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## Product market regulation and market work: A benchmark analysis

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Product Market Regulation and Market Work:  
A Benchmark Analysis

Lei Fang and Richard Rogerson

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## Product Market Regulation and Market Work: A Benchmark Analysis

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**Abstract:** Recent empirical work finds a negative correlation between product market regulation and aggregate employment. We examine the effect of product market regulations on hours worked in a benchmark aggregate model of time allocation as well as in a standard dynamic model of entry and exit. We find that product market regulations affect time devoted to market work in effectively the same fashion that taxes on labor income or consumption do. In particular, if product market regulations are to affect aggregate market work in this model, the key driving force is the size of income transfers associated with the regulation relative to labor income, and the key propagation mechanism is the labor supply elasticity. We show in a two-sector model that industry-level analysis is of little help in assessing the aggregate effects of product market regulation.

JEL classification: E24, J22, L5

Key words: labor supply, product market regulation, entry barriers

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# 1 Introduction

Time devoted to market work differs greatly across OECD economies: total hours of work per person of working age are currently more than 30% lower in Belgium, France, Germany, and Italy than they are in the US. A growing literature seeks to understand the causes of these differences.<sup>1</sup> Any explanation for these differences must consist of two components: driving forces and propagation mechanisms. The driving forces are those factors that differ across these economies, and the propagation mechanism is the economic channels through which these factors influence hours of work. Many driving forces have been suggested in the literature, including taxes, labor market regulations, and unions. A recent literature has emerged on the importance of product market regulations for labor market outcomes. Empirical work by Boeri et al (2000), Bertrand and Kramarz (2002), and Lopez-Garcia (2003) finds a strong negative correlation between product market regulation and employment. Theoretical work includes contributions by Nickell (1999), Fonseca et al (2001), Blanchard and Giavazzi (2003), Messina (2006), and Ebell and Haefke (2004, 2006).

Interpreting the results of purely empirical analyses can be difficult. On the one hand, there is always the danger that the results only reflect a correlation of the variables of interest, and are not evidence of causation. Second, even if the empirical evidence is taken to imply a causative relationship, a full understanding requires knowledge of the important economic mechanism that underlies the causation. But a purely empirical analysis cannot provide this information. A deeper understanding of how product market regulations potentially affect labor market outcomes requires a systematic assessment of the channels through which

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<sup>1</sup>Recent examples include Alesina et al (2006), Davis and Henrekssen (2004), Prescott (2004), and Rogerson (2006, 2008). A related literature seeks to understand differences in unemployment rates, but these differences are almost an order of magnitude smaller in terms of implications for differences in hours devoted to market work.

these regulations affect equilibrium outcomes in various economic environments. This paper contributes to this effort by examining the effects of one prominent aspect of product market regulations—increased entry costs— on labor market outcomes in a simple benchmark model of aggregate time allocation embedded in a model of entry.

Our analysis generates two important insights about the effect of product market regulations which take the form of entry barriers. First, from the perspective of influencing time devoted to market work, the key driving force is the size of nonlabor income relative to labor income that accrue to households as a result of the regulation. Second, the extent to which this driving force leads to less market work is completely determined by the elasticity of labor supply. These two insights taken together imply that understanding the effects of product market regulations on time allocated to market work in this setting is isomorphic to the problem of understanding the effects of labor income taxes on time allocated to market work. In both cases the key driving force is the size of transfers relative to labor income, and the key parameter of the propagation mechanism is the labor supply elasticity.

Two conclusions follow from these results. First, the importance of product market regulation relative to taxation of labor income is completely dictated by the relative magnitude of the nonlabor income payments induced by each. Second, entry barriers that consist of real resource costs have no impact on the volume of market work. Specifically, in this case it does not matter how large the barriers are, since they do not generate any transfer payments in equilibrium. We emphasize that effects on hours of work are only one dimension through which entry barriers can affect economic outcomes. Even when entry barriers do not have any effect on hours of work, they do entail welfare costs by affecting the amount of entry.

We first establish our results in the context of a simple static model, since this allows

us to derive the results analytically and best highlights the key economics at work. We consider a dynamic model of entry and exit that is able to replicate the key stylized facts about entry and exit. This setting is of interest because it allows for effects on the selection of firms in operation as well as allowing for positive profit flows in steady state. Since we cannot establish analytical results in this setting, we report the results of policy changes in a calibrated version of the model. The findings in this more empirically reasonable model of firm entry and exit are effectively identical to those in the simpler static model. We also relate our findings to those of Hopenhayn and Rogerson (1993) regarding the effect of firing taxes, and show that a key qualification regarding their results is that they assume that firing taxes are used to fund a lump-sum transfer payment. When this assumption is removed, say because the firing tax represents a real resource cost, we find that firing taxes do not lead to lower hours, just as is true for the case of entry barriers.

Our results are most related to those obtained in Messina (2006), and suggest that his analysis overstates the effect of entry barriers on hours of work. He assumes that the entry barrier is a payment which effectively leads to a transfer payment to consumers. But he calibrates the size of the entry by using data from Djankov et al (2002), which is based on measures of time costs. But if one models the entry barrier as a time cost then there are no transfer payments generated and the impact on hours would be zero. Similarly, Ebell and Haefke (2006) consider a model with trading frictions, and their quantitative analysis shows that changes in regulations which reflect real resource costs have virtually no effect on unemployment.

An outline of the paper follows. The next section lays out the static model and characterizes how labor taxes and entry barriers affect equilibrium hours worked. Section 3 shows

that the results in Section 2 continue to hold in several extensions of the simple static model. Section 4 presents the dynamic model and calibration results. Section 5 concludes.

## 2 Static Analysis

This section lays out the benchmark static model of monopolistic competition and characterizes the equilibrium allocation for the model. We then analyze the implications for the effect of taxes and product market regulation on equilibrium hours of work.

