

# Informality, Entry and Welfare\*

Madigu Godfrey<sup>†</sup>      Pedro Mendi<sup>‡</sup>

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## Abstract

We propose a theoretical model to analyze a potential way in which the existence of an informal sector may have an effect on welfare. In the context of price competition among vertically differentiated producers, the presence of an informal sector brings about a positive output-expansion effect, which may be welfare-increasing. However, the presence of informal producers may also reduce the range of products being produced in equilibrium, which is welfare-decreasing. We analyze under what circumstances the latter effect dominates the former.

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## 1 Introduction

In this paper we explore a channel through which the existence of an informal sector in the economy may have an impact on welfare. Specifically,

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<sup>†</sup>Navarra Center for International Development, Universidad de Navarra. 31080 Pamplona, Spain. Email: gmadigu@alumni.unav.es

<sup>‡</sup>Navarra Center for International Development, Universidad de Navarra. 31080 Pamplona, Spain. Email: pmendi@unav.es

we analyze whether the presence of an informal sector affects the entry pattern of vertically differentiated producers in the formal sector. The informal sector is modeled as a perfectly competitive sector in which an unspecified number of producers sell a good that is of lower quality than those produced by produced by firms in the formal sector. Price competition leads producers in the informal sector to price at marginal cost. In contrast, the formal sector produces goods of superior quality than those produced by firms in the informal sector. We allow for the possibility of quality differences among producers in the formal sector.

In this setting, it is easy to see that the existence of an informal sector has a positive effect on welfare: since informal producers price at marginal cost, the presence of an informal section in the economy always involves an output expansion. However, at the same time, the existence of differences in quality among active producers may induce a rearrangement of sales that may have a negative impact on welfare. This is because it may be the case that some consumers may purchase lower-quality products than in the absence of the informal sector. The purpose of this paper is to study under what circumstances the former effect dominates the latter.

A salient characteristic of many developing countries is the large size of the informal sector, defined as those firms that are not formally registered with the tax authority, see La Porta Shleifer (2008). The existence of an informal sector translates into a lower tax base. From the perspective of firms in the formal sector, informal firms compete in unfair terms with formal firms, since informal firms do not fail taxes and are not affected by other types of regulations. Additionally, the presence of a large informal sector in the economy may perpetuate the problem of misallocation, see Hsieh Klenow (2009).

Some theoretical papers have attempted to model the informal sector from different perspectives, see for instance Rauch (1991) for a seminal contribution, Amaral Quintin (2006), de Paula Scheinkman (2011). In this paper, we will adopt a partial equilibrium approach, in which firms in the formal and informal sectors sell products that are vertically differentiated. In fact, it is argued in Banerji Jain (2007) that informal firms typically sell lower-quality versions of the goods that are sold by formal firms.

Shaked Sutton (1982) and Shaked Sutton (1983) are early references in the literature on competition with vertically differentiated products. Our

modeling framework is based on these contributions. In essence, consumers differ in their willingness to pay for quality and purchase at most one unit of one of the goods offered by one of the active firms. Lack of differentiation among informal producers and free entry imply that these firms will price at marginal cost. We study how the presence of these producers affects the entry decisions of formal firms.

Other theoretical papers that are relevant in the literature on competition with vertically differentiated products are Aoki Prusa (1997), Motta (1993), Bercard (2010), Choi Shin (1992), Lehmann-Grube (1997), Greenstein Ramey (1998), Murphy Shleifer (1997) or Li (2014). While most of these references combine price and quantity competition, in this paper, we focus on price competition, leaving quantity competition for future work.

The remainder of the paper is organized as follows: Section 2 outlines the model. Section 3 introduces the welfare calculations, and numerical examples that illustrate these are found in section 4. Finally, section 5 presents some concluding comments.

## 2 The model

As pointed out in the introduction section, the theoretical model is one of vertical differentiation, as originally proposed in Shaked Sutton (1982) and Shaked Sutton (1983). In particular, assume a continuum of consumers with heterogeneous willingness to pay for at most one unit of a good. As in Tirole (1989), consumers' utility if consuming a product with quality level  $s_i$  is given by:

$$U(\theta, p_i) = \theta s_i - p_i$$

where the  $\theta$  parameter is distributed  $\theta \sim U[0, 1]$ .

