Albert G. Schweinberger and Jens Suedekum

De-Industrialisation, Entrepreneurial Industries and Welfare

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Abstract

We develop a two-sector general equilibrium model with monopolistic competition featuring nonhomothetic production and a variable demand elasticity for the manufactured goods. An increase in the relative price of manufacturing varieties can lead to a decline in total industrial output in our framework, i.e., to de-industrialisation. The two key mechanisms behind this surprising result are that the founding of firms requires skilled labour as a fixed input requirement, and that the price increase can raise the profit margin in the manufacturing industry and thereby induce firm entry. When the manufacturing sector mainly adjusts at the extensive margin, we refer to this industry as being *entrepreneurial*. Due to the fixed input requirement entry reduces the effective endowment of skilled labour available for production. This reduces industrial output owing to a novel generalized version of the Rybczynski effect. De-industrialisation occurs if that effect is sufficiently large in comparison with the standard output price effect for a given number of firms. Furthermore we prove the counterintuitive result that de-industrialisation implies a fall in the output per firm and under plausible conditions a rise in welfare. Our results shed new light on the current debates about possible causes of premature de-industrialisation and its welfare effects.

JEL Classification: F12, D43

Keywords: Entrepreneurial industries, monopolistic competition, de-industrialisation, welfare effects

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1). Introduction

De-industrialisation, defined either as a fall in the share of industrial output in GDP or the share of industrial employment in total employment, and its short and long run term effects on growth and development are time honoured topics of a huge empirical and theoretical research effort since the seminal contributions by Kaldor (1966, 1967). Recently the topic has acquired a new dimension because some economists have focussed in their empirical work on "premature de-industrialisation", i.e., de-industrialisation at a much lower level of per capita income than observed historically in today's advanced economies (see e.g., Dasgupta and Singh 2007). A structural tendency of premature de-industrialisation appears to be evident in a number of countries in Latin America in the 80's and 90's. In Asian countries de-industrialisation occurs in mature economies such as Hongkong China or Taipei China. One of the reasons is undoubtedly a relocation of production to mainland China. On the other hand, there exists also some prima facie evidence that premature de-industrialisation exists in less mature Asian countries such as the Philippines, Indonesia or India.[1] This raises two key issues: (a) what are the main causes of de-industrialisation? (b) is de-industrialisation a pathological or benign structural tendency?

To answer these questions we adopt a perspective that is based on a two-sector general equilibrium model of a small open economy with monopolistic competition. It seems to us that, the many interesting results of the received literature on the causes and consequences of de-industrialisation notwithstanding, our approach yields a number of novel and important insights. This is mainly due to the fact that monopolistic competition models allow us to capture in a relatively simple framework the interaction between the number of firms, firm size, and total industry output.

Standard wisdom suggests that a small open economy which faces an increase in the world relative price of its export commodity – an improvement in the country's terms of trade – will expand the export industry and receive a welfare gain. This holds true in a perfectly competitive model and, subject to standard assumptions, also if the export sector is monopolistically competitive (see

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[1] Recent empirical contributions on these issues include Rodrik (2006), Debande (2006) or Felipe and Estrada (2008).

Helpman and Krugman 1985).[2] In contrast we show that de-industrialisation can occur in a model of monopolistic competition if one relaxes some of the standard but empirically questionable assumptions of the received literature.

In the received literature, it is typically assumed that production in the increasing returns industry uses only labour (Krugman 1979, 1980) or that production is homothetic (e.g., Helpman/Krugman, 1985; Markusen/Venables, 2000). The basic tenet of our paper is that the setting up of new firms is an *entrepreneurial* activity which requires special skills. Not all the factors used in production are endowed with such skills. In our simple 2Δ2 model both industries use both factors (unskilled and skilled labour) as variable inputs. In addition, there is a fixed input requirement of skilled workers to act as entrepreneurs, i.e., to start up new manufacturing firms. This setup cost gives rise to non-homotheticity.[3] The second widely adopted assumption in monopolistic competition models is constant demand elasticity for manufactured goods, typically owing to preferences with a constant elasticity of substitution across varieties (see Dixit and Stiglitz, 1977). As is well known, this property implies that producers charge constant markups over marginal costs, which leaves no room for price changes to affect profit margins. In our model we relax this standard assumption and allow for variable demand elasticity and therefore endogenous profit margins.[4]

Consider an increase in the world relative price of manufacturing goods. According to the received literature this should lead to an expansion of total industrial output. Yet, due to changes in the profit margin in the short run equilibrium, there occurs also an endogenous change in the number of firms. If the price increase has a sufficiently strong positive effect on the profit margin this induces entry

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[2] Evidence for this scenario has been provided by Dodzin and Vamvakidis (2004), who argue that openness tends to raise the industrial value added share in LDCs rather than the share of low-quality agriculture. Wacziarg and Wallack (2004), however, obtain more mixed results for the implications of trade liberalization episodes on the sectoral reallocations of labour. Empirical research on the effect of terms of trade changes on (de-)industrialization is in its early stages and has not yet come up with definite conclusions.

[3] Empirical work strongly suggests that non-homothetic production is a salient feature of reality (McDonough, 1992).

