

# Import Substitution with Labor Misallocation

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## Abstract

This paper argues that relying on major policy distortions to create a domestic automotive industry through import substitution generates significant costs for the economy, in terms of foregone output, lower consumption, and reduced overall welfare. To bring this issue into sharp relief, the paper focuses on the extreme case of an outright vehicle import ban (complemented by an export subsidy), which gives rise to a misallocation of resources that will ultimately reduce the overall productivity of labor. More specifically, a share of the labor force is diverted to the production of previously-imported vehicles, which would have not happened in the absence of import restrictions. In particular,

the output of the final good goes down; consumption is lowered; and overall welfare is reduced. Importantly, the equilibrium stock of vehicles available in this economy is also reduced, defeating the purpose of the imposition of import substitution. Additionally, the creation of an automotive sector is not neutral with respect to factor prices: the resulting lower wages imply that revenues in the newly-created sector are generated at the expense of labor income. Technological change in the automotive industry might act as a countervailing force for labor misallocation, albeit only partially.

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# Import Substitution with Labor Misallocation <sup>1</sup>

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<sup>2</sup> *In memoriam*. Marco A.C. Martins passed away unexpectedly before this paper could be completed. He was a dear friend, a very fine gentleman and an outstanding Chicago-trained economist with significant contributions to monetary theory and to the understanding of Brazil's economy. I am also grateful to my co-author's family, especially Marco A.C. Martins Filho, for authorizing me to complete this joint work after Marco's passing (J.T.A.).

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# IMPORT SUBSTITUTION WITH LABOR MISALLOCATION

## I. Introduction

The debate over the role of the state regained intensity in Latin America following the 2008 global financial crisis (Foxley [2010]; Cárdenas and Helfand [2011]). After three decades of a clear preponderance of a market-driven approach to development in the region, industrial policy has made a remarkable comeback in the form of “productive development policies”.<sup>4</sup> Such resurgence partly reflects the new role of China both as a source of demand and as a competitor for the Latin American economies<sup>5</sup> as well as concerns about “premature deindustrialization”.<sup>6</sup>

While this paper is not intended to discuss the overall effectiveness of industrial policies, it hopefully sheds light on the overall impact of some of their most extreme versions. To this end, the paper develops a simple framework with which to analyze the introduction – from the ground up – of domestic production of automotive vehicles. In so doing, it draws on insights from the recent literature on the effects of resource misallocation on economic development.<sup>7</sup>

The establishment of an automotive industry has been a key element in the industrialization strategies adopted in developing countries over the second half of last century, including Argentina, Brazil, Malaysia, Mexico, the Republic of Korea and Thailand. In particular, the creation of a brand-new vehicle assembling sector has played a key role in Brazil’s import substitution industrialization strategy, with ample support from the state. A major impulse to the Brazilian automotive industry was given by President Juscelino Kubistchek’s *Plano de Metas* in the late 1950s, which contained a whole slew of incentives for domestic vehicle production (Cechini *et al* [2007]). The rationale for the choice of the car industry as the focus for state promotion largely stems from its dense forward and backward linkages – whereby import substitution was seen as helping spawn many ancillary activities throughout the economy.

However – as argued in this paper – the reliance on major policy distortions to achieve the import substitution goal generates significant costs for the economy, in terms of foregone output, lower consumption and reduced overall welfare. Here distortionary policy making is represented by the extreme assumption of an outright vehicle import ban – equivalent to a “big push” strategy of “forcing” industrialization in a particular sector. The reason for this outcome is that such distortions give rise to a misallocation of resources that will ultimately reduce the overall productivity of labor.

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<sup>4</sup> See IDB (2014). The Inter-American Development Bank’s flagship report prefers the term “productive development policies” to “industrial policies”: “For the most part, the report uses the term productive development policies instead of industrial policies. This choice is meant to emphasize that the report analyzes policies that go beyond industrialization and the manufacturing sector, to agriculture as well as services, and that it offers a fresh look that departs from traditional industrial policy. Furthermore, the use of the term productive development policies avoids a term that has become ideologically charged.” (p. i, fn. 1)

<sup>5</sup> “The emergence of China as a major trading partner – and competitor – is perhaps the most significant economic development in Latin America since 2000. It also helps to explain the re-emergence of productive development policies in the region.” (Cárdenas and Helfand, *op. cit.*, p. 9)

<sup>6</sup> Rodrik (2016).

<sup>7</sup> There is a burgeoning literature on how resource misallocation – in which policy distortions lead to diversion of resources to less productive ends – adversely impacts aggregate productivity growth. See e.g. Restuccia and Rogerson (2008) and Hsieh and Klenow (2009).

More specifically, a share of the labor force is diverted to the production of previously-imported vehicles, which would have not happened in the absence of import restrictions. These adverse effects were probably not factored in by the proponents of this style of industrialization. This strategy has become even more perilous in a world dominated by global value chains which, per Baldwin (2016, p. 251), “destroyed the economic logic of single-nation automobile production.”