On the supply side, we assume that firms in the formal sector may produce products with two quality levels,  $s_1$  and  $s_2$ , with  $s_1 > s_2$ . Fixed entry costs are  $f_1$  and  $f_2$ . Additionally, there could be an informal sector with quality  $s_3$  such that  $s_3 < s_2$ . All firms have the same constant marginal cost of production,  $c$ , and there is free entry in the informal sector, so that  $p_3 = c$ .

We are interested in the determination of the range of products that will be produced in equilibrium, as well as in the level of welfare. Specifically,

we want to investigate under what circumstances the presence of a perfectly competitive informal sector is welfare-decreasing. This situation is likely to arise if the presence of an informal sector leads to insufficient entry, which reduces the range of products that are produced in equilibrium, and thus to a reduction in welfare.

We consider two situations, with and without an informal sector. In both cases, there is an entry game in the formal sector, in which potential entrants sequentially choose whether to enter and if so, which quality level. As stated above, quality level  $s_i$  entails an entry cost  $f_i$ ,  $i = 1, 2$ . We are implicitly assuming that at most two firms enter the formal sector (while an unspecified number of firms enter the informal sector, should it exist).

In both versions of the model, with and without an informal sector, one of the firms, call it the leader, chooses whether to enter and the quality level first. Then the follower chooses. The timing of the game is as follows:

1. The leader chooses whether to enter and the quality level of its product.
2. The follower chooses whether to enter and the quality level of its product.
3. Active firms simultaneously choose prices and equilibrium quantities and profits are realized.

Given available qualities, the consumer chooses the product that yields the highest surplus, or decides not to purchase at all. Therefore, the determination of the demands for the available products involves the location of the indifferent consumers. For instance, figure 1 shows how to locate the indifferent consumers with two available quality levels. In this specific case, the firm that produces the product with quality  $s_1$  and charges  $p_1$  sells  $\bar{q}$ , whereas that which produces the product with quality level  $s_2$  and charges  $p_2$  sells  $\tilde{q} - \bar{q}$ . There are some consumers, represented by the  $D_3$  segment that do not purchase at all. In the presence of a informal sector, the price charged by firms in the informal sector would always be  $p_3 = c$ , since we are assuming price competition in the absence of quality differentiation among firms in the informal sector. A new indifferent consumer between purchasing the products with quality level  $s_2$  and  $s_3$  would appear, and there would be fewer consumers that would decide not to purchase any product.

The remainder of the paper analyzes the cases with and without informal

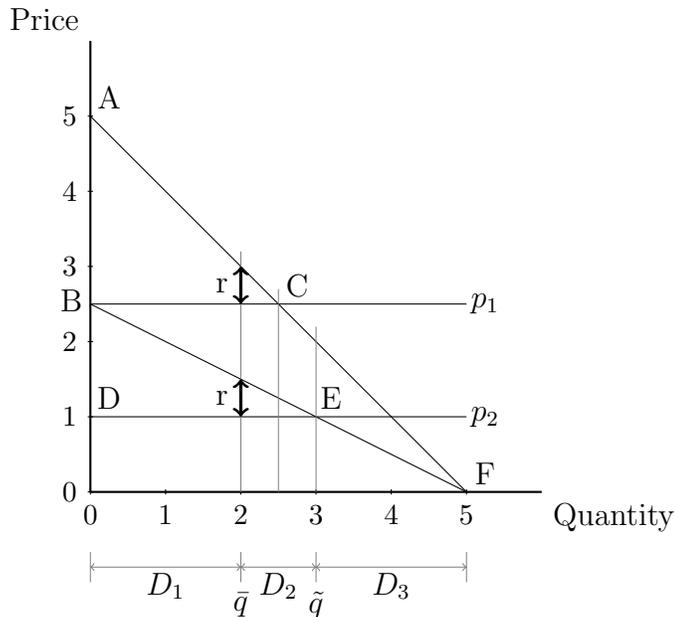


Figure 1: Determination of the indifferent consumers with two quality levels

sector, and compares them in terms of welfare. Notice that the inclusion of an informal sector in principle has a positive effect on welfare, namely to expand output (the marginal consumer has willingness to pay  $c$  for a product with quality level  $s_3$ ). However, the presence of an informal sector may have a negative impact on welfare, which is the reduction in the range of products that is offered in equilibrium.