[4] There is an older literature (Helpman 1980, Horn 1983, Lawrence and Spiller 1983, Chao and Takayama 1990) that has looked at non-homothetic production in monopolistic competition models. Furthermore a more recent literature uses quasi-linear preferences in trade models, which generate demand systems with variable demand elasticity (see Ottaviano et al. 2002). However the absence of income effects of demand gives these models a strong partial equilibrium flavour. Behrens and Murata (2007) have recently studied quasi separable preferences in a fully-fledged one factor general equilibrium model of monopolistic competition. In sum, to our best knowledge there is no paper that simultaneously relaxes homothetic production and constant demand elasticity. Furthermore, none has focussed on the precise mechanism of de-industrialisation and welfare changes which represents the key contribution of this paper.

of new firms in the manufacturing industry, i.e., it induces *entrepreneurial* activity.[5] Due to non-homothetic production this implies that more skilled labour must be used as fixed input requirement and therefore the effective endowment of skilled labour available for production purposes decreases. [6] On the other hand the decrease in the endowment of skilled labour for production per se does not imply de-industrialisation. This is due to the fact that, given the number of firms in the manufacturing industry, the price increase also entails the well known output price effect. Which effect dominates depends, inter alia, on the relative allocation of skilled labour to the setting up of firms and production. To answer this question, we put forward a novel generalized Rybczynski effect. It turns out that the increase in the relative price of the manufacturing good can lead to a *decline* in total manufacturing output (i.e., to de-industrialisation) if the positive impact on the profit margin and the generalized Rybczynski effect are larger than the short run output price effect.

Even more surprising, we show that – subject to plausible assumptions – the de-industrialisation which may be induced by the price increase is still associated with a welfare gain rather than a welfare loss. This is a counterintuitive result because it is well established that the monopolistically competitive long run equilibrium with a variable demand elasticity can be inefficient essentially for two reasons (a) the number of varieties may not be optimal and (b) the output per firm is too low (see e.g. Mankiw and Whinston 1986). In our framework, paradoxically, de-industrialisation does *not* give rise to a welfare loss. This follows because de-industrialisation is associated with an increase in the number of varieties, and the latter can be shown to be underprovided. Most importantly, given our framework the decline in output per firm associated with de-industrialisation, in contrast to the received literature, does not lower welfare.

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[5] It is well documented that in some industries the adjustment to positive exogenous shocks, as for example an increase in world prices, takes place mainly at the extensive margin through a setting up of new firms rather than through an increase in the output per firm at the intensive margin. Klemper and Graddy (1990) typify the evolution of firm numbers and industry concentration in response to new market opportunities. During an early stage they find that firms rush in to take advantage of the new opportunities. It is followed by a stage of a shakeout that reduces the number of inefficient firms, see also Brandt et.al. (2008). An entreneurial industry in our definition would, thus, be one in the early stage where positive shocks generate entry.

[6] Start-up costs also play a crucial role as a development trap in Ciccone and Matsuyama (1996).

From a broader perspective, our approach highlights a shortcoming of the received literature on pro or anticompetitive effects of price changes (which may be brought about, e.g., by trade liberalisation or commercial policy). On the one hand an increase in the profit margin is defined as an anticompetitive effect. However the said *anticompetitive* effect may have long run *procompetitive* consequences, in the sense of bringing about an increase in the number of firms. Our results can have far reaching policy implications. For example, a tariff on manufacturing varieties may be protective by raising domestic profit margins in the short run, but anti-protective in the long run because it lowers output.

Our model is complementary to several contributions which address the long-standing concern that exposure to international trade may lead to de-industrialization due to the presence of increasing returns (see e.g. Faini 1983). Similar results can also be found in the vast literature on the home market effect and in the new economic geography (Krugman 1980, 1991). Furthermore some classical causes of de-industrialisation have been discussed in the development literature, such as *immiserizing growth* or the *Dutch disease* (Neary and Corden 1984). Clearly, there are many possible causes of de-industrialization. We believe that we have unearthed a novel cause which is intrinsic to a "more realistic" model of monopolistic competition. Our theory may be particularly helpful to understand the aforementioned trends of premature de-industrialisation in some Asian countries. This follows because there exists some prima facie evidence (see e.g. Brandt et alii, 2008) that in some Asian economies entrepreneurship and entrepreneurial industries play a very important part in the development process.

The rest of this paper is structured as follows. In section 2 we develop the basic model structure. The positive analysis of the relative price change is presented in section 3, whereas section 4 turns to the welfare analysis. Section 5 concludes and discusses some directions for further research.

2.) The model

Consider a small open economy with exogenous endowments of unskilled labour V_1 and skilled labour V_2. All individuals have identical and homothetic preferences. Production in industry 1 ("agriculture") is perfectly competitive. This good serves as the numeráire. Industry 2 ("manufacturing") is characterized by product differentiation and monopolistic competition. In total there are n symmetrical varieties, each produced by a single firm. Both industries use both factors as variable inputs. In addition, there is a fixed input requirement of b units of skilled labour per manufacturing firm. Manufacturing production is non-homothetic owing to the set up costs. The economy is described by the following five equations.

$$a_{11}/w_1,w_2 0 X_1 2 a_{12}/w_1,w_2 0 X_2 | V_1 \tag{1}$$

$$a_{21}/w_1,w_2 0 X_1 2 a_{22}/w_1,w_2 0 X_2 | V_2 4 b \, \mathring{n} \sum \mathring{V}_2 \tag{2}$$

$$c_1/w_1,w_2 0 \sum a_{11}/w_1,w_2 0 w_1 2 a_{21}/w_1,w_2 0 w_2 | p_1 \sum 1 \tag{3}$$

$$c_2/w_1,w_2 0 \sum a_{12}/w_1,w_2 0 w_1 2 a_{22}/w_1,w_2 0 w_2 | MR_2/p_2 0 \tag{4}$$

$$\left(p_2 4 c_2/w_1,w_2 0\right) [X_2/1, MR_2(p_2), V_1, \mathring{V}_2 0| w_2 \, \mathring{b} \, \mathring{n} \tag{5}$$