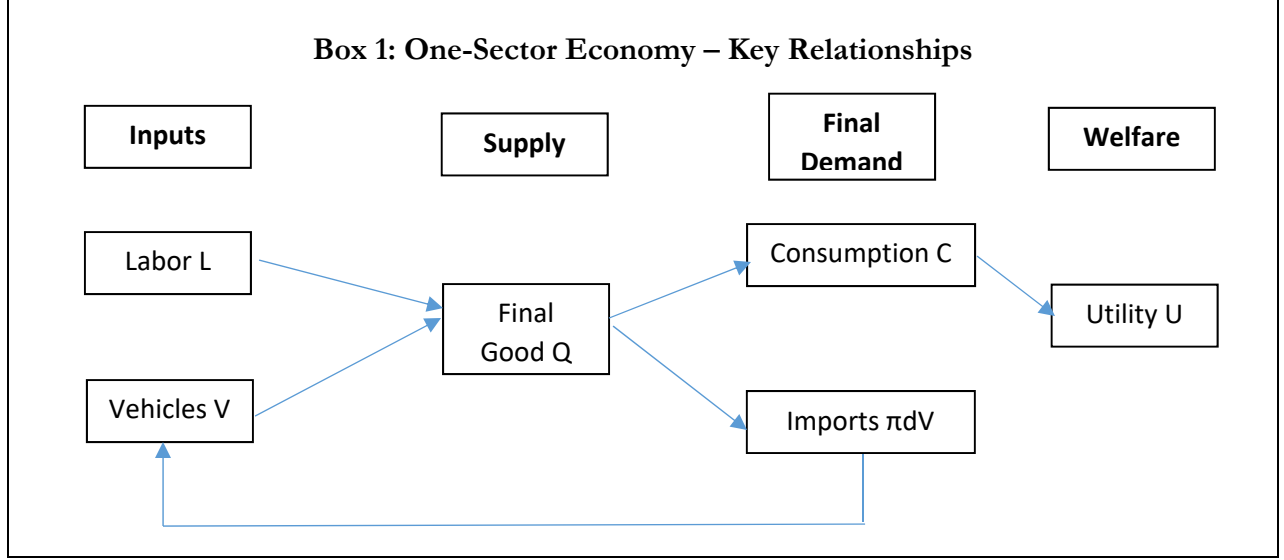
The paper is organized as follows. Section II introduces a simple model of a small open economy with only one sector, in which finished vehicles are imported with the aim of providing transport services (as an intermediate input) to produce a final good. Import substitution is discussed in Section III, taking the form of a policy decision to assemble domestically all the vehicles required to produce the same final good. To analyze this case, a small, two-sector general equilibrium variant of the model is presented. A critical assumption is that vehicles are treated as intermediate goods and cannot be directly consumed by (and thus do not directly yield to) individual consumers. The implications and costs of such decision are also analyzed in this section. Section IV presents simulations of the impact of the labor misallocation parameter on the key endogenous variables of the import substitution model. Section V assesses the extent to which technological change works as a countervailing force for labor misallocation. The limitations of the model and possible extensions are considered in Section VI. Concluding remarks are made in Section VII. The appendix discusses technical aspects of the choice of *numeraire*.

## II. A One-Sector Economy

The starting point of this paper is a one-sector economy, which produces a finished good  $Q$ , using labor  $L$  and non-consumed transport services from finished imported vehicles  $V$ . Therefore, transport services can be interpreted as intermediate inputs to produce  $Q$ . The following simplifying assumptions are adopted:  $L$  is constant; the whole supply of  $V$  is imported; utility  $U$  equals consumption  $C$ ; the stock of  $V$  is owned by individuals. The other parameters of the model are the vehicle depreciation rate  $d$ ; the rental rate  $r$  for transport services; the price  $p$  of the final good  $Q$ ; the wage rate  $w$ ; and import prices  $\pi$ . Under the small open economy assumption, import prices  $\pi$  are taken as given. The demand for new vehicles is determined by the depreciation rate of the stock  $V$  of existing vehicles. A Leontief-type fixed proportions technology is assumed. To keep it simple, we assume that vehicles are used up as they are in the production of  $Q$ , that is, they do not undergo any transformation. The key relationships in this economy are summarized in Box 1.

$$Q = \min[L, V] \tag{a}$$

Where  $V = vQ$  and  $L = Q$ .



Firms maximize profits  $\Pi$ , specified as follows:

$$\Pi = pQ - wL - r\pi V - \pi dV = Q(p - w - r\pi v - d\pi v) \quad (b)$$

Individuals maximize  $U=C$ , subject to the budget constraint below:

$$pC = wL + r\pi V \quad (c)$$

The individuals' optimization problem simply means that they fully spend their entire disposable income.

Normalizing output price as  $p=1$ , profit maximization implies that one unit of output (domestic supply per capita) equals national income plus imports, both in per capita terms:

$$w + r\pi v + d\pi v = 1 \quad (d)$$

Inserting (d) into (c) yields the equilibrium level of consumption:

$$C = wL + r\pi V = (w + r\pi v)Q = (1 - r\pi v)Q \quad (e)$$

### III. A Two-Sector Economy

This section introduces a simple general equilibrium analysis of the impact of building a new automotive sector through import substitution. Specifically, a policy decision is made to impose a complete ban on imports of finished vehicles while allowing for the imports of vehicle parts to be assembled domestically.

