows lower BL multipliers in reference to value added, GHGs and jobs than the whole economy. But when computing GHGs and jobs BL multipliers per unit of value added generated, the first one keeps almost constant, while the second slightly increases. This raise is great when making the comparison in reference to the rest of the economy. This is explained because of both skilled and non jobs multipliers. Furthermore, the imports multipliers, that was already higher than the one for the whole economy, also increases.

This result has relevant implications from a global and national development perspective. First, if imported M&Hss inputs production stages are transfer to the country, they are going to be produced under cleaner processes than abroad, representing a global welfare increase in terms of pollution. This is particularly true for sectors whose imported inputs arrives form countries whose exports are produced through carbon based productive processes. Uruguayan energy matrix is much cleaner than most of the countries that provide inputs to these sectors and changing to the domestic technology would mean a global emissions decrease (Peters, 2008). Of course, if countries emissions are going to increase, but if production with dirty technologies in other part of the world is substituted, an improvement in global welfare will be reached. One issue that must be taken into account is the feasibility of transferring this productive stage because of both, inputs and (cleaner) energy requirements. However, in actual Uruguayan context, where new mineral resources have been discovered, thinking about this in the long term is not a non-sense idea.

Second, internalizing these earlier stages of the productive chain would be also good for increasing skilled jobs demand. 35% of the skilled jobs employed for satisfying M&Hss final demand are employed in the RoE. This external spillover is a relevant issue as a strategy of growing for equality. This would imply also active education policies for attending these sectors demand. However, this issue must be taken carefully. On the one hand, the early stages of M&Hss imported inputs productive chain related with metals can be intensive in non-skilled labor. This would mean less labor quality improvements than if the actual employment structures is kept. Finally, metals, fertilizers and chemicals inputs are imported mainly from the region or from developed countries. Internalizing this stages of the global productive chain could be difficult because both, trade relationship with this countries, and inputs availability.

References

Alcántara, V. (1995) “Economía y contaminación atmosférica: hacia un Nuevo enfoque desde el análisis input-output” Tesis doctoral, Universitat de Barcelona.

Balassa, B. (1967) *Trade Liberalization Among Industrial Countries*. McGraw-Hill, New York.

Brunini, A., Fleitas, S. and Ourens, G. (2009) “Crecimiento económico y especialización productiva: los caminos de la transformación estructural en Uruguay en comparación con otras economías intensivas en recursos naturales (1985-2006)”, XXIV Jornadas Anuales de Economía

Banco Central del Uruguay, 5 y 6 de Octubre de 2009, Montevideo-Uruguay

Cimoli, M., Fleitas, S. and Porcile, G. (2011) “Real Exchange Rate and the Structure of Exports”, Munich Personal RePec Archive.

Dalum, B., Laursen, K. and Verspagen, B. (1999) “Does specialization matters for growth”, *Industrial and corporate change*, vol. 8, nº 2, p. 267-288.

ECLAC (2012) *Structural change for equality An Integrated Approach to Development*, 34th session of ECLAC, 27 – 31 August 2012, San Salvador, El Salvador.

Dietzenbacher, E., Pei, J. and Yang, C. (2012) “Trade, production fragmentation, and China’s carbon dioxide emissions “, *Journal of Environmental Economics and Management*, Vol. 64 (1), pp. 88-101

Dietzenbacher, E. (2002) “Interregional Multipliers: Looking Backward, Looking Forward”, *Regional Studies*, Vol. 36, Nº 2, pp. 125-136.

DNETN (2008) *Estudios de base para el diseño de estrategias y políticas energéticas: relevamiento de consumos de energía sectoriales en términos de energía útil a nivel nacional*, Asistencia Técnica para la Modernización de los Servicios Públicos en Uruguay, OPP-BM 4598-UR-PNUD-URU/01/010, Ministerio de Industria, Energía y Minería, Dirección Nacional de Energía y Tecnología Nuclear, Uruguay.

Eurostat (2009) *Manual for Air Emissions Accounts*, Eurostat: Methodologies and Workin papers, European comission

Hausmann, R., Hwang, J. and Rodrik, D. (2005a) “What you export matters”, NBER Working paper, 11905.

Hausmann, R., Rodríguez-Clare, A. and Rodrick, D. (2005b) “Towards a strategy for economic growth in Uruguay”, Economic and Social Study Series, RE1-05-00-, Inter-American Development Bank.

Hausmann, R. y Klinger, B. (2006): “Structural Transformation and Patterns of Comparative Advantage in the Product Space"; Center for International Development; WP128, Harvard University

Hummels, D., Ishii, J. and Yi, K. (2001) “The Nature and Growth of Vertical Specialization in World Trade” *Journal of international economics*, 54, pp.75-96.