The a_{ij}'s are the unit input coefficients of factor i in industry j, which depend on the factor prices w_1 and w_2. By $\mathring{V}_2$ we denote the amount of skilled labour available for production. Equations (1) and (2) are factor market clearing conditions. Equation (3) represents the zero net profitability condition in the perfectly competitive industry. Equation (4) follows from profit maximisation in the monopolistically competitive industry. X_j stands for the total output in industry j. In manufacturing, marginal costs $c_2/w_1,w_2 0$ must equal marginal revenue $MR_2/p_2 0| p_2/1 4 1/\omega(\int 0$, where $\omega(\int \sum 4/dx_2(p_2)/dp_2 0 \int p_2/x_2(p_2)0\} 1$ is the price elasticity of demand for a typical variety. Finally, equation (5) represents the zero net profit condition for the manufacturing sector. Aggregate profits from production equal aggregate fixed costs, $w_2 \, \mathring{b} \, \mathring{n}$.

Note that $X_2 / \emptyset$ is an aggregate supply function which is linear-homogeneous in V_1 and $\mathring{V}_2$. It seems natural to assume that manufacturing production is intensive in skilled labour ($a_{22}/a_{21} \} a_{12}/a_{11}$ &w_1, w_2). Furthermore, from expression (5) it follows that long run profits in the manufacturing industry decline (rise) monotonically as n rises (falls). This entails that the equilibrium solution of equations (1) to (5) is unique provided only that the Jacobian determinant of the production cost functions is nonzero. We assume throughout the paper that both goods are produced. Furthermore, following a huge literature, we also assume that preferences are homothetic, on the other hand, in contrast to the received literature we do not make use of specific utility functions.

Our model has three useful properties. Firstly, it focuses on the interactions between goods and factor markets assigning a special role to skilled labour as *entrepreneurs*. As will be shown below, many of our results hinge on the allocation of skilled labour between entrepreneurial tasks (the founding of firms) and production. Secondly, it is more general than many standard models of monopolistic competition because we do not postulate constant demand elasticity. This allows us to consider the effects of price changes on the profit margin. Thirdly, it lends itself to an application of duality theory. We can make use of an appropriately defined optimization theorem (see Woodland 1982: 49ff.) to derive a marginal revenue function $R\left(1, MR_2(p_2), V_1, \mathring{V}_2\right\} \mid X_1 2 MR_2(p_2)X_2$, which has standard properties, e.g.: it is linearly homogeneous and concave in V_1 and $\mathring{V}_2$, and convex in $MR_2(p_2)$.

In what follows we perform a comparative static exercise and investigate the effects of an increase in the price of a manufacturing variety, p_2, which is brought about by a change in world relative prices which the small country takes as given.[7] During this analysis we distinguish carefully

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[7] Since all varieties are assumed to be symmetrical there is just one price in equilibrium. For simplicity we will frequently refer to the monopolistically competitive sector as the "manufactured good". Further note that, if the small country is a net exporter of the manufactured good, the relative price increase represents an improvement in the country's terms of trade.

between short run effects (keeping n unchanged) and long run effects on total manufacturing output X_2 (allowing n to adjust so that equation (5) is fulfilled).

Before proceeding with the formal analysis, it is useful to focus on the role played by non-homotheticity of production in our model. Note that the long run equilibrium condition (5) implies that $p_2 \mid c_2(w_1, w_2) 2 w_2 b / x_2$, where x_2 denotes output per firm. This expression highlights that the production of the manufactured good diverges more from homotheticity the lower x_2. We should therefore expect to obtain counterintuitive results if an increase in p_2 is associated with a lower x_2.

3.) An increase in the relative price and de-industrialisation

We consider an increase in the world price of manufacturing varieties p_2. The small country may be a net exporter or net importer of manufacturing varieties. Totally differentiating total industry output $X_2 / \mathring{0}$, while leaving endowments unchanged, yields

$$dX_2 / \mathring{0} \mid \frac{\in X_2}{\in MR_2} \left(\frac{\in MR_2}{\in p_2} \left(dp_2 \; 4 \; \frac{\in X_2}{\in \mathring{V}_2} \right) \right) \mathring{b} \; \left(dn \right) \tag{6}$$

For notational convenience we denote an elasticity by $\kappa_{a,b} \sum d\log(a)/d\log(b)$ from now on, so that the *competitive effect* of the price increase is represented by $\kappa_{MR_2, p_2} \} 0$.[8] Furthermore, let $\pi \sum b \, n / \mathring{V}_2 \} 0$ stand for the ratio of skilled labour used in the setting up of firms relative to its use in production. Furthermore let relative changes be expressed by a "hat". We can then rewrite (6) as

$$\hat{X}_2 \mid \left(\kappa_{X_2, MR_2} \; \left(\kappa_{MR_2, p_2} \right) \hat{p}_2 \; 4 \left(\pi \; \left(\kappa_{X_2, \mathring{V}_2} \right) \hat{n} \right. \tag{6'}$$

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[8] We assume throughout the paper that $\kappa_{MR2, p2} \sum d\log / MR_2 \mathring{0} / d\log / p_2 \mathring{0} \} 0$. There is an anti-competitive effect if the elasticity of marginal revenue with respect to price is smaller than one, i.e., if $0 \{ \kappa_{MR2, p2} \{ 1$. In the special case with iso-elastic demand we would have $\kappa_{MR2, p2} \mid 1$, whereas a pro-competitive effect requires that the elasticity of demand is a decreasing function of consumption, $\kappa_{MR2, p2} \} 1$ (see Feenstra 2004). Helpman/Krugman (1985: 134) use a similar measure of "monopoly power". On pro- and anti-competitive effects, see also Schweinberger (1996).