To see this, think of a situation in which in the absence of informal sector, both quality levels,  $s_1$  and  $s_2$  are offered. Now, in the presence of an informal sector, it may be the case that entry in the intermediate quality level is no longer profitable. This may lead to a welfare reduction because the firm that produces with quality  $s_1$  may be able to raise its price, leading to fewer consumers being serviced by the high-quality formal producer, and some consumers that previously purchased from the low-quality formal producer being forced to purchase from informal firms. If these reductions in surplus are larger than the increases in surplus associated with an expanded output (because informal firms price at marginal cost) and the fixed cost  $f_2$  being avoided, then there is a net welfare loss.

Our task, therefore, is to specify what parameter values lead to a welfare decrease associated with the presence of an informal sector in the economy. For this reason, we will consider the two cases, with and without the informal sector, separately.

## 2.1 Equilibrium without an informal sector

In the absence of an informal sector, we have to consider three possibilities: no entry, entry by one firm that chooses to produce the high-quality product, and entry by one firm that chooses to produce the low-quality product. Which of these will be the equilibrium outcome depends on the level of fixed cost of entry.

First, notice that a monopolist that produces a product with quality level  $s_i$  optimally produces  $q^M(s_i) = \frac{s_i - c}{2s_i}$ , setting a price  $p^M = \frac{s_i + c}{2}$ , yielding profits  $\pi = \frac{(s_i - c)^2}{4s_i}$ .

Now assume that the entry costs and the quality levels  $s_1$  and  $s_2$  are such that both quality levels are produced in equilibrium. Then, one of the firms produces with quality level  $s_1$  and the other with quality level  $s_2$ . Then, given prices  $p_1$  and  $p_2$ , quantities produced will be:

$$q_1(p_1, p_2) = 1 - \frac{p_1 - p_2}{s_1 - s_2} \quad (1)$$

$$q_2(p_1, p_2) = \frac{p_1 - p_2}{s_1 - s_2} - \frac{p_2}{s_2}. \quad (2)$$

Therefore, the equilibrium prices are:

$$p_1(s_1, s_2) = \frac{2s_1(s_1 - s_2) + 3s_1c}{4s_1 - s_2} \quad (3)$$

$$p_2(s_1, s_2) = \frac{s_2(s_1 - s_2) + c(2s_1 + s_2)}{4s_1 - s_2} \quad (4)$$

Once the equilibrium prices are obtained, quantities are given by:

$$q_1(s_1, s_2) = \frac{2s_1 - c}{4s_1 - s_2} \quad (5)$$

$$q_2(s_1, s_2) = \frac{s_1(s_2 - 2c)}{s_2(4s_1 - s_2)} \quad (6)$$

and therefore, total output is given by

$$q(s_1, s_2) = \frac{3s_1s_2 - c(2s_1 + s_2)}{s_2(4s_1 - s_2)} \quad (7)$$

Then if the product with quality  $s_1$  is produced, a necessary condition for the product with quality level  $s_2$  to be produced in equilibrium is that  $s_2 > 2c$ . Regarding profits, if both quality levels are produced in equilibrium, we have:

$$\pi_1(s_1, s_2) = \frac{(s_1 - s_2)(2s_1 - c)^2}{(4s_1 - s_2)^2} \quad (8)$$

$$\pi_2(s_1, s_2) = \frac{s_1(s_1 - s_2)(s_2 - 2c)^2}{s_2(4s_1 - s_2)^2} \quad (9)$$

## 2.2 Equilibrium with an informal sector

If there is free entry at a lower quality level  $s_3$ , lack of vertical product differentiation will imply that the price of firms producing a product with quality level  $s_3$  will be  $p_3 = c$ , thus making zero profits. Given this, there could be a number of different outcomes, in terms of the number of varieties that are being produced. For instance, it could be the case that  $s_3$  is so low that even though informal firms price at marginal cost, no consumer finds it profitable to consume this product. At the other extreme, it could be the case that all three different varieties are produced in equilibrium. Other cases, where only two or one varieties are produced in equilibrium may arise, depending on the specific values of the different quality levels, as well as entry costs  $f_1$  and  $f_2$ .