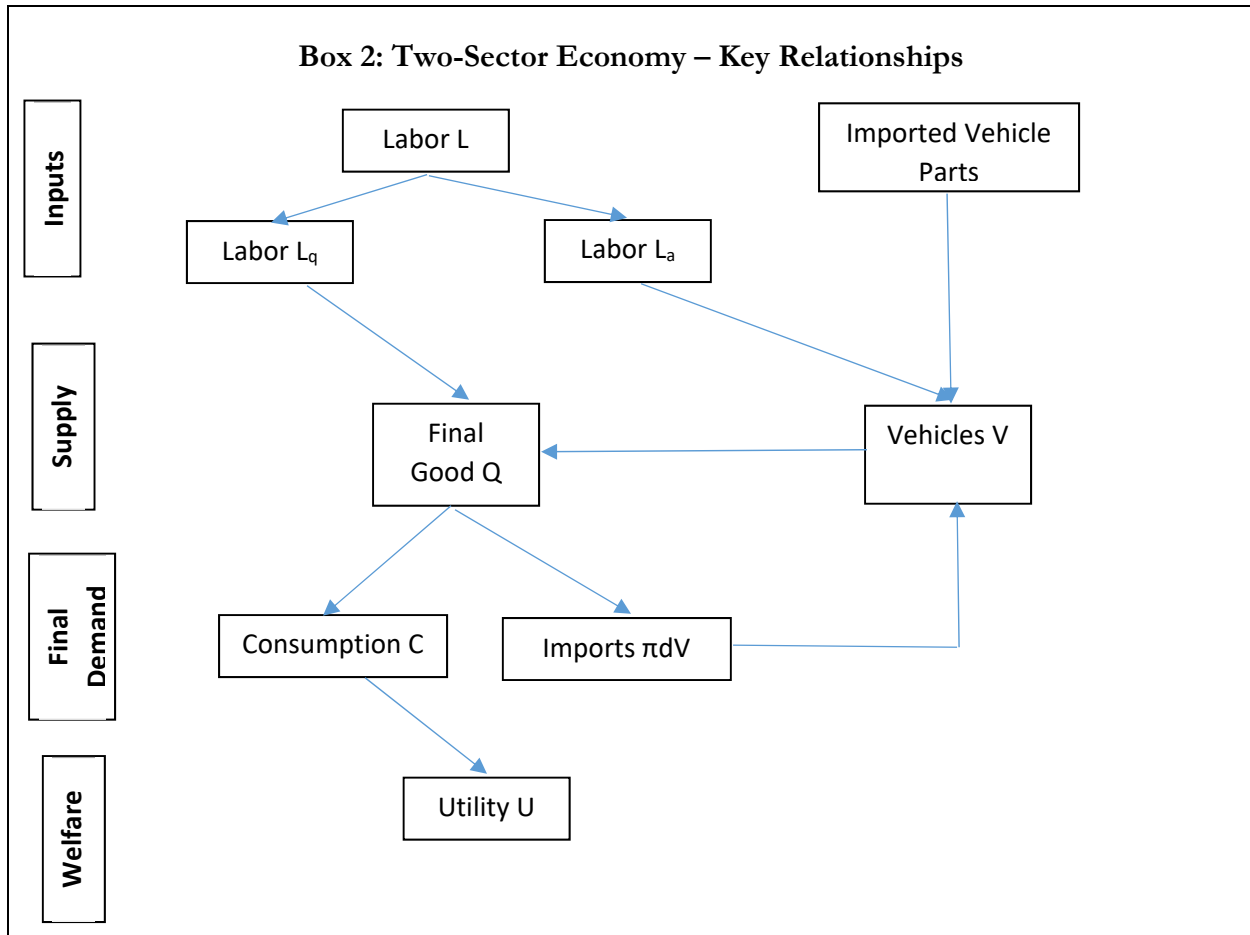
The key variables of the model can now be described as follows: population  $L$ , i.e. labor force is constant;  $V$  is the steady-state stock of vehicles accumulated by the individuals in the past;  $Q$ , the only consumable good cannot be stored;  $C$  is the quantity of  $Q$  consumed by them;  $L_q$  and  $S$  are

respectively the quantities of labor and of productive-transportation services demanded by firms for the production of  $Q$ ;  $L_a$  is the quantity of labor demanded for the assembling sector;  $V$  is the stock of vehicles rented by firms for the production of  $S$ ;  $p_q$ ,  $p_s$ ,  $w$ ,  $\rho$ ,  $p_v$  and  $\pi$  are the domestic supply price of  $Q$ , the world-wide price of  $Q$ , the wage rate, the price of  $S$ , the domestic price of  $V$  and the import price of  $V$ , respectively;  $r$  is the individuals' rate of time preference; and  $d$  is the vehicles' depreciation rate.

The utility function remains  $U(C) = C$  in steady state. The production functions for  $Q$  and  $S$  continue to follow simple Leontief technologies, highlighting the roles of  $S$  as a factor of production and of  $V$  as provider of productive-transportation services. They are:  $Q = \min[ Lq, S ]$  and  $S = sV$ . The automotive technology is conditioned by two efficiency parameters. First, the parameter  $s$  measures the level of efficiency in the transformation of  $V$  into  $S$ . A larger value for  $s$  is overall beneficial to the economy. Second, the vehicle assembling technology is also straightforward. It is given by  $L_a = \sigma dV$ , where  $\sigma$  measures the degree of inefficiency in assembling vehicles. The larger is  $\sigma$ , the more inefficient (i.e., the more labor-absorbing) is vehicle assembling.

The model in this paper assumes a zero-growth stationary state, with a small open economy without technological progress. The model will focus only on steady states and will leave aside transitional dynamics. Given the production functions of  $Q$  and of  $S$  it can be easily shown that any steady state will feature  $sV=Q$ .

The steady-state operation of this economy may be described in a few words: individuals need to consume  $C$ . To make their livings they sell labor and rent vehicles to the firms. They spend all their income on  $C$ . Entrepreneurs want to produce  $Q$ . To do that they face three types of costs: labor costs and rental and depreciation costs of using  $V$ . To face the depreciation costs, they must import  $V$  from abroad directly, or indirectly from the domestic assembling sector. To pay for these imports  $Q$  must be exported. Box 2 summarizes the workings of this economy, which is now significantly more complex than that described in the previous section.



Now assume that  $Q$  and  $V$  are competitively offered in world markets and that  $p_i$  and  $\pi$  are their infinitely-elastic worldwide supply prices.

### *Numeraire*

Simple as it appears, the first of these assumptions imposes severe restrictions on the working of the model. First, note that  $Q$  cannot be exported for a price greater than its world price  $p_i$ . Second, as this economy has no money, a unit of account or *numeraire* is required. In addition, note that  $r$  is given and  $q$  is a focus of the analysis. So,  $p_q$  and  $w$  are the only candidates to play the role of *numeraire*. Does it matter which one is chosen? Yes, it does, because this choice bears on the international competitive equilibrium of this small open economy. For instance, taking  $w$  as *numeraire* requires complementary assumptions to prevent it from collapsing as the assembling sector is implemented. This case is discussed in the appendix. In this Section,  $p_q$  is taken as the *numeraire*.