The *output effect* of the price increase makes, ceteris paribus, for an expansion of the manufacturing industry ($\hat{X}_2 > 0$). This effect shows up in the first term in (6′), which is positive and represents the typical movement along the domestic transformation curve as the relative price of the manufacturing good increases. Note that this effect is ceteris paribus smaller the stronger the *anticompetitive effect* of the price increase, i.e., the smaller κ_{MR_2, p_2}.

If manufacturing production were homothetic and the demand elasticity constant, this output effect would clearly dominate because total output and the number of firms then always change proportionally and output per firm remains constant. In a model with non-homothetic production, however, the induced change in the number of firms may overturn this standard result. Induced entry $\hat{n} \} 0$ works against domestic output expansion, because the skilled labour endowment used in production decreases. This decrease in the labour endowment $\overset{\circ}{V}_2$ will reduce total output X_2. The extent of the reduction in output depends not only on the well-known standard Rybczynski effect but also on the allocation of skilled labour to the setting up of firms and production. We therefore make use of a novel *generalized Rybczynski effect*. The latter is equal to the standard Rybczynski effect, $\kappa_{X_2, \overset{\circ}{V}_2}$, weighted by the share of skilled labour used in the setting up of firms relative to the share used in production. From the standard Rybczybski theorem we know that $\kappa_{X_2, \overline{V}_2} \} 1$. This standard Rybczybski effect is magnified if $\pi \sum bn / \overset{\circ}{V}_2 \} 1$, i.e., if relatively more skilled labour is used in the setting up of firms than in production.

To address the induced change in the number of firms, we totally differentiate expression (5) and solve for $\hat{n}$ (see appendix A for details of this derivation). We obtain:

$$\hat{n} \mid \frac{\kappa_{X_2, MR_2} \left(\kappa_{MR_2, p_2} 4 \kappa_{w_2, MR_2} \left(\kappa_{MR_2, p_2} 2 ' \mid p_2 4 MR_2 (\int \left(\kappa_{MR_2, p_2} 0 \right) \right) \right)}{1 2 \pi \left(\kappa_{X_2, \overset{\circ}{V}_2} \right)} \hat{p}_2 \tag{7}$$

where $' \sum \left| 1 2 \frac{c_2 / (X_2 / 0)}{b (k_2 / 0)} 0 \right) / p_2 \} 0$. In order to gain insights from expression (7), it is useful to interpret it in terms of a movement along an isoprofit line for the whole industry.

Define industry profits as $\phi \equiv \left[p_2 \, \& \, MR_2/p_2 \, (\!\!\, X_2 /.04 \, w_2 bn \, \right] \, \phi/p_2 , n)$. Clearly, before and after the increase in p_2 we must have (in the long run) $\phi(p_2, n) \equiv 0$. Therefore we can write $d\phi \equiv \partial\phi/\partial p_2 dp_2 \, 2 \, \partial\phi/\partial n dn \equiv 0$. Since we know that $\partial\phi/\partial n < 0$, it follows at once that $dn/dp_2 > 0$ if and only if $\partial\phi/\partial p_2 > 0$. The economic interpretation of $\partial\phi/\partial p_2$ is clearcut: it stands for the short run effect of the price increase on the profitability of the industry (keeping n fixed). In other words, the price increase will induce entry of firms if it raises the short run profitability of the manufacturing industry, and the extent of the increase in n depends upon how much profitability declines as more firms enter the industry (on $\&\,\partial\phi/\partial n \equiv \, 12 \, \pi \, (\!\kappa_{X_2, \dot{V}_2})$).

The short run effect of the price increase $\hat{p}_2 > 0$ on industry profitability shows up in expression (7) as the three terms in the numerator. We can distinguish the following channels:

(1) <u>Output effect</u>: Industry profitability rises because in the short run an increase in p_2 implies a rise in X_2 (keeping the profit margin from production constant), $\kappa_{X_2, MR_2} \, (\!\kappa_{MR_2, p_2}) > 0$.

(2) <u>Stolper-Samuelson effect</u>: Industry profitability falls because the increase in p_2 entails an increase in the price of the factor used more intensively in manufacturing, namely skilled labour. The rise in w_2 then increases the cost to set up new firms, $\&\,\kappa_{w_2, MR_2} \, (\!\kappa_{MR_2, p_2}) < 0$.

(3) <u>Profit margin effect</u>: Industry profitability may rise or fall because an increase in p_2 may raise or lower the profit margin $p_2 \, \& \, MR_2(p_2) \equiv \, p_2 \, \& \, c_2(w)$. The sign of the third term is, thus, ambiguous a priori and depends on the competitive effect κ_{MR_2, p_2}.