First, consider the simplest case in which a single firm in the formal sector, with quality level  $s_i$ , with  $i = \{1, 2\}$  competes against firms in the informal sector, whose quality level is  $s_3$ . Then, it is easy to see that, since the firms in the informal sector will set a price  $p_3 = c$ , the firm that produces with quality level  $s_i$  will choose

$$p_i(s_i, s_3) = c + \frac{s_i - s_3}{2} \quad (10)$$

and thus the formal and informal firm's output and the formal firm's profits

are:

$$q_i(s_i, s_3) = \frac{1}{2} \quad (11)$$

$$q_3(s_i, s_3) = \frac{s_3 - 2c}{2s_3} \quad (12)$$

$$\pi_i(s_i, s_3) = \frac{s_i - s_3}{4} \quad (13)$$

and informal firms make zero profits. Additionally, we need that  $s_3 > \frac{2cs_i}{s_i+c}$ , otherwise the informal sector would not exist even if the formal firm produced the monopoly level of output.

Recall that if two formal producers compete and in the absence of an informal sector, the high-quality producer produces  $q_1(s_1, s_2) = \frac{2s_1-c}{4s_1-s_2}$ . Therefore, the high-quality producer in the formal sector produces more if it competes against another, lower-quality formal firm than if it competes against informal firms as long as  $s_2 > 2c$ .

Now, let us focus our attention to the case in which all three quality levels are produced in equilibrium. If this is the case, then given that prices chosen by firms producing products with quality level  $s_i$  are  $p_i$  quantities produced are:

$$q_1(p_1, p_2, c) = 1 - \frac{p_1 - p_2}{s_1 - s_2} \quad (14)$$

$$q_2(p_1, p_2, c) = \frac{p_1 - p_2}{s_1 - s_2} - \frac{p_2 - c}{s_2 - s_3} \quad (15)$$

$$q_3(p_1, p_2, c) = \frac{p_2 - c}{s_2 - s_3} - \frac{c}{s_3} \quad (16)$$

keeping in mind that competition among informal firms implies  $p_3 = c$ .

Equilibrium prices chosen by firms with quality levels  $s_1, s_2$  are:

$$p_1(s_1, s_2, s_3) = c + 2 \frac{(s_1 - s_2)(s_1 - s_3)}{4s_1 - s_2 - 3s_3} \quad (17)$$

$$p_2(s_1, s_2, s_3) = c + \frac{(s_1 - s_2)(s_2 - s_3)}{4s_1 - s_2 - 3s_3} \quad (18)$$

and, of course,  $p_3 = c$ . Notice that these prices are positive and strictly greater than the marginal cost of production,  $c$ , since  $s_1 > s_2 > s_3$  by

assumption. Given these prices, equilibrium quantities are:

$$q_1(s_1, s_2, s_3) = \frac{2(s_1 - s_3)}{4s_1 - s_2 - 3s_3} \quad (19)$$

$$q_2(s_1, s_2, s_3) = \frac{s_1 - s_3}{4s_1 - s_2 - 3s_3} \quad (20)$$

$$q_3(s_1, s_2, s_3) = \frac{s_3(s_1 - s_2) - c(4s_1 - s_2 - 3s_3)}{s_3(4s_1 - s_2 - 3s_3)} \quad (21)$$

so that total output is  $1 - \frac{c}{s_3}$ . In order for informal firms to produce in equilibrium (and therefore, the above expressions be correct), it must be the case that the equilibrium output of firms in the informal must be positive. This is so if

$$s_3 > \frac{c(4s_1 - s_2)}{s_1 - s_2 + 3c}$$

Regarding profits, these are:

$$\pi_1(s_1, s_2, s_3) = \frac{4(s_1 - s_2)(s_1 - s_3)^2}{(4s_1 - s_2 - 3s_3)^2} \quad (22)$$

$$\pi_2(s_1, s_2, s_3) = \frac{(s_1 - s_2)(s_1 - s_3)(s_2 - s_3)}{(4s_1 - s_2 - 3s_3)^2} \quad (23)$$

### 3 Welfare analysis

We will compare total welfare in both cases, and study under what circumstances the presence of an informal sector leads to a welfare loss. This will depend on the specific values of  $s_1, s_2, s_3, f_1, f_2, c$ , which will in turn determine what quality levels are offered by formal firms, with and without an informal sector.

First, it is useful to note that the total welfare associated with a monopolist that produces a product with quality level  $s_i$  is, gross of entry costs:

$$TS^M = \frac{3(s_i - c)^2}{8s_i} \quad (24)$$

Notice that a single formal firm with quality  $s_i$  that competes against informal firms always produces an output level  $\frac{1}{2}$ , and in the absence of competition from informal firms, it would produce  $q^M = \frac{s_i - c}{2s_i} < \frac{1}{2}$ . Therefore, the introduction of an informal sector is always welfare-increasing, if the initial situation is that of a single firm in the formal sector, regardless of the level of quality of its product.