### *Export Subsidy*

Another feature of this model is the introduction of an export subsidy for  $Q$ . That is, a provision must be made to subsidize  $Q$  exports whenever its domestic offer price,  $p_q$ , is greater than  $p_i$ , its worldwide equilibrium price. This feature is required insofar as there is no guarantee that  $p_q$  and  $p_i$  will always coincide. As such, it works as a complementary distortion with respect to the import ban. The export



subsidy, denoted by  $X$ , is given by equation (1a). The export subsidy can be thought of as being imposed by the government and fully financed by extracting commensurate resources from producers and/or consumers.

$$X = \frac{(p_q - p_i)d\pi V}{p_i} = \frac{(p_q - p_i)d\pi S}{sp_i} \quad (1a)$$

For simplicity, the burden of financing the export subsidy is imposed on only one of three categories of economic agents (producers of Q, producers of V, and consumers) at a time. The coefficients  $a$ ,  $b$  and  $c$  (respectively, the export subsidy incidence on consumers, Q-producers, and V-producers) are either equal to 1 or equal to 0 and only one of them may be equal to 1 at any time.

#### *Optimization Problem*

In this economy, Q-producing firms hire labor for with a wage bill totaling  $wL_q$ ; rent vehicles at the cost of  $rp_vV$ ; and cover their depreciation costs either by importing vehicles directly, or by purchasing them from the domestic assembling sector. The optimal plan is achieved by maximizing profits  $\Pi_q$  with respect to  $\{Q, L_q, S\}$  where  $\Pi_q$  is given by equation (1b).

In order to produce  $dV$  units of vehicles, the vehicle assembling sector uses the  $L_a = \sigma dV$  technology; hire labor for a wage bill totaling  $wL_a$  and import vehicle parts at a cost of  $\pi dV$ . The optimal plan is achieved by maximizing profits  $\Pi_a$  with respect to  $\{V, L_a\}$ , where  $\Pi_a$  is given by (1c).

Individuals finance their consumption by selling labor for  $wL$  where  $L = L_q + L_a$  and by renting vehicles for  $rp_vV$ . In steady state, they fully spend their entire disposable income as expressed by (1d), to maximize their utility function  $U(C) = C$ .

$$\begin{aligned} \pi_q &= p_q - wL_q - (r + d)p_vV - bX = \\ &= p_q - wL_q - \frac{(r+d)p_vS}{s} - bX \end{aligned} \quad (1b)$$

$$\begin{aligned} \pi_a &= p_vdV - wL_a - \pi dV - cX = \\ &= p_vdV - w\sigma dV - \pi dV - cX \end{aligned} \quad (1c)$$

$$p_qC = wL + rp_vV - aX \quad (1d)$$

The maximization processes for  $\Pi_q$ ,  $\Pi_a$  and  $U(C)$  are straightforward. To maximize  $\Pi_q$ , insert the  $Q$  and the  $S$  technologies into (1a) and make  $\Pi_q = 0$  to obtain the following two marginal (and average) equilibrium conditions:

$$L_q = S = sV = Q \quad (2a)$$

$$p_q = w + \frac{(r+d)p_v}{s} + \frac{b(p_q-p_i)d\pi}{sp_i} \quad (2b)$$

$$\rho = \frac{(r+d)p_v}{s} + \frac{b(p_q-p_i)d\pi}{sp_i} \quad (2c)$$

where  $\rho$  is the marginal (and average) price of  $S$ . Equation (2b) represents the marginal (and average) cost of producing  $Q$ ; it is also its supply function.

To find the vehicle assembling sector's optimal plan, insert  $L_a = \sigma dV$  into (1b). Then make  $\Pi_a = 0$  to obtain (3), the domestic supply function of  $V$ :

$$p_v = \pi + \sigma w + \frac{c(p_q-p_i)\pi}{sp_i} \quad (3)$$

Now use  $sV = Q$  from (2a) to simplify (1c), the consumers' budget constraint:

$$p_q C = wL + \frac{rp_v Q}{s} - \frac{a(p_q-p_i)d\pi Q}{sp_i} \quad (4)$$

Finally, use the definitions  $L = L_q + L_a$ ,  $L_a = \sigma dV$  and  $L_q = Q = sV$  from (2a) to express the allocation of  $L$  between  $L_q$  and  $L_a$ :

$$L_q = \frac{sL}{s+\sigma d} \quad (5a)$$

$$L_a = \frac{\sigma dL}{s+\sigma d} \quad (5b)$$

For any steady state, the values of  $r, d, s, \sigma, p_i, \pi$  and  $L$  are given from the outset.

### *Solving the Model*

The remainder of the model can be solved as follows. First, use (2a) and (5a) to obtain the solutions for  $L_q, S, V$  and  $Q$  as in (6a). Second, plug (3) into (2c) to obtain (6b), the most general solution for  $\rho$ . Then insert (3) into (2b) to obtain (6), which only solves for either  $p_q$  or for  $w$ , not for both. The equilibrium value of  $C$  is given by (6d). To find it just plug (3) into (4) and simplify.

$$L_q = Q = sV = S = \frac{sL}{s+\sigma d} \quad (6a)$$

$$\rho = \frac{(r+d)(\pi+\sigma w)}{s} + \frac{(bd+c(r+d))(p_q-p_i)\pi}{sp_i} \quad (6b)$$

$$p_q = 1 + \frac{(r+d)\sigma w}{s} + \frac{(r+d)\pi}{s} + \frac{(bd+c(r+d))(p_q-p_i)\pi}{sp_i} \quad (6c)$$

$$C = wL + \frac{r(\pi+\sigma w)Q}{sp_q} + \frac{(cr-ad)(p_q-p_i)\pi Q}{sp_i p_q} \quad (6d)$$

Equations (3) and (6a) - (6d) summarize the general solution of this basic model of productive-transportation services provided by vehicles.