Using (7) in (6′) we can derive the endogenous reaction of total manufacturing output, taking into account the change in the number of firms that is induced by the price increase.[9]

$$\hat{X}_2 \equiv \frac{\kappa_{X_2, MR_2} \, (\!\kappa_{MR_2, p_2}) \, 2 \, \pi \, (\!\kappa_{X_2, \dot{V}_2}) \left(\kappa_{w_2, MR_2} \, (\!\kappa_{MR_2, p_2}) \, \& \, ' (p_2 \, \& \, MR_2 \, (\!\kappa_{MR_2, p_2}))\!\right)}{|\,12 \, \pi \, \kappa_{X_2, \dot{V}_2} \, ()} \, (\!\hat{p}_2 \qquad (8)$$

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[9] Recall from (6′) that firm entry is only a necessary but not a sufficient condition for de-industrialization.

As in expression (7), the numerator of (8) is made up of three effects: an output effect, a Stolper-Samuelson effect and a profit margin effect. It can readily be seen that the output effect $\kappa_{X_2, MR_2} \left(\kappa_{MR_2, p_2} \right\} 0$ makes for an increase in the number of firms as well as for an increase in aggregate output. Secondly, the Stolper-Samuelson effect $\kappa_{MR_2, p_2} \left(\kappa_{w_2, MR_2} \right\} 0$ lowers the number of firms but pushes aggregate output in the opposite direction. This is not surprising: the Stolper-Samuelson effect raises fixed costs and thereby discourages the setting up of new firms. This implies ceteris paribus that more skilled labour is available for the use in production. Finally, the third term in the numerator of (8) and (7) is the profit margin effect. As said above, the overall sign of this effect is ambiguous as the profit margin may rise or decline after the price increase. Yet, when assuming that $0 \left\{ \kappa_{MR_2, p_2} \left\{ 1 \right. \right.$, it will be the case that the price increase $\hat{p}_2 \right\} 0$ raises the profit margin in the manufacturing industry.[10] In that case we obtain the interesting result that the price increase induces an *anticompetitive* effect in the short run, but finally has *procompetitive* consequences in the sense of bringing about an increase in the number of firms. At the same time this profit margin effect makes for de-industrialization as firm entry reduces the amount of skilled labour available for use in production. Notice that in contrast to expression (7), the Stolper-Samuelson effect and the profit margin effect are weighted in expression (8) by $\pi \left(\kappa_{X_2, \hat{V}_2} \right.$. Hence, whichever of the two effects dominates, the net impact on total industrial output will be stronger the larger the generalized Rybczynski-effect $\pi \left(\kappa_{X_2, \hat{V}_2} \right.$. In particular, the net impact will be stronger the larger the magnification term π.

We are now in a position to derive our first main result. To this end we first define two useful new concepts associated with an increase of the price of the manufactured good.

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[10] It seems one can make a strong empirical case for the increase in the price having a significant positive effect on the profit margin, at least in certain types of manufactured goods. In this context it is noteworthy that Feenstra (2004: page 138) puts considerable emphasis on the restrictiveness of the standard assumption of the received literature that an increase in consumption entails a fall in the elasticity of demand.

Definitions: The *marginal profitability of manufacturing production* (given the number of firms) is defined as: $MPP \equiv \kappa_{X_2,MR_2} \cdot \kappa_{MR_2,p_2}$. The *marginal profitability of setting up firms* is defined as $MPS \equiv -[p_2 + MR_2 \cdot \kappa_{MR_2,p_2}] + \kappa_{w_2,MR_2} \cdot \kappa_{MR_2,p_2}$.

Notice that the *MPS* is equivalent to the sum of the Stolper-Samuelson and the profit margin effect, while the *MPP* is tantamount to the output effect. Using these terms we have the following result:

Proposition 1   Assume that the *MPS* is positive.

(a) A price increase of the manufactured good ($\hat{p}_2 > 0$) implies de-industrialisation ($\hat{X}_2 < 0$) if:

$$\pi \cdot \kappa_{X_2,\hat{V}_2} > \frac{MPP}{MPS}$$

(b) Assume that the manufacturing industry uses more skilled labour in the setting up of firms than in production, i.e., $\pi < 1 \Leftarrow bn < \mathring{V}_2$. Then an increase in the price of the manufactured good entails de-industrialisation if the *MPS* is larger than the *MPP*.

Proof: Proposition 1 readily follows from expression (8).

If the price increase raises total output only by a small amount (for given n), but the *MPS* is relatively high, then de-industrialisation will occur if more skilled labour is used in setting up of firms than in production, since the generalized Rybczynski effect is then particularly large. We now proceed to formalise a Corollary to Proposition 1 which highlights the important role of the anticompetitive effect, i.e., the magnitude of κ_{MR_2,p_2} in the fulfilment of the above stated two conditions for de-industrialisation.

Corollary to Proposition 1: de-industrialisation will occur if the anticompetitive effect of an increase in the price of the manufactured good is strong enough.

Proof: As $\kappa_{MR_2, p_2} \Downarrow 0$, expression (7) tends to a positive but expression (8) to a negative value. The condition stated in Proposition 1(a) is fulfilled, because the right hand side tends to zero.

In sum, if the price increase has a strongly anticompetitive effect, the profit margin effect dominates all other effects. Note especially that in the latter case not only new firms enter the industry but also the output price effect tends to zero.

How are increases or decreases in the degree of non-homotheticity of production related to the possible occurrence of de-industrialisation? As argued above, output per firm can be used as a measure of the degree of non-homotheticity. It is straightforward to derive the following result:

Proposition 2: Assume an increase in the price of the manufactured good, $\hat{p}_2 \} 0$.