However, when, in the absence of an informal sector both quality levels coexist in the formal sector, a number of different cases may arise, with different welfare implications, depending on the specific parameter values. Whether total surplus increases or decreases with the presence of the informal sector depends on the interaction between the output expansion effect, the output reallocation effect, and the fixed entry cost. Specifically, while the output expansion effect increases welfare since informal producers price at marginal cost, it is also true that there are output rearrangements that might be welfare-decreasing.

For instance, if a single formal firm competes against a group of informal producers, it is shown that the formal firm with a quality level  $s_1$  optimally produces an output level equal to  $\frac{1}{2}$ . This is less than what the same formal firm would produce if facing competition against a lower-quality, formal firm. Therefore, some consumers that would purchase the high-quality output in the absence of an informal sector would switch to the informal producers if these are present. This is clearly welfare-reducing, and whether or not it offsets the output expansion effect depends on the specific parameter values.

To be more specific, let  $TS = \sum_{i=1}^N TS_i$  be total surplus, gross of entry costs, where  $TS_i$  is total surplus generated by sales of product with quality level  $i$ , and  $N$  is the total number of quality levels being offered.

First, if there is only one firm in the formal sector, competing against informal firms with quality level  $s_3$ , then since the formal firm will always produce  $q_i = \frac{1}{2}$  then

$$TS_1 = \frac{3s_i - 4c}{8} \quad (25)$$

$$TS_3 = \frac{(s_3 - 2c)^2}{8s_3} \quad (26)$$

and we know that the total surplus exceeds the total surplus in the case of a monopolist of quality  $s_i$ , with  $i = \{1, 2\}$  that does not face competition

against informal firms.

If only quality levels 1 and 2 are being offered, then

$$TS_1 = q_1 \left[ s_1 \frac{2 - q_1}{2} - c \right] \quad (27)$$

$$TS_2 = q_2 \left[ s_2 \frac{2 - 2q_1 - q_2}{2} - c \right] \quad (28)$$

Now, if all three quality levels are offered, it is easy to see that

$$TS_1 = q_1 \left[ s_1 \frac{2 - q_1}{2} - c \right] \quad (29)$$

$$TS_2 = q_2 \left[ s_2 \frac{2 - 2q_1 - q_2}{2} - c \right] \quad (30)$$

$$TS_3 = q_3 \frac{s_3(1 - q_1 - q_2) - c}{2} \quad (31)$$

where the quantities are the equilibrium quantities obtained above, provided that they are positive. The net surplus therefore equals the gross surplus minus the entry costs. If all quality levels are being offered, these entry costs equal  $f_1 + f_2$ .

## 4 Numerical examples

In this section, we illustrate the welfare implications of our model by means of some numerical examples. Specifically, let in all cases  $s_1 = 1$ , and  $c = 0$ . We will compare the equilibrium outcomes with two firms in the formal sector, the follower having quality level  $s_2 < 1$ , and that with two firms in the formal section, with quality levels 1 and  $s_2 < 1$  and an informal sector of producers with quality level  $s_3 < s_2$ .

First, if there are two firms in the formal sector only, the expressions for the equilibrium quantities simplify to:

$$q_1(s_1, s_2) = \frac{2}{4 - s_2} \quad (32)$$

$$q_2(s_1, s_2) = \frac{s_2}{s_2(4 - s_2)} \quad (33)$$

Therefore, if, in the absence of informal firms,  $s_2 = \frac{2}{3}$ , then  $q_1 = \frac{3}{5}$  and  $q_2 = \frac{3}{10}$ , for a total output  $\frac{9}{10}$ . Notice that firm 2's gross profits are  $\pi_2(s_1, s_2) = \frac{1}{50}$ , therefore, the follower will enter as long as  $f_2 \geq \frac{1}{50}$  (and the leader as long as  $f_1 \geq \frac{3}{25}$ ).