### *Implications*

Several observations can be made at this point with respect to the steady-state solution to the model:

First, wages are lower and the supply price of assembled vehicles is higher than in the one-sector model. Therefore, the model described in this Section depicts not only a *costlier* economy, but one in which the vehicle assembly sector amasses resources to the detriment of labor income.

Second, one implication of the decision to produce vehicles domestically is that the output of final good  $Q$  – which is constrained by the amount of labor allocated to its production – is lower than in the case where all vehicles are imported (that is,  $\sigma = 0$ ), as described under the one-sector model. The technological parameter  $\sigma$  plays a key role here: the larger it is, the greater the share of labor that is deviated from the production of  $Q$  to the assembly of vehicles. In this sense, parameter  $\sigma$  can be interpreted as a measure of the *degree of resource (i.e. labor) misallocation* in this model economy.

This point is worth elaborating further. There is a growing literature (see e.g. McMillan and Rodrik [2011] and Schiffbauer *et al.* [2016]) suggesting that certain forms of structural change – understood as movements of workers from one sector to another – may have an adverse impact on aggregate average productivity of labor. This happens if labor shifts from high- to low-productivity sectors, due to policy or institutional distortions that create perverse incentives for sectoral resource reallocations. The typical “growth-reducing” structural change identified in this literature refers to shifts of labor from manufacturing to lower-productivity agriculture or services. The present model describes a somewhat different instance of this phenomenon. Here, a fraction of the labor force is diverted from the production of the final good  $Q$  to that of vehicles, which would have been imported if not for the decision to produce them domestically. Notice vehicles are treated here as an intermediate good, of which *raison d’être* is to generate transport services for the production of  $Q$ . The fact that the output of  $Q$  actually *goes down* clearly shows that the import ban would ultimately backfire.

Another way to look into this phenomenon is by considering the impact of  $\sigma$  on *aggregate value-added per worker*, which will be denoted by  $y = Q/L$ . The maximum value  $y$  can take is 1, which can only happen in the one-sector economy, that is, for  $\sigma = 0$ . Equation (6a) clearly shows that there is a negative relationship between  $y$  and  $\sigma$ , that is, the average labor productivity for the economy as a whole falls with  $\sigma$ .<sup>8</sup>

Finally, both  $V$  and  $C$  are lower in this case than under the one-sector model. Since  $U = C$  by construction, this also means that the forced introduction of a previously non-existing vehicle assembling sector leads to a *welfare loss* for individuals in this economy.<sup>9</sup>

#### IV. Simulating the Economywide Impact of the Labor Misallocation Parameter

This section describes the outcomes of numerical simulations conducted with the model presented in Section III. Table 1 displays the results. The middle column describes the one-sector economy, which serves as a benchmark, by assuming  $\sigma = 0$  and  $a = b = c = 0$  for equations (3) and (6a)-(6d). In steady-state  $r, d, s, \sigma, p[i]$  and  $\pi$  are given. As before,  $p_q$  is taken as *numeraire*. To further simplify, the following additional assumptions are made:  $r = d = 0.05$ ;  $s = 0.20$ ;  $\pi = 1$ ;  $L = 1$ . Then equations 3 and 6a-6d are reduced to the following expressions:

$$p_v = 1 + \sigma w + \frac{c(p_q - p_i)}{p_i} \quad (3')$$

$$L_q = S = sV = Q = \frac{4}{4+\sigma} \quad (6a')$$

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<sup>8</sup> We will return to this point in section V, where the role of  $s$  as a possible countervailing force will be examined.

<sup>9</sup> There is another channel whereby welfare could be reduced by this particular form of import substitution. If individuals value variety, then the closing down of imports of differentiated goods would also be welfare-reducing. I am indebted to Philip Schellekens for bringing this point to my attention.

$$\rho = \frac{1}{2} + \frac{1}{2}\sigma w + \frac{0.25(b+2c)(p_q-p_i)}{p_i} \quad (6b')$$

$$p_q = \left(1 + \frac{1}{2}\sigma\right)w + \frac{1}{2} + \frac{0.25(b+2c)(p_q-p_i)}{p_i} \quad (6c')$$

$$C = \frac{w}{p_q} + \frac{0.25(1+\sigma w)Q}{p_q} + \frac{0.25(c-a)(p_q-p_i)Q}{p_i p_q} \quad (6d')$$

**Table 1. Simulations with  $p_q$  as *numeraire***

<i>Variables</i>	$\sigma = 0$	$0 < \sigma$
$p_i$	1	1
$p_q$	1	1
$w$	$\frac{1}{2}$	$\frac{1}{2 + \sigma}$
$p_v$	1	$2 \frac{1 + \sigma}{2 + \sigma}$
$\rho$	$\frac{1}{2}$	$\frac{1 + \sigma}{2 + \sigma}$
$Lq$	1	$4 \frac{1}{4 + \sigma}$

$La$	0	$\frac{\sigma}{4 + \sigma}$
$S$	1	$4 \frac{1}{4 + \sigma}$
$Q$	1	$4 \frac{1}{4 + \sigma}$
$C$	$\frac{3}{4}$	$3 \frac{1}{4 + \sigma}$
$V$	5	$20 \frac{1}{4 + \sigma}$

The numerical simulations clearly show that moving from the one-sector case ( $\sigma = 0$ ) to the two-sector model of “forced” introduction of an automotive sector ( $\sigma > 0$ ) leads to several unintended effects: higher domestic vehicle prices; a lower wage rate; a more inefficient production process for vehicle services (i.e., a lower  $S$ ); a lower output of  $Q$ ; reduced consumption; and, paradoxically, a lower supply of vehicles.