(a) The output per firm x_2 rises if and only if $\kappa_{w_2, MR_2} \left(k_{MR_2, p_2} 4' / p_2 4 MR_2 \left(k_{MR_2, p_2} \left()\right\} 0\right.$, i.e., if and only if *MPS<0*.

(b) De-industrialisation is impossible if the degree of non-homotheticity of production declines as a result of the price increase, i.e.: x_2 rises.

The proof follows directly by subtracting (7) from (8). If de-industrialisation occurs this must be associated with a decline in firm size.[11]

Having derived a set of conditions under which, subject to our assumptions, de-industrialisation occurs, we now address the following all important issue: should de-industrialisation be of concern to policy makers because it implies a welfare loss?

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[11] There exists an interesting empirical literature, see Head and Ries (1999) and Feenstra (2004), which examines the effect of trade liberalization on the output per firm in export industries. Contrary to the predictions of Krugman (1979), the upshot is that there is no clearcut evidence that the output per firm rises as trade is liberalised.

4.) The welfare effects of changes in the terms of trade

De-industrialisation, generally speaking, may be welfare reducing (pathological) or welfare improving (benign). Dasgupta and Singh (2007) regard de-industrialisation as pathological if it augments unemployment and/or lowers the growth rate of GDP. If, on the one hand, de-industrialisation is due to a resource discovery as in the literature on the *Dutch disease* (see e.g., Neary and Cordon 1984), it is normally regarded as benign. On the other hand, recalling the literature on premature de-industrialisation there appears to be a presumption that it lowers welfare. Clearly there are many causes of de-industrialisation and, therefore, one should not expect to obtain clearcut welfare results across all possible models.

In this paper we focus on the hypothesis that overall de-industrialisation is due to the founding of new firms in the transition process from the short to the long run equilibrium. Intuitively, the following trade-off arises in our model. On the one hand it may be conjectured that de-industrialisation should lower welfare. Recall from proposition 2 that it must entail a fall in the output per firm. This may be perceived as a larger distortion in the economy. As is well known, generally speaking output per firm is too low in models with imperfect competition (and increasing returns to scales). However, if it can be shown that the number of varieties is underprovided in the situation prior to the price increase, then the induced entry of new firms, which in our model is a necessary by-product of de-industrialisation, should raise welfare. A priori it is not obvious which argument prevails.

For the formal welfare analysis we make use of the following expenditure income equality:

$$H \cdot E\left(1, G/p_2, n0, u\right) | Y/p_2, n0, \tag{9}$$

where H stands for the number of households, $E()$ is the expenditure function of a representative household, $G/p_2, n0$ is the price index of the manufacturing varieties, and $Y/p_2, n0$ is the total income function for the whole economy, see appendix B. Notice that $WTP \sum \in E/\in G \in G/\in n \{ 0$ stands for the representative household's marginal willingness to pay (*WTP*) for an increase in the

number of varieties. Since it is generally assumed that this *WTP,* ceteris paribus, declines with the number of varieties already available, one may argue that in developing countries (with small domestic n) this *WTP* should be relatively high.[12]

Using expression (9) we can derive the following condition that must hold for the price increase $\hat{p}_2 \} 0$ to induce a welfare improvement for the small country:

Proposition 3   Assume the price of the manufactured good rises. Welfare increases if the following condition holds:

$$\frac{p_2 / X_2 4 C_2 0}{H} 4 WTP \left(\frac{MPS}{2 \pi \left(\kappa_{X_2, \dot{V}_2} \right)} \right\} } 0 \tag{10}$$

Proof: see appendix B.

The first term in (10) is negative if manufacturing varieties are imported, $p_2 C_2 \} p_2 X_2$, and positive if the country is an exporter of manufactured goods, $p_2 C_2 \{ p_2 X_2$. Owing to the fact that $WTP \sum \in E / \in G \left(G / \in n \{ 0 \right.$ and $\pi \left(\kappa_{X_2, \dot{V}_2} \right) \} 0$ the second term in (10) is positive provided that the *marginal profitability of setting up firms* is positive, i.e., if $MPS \} 0$.

Proposition 3 yields several interesting insights. Assume first that good 2 is exported. In the latter case we obtain the following result from expression (10).

Corollary to Proposition 3: Assume that the small open economy exports the manufactured goods in free trade equilibrium and the price of the manufactured goods rises.

(a)   There is a welfare gain if the *MPS* is positive, i.e., if

$$MPS \sum \; / p_2 4 MR_2 \left(\kappa_{MR_2, p_2} \right) 04 \kappa_{w_2, MR_2} \left(\kappa_{MR_2, p_2} \right) \} 0$$

(b)   Assume that $\hat{p}_2 \} 0$ entails de-industrialisation,i.e.: $\hat{X}_2 \{ 0$. Then $\hat{p}_2 \} 0$ implies a welfare

gain.

Proof: see expressions (7), (8), (10) and appendix B.