Keeping these results in mind, let us now turn our attention towards the case in which there is an informal sector with quality level  $0 < s_3 < s_2$ . If the marginal cost is zero, recall that the profits of a formal firm that produces with a quality level  $s_2$  if facing competition against a formal firm that produces with quality level  $s_1 = 1$  and informal firms are given by:

$$\pi_2(s_1, s_2, s_3) = \frac{(1 - s_2)(1 - s_3)(s_2 - s_3)}{(4 - s_2 - 3s_3)^2} \quad (34)$$

If  $s_2 = \frac{2}{3}$ , then  $\pi_2(s_1, \frac{2}{3}, s_3) = \frac{\frac{1}{3}(1-s_3)(\frac{2}{3}-s_3)}{(\frac{10}{3}-3s_3)^2}$ . Therefore, if, for instance,  $s_3 = \frac{7}{12}$ , then  $\pi_2 = \frac{5}{3 \cdot 19^2}$ , which is strictly smaller than firm 2's profits in the absence of an informal sector. Therefore, for any values of the fixed cost of entry in the quality level  $s_2$  such that  $\frac{5}{3 \cdot 19^2} < f_2 < \frac{1}{50}$ , then there is no entry in the quality level  $s_2$ , and entry in the formal sector occurs in quality level  $s_1$  only.

Now, regarding total welfare, in the absence of an informal sector, if only the two formal firms (those with quality levels  $s_1 = 1$  and  $s_2 = \frac{2}{3}$ ) operate, total welfare is  $\frac{47}{100} - f_1 - f_2$ . Assume that  $f_2 > \frac{5}{3 \cdot 19^2}$  so that it is not profitable for the formal firm with a quality level  $s_2 = \frac{2}{3}$  to operate in the presence of informal firms with a quality level  $s_3 = \frac{7}{12}$ .

If this is the case, then the industry structure is that with a formal firm with quality level  $s_1 = 1$  and an informal sector with quality level  $s_3 = \frac{7}{12}$ . Then the formal firm produces  $q_1 = \frac{1}{2}$ , whereas informal producers collectively produce  $q_3 = \frac{1}{2}$ . Notice the reduction in output of the firm that produces with quality level  $s_1 = 1$ , from  $\frac{3}{5}$  to  $\frac{1}{2}$ . Even though total output expands, relative to the previous case, from  $\frac{9}{10}$  to 1, total welfare is now  $\frac{43}{96} - f_1$  (assuming that  $f_1 < \frac{5}{48}$ , which is the profit of the high-quality firm if competing against informal firms with quality  $s_3 = \frac{7}{12}$ ).

Hence, computing the difference between the two total surplus levels, without and with an informal sector, the difference equals  $\frac{47}{100} - \frac{43}{96} - f_2$ . Recall that

the formal firm that produces with a quality level  $s_2 = \frac{2}{3}$  does not enter in the presence of informal firms with quality  $s_3 = \frac{7}{12}$  as long as  $f_2 > \frac{5}{3 \cdot 19^2}$ .

Hence, for

$$\frac{5}{3 \cdot 19^2} < f_2 < \frac{47}{100} - \frac{43}{96},$$

the firm with quality level  $s_2 = \frac{2}{3}$  decides not to enter in the presence of informal firms with quality level  $s_3 = \frac{7}{12}$ , and this lack of entry at the intermediate quality level, caused by the presence of informal firms is welfare decreasing.

## 5 Conclusions

In virtually all developing (and some developed) countries, the presence of informal firms often introduces important constraints on the normal operations of firms in the formal sector. In this paper we have proposed a theoretical model to analyze a potential way in which the existence of an informal sector may affect welfare.

In particular, we consider a model of price competition among vertically differentiated producers, in which the informal sector is modeled as a competitive fringe that produces a lower-quality version of the goods offered by formal firms, and where informal firms lack differentiation among them. In this context, the presence of an informal sector brings about a positive output-expansion effect, which may potentially be welfare-increasing. However, the presence of informal producers may also reduce the range of products being produced in equilibrium, which is welfare-decreasing, since it may lead to an inefficient reallocation of output among producers.

Specifically, it could be the case that the presence of an informal sector may prevent entry of a formal producer of a good with an intermediate level of quality, thus leading to an industry configuration in which a single, high-quality producer, coexists with informal producers. Facing a relatively less intense competition from informal producers than from the formal producer with an intermediate level of quality, the high-quality formal producer may end up producing less than in the absence of an informal sector. This may be welfare decreasing, since some producers who previously purchased from

formal producers now purchase from informal producers, which offer a lower-quality product. We present numerical results to illustrate this argument.

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