## V. Technological Change in the Automotive Sector: A Countervailing Force?

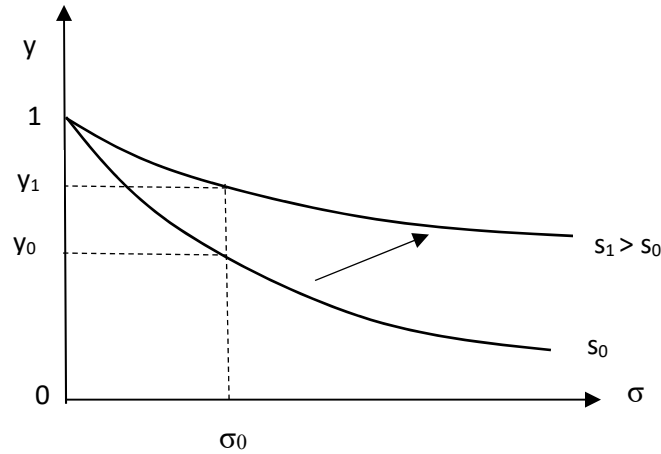
Equation (6a) provides a glimpse into the roles that technological change can play in the automotive industry as well as in the overall economy. The role of  $\sigma$  has been discussed in the previous sections. Here it suffices to say that a *lower*  $\sigma$  is associated with a higher  $Q$  (and thus higher  $C$  and  $U$ ), simply because it implies lower labor allocations to the automotive sector. Equation (6b) also implies a simple graphical representation for the relationship between aggregate value-added per worker  $y$  and  $\sigma$ , as shown in Figure 1 below.

Figure 1 shows that when  $\sigma = 0$ , the maximum value for  $y$  (i.e.,  $y = 1$ ) obtains. This (0,1) pair corresponds to the one-sector version of the model. The two curves drawn in Figure 1 show the  $(y, \sigma)$  *loci* for each level of the parameter  $s$ . Technological progress takes one or both of two forms: (i) movements along the curves in the NW direction represent reductions in  $\sigma$  accompanied by increases in  $y$ : that is, a lower  $\sigma$  implies a higher  $y$  up to its maximum value of 1, thanks to lower labor reallocations to the automotive industry; and (ii) outward shifts in the curves depict the effects of

higher values for  $s$ : for any given value of  $\sigma$ , a higher  $s$  (say, from  $s_0$  to  $s_1 > s_0$ ) is associated with a higher value of  $y$  (say, from  $y_0$  to  $y_1 > y_0$ ).

While technological progress in the automotive industry in and of itself cannot fully offset the adverse impacts of labor reallocation, it does go some way towards providing a partial countervailing force. Furthermore, from the point of view of a government that inherits a previously-established auto-industry, technological change will make all the difference: Policies that help reduce  $\sigma$  or increase  $s$  will determine the overall impact on output and welfare.

**Figure 1. Value-Added Per Worker and Labor Misallocation**



## VI. Model Limitations and Possible Extensions for Future Research

While highly stylized, the model discussed in this paper sheds light on the risks and costs of fomenting structural change by fiat, through the use of highly distortionary policy choices. The results of the model are also consistent with the empirical evidence presented in IDB (2010) and the papers in Araujo *et al* (2016) on the role of resource misallocation in constraining Latin America’s economic growth prospects. Nonetheless, the analysis in this paper could usefully be extended in different directions, which are not pursued here but rather left as a possible future line of research.

One such extension is the introduction of a time dimension. As it is, the model is presented in a static, one-period setup. An intertemporal setup would allow for a more refined discussion of consumption behavior as well as for the possible consideration of positive externalities – such as learning effects or technology transfer – from manufacturing vehicles domestically. Such spillovers could only be appropriately analyzed in a dynamic context, in which they could (at least partially) compensate over time for the adverse effects from import substitution discussed in the previous section.

The model could also potentially be extended to incorporate spatial dimensions. This would involve modeling “regions” at different development levels within a country. In this case, policy distortions could take the form of fiscal incentives (such as tax breaks) designed to attract vehicle manufacturing

plants to underdeveloped regions, with benefits which are ultimately uncertain even for the direct beneficiaries.<sup>10</sup>

Furthermore, import substitution policies could be presented in less extreme forms than an outright ban on import vehicles. For example, the two-sector model could replace the import ban assumption with the introduction of a tariff on finished vehicle imports or a subsidy to the domestic production of vehicles. This would be closer to what has been done in practice (Cechetti *et al.* [2007]). Such extensions would allow for a more nuanced policy discussion and an explicit consideration of trade, fiscal and industrial policy options and their implications.

## VII. Conclusions

The model presented in this paper unambiguously shows that creating a new sector from scratch by means of imposing a major distortion – in this case a direct ban on finished vehicle imports – can have serious economic costs. In fact, this “forced” introduction of an automotive sector generates large costs for the economy in terms of reduced output, consumption and welfare, as well as lower real wages. These costs are brought about by a resource misallocation at the genesis of the process, namely, the diversion of labor from the final good sector to vehicle assembling. Ultimately, this labor diversion acts like a tax on firms producing the final good.

Despite its simplicity, the model shows in rather stark terms the consequences of this original misallocation. Relative to the model where imports of finished vehicles are allowed, the output of the final good goes down; consumption is lowered; and overall welfare is reduced. Importantly, the equilibrium stock of vehicles available in this economy is also reduced, defeating the purpose of the imposition of import substitution. Finally, the creation of an automotive sector is not neutral regarding factor prices: the resulting lower wages imply that revenues in the newly-created sector are generated at the expense of labor income. Technological progress in the automotive sector provides some compensation for these adverse impacts – but cannot fully offset them unless  $s$  tends to infinity and/or  $\sigma$  tends to zero. However, once an automotive industry is brought into existence, its technological makeup will be fundamental to determine the overall impact on output and welfare.