Iglesias, R. (2005) “El rol del tipo de cambio real y la inversión en la diversificación de exportaciones en América Latina y el Caribe”, CEPAL - . Serie Macroeconomía del Desarrollo. ISSN 1680-8843.

Isabella, F. (2012) “Cambio estructural y dinámica de los sectores productivos. Una propuesta para observar sectores clave y su aplicación a Uruguay”, Jornadas Académicas de la Facultad de CC.EE. y A., 22 – 24 de Agosto de 2012, Montevideo, Uruguay.

Koopman, R., Wang, Z., and Wei, S.J. (2008) “How much of Chinese exports is really made in China? Assessing domestic value-added when processing trade is pervasive” NBER Working Paper 14109.

Lall, S. (2000) *“The technological structure an performance of developing country manufactured exports, 1985 – 1998”.* Oxford : University of Oxford, 2000 - . Queen Elizabeth House Working Paper Series, Nº 44.

Mordecki, G. and Piaggio, M. (2012) "Regional Integration: economic growth through export diversification", *Revista de Economía y Estadística*, in press.

Murphy, K.M., Shleifer, A., and Vishny, R.W. (1989) “Industrialization and the Big Push”, *The Journal of Political Economy*, Vol. 97, Issue 5, pp. 1003 – 1026.

MVOTMA (2010) *Third National Communication to the Conference of the Parties in the United Nations Framework Convention on Climate Change*, Ministerio de Vivienda, Ordenamiento Territorial y Medio Ambiente, Dirección Nacional de Medio Ambiente, Unidad de Cambio Climático, Uruguay.

Piaggio, M., Alcántara, V. and Padilla, E. (nd) “Input – output subsystems: agro industrial CH4 and services CO2 emissions in Uruguay”, PhD thesis ECAP – UAB, work in progress.

Pyatt, G. and Round, J. I. (1979) “Accounting and fixed price multipliers in a social accounting framework”, *The Economic Journal*, Vol. 89, pp. 850–79

Rosenstain-Rodan, P. N. (1943) “Problems of industrialization of Eastern and South-eastern Europ”, *Economics Journal*, Vol. 53, pp. 202-11.

Round, J. I. (1985) “Decomposing multipliers for economic systems involving regional and world trade”, *The Economic Journal*, Vol. 95, Nº 378, pp. 383–99.

Round J. I. (2001) “Feedback effects in interregional input–output models: what have we learned?”, in Lahr, M. L. and Dietzenbacher, E., (Eds) *Input–Output Analysis: Frontiers and Extensions*, pp. 54–70. Palgrave, Basingstoke.

Sraffa, P. (1960) *Production of commodities by means of commodities*, Cambridge, Cambridge University Press.

Terra, M.I. (cord.), Barrenechea, P., Cuadrado, E., Pastori, H., Resnichenko, I. and, Zaclicever, D. (2009) *¿Cuál es la importancia real del sector agropecuario sobre la economía uruguaya?*, Oficina de Programación y Política Agropecuaria, Ministerio de Agricultura y Pesca, Acuerdo RED Mercosur-FAO.

Appendix

Table A.1: Rest of the Economy and M&Hss total and spillover component – Value added, skilled labor, and non-skilled labor

	Value Added				Skilled labor				Non skilled labor			
	Spillover[a]	%[b]	Total	%[c]	Spillover[a]	%[b]	Total	%[c]	Spillover[a]	%[b]	Total	%[c]
RoE												
Primary	154,9	24,2%	641,4	4,0%	8347	13,6%	61401	6,1%	3400	33,5%	10154	2,2%
Industrial	2334,3	47,0%	4969,5	31,1%	160481	45,3%	354064	35,4%	45702	56,6%	80760	17,4%
Services	2122,4	21,2%	10001,8	62,6%	102053	18,1%	565189	56,5%	54266	14,9%	363546	78,5%
Total RoE	**4611,7**	**29,5%**	**15612,7**	**97,7%**	**270880**	**27,6%**	**980655**	**98,1%**	**103369**	**22,7%**	**454460**	**98,1%**
M&Hss	130,8	35,1%	372,5	2,3%	6936	35,9%	19325	1,9%	3616	41,3%	8750	1,9%
Total Economy	**4742,4**	**29,7%**	**15985,2**	**100%**	**277817**	**27,8%**	**999980**	**100%**	**106985**	**23,1%**	**463210**	**100%**

[a]The Total spillover component is computed as the sum of the total spillover component of the individual sectors. In this w ay, this component is the sum of the internal and external spillover components.
[b](spillover/total) by branch
[c](total by branch/tota economy)