Clearly part (a) of the corollary states a more general condition than part (b). This follows because a

positive *MPS* implies that the number of firms rises but not necessarily de-industrialisation (see

proposition 1). Proposition 3 and its corollary evidently entail that the supposedly negative effect on

welfare of a decline in output per firm is more than offset by the positive effect of an increase in the

number of varieties. We know that an increase in the number of firms "causes" de-industrialisation

if the conditions of Proposition 1 or its corollary are satisfied. Note that in our model changes in *n*

per se have no effects on total income since the allocation of skilled labour to production and the

setting up of firms is supply-side efficient. In other words the assumed perfect mobility of skilled

labour between production and the setting up of firms has decoupled de-industrialization and

supply-side welfare effects (see appendix B). [13] We know from proposition 2 that de-

industrialisation can occur only if the output per firm falls. In the received literature a fall in the

output per firm implies (ceteris paribus) a welfare loss. This is not the case in our model. There are

two main reasons for this. Firstly, the number of varieties (firms) is too low (see appendix B for the

formal proof). Secondly, changes in the output per firm have no welfare effects if both goods are

produced before and after the increase in p_2 .

Let us now turn to the case where the manufactured good is *imported*, i.e., where the price increase

implies a *deterioration* of the country's terms of trade. This scenario may be particularly relevant

for some developing countries which produce relatively few manufacturing varieties domestically

and, therefore, rely on imports of varieties from developed countries. The welfare effects are less

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[13] In the real world, it may be unlikely that skilled labour is *perfectly* mobile between production and the entrepreneurial activity of setting up new firms. However, assuming a fixed positive wage differential between entrepreneurial activity and the production use of skilled labour one can show that all the qualitative results of our paper remain unchanged. The proof of this statement is available from the authors upon request.

clear cut as the first term in (10) is now negative. An overall welfare gain will only come about if that term is more than offset by the positive second term.

Ceteris paribus, the positive second term in (10) is larger: (i) the higher the marginal willingness to pay for additional manufacturing varieties (the higher *WTP*), (ii) the higher the marginal profitability of setting up firms (the higher *MPS*), and (iii) the smaller the generalized Rybzynski effect $\pi\left(k_{X_2,\dot{V}_2}\right)$. The intuition is clear cut: If *MPS* is positive, the price increase will induce firm entry and, thus, an increase in consumption variety. Also the higher *WTP*, the stronger are the associated welfare gains if this results in an increase of consumption variety. Finally, more firms will enter the industry the lower the generalised Rybczynski-effect. This follows because in that case the rate of decline in the profitability of the industry, due to the entry of new firms, is lower, see expression (7). Clearly, a welfare gain is more likely to occur the lower the magnification term π .[14]

Now let the manufactured goods be imported. In this case, note that a welfare gain is more likely to result the smaller the *per capita* imports of varieties. This result is noteworthy because it highlights the public goods nature of *n*. It is clear that per capita consumption and production are smaller in more populous economies for given total factor endowments. On the other hand, in our model, the number of households H has per se no effects on total consumption and production due to identical and homothetic preferences. Hence, for given total factor endowments the first term in (10) is closer to zero the larger H, and therefore overall welfare gains are more likely to occur in more populous economies.[15]

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[14] The condition for a welfare gain (expression 10) is still compatible with the condition for de-industrialization, even though this outcome is more likely to occur the higher π is. The *MPS* can be very large (larger than *MPP*) in which case de-industrialization will occur even if π is smaller than one (see proposition 1).

[15] In other words, if the manufactured good is imported and the world market price of the manufactured good rises, it follows immediately that the standard result of a welfare loss due to deteriorating terms of trade may be reversed if enough entry is triggered and the country is very populous. This possible outcome of our model fits nicely to the argument by Neary (2004) that the WTP for an increase in the number of varieties, which is likely to be high in developing countries, plays a crucial role for evaluating welfare implications in models with product differentiation.

5.) Summary of the results and suggestions for further research

The key tenet which sets our paper apart from the received literature is that the production activity of firms is essentially different from the activity of setting up new firms, an entrepreneurial activity. This feature of our model gives rise to non-homotheticity of production, which drives virtually all our results. Since we assume that only skilled labour is used in production and the setting up of firms, our analysis features a novel generalized Rybczynski effect. Equally important, we relax the standard assumption that the price elasticity of demand is constant. Together these two (realistic) features of our model can overturn many results of the received literature on the positive and normative consequences of a relative price increase of manufacturing varieties. Such a price increase gives rise to adjustments at the intensive and the extensive margin in the manufacturing industry. In particular, if it triggers entry of new firms through a strong positive effect on the profit margin, this may entail de-industrialization if the generalized Rybczynski effect is large relative to the standard output price effect for a given number of firms, see proposition 1. A fall in the output per firm (increase in the degree of non-homotheticity) is a necessary condition for this de-industrialisation, see proposition 2.

Turning to the welfare analysis, we have derived a general expression (see proposition 3) which highlights that de-industrialisation raises welfare if the country exports the manufactured goods. This follows even though we have shown that the output per firm falls if de-industrialisation occurs. The surprising result that de-industrialisation raises welfare hinges on the fact that in our framework de-industrialisation augments the number of varieties and varieties are underprovided. Note specially that in our model a fall in the output per firm per se does not affect welfare. If the country is an importer of manufactured goods we have shown that the interpretation of the number of varieties as a public good leads to a number of interesting insights. In particular an increase in the price of the manufactured goods and the associated deterioration in the terms of trade will, ceteris paribus, still give rise to a welfare improvement in very populous economies.