A key issue for policy makers is what to do next, once they are aware of the costs of labor misallocation: Namely, dismantle or reform the automotive sector, by attempting to make it more competitive? The model presented in Section III cannot answer all the questions that would arise from undertaking an adjustment process. However, given that  $s$  and  $\sigma$  are measures of (in)efficiency, policy makers could endeavor to reduce them through investing in infrastructure; fostering human capital accumulation; and making the economy more competitive via greater trade and FDI openness.

The analysis also suggests that sector-oriented, “vertical” policies need to be conceived within a general equilibrium context. That is, industrial policies need to be evaluated in terms of their impact on all economic sectors, not just those that are directly targeted by them. Only then can the trade-offs associated with such policy decisions be properly assessed.

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<sup>10</sup> See e.g. Cavalcanti and Uderman (2004).



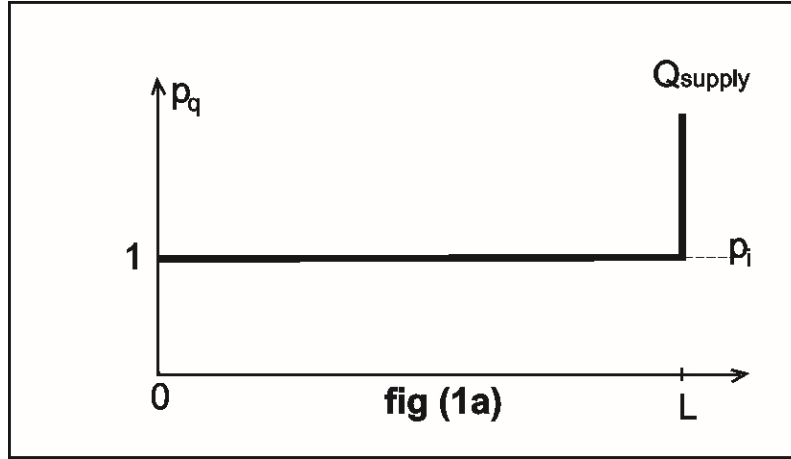
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### Appendix. Implications of the Choice of *Numeraire*

As it will become clear, the selection of  $p$  as numeraire is not a mere choice of a unit-of-account. This choice directly implies that the supply function of  $Q$  is the one depicted in Figure 1(a).

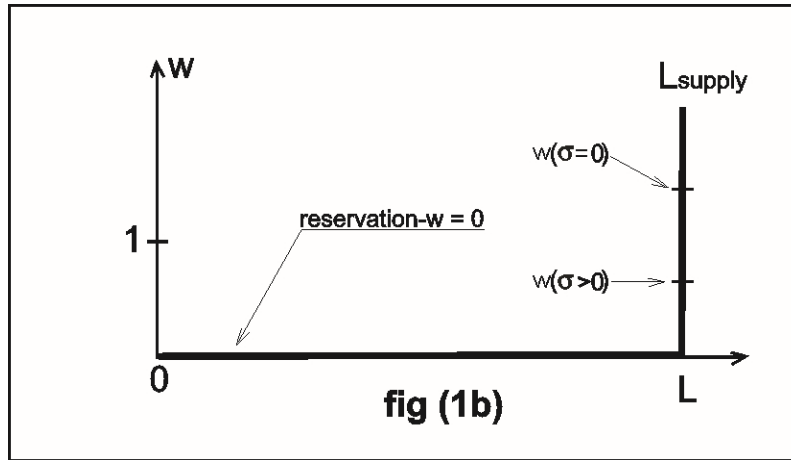
**Figure 1(a). Supply Function of  $Q$  with  $p$  as Numeraire**



In other words,  $p$  as numeraire implies that: (1) the supply function of  $Q$  is infinitely elastic in steady-state for  $Q \leq Q = sV$  regardless any cost raising effects brought about by the assembling technology; and (2) despite any increase in the cost of  $S$ , the total production cost of  $Q$  remains constant. But this is possible if and only if wages,  $w$ , fall enough to compensate for this cost increase.

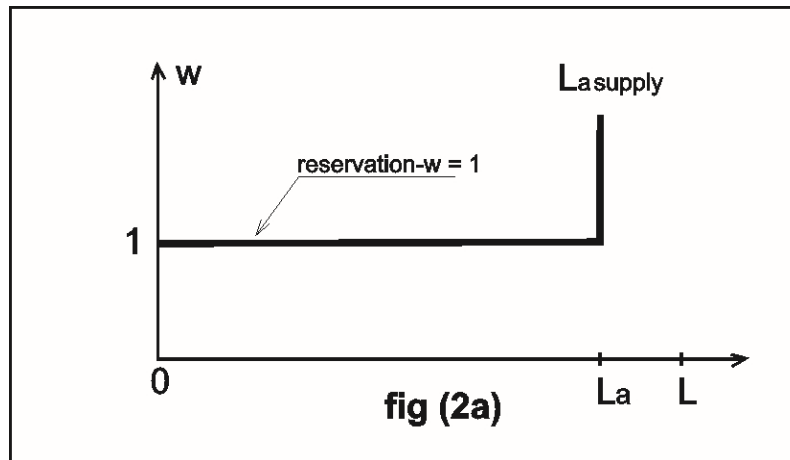
This, in turn, requires that the supply of labor be perfectly inelastic, with individuals' reservation-wage equal to zero, along that relevant range, as depicted in Figure 1(b).

**Figure 1(b). Supply Function of  $L$  with  $p$  as Numeraire**



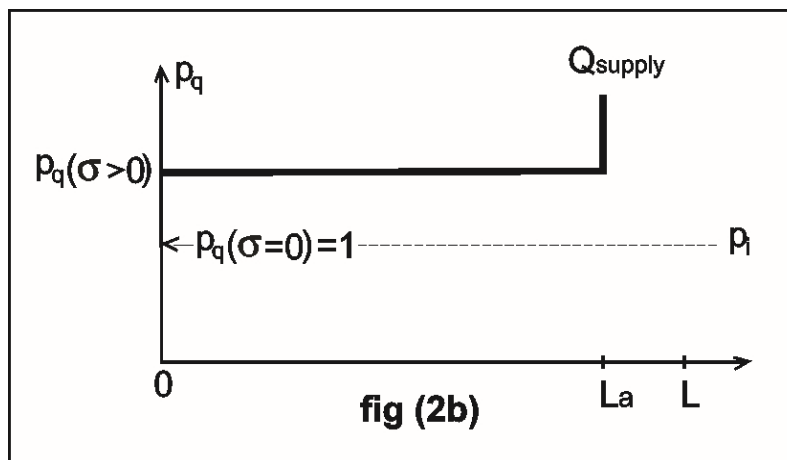
Now take  $w$  as *numeraire*. Again, this is not just a mere “mechanical” way of choosing the unit-of-account. This choice means that the reservation wage is constant and positive,  $w > 0$ , so that the supply function of labor is like the one depicted in Figure 2(a).

Figure 2(a). Supply Function of  $L$  with  $w$  as Numeraire



Under these circumstances, any increase in the cost of providing vehicle services  $S$  will: (1) increase the total cost of production of  $Q$  by the same amount; and (2) push the domestic supply price of  $Q$  upwards, as shown in Figure 2(b).

Figure 2(b). Supply Function of  $Q$  –  $w$  as Numeraire



However, in this version of the model the economy can no longer export  $Q$  to pay for its imports of  $V$ . At the same time, consumers become willing to import  $Q$  from abroad. The economy is in danger of collapsing. Clearly, a set of complementary assumptions is necessary to save the economy from collapsing.

The first and inevitable complementary measure to save it is the prohibition to import  $Q$ : protectionism in the  $V$  industry calls for protectionism in the  $Q$  industry. But that it is not enough: Just protecting the  $Q$  industry does not help the country to export  $Q$  in order to pay for the  $V$  imports: export prices must be equal to be  $p_i$  but now the domestic supply price of  $Q$  is greater than  $p_i$ . This economy has become hostage of policies aimed to increase exports.

One solution to this dilemma would be to implement export-subsidy policies. A scheme of price discrimination under which domestic firms would sell  $Q$  competitively at the international level and offer it for a price greater than  $p_i$  domestically could be devised.

Their message is clear: once a protectionist policy is introduced, a cascade of further protectionism and inefficient corrective policies is put forth to deal with all the problems created by the original distortion.

The introduction of  $w$  as numeraire also affects the simulation results presented in Section IV. This choice of numeraire implicitly assumes that the *reservation-wage* is given and positive. Consequently,  $\sigma > 0$  pushes both  $\varrho$  and  $p[q]$  upwards. As  $p[q]$  becomes greater than  $p[i]$  it is necessary (a) to prohibit imports of  $Q$  and (b) to subsidize its exports, otherwise the domestic economy will sink. The initial cost of the subsidy may be directly imposed on any one of three economic agents alone or on a combination of them. To simplify, this paper imposes such a cost on only one of them at a time, the household, the  $Q$  producers or the  $V$  producers.

**Table 2. Simulations with  $w$  as *numeraire***

	$\sigma = 0$	$0 < \sigma$	$0 < \sigma$	$0 < \sigma$
<i>Variables</i>		$a = 1$	$b = 1$	$c = 1$
$p_i$	$\frac{3}{2}$	$\frac{3}{2}$	$\frac{3}{2}$	$\frac{3}{2}$
$p_q$	$\frac{3}{2}$	$\frac{3}{2} + \frac{1}{2}\sigma$	$\frac{3}{2} + \frac{3}{5}\sigma$	$\frac{3}{2} + \frac{3}{4}\sigma$
$w$	1	1	1	1

$p_v$	1	$1 + \sigma$	$1 + \sigma$	$1 + \frac{3}{2}\sigma$
$\rho$	$\frac{1}{2}$	$\frac{1}{2} + \frac{1}{2}\sigma$	$\frac{1}{2} + \frac{3}{5}\sigma$	$\frac{1}{2} + \frac{3}{4}\sigma$
$Lq$	1	$4 \frac{1}{4 + \sigma}$	$4 \frac{1}{4 + \sigma}$	$4 \frac{1}{4 + \sigma}$
$La$	0	$\frac{\sigma}{4 + \sigma}$	$\frac{\sigma}{4 + \sigma}$	$\frac{\sigma}{4 + \sigma}$
$S$	1	$4 \frac{1}{4 + \sigma}$	$4 \frac{1}{4 + \sigma}$	$4 \frac{1}{4 + \sigma}$
$Q$	1	$4 \frac{1}{4 + \sigma}$	$4 \frac{1}{4 + \sigma}$	$4 \frac{1}{4 + \sigma}$
$C$	$\frac{5}{6}$	$\frac{10}{3} \frac{1}{4 + \sigma}$	$\frac{10}{3} \frac{1}{4 + \sigma}$	$\frac{10}{3} \frac{1}{4 + \sigma}$
$V$	5	$20 \frac{1}{4 + \sigma}$	$20 \frac{1}{4 + \sigma}$	$20 \frac{1}{4 + \sigma}$
<i>Subsidy</i>	0	$\frac{1}{3} \frac{\sigma}{4 + \sigma}$	$\frac{2}{3} \frac{\sigma}{4 + \sigma}$	$\frac{1}{2} \frac{\sigma}{4 + \sigma}$