### 2.1 Model and Equilibrium

There is a representative household with preferences defined over consumption of a final good ( $c$ ) and leisure ( $1 - h$ ) given by:

$$\alpha \log(c) + (1 - \alpha) \frac{(1 - h)^{1-\gamma} - 1}{1 - \gamma}. \quad (2.1)$$

where  $0 < \alpha < 1$  and  $\gamma \geq 0$ . We adopt this specification of preferences because it is consistent with balanced growth and permits a parsimonious way of incorporating a range of labor supply elasticities. All of the results derived below continue to hold in the more general case of any utility function consistent with balanced growth.

There are two production sectors: an intermediate goods sector and a final goods sector. Each point on the positive real line represents a potential intermediate good. Each intermediate good  $i$  can be produced using a linear technology  $y(i) = h(i)$ , where  $h(i)$  is labor input for the intermediate good  $i$ , but there is a fixed cost  $\phi > 0$  associated with operating any of these technologies. We assume that the fixed cost is in units of labor. For the purposes

of the decentralization we will also assume that each point on the real line corresponds to a different firm.

The final goods sector combines the available intermediate goods into the final good (i.e., consumption) via the CES production function:

$$c = \left[ \int_0^\infty y(i)^\rho di \right]^{1/\rho}. \quad (2.2)$$

We assume that the final goods sector is competitive, and hence for simplicity we assume that there is a single representative firm in this sector. The representative household owns all of the firms and hence receives any profits that might accrue in equilibrium.

We study an equilibrium in which the consumer behaves competitively in both the output and the labor markets and the final goods firm behaves competitively in both the final goods market and the intermediate goods market, while intermediate goods firms behave as monopolistic competitors in output markets and as perfect competitors in the labor market. Given the symmetry imposed on the environment, we focus on equilibria in which all active intermediate goods firms charge the same price and produce the same amount. Given that we have an unbounded set of potential firms, profits in equilibrium will be zero for any firm that operates. The equilibrium will only determine the mass of firms that operate and not the identities of these firms, so without any loss of generality we assume that the firms that operate lie in an interval with left endpoint equal to 0. We normalize the price of the final good to be equal to one and denote the symmetric price of the intermediate goods by  $p$ , and the wage rate by  $w$ .

Formally, a symmetric equilibrium for our model is a list  $c^*, h^*, y^*, N^*, p^*, w^*, d^*(p)$ , with the function  $d^*(p)$  denoting the demand function that an intermediate goods producer



faces for its product. It is easy to characterize the equilibrium for this model, and since this derivation is useful for the policy exercises conducted in the next section, we sketch it here. The production function of the final good producer implies that the demand function  $d^*(p)$  takes the form  $d^*(p) = Bp^{\frac{1}{\rho-1}}$ , where  $B$  is a constant that depends on the number of intermediate producers. This demand function in turn implies a simple markup rule for the equilibrium price of intermediate goods:  $p^* = \frac{1}{\rho}w^*$ .

The consumer maximization problem is to choose values of  $c$  and  $h$  to maximize utility subject to the budget constraint  $c = w^*h$ .<sup>2</sup> This yields the first order condition:

$$\frac{(1-\alpha)}{\alpha} \frac{h^*}{(1-h^*)^\gamma} = 1, \tag{2.3}$$

which completely characterizes the equilibrium value of  $h$ .

The zero profit condition for an intermediate goods producer is:  $(p^* - w^*)y^* = w^*\phi$ . Using the fact that  $p^* = w^*/\rho$ , this implies  $y^* = \frac{\rho}{1-\rho}\phi$ . Given values for  $h^*$  and  $y^*$ , the feasibility condition determines  $N^*$  as  $N^* = \frac{h^*}{(y^*+\phi)}$ . Finally, consumption of the final good is then computed as  $c^* = N^{*1/\rho}y^*$ .

## 2.2 Labor Taxes and Market Work

While our objective is to understand the effects of product market regulations on time devoted to market work, one of our main results is that the effects of product market regulations are intimately related to the effects of labor income taxes. It is therefore useful as a first step to characterize the effect of a proportional tax  $\tau$  on labor income. A key message from economic theory is that the effects of this tax depend critically on what is done with the

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<sup>2</sup>Recall that the price of the final good is normalized to one and that in equilibrium profits will be zero.

resulting revenue. To illustrate this we contrast two extreme scenarios. In the first scenario we assume that the revenue is rebated lump-sum to the representative consumer.<sup>3</sup> The key feature of this scenario is that the resulting transfer serves as a perfect substitute for private spending. The second scenario assumes that the government uses its revenues to purchase the final consumption good, but assumes differently that the government discards these goods, or equivalently, uses them to in turn produce something that consumers do not value.<sup>4</sup> The key feature in this case is that the government uses revenues in a manner that does not affect the marginal utility of private consumption.

Let  $g$  denote government purchases of the final consumption good and let  $T$  denote government lump-sum transfers in units of the consumption good. The household budget equation is now written as  $c = w^*h + T^*$ . In scenario one we add the condition  $T^* = g^* = \tau w^*h^*$  to the set of equilibrium conditions, while in scenario 2 we add the condition  $g^* = \tau w^*h^*$  but set  $T^* = 0$ . It is easy to show that the presence of these tax systems do not affect the form of the demand function for a given intermediate good, implying that in equilibrium the price charged by intermediate goods producers will continue to satisfy  $p^* = w^*/\rho$ . We next derive the implications for equilibrium allocations.

### 2.2.1 Lump-Sum Transfers

With lump sum transfers, the first order condition for  $h$  is given by:

$$\frac{\alpha(1-\tau)w^*}{(1-\tau)w^*h + T^*} = \frac{(1-\alpha)}{(1-h)^\gamma} \quad (2.4)$$

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<sup>3</sup>In a one good model such as this it does not matter if the government transfers purchasing power or goods.

<sup>4</sup>Alternatively, it is equivalent to assume that the goods are used to produce a second good that enters utility additively with respect to utility from  $c$  and  $1-h$ . National defense is a good example of this type of spending.

Since the government budget constraint requires that  $T^* = \tau w^* h^*$ , this equation reduces to:

$$\frac{(1 - \alpha)h}{\alpha(1 - h)^\gamma} = (1 - \tau) \quad (2.5)$$

This equation implies that if tax revenues are rebated lump-sum then hours of work are decreasing in taxes. The magnitude of this effect for a given change in  $\tau$  depends on the labor supply elasticity parameter  $\gamma$ . While our focus will be on the labor market effects, we note that the zero profit constraint implies the same value for  $y$  as in the no-tax case, i.e.,  $y = \frac{\rho}{1-\rho}\phi$ . Since the feasibility condition is unchanged,  $N$  decreases proportionately to the decrease in  $h$ , and  $c$  decreases with the decrease in  $N$ .

For future purposes it is also useful to rewrite equation (2.5) in the following form:

$$\frac{(1 - \alpha)h}{\alpha(1 - h)^\gamma} = \frac{1}{1 + \frac{\tau}{(1-\tau)}} \quad (2.6)$$

Because the term  $\tau/(1 - \tau)$  has the interpretation of the ratio of the transfer to after tax labor income, this equation tells us that the distortion of  $h$  is determined by the extent of the lump-sum transfer relative to after tax labor income.

### 2.2.2 Discarded Revenues

If government revenues are discarded rather than returned to the household, the first order condition for  $h$  now yields:

$$\frac{(1 - \alpha)}{\alpha} \frac{h}{(1 - h)^\gamma} = 1 \quad (2.7)$$

which is identical to the case in which there was no tax. Considering the outcomes for  $y$  and  $N$  it is easy to show that  $y$  continues to have the same value as in the no-tax case and

therefore that  $N$  will as well. This does not imply that allocations are not affected by taxes in this case. In particular, given the budget constraint and no change in  $w$  and  $h$ , it follows that  $c$  is equal to  $(1 - \tau)$  of its value in the no-tax case.

### 2.2.3 Summary

The preceding analysis has a very important implication for assessing the role of labor taxes in accounting for the large differences in hours of work across countries. For a given value of the labor supply parameter  $\gamma$ , what matters is not the difference in tax rates across countries but rather the difference in the amount of income that is being transferred relative to labor income. Large differences in tax rates that are not accompanied by large differences in transfer payments (whether monetary or in kind) do not generate large differences in hours of work. As we will see in the next section, this same message will apply forcefully to the analysis of how entry barriers affect market work.

## 2.3 Product Market Regulation and Market Work

Given the simple form of our model we cannot consider a rich class of regulatory policies. However, the literature that we referred to in the introduction typically focuses on one particular aspect of regulatory policy, and this is the size of fixed costs associated with entry. Hence, we focus on regulatory policies as they impact on the size of the fixed entry cost  $\phi$ . Consistent with the preceding analysis of labor taxes, which shows that the consequences for labor market outcomes depend very much on what is done with the tax revenue, the same result will emerge in the analysis of entry barriers. To show this we consider two different kinds of regulatory entry barriers. The first type of barrier represents real resource

costs. Examples of this include regulations that require additional resources to be used up in the entry process, by requiring additional studies, filing additional reports, requiring more meetings and approval at various levels etc....The second type of regulation involves purely a nominal cost and does not involve any direct use of resources. An example of this is when entry requires the purchase of a license. In line with the analysis of tax policies, in this case we will further distinguish between two cases based on what is done with the revenues generated by the nominal entry cost payments: are they returned to consumers via a lump-sum transfer or are they discarded.

In all of the above cases, equilibrium will continue to require that profits are zero. A fourth case that we consider is one in which the nature of regulation does not lead to zero profits. In particular, we will consider a policy in which the government controls the number of firms that operate in equilibrium, possibly by randomly issuing permits, but that there is no market for these permits. Assuming the number of permits is less than the equilibrium value of  $N$  in the case without permits, then any firm that receives a permit will make positive profits in equilibrium.

### **2.3.1 Barriers to Entry I: Real Resource Costs**

Assume that the barrier takes the form of a real resource cost, i.e., it represents an increase in the fixed cost  $\phi$ , which recall was measured in units of labor. From the expressions derived earlier to characterize equilibrium we see that an increase in the value of  $\phi$  has no effect on  $h$ , but leads to an increase in  $y$  and a decrease in  $N$ . Intuitively, higher entry costs lead to less entry, but in equilibrium firm size increases. While there is no effect on market work, it is important to note that the decrease in  $N$  leads to lower productivity in the final goods sector and hence lower consumption and lower welfare. This result is directly relevant for

evaluating many arguments about the effect of entry barriers on labor market outcomes. In particular, since most measures of entry barriers, including those in Djankov et al (2002) reflect the actual time costs associated with entry the above result is the relevant one, and it says that while these barriers do affect economic outcomes, they do not affect equilibrium hours of work.

This result serves to highlight the importance of analyzing the labor market effects of entry barriers in a model that features the canonical consumption-leisure tradeoff in an empirically plausible form. In particular, if one followed much of the literature and adopted a specification of preferences in which there are no income effects, i.e., the utility function is linear in consumption, one would conclude that entry barriers that take the form of real resource costs do lead to less market work.

### **2.3.2 Barriers to Entry II: License Fees**

Assume now that the barrier takes the form of an entry fee, denoted by  $\kappa$ , and for convenience assume that the fee is denominated in units of the wage rate  $w^*$ . This entry fee will generate government revenues, and completely analogously to the earlier discussion of labor taxes, we will see that the effect on hours of work depend critically on what is done with the revenue. We first consider the case in which the proceeds from this entry fee are thrown away by the government, i.e., that the government uses the proceeds to purchase the final consumption good but then discards it. The household's optimization problem does not change and as a result the first order condition for the consumer maximization problem continues to generate the usual expression for  $h$ :

$$\frac{(1 - \alpha)}{\alpha} \frac{h}{(1 - h)^\gamma} = 1, \quad (2.8)$$

implying that there is no effect on hours of work. There is, however, an affect on  $c$  and  $y$ . In particular, the zero profit condition now reads  $(\frac{1}{\rho}w^* - w^*)y^* = w^*(\phi + \kappa)$ , implying that  $y^* = \frac{\rho}{1-\rho}(\phi + \kappa)$ . It follows that  $y^*$  is increasing in  $\kappa$ . But since  $\kappa$  only represents a pecuniary cost, the feasibility condition is the same as before, so that  $N^* = \frac{h^*}{(y^* + \phi)}$ . It follows that allocations in this case are identical to those obtained in the case where the entry cost represents a real resource cost. Specifically, although product market regulations in this context do affect allocations and welfare, they do not manifest themselves in changes in hours of market work.

Next assume that the government rebates the proceeds to the household as a lump-sum transfer. In this case the household budget constraint becomes  $c = w^*h + T$  where  $T$  is the size of the transfer. Solving the consumer's maximization problem, the implied condition for  $h$  is

$$\frac{(1 - \alpha)}{\alpha} \frac{w^*h + T}{(1 - h)^\gamma} = w^*. \quad (2.9)$$

The size of the transfer is determined by the government budget constraint:  $T^* = w^*N^*\kappa$ . As before,  $y^*$  can be determined solely from the zero-profit condition, and  $N$  can then be determined from the feasibility condition as a function of  $h$ . Using the resulting expression to substitute into the government budget equation gives:

$$T^* = w^*N^*\kappa = \frac{(1 - \rho)\kappa}{\phi + \rho\kappa} w^*h \quad (2.10)$$

Using this in equation (2.9) yields:

$$\frac{(1 - \alpha)}{\alpha} \frac{h}{(1 - h)^\gamma} = \frac{1}{1 + \frac{(1 - \rho)\kappa/\phi}{1 + \rho\kappa/\phi}} \quad (2.11)$$

However, it is perhaps more revealing to instead multiply both sides of equation (2.9) by  $h$ , and rearrange to yield:

$$\frac{(1 - \alpha)}{\alpha} \frac{h}{(1 - h)^\gamma} = \frac{1}{1 + \frac{T}{w^*h}} \quad (2.12)$$

Note that the term  $T/w^*h$  represents government transfers as a fraction of total (after tax) labor income in the economy. It follows that this expression has an identical interpretation as equation (2.6). It follows that for a given value of  $\gamma$ , the key value is not the size of entry barriers but rather the size of the income transfer relative to labor income that is generated by entry barriers.

### 2.3.3 Barriers to Entry III: Direct Restriction on Entry

In this subsection we assume that the government directly controls entry through a process of permits, but there is no charge for a permit. Specifically, in order to operate an intermediate producer must obtain a permit, and we assume that the government restricts the number of permits to be less than the entry that would occur in a decentralized equilibrium. If the number of permits is less than the amount of entry in the decentralized equilibrium, it follows that profits will be positive for any firm that receives a permit. Hence, if it is costless to apply for a permit, all firms would apply. Government policy can be thought of as granting permits to a randomly chosen mass of applicants. While we have offered one possible interpretation, it is worth noting that this policy is similar to some others of



potential interest. For example, suppose that for some reason (e.g., political connections) the barriers to entry for some firms are higher than they are for other firms, so that the barriers keep out potential entrants even though profits are positive for firms that operate. The permit policy described above is a special case of this policy in which the policy induced barrier is zero for some firms and infinite for other firms.

Let  $\bar{N}$  be the mass of permits granted by the government, and assume that this number is binding, in the sense that absent the restriction on permits, additional firms would like to operate. Denote profits earned by an intermediate producer in equilibrium by  $\pi$ . Since the household owns all of the firms in the economy, these profits will be returned to the household and the household budget constraint will now be:

$$c = w^*h + \pi \tag{2.13}$$

The fact that entry is restricted does not change the slope of the demand function  $d^*(p)$  and hence does not change the fact that in equilibrium we will have  $p^* = w^*/\rho$ . Substituting the budget equation into the consumers objective function, one obtains the following equation to characterize the optimal choice of  $h$ :

$$\frac{(1 - \alpha) w^*h + \pi}{\alpha (1 - h)^\gamma} = w^*. \tag{2.14}$$

While we could solve for  $\pi$  as a function of the equilibrium value of  $h$  and obtain an equation in only  $h$ , it is again more revealing to simply multiply both sides by  $h$  and rearrange to obtain:

$$\frac{(1 - \alpha)}{\alpha} \frac{h}{(1 - h)^\gamma} = \frac{1}{1 + \frac{\pi}{w^* h}}. \quad (2.15)$$

The message from this expression is exactly the same as from equation (2.12) in the previous subsection. Specifically, this type of policy does have an impact on hours of work, but the key forcing variable is the magnitude of profits created by the policy relative to total labor income, and the key factor that determines how this translates into changes in hours is the labor supply elasticity.

### 2.3.4 A Restriction on Size

The previous case imposed an exogenous restriction on the number of firms and examined the implications for the equilibrium size of these firms. It is also of interest to consider what happens if the nature of the regulation is to restrict the size of firms, but does not change in any way the cost of entering. In particular, suppose that there is a regulation that requires  $h$  to be less than some value  $\bar{h}$ . If  $\bar{h}$  is less than the original equilibrium value  $h^*$  then the regulation will be binding. The fact that firms face a size constraint implies that equilibrium value of  $p^*/w^*$  will not equal  $1/\rho$ . Instead, zero profit will require that:

$$(p^* - w^*)\bar{h} = w^* \phi \quad (2.16)$$

or:

$$\frac{p^*}{w^*} = 1 + \frac{\phi}{\bar{h}} \quad (2.17)$$

But because profits are equal to zero in equilibrium and there are no transfers, it remains true that equilibrium hours are determined by the condition:

$$\frac{(1 - \alpha)}{\alpha} \frac{h}{(1 - h)^\gamma} = 1.$$

This implies that there is no change in  $h$ . Given that there is no change in total hours but that each firm demands fewer hours, it follows that the number of firms is larger.

### 2.3.5 Implications for Understanding Differences in Hours of Work

The previous analysis shows that under some circumstances it is possible for entry barriers to lead to lower hours worked. A key issue is to determine whether these circumstances apply, and if so, to assess how large these effects might. As noted earlier, most studies that document differences in entry costs refer to real resource costs, and therefore have no implication for differences in hours of work. But more generally, considering the cases in which theory predicts the possibility of labor market effects, the comparison with labor taxes is extremely useful in providing guidance on at least the relative importance of entry barriers in accounting for differences in hours of work. In particular, what we know is that the key mechanism is the same when thinking about the effects of labor taxes and entry barriers, and comes down to assessing the effect on income transfers relative to labor income. In the case of labor taxes, we know the effect is determined by the extent of differences in transfers (whether in kind or monetary) that are funded by differences in labor taxes.<sup>5</sup> We know that differences in effective taxes on labor across countries are as large as twenty percentage points, implying that the scope for these differences to have large effects on transfers relative

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<sup>5</sup>As is well known, since both consumption and labor taxes operate by distorting to the consumption-leisure tradeoff, it is the sum of labor and consumption taxes that are relevant for this assessment.

to labor income is substantial. In the case of license fees, the effect is bounded by the importance of these fees as a source of government revenue.<sup>6</sup> McDaniel (2008) details the various categories of government revenues in constructing tax measures, and finds that the category that would contain this revenue source is of practically no significance in terms of generating revenue. It follows that differences in this category across countries also cannot be significant. In the case of direct restrictions on entry (whether implicit or explicit), the effect is bounded by knowing the extent of the effect on pure economic profits. Definitive measures of economic profits are somewhat scarce, but the consensus in the literature seems to be that they are small in industrialized economies, almost certainly less than 5% of total income. (See, for example, Basu and Fernald (1997) and the references contained therein.) The key conclusion is that even if the nature of entry barriers is such that hours of market work decrease, the available evidence suggests that the effects associated with entry barriers are small relative to those associated with taxes on labor. In view of this we conclude that it is highly unlikely that product market regulation that takes the form of entry barriers or size restrictions will be as important as labor taxes in accounting for differences in hours of work across countries.

### 3 Extensions to the Basic Model

In the previous section we examined how product market regulations influence equilibrium hours of work. In this section we show that the results of this analysis carry over to some more general environments.

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<sup>6</sup>Many authors have produced estimates of differences in effective average tax rates on labor and consumption across countries. Mendoza et al (1994) is one of the early examples, but more recent examples include Prescott (2004) and McDaniel (2008).

### 3.1 General Preferences

The previous analysis has focused on preferences that are consistent with balanced growth. While there is good reason to use this condition to discipline preferences in the context of issues involving aggregate labor supply, it is also of interest to understand how our results carry over to other specification of preferences. The key point that we want to make in this section is that the strong link between how labor taxes and entry barriers affect hours of work continues to hold with more general preferences.

We begin with the analysis of labor income taxes. If we had simply started with a utility function  $u(c, 1 - h)$ , then the expressions that we would have derived for the effect of taxes would have been:

$$\frac{u_2((1 - \tau)wh, 1 - h)}{u_1((1 - \tau)wh, 1 - h)} = (1 - \tau)w \quad (3.1)$$

in the case where the tax revenues are not returned by a lump-sum transfer, and

$$\frac{u_2(wh, 1 - h)}{u_1(wh, 1 - h)} = (1 - \tau)w \quad (3.2)$$

for the case in which revenues are returned via a lump-sum transfer. The difference between these expressions and those derived earlier is that the wage rate  $w$  now appears. In equilibrium, wages are an increasing function of  $N$ , and since taxes will influence  $N$ , the wage rate  $w$  will vary in response to tax policies, thereby introducing additional effects. However, in the first expression above, it should be noted that the effect on  $h$  is determined by the change in  $w(1 - \tau)$  in conjunction with the properties of preferences. In the second case there are two effects: holding  $w$  constant, the increase in  $\tau$  leads to lower hours worked, but

then there is the additional effect on hours due to the change in  $w$ .

Next consider the case of changes to entry barriers. If the entry barrier represents real time costs, then hours will be determined by the condition:

$$\frac{u_2(wh, 1 - h)}{u_1(wh, 1 - h)} = w \quad (3.3)$$

where once again, the wage  $w$ , will be increasing in  $N$ , which is directly affected by the entry barrier. Comparing this expression to equation (3.1), the key point is that the mechanics are identical: the equations are of the exact same form, and the driving forces enter in exactly the same form. One should not conclude that the driving force is larger in the case of taxes, since the effect on  $w$  is larger in the entry barrier case due to the fact that the entry barrier has a direct effect on  $N$ .

If we instead considered the case in which the entry barrier represents a fee that is transferred to consumers via a lump-sum transfer, then the condition for hours becomes:

$$\frac{u_2(wh + T, 1 - h)}{u_1(wh + T, 1 - h)} = w \quad (3.4)$$

As before, in equilibrium,  $T$  is proportional to  $wh$ , so that letting this constant of proportionality be equal to  $b$ , this can be written as:

$$\frac{u_2((1 + b)wh, 1 - h)}{u_1((1 + b)wh, 1 - h)} = w \quad (3.5)$$

But making the change of variable  $\tilde{w} = (1 + b)w$ , and defining  $(1 - \tilde{\tau}) = 1/(1 + b)$ , this expression can be rewritten as:

$$\frac{u_2(\tilde{w}h, 1 - h)}{u_1(\tilde{w}h, 1 - h)} = (1 - \tilde{\tau})\tilde{w} \quad (3.6)$$

Comparing this expression with equation (3.2), one again notes that they take on the same form.

### 3.2 Endogenous Markups

In the previous analysis policies that influence entry costs do not affect the markup of price over marginal cost in equilibrium. One might suspect that one of the key channels through which product market regulations work is to increase markups, and that by virtue of not having this channel the previous analysis is of limited interest. In this section we show that adding this channel to the analysis has no impact on the previous results.

The only change that we make to the previous model is in the technology for the final goods sector. Specifically, rather than letting  $\rho$  be a fixed parameter, we assume that  $\rho$  is an increasing function of the mass of different intermediate products that are available, and write this as  $\rho(N)$ . The motivation for this extension is the intuitive notion that as more intermediate goods are produced, the more similar they are, and hence the more substitutable they become. Formally, this should be modelled explicitly as a property of the commodity space, and the equilibrium should deal explicitly with the issue of how intermediate firms decide where to locate in the commodity space. We sidestep this issue here and simply assume that firms that operate always locate in a symmetric fashion so that all of the intermediate goods are equally substitutable, and that this substitutability is solely a function of  $N$ .

For a given mass  $N$  of operating intermediate goods producers, this model behaves just as the previous model, if we set  $\rho = \rho(N)$ . In particular, the final good producer's demand

function takes the same form as before and as a result, optimal behavior on the part of the intermediate goods producers will give  $p^* = w^*/\rho$ . However, it now follows that any policy which alters the value of  $N$  will necessarily alter the markup in equilibrium, through its effect on  $\rho$ .

Although this extension does have implications for the effects of tax and regulatory policies on both allocations and welfare, it turns out that it has no impact on how these policies qualitatively affect the total volume of market work. This can be seen quite readily from an examination of the household's utility maximization problem. Write the budget equation as  $c = w^*h + I$ , where we allow for the possibility that the household receives some form of non-labor income  $I$  from the government or some profits from firms. The resulting first order condition can be rearranged to give:

$$\frac{(1 - \alpha)}{\alpha} \frac{h}{(1 - h)^\gamma} = \frac{1}{1 + \frac{I}{w^*h}}. \quad (3.7)$$

In particular, if non-labor income is zero, because either license revenues are discarded, or because the entry costs represent real costs, then there will be no effect on the volume of market work. However, we know from the previous analysis that in the case of a regulation that takes the form of a real resource cost, regulations do lead to less entry and hence a lower value of  $N$ . This lower value of  $N$  necessarily implies that there will be higher markups in equilibrium, but the above expression tells us that when  $I = 0$ , the fact that the markup increases has no implications for the volume of market work in equilibrium. It does not follow that endogenous markups have no implications for the effect of entry barriers on allocations.



The zero profit condition now implies that:

$$y = \frac{\rho(N)}{1 - \rho(N)}\phi \tag{3.8}$$

so that if  $\phi$  increases, the reduction in  $N$  leads to an opposing effect on  $y$ . Since feasibility requires that  $N(y + \phi) = h$  it follows that a given increase in  $\phi$  will have a smaller effect on  $N$  than in the case where markups were exogenous. Lastly, recall that consumption of the household is given by  $c = N^{1/\rho}y$  so that the endogenous markup will affect the drop in  $c$  associated with a given increase in  $\phi$  due to regulations.

In cases where the regulation leads to non-labor income, either through rebate of license fees or through higher profits, it remains true that the key impulse is the size of the transfer relative to labor income and that the key parameter that determines the magnitude of the effect is the labor supply elasticity  $\gamma$ . In particular, given the volume of the transfer relative to labor income, from the perspective of what happens to hours of market work it is completely irrelevant whether the regulation is accompanied by a change in markups.

### 3.3 Imperfect Competition in the Labor Market

The previous analysis has assumed that labor markets are competitive. Several papers suggest that the effect of regulation, specifically entry barriers, on labor market outcomes is very much influenced by this assumption. In this section we extend the model to allow for monopolistically competitive behavior in the labor market on the part of workers and show that the results from the previous analysis continue to hold. This finding should not be interpreted to suggest that noncompetitive wage setting cannot have interactions with product market regulation that influence time devoted to market work. Rather, the analysis

should be interpreted as showing that the mere presence of noncompetitive wage setting does not overturn the previous results.

The extension that we consider seems a natural way to bring noncompetitive wage-setting into the standard model of time allocation that does not introduce trading frictions, and follows the approach in Comin and Gertler (2006). Specifically, we now assume a continuum of households with mass equal to one, each with the same preferences as used earlier in the analysis. What distinguishes the households is that each is endowed with a different type of labor services. The production technology for intermediate goods is now written as:

$$y(i) = \left[ \int_0^1 h(j)^\eta dj \right]^{1/\eta} \quad (3.9)$$

where  $h(j)$  is the input of labor services from household  $j$ , and  $0 < \eta < 1$  determines the degree of substitutability of the various labor types. Our previous analysis can be seen as the special case of  $\eta = 1$ , in which case all labor services are perfect substitutes. Once again there is a fixed cost  $\phi$  associated with operating each intermediate goods technology, but it is now more convenient to assume that this cost is measured in units of the final consumption good rather than labor, since labor is no longer homogeneous.

We consider a decentralized equilibrium in which each household sets the wage rate for its labor taking as given all other prices in the economy. Each intermediate producer will behave competitively in the labor market, taking the wages of each labor type as given. We first solve for the decentralized equilibrium in the absence of any taxes or regulations, though in the interest of space we focus on the equilibrium value of  $h$ . Because this case is a relatively straightforward extension of the earlier model we do repeat a formal definition of equilibrium. We note, however, that a symmetric equilibrium will now involve all of the

same objects as before, and a new function  $g^*(w)$  that represents the demand for each type of labor as a function of its own wage holding all other prices equal to their equilibrium values. Similarly to what happens in the market for intermediate goods, it is easy to show that this function takes the form  $Bw^{\frac{1}{\eta-1}}$ , where  $B$  is a constant. It follows that in equilibrium, household  $j$  will choose  $c$ ,  $h$  and  $w$  to maximize:

$$\alpha \log(c) + (1 - \alpha) \frac{(1 - h)^{1-\gamma} - 1}{1 - \gamma} \quad (3.10)$$

subject to:

$$\begin{aligned} c &= wh \\ h &= Bw^{\frac{1}{\eta-1}} \end{aligned} \quad (3.11)$$

Substituting into the objective function, taking first order conditions and rearranging, one obtains the following expression that characterizes the optimal choice of  $h$ :

$$\frac{(1 - \alpha)}{\alpha} \frac{h}{(1 - h)^\gamma} = \eta. \quad (3.12)$$

This expression has a natural interpretation in terms of markups. The inverse of the left-hand side of this equation reflects the gain to the worker of supplying an extra unit of labor, and the right hand side says that in the monopolistically competitive equilibrium this value will be a markup of  $1/\eta$  times its value in the competitive case.

It turns out that the previous analysis of the effects on hours of work goes through without any change. Specifically, all of the previous expressions for hours of work remain unchanged except for the addition of the term  $\eta$  on the right hand side. It follows that the

presence of labor market imperfections of the sort considered here has effectively no impact on how *changes* in regulation affect market work. In particular, the result that regulations that increase the real resource costs associated with entry has no effect on time allocated to market work continues to hold in this model, independently of the value of  $\eta$ . The same holds true for the case of license fees that are thrown away. In the case of license fees that are rebated, it remains true that the key driving force is the size of the rebates relative to labor income and the key parameter that dictates how this driving force is transformed in a change in hours is the labor supply elasticity parameter  $\gamma$ .

The statement that the value of  $\eta$  does not affect how a given change in product market regulations affect total market work should not be confused with the statement that the value of  $\eta$  does not affect hours of market work. Our results most definitely imply that differences in  $\eta$  do impact on hours of work, so that economies with different values of  $\eta$  will have different equilibrium time allocations.

### 3.4 A Two-Sector Analysis

The framework used for the above analysis is best suited to comparing two economies which have differences in product market regulation across all sectors. However, in reality there are many prominent examples of product market regulations that are sector specific. In this section we consider the simplest extension of the model to permit an analysis of this issue. To pursue this we extend the original model to allow for two final consumption goods. We now write preferences as:

$$\alpha \log(c) + (1 - \alpha) \frac{(1 - h)^{1-\gamma} - 1}{1 - \gamma} \tag{3.13}$$

where  $c$  is now total consumption and  $h$  is total time devoted to market work. Total consumption is a CES aggregate of the two final consumption goods, denoted by  $c_1$  and  $c_2$ :

$$c = (\mu c_1^\varepsilon + (1 - \mu)c_2^\varepsilon)^{1/\varepsilon} \quad (3.14)$$

where  $\varepsilon$  determines the elasticity of substitution between the two goods.

The technology in sector 2 is the same as that considered previously: there is a continuum of potential intermediate goods that have linear production functions with unit marginal cost and face the fixed set-up cost  $\phi$ , and there is a final goods producer that aggregates the intermediate goods into the final consumption good  $c_2$ :

$$c_2 = \left[ \int_0^N y(i)^\rho di \right]^{1/\rho}. \quad (3.15)$$

While we could consider a symmetric structure for the production of the other final good, for our purposes it is sufficient to consider the simpler structure in which  $c_1$  is produced using only labor with a linear technology. We set the marginal productivity of this technology to one and assume that there are no fixed costs of operation in this sector.

We consider an equilibrium in which the market for labor and the markets for final goods are competitive, but assume that the market for intermediates used in production of the  $c_2$  is monopolistically competitive as before. Equilibrium for this economy is a straightforward generalization of that in the previous economies studied, so we do not present the details here. As before, we focus on symmetric equilibria, in which the prices of all intermediate goods are the same, denoted by  $p_y^*$ . We normalize the price of  $c_1$  to be one, denote the wage rate by  $w^*$ , and the price of  $c_2$  by  $p_2^*$ . Given the linear technology to produce  $c_1$ , it must be

that  $w^* = 1$  in equilibrium. The demand functions for intermediate goods take on the same form as previously, and hence prices in equilibrium will still be given by the same markup,  $p_y^* = \frac{1}{\rho}$ . Finally, given that the final goods producer of  $c_2$  is competitive, profits must equal zero in equilibrium, implying that  $p_2^* N^{1/\rho} y^* - N p_y^* y^* = 0$ . Using  $p_y^* = 1/\rho$  implies that:

$$p_2^* = \frac{1}{\rho} N^{\frac{\rho-1}{\rho}}. \quad (3.16)$$

Letting  $\lambda$  be the multiplier on the budget constraint, the three first order conditions to the consumer's problem are: we obtain first order conditions:

$$(1 - \alpha)(1 - h)^{-\gamma} = \lambda \quad (3.17)$$

$$\frac{\alpha \mu}{c_1^\varepsilon} c_1^{\varepsilon-1} = \lambda \quad (3.18)$$

$$\frac{\alpha(1 - \mu)}{c_2^\varepsilon} c_2^{\varepsilon-1} = \lambda p_2^* \quad (3.19)$$

Combining equations (3.17), (3.18) gives:

$$(1 - \alpha)(1 - h)^{-\gamma} = \frac{\alpha \mu}{c_1(\mu + (1 - \mu)[\frac{c_2}{c_1}]^\varepsilon)}. \quad (3.20)$$

Equations (3.18) and (3.19) and (3.16) imply:

$$\frac{c_2}{c_1} = \left[ \frac{\mu}{(1 - \mu)\rho} N^{\frac{\rho-1}{\rho}} \right]^{\frac{1}{\varepsilon-1}} = A(N) \quad (3.21)$$

Using equation (3.16) to substitute for  $p_2^*$  in the budget equation gives:

$$N^{(\rho-1)/\rho} c_2 = \rho(h - c_1). \quad (3.22)$$

Using equation (3.21) this can be written as:

$$c_1 = \frac{\rho h}{N^{(\rho-1)/\rho} A(N) + \rho}. \quad (3.23)$$

Substituting equations (3.21) and (3.23) into the right hand side of equation (3.20) and simplifying yields:

$$\frac{(1 - \alpha)}{\alpha} \frac{h}{(1 - h)^\gamma} = 1 \quad (3.24)$$

which is exactly the same expression as in the one-sector case. Having determined the equilibrium value of  $h$  one can easily solve for the other components of the equilibrium allocation.

One can now show that the previous analysis continues to carry over to the current context as well. In particular, if there is a regulation that involves a license fee  $\kappa$  to enter the intermediate goods sector, then aggregate market work will satisfy:

$$\frac{(1 - \alpha)}{\alpha} \frac{h + T}{(1 - h)^\gamma} = 1 \quad (3.25)$$

where  $T$  is the magnitude of the transfer from the government to the representative household. This gives rise to the same type of expression as derived earlier in the one sector case.

An interesting feature of the two-sector analysis is that we can also address how industry specific regulations affect the sectoral allocation of hours. In this regard, it is of interest to rewrite expression (3.23) as:

$$\frac{h_1}{h} = \frac{\rho}{A(N)N^{(1-\rho)/\rho} + \rho} \quad (3.26)$$

which can be simplified to:

$$\frac{h_1}{h} = \frac{1}{\left(\frac{\mu}{1-\mu}\right)^{\frac{1}{\varepsilon-1}} \rho^{\frac{\varepsilon}{1-\varepsilon}} N^{\frac{\varepsilon(\rho-1)}{(\varepsilon-1)\rho}} + 1} \quad (3.27)$$

This expression gives the fraction of total work that is carried out in sector 1. This expression is useful in interpreting findings from industry level studies. In particular, consider the case of a regulation that increases entry costs in the intermediate goods sector, and assume that this increase takes the form of real resource outlays, i.e., an increase in the value of  $\phi$ . As was true in the one-good model, our earlier analysis tells us that this regulation will have no effect on aggregate market work. However, this type of regulation will lead to a decrease in the mass of intermediate goods firms that operate, and equation (3.27) shows how this decrease in  $N$  will translate into a change in the relative amount of work done in each of the two sectors. The size of this effect depends on the two elasticity parameters,  $\varepsilon$  and  $\rho$ , but recalling that  $\rho$  satisfies  $0 < \rho < 1$ , the sign of the response will be determined by the sign of  $\varepsilon$ . In particular, if  $\varepsilon > 0$ , then hours of market work in sector 2 will decrease, while if  $\varepsilon < 0$ , hours of market work in sector 2 will actually increase. The key point however, is that the change in industry hours is not informative about the effect of this type of regulation on aggregate hours of work.

There is an alternative interpretation of our two-sector analysis which is also of potential



interest. Specifically, rather than interpreting the two sectors to be two different market sectors, one could interpret sector 1 to be the home sector and sector 2 to be the market sector. In this case, any movement of hours between the two sectors will show up as changes in market work even if changes in total work are constant. In the case just discussed in the previous paragraph, if we assume that home and market goods are relatively good substitutes, so that  $\varepsilon > 0$ , then a regulation which increases the real resource costs of entry in the intermediate goods sector will lead to a fall in hours of market work. Of course, this fall in market work will be accompanied by an offsetting increase in the amount of homework. Recent work on cross-country comparisons of time use (see e.g., Freeman and Schettkat (2002), Olovsson (2004) and Ragan (2005)) indicate that homework is higher in the countries of continental Europe, so this channel may be significant. Of course, as shown in Olovsson (2004), Ragan (2005) and Rogerson (2006, 2007), it is also true that adding home production influences how market hours respond to other driving forces, such as taxes.

## 4 Dynamic Analysis

In the previous sections we provided analytic results for a static economy with a particular production structure. In this section we build and calibrate a monopolistic competition version of the dynamic industry equilibrium model used by Hopenhayn and Rogerson (1993) to study the effects of firing taxes, and use it to assess the steady state effects of entry barriers. This analysis is of potential interest for three reasons. First, in a dynamic setting, entry barriers will influence both the entry and exit decision, and therefore influence the distribution of firm level productivities via a selection effect. A dynamic model allows us to evaluate this effect. Second, whereas in a static model the free entry condition implies that

profits are zero in equilibrium, in a dynamic model the free entry condition only implies that the expected present value of profits are equal to zero. If interest rates are positive, this does not imply that the steady state profit flow is equal to zero. Changes in steady state profits induce income effects on labor supply and hence our dynamic model