There are many possible extensions of our approach to the modelling of firm entry and de-industrialisation. First and foremost, there is the concern that de-industrialisation could – at least in the short run – lead to more unemployment. To address this issue, one may want to introduce a third sector producing services and to model the process of reallocation of labour from manufacturing to services. The latter, generally speaking, is associated with a retraining of workers which may be very costly and give rise at least to temporary unemployment. Another worthwhile extension would be to introduce international entrepreneurs which respond to differences in the net rates of return to the setting up of firms in different countries. By the net rate of return to the setting up of firms, we mean the net profits accruing to an entrepreneur divided by the cost of setting up a firm. In the latter case there are pure profits (accruing to entrepreneurship) in the long run equilibrium of a model with monopolistic competition. The said extension addresses not only one of the key aspects of globalisation in the real world but also would provide a much needed theoretical contribution: an integration of models of monopolistic competition and general equilibrium models of oligopoly (Neary 2003).

It is straightforward to extend out model by introducing firm heterogeneity in start-up requirements. This would enable us to relate it to the vast literature based on Melitz (2003). Furthermore it can also shed new light on the wage gap debate in general and on the determination of the skill premium in particular (as in Epifani and Gancia 2008). This follows because the possibility of entrepreneurial activity of skilled labour presumably should be an important determinant of the skill premium. Equally important, an increase in the number of varieties as a result of globalisation may give rise to an increase in the real wage of unskilled workers, see Broda and Weinstein (2006).

Finally it should be noted that in the real world the entry of firms into an industry is heavily regulated in some countries (Djankov et al., 2002). Regulation of entry should have a significant effect on entry decisions of entrepreneurs, and it would seem interesting to introduce the modelling of regulation of the entry of firms into an industry. This would open up a new political economy

perspective on the interaction between governments and industries in a general equilibrium framework.

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Appendix

Appendix A: Induced change in the number of firms

Totally differentiate (5) to obtain

$$\left(p_2 4 c_2 / 0\right)\left\{\left(\frac{\in X_2}{\in MR_2(p_2)}\frac{\in MR_2(p_2)}{\in p_2} dp_2 4 \frac{\in X_2}{\in \dot{V}_2} b dn\right\} 2 X_2 / 0\left(14 \frac{\in MR_2(p_2)}{\in p_2}\right\} dp_2\right.$$

$$| b n \left(\frac{\in w_2}{\in MR_2(p_2)}\frac{\in MR_2(p_2)}{\in p_2} dp_2 2 w_2 b dn\right.$$

where we have used $c_2 / 0 | MR_2 / p_2 0$ and $w_2 | w_2 / 1, MR_2 / p_2 00$. Rewriting this in terms of relative changes, dividing by $w_2 b n | \left(p_2 4 c_2 / 0\right)X_2 / 0$ and using (6) yields expression (7) in the text.

Appendix B: Proof of Proposition 3

Define Y as total income in the small open economy in the following way:

$$Y | X_1 2 p_2 X_2 | Y/P_2, n0 \tag{B1}$$

Totally differentiating (B1) we have $dY | | \in Y/\in p_2 0 dp_2 2 | \in Y/\in n0 dn$. Keeping n for the moment fixed we obtain $dY_{\bar{n}} | dX_1 2 p_2 dX_2 2 X_2 dp_2$. If n is fixed we know from cost minimisation that $dX_1 2 MR_2 dX_2 | 0$, hence we can write

$$dY_{\bar{n}} | | p_2 4 MR_2 0 dX_2 2 X_2 dp_2 \tag{B2}$$

We now prove that $dY_{\bar{p}_2} = (\partial Y/\partial n)\,dn > 0$ because $\partial Y/\partial n > 0$. To this end note that (B1) may be rewritten as follows:

$$Y = R\!\left(1, MR_2/p_2, V_1, V_2 - bn\right) + \left(\Phi_2 - MR_2/p_2\right) X_2 \tag{B3}$$

where $R(.)$ stands for the envelope function defined in section 2. Differentiating (B3) with respect to n keeping p_2 fixed we obtain:

$$dY = \left[-b\,\frac{\partial R}{\partial \tilde{V}_2} - b\left(\Phi_2 - MR_2/p_2\right)\frac{\partial X_2}{\partial \tilde{V}_2} \right] dn \tag{B4}$$

We know that n adjusts such that: $\left(\Phi_2 - MR_2/p_2\right) X_2 = w_2 bn$. Differentiating the last expression totally with respect to n we have:

$$-b\left(\Phi_2 - MR_2/p_2\right)\frac{\partial X_2}{\partial \tilde{V}_2}\,dn = w_2 b\,dn \tag{B5}$$

where we have assumed that the changes in n are such that both goods are produced before and after the change. Furthermore note that: $R\!\left(1, MR_2/p_2, V_1, V_2 - bn\right) = w_1 V_1 + w_2 \tilde{V}_2$, therefore we have: $\partial R/\partial \tilde{V}_2 = w_2$. This together with (B4) and (B5) clearly implies that: $\partial Y/\partial n > 0$. Proposition 3 can be derived from the result that $\partial Y/\partial n > 0$ by totally differentiating expression (9) of the text and then substituting expression (7) for dn in terms of dp_2.

Under-provision of varieties follows follows directly from $\partial Y/\partial n > 0$ and the properties of the envelope function $R(.)$ in (B3), which can be rewritten as

$$R\!\left(1, MR_2/p_2, V_1, \mathring{V}_2\right) = w_1 V_1 + w_2 (V_2 - bn) > 0. \tag{B6}$$

From the envelope theorem it follows immediately that $\partial R/\partial n = -b\, w_2 < 0$. For given utility expenditure falls in n because $\partial G/\partial n < 0$, hence utility must rise if the number of varieties increases. This under-provision result is consistent with the result by Mankiw and Whinston (1986), who show that insufficient entry is characteristic for frameworks that do not assume CES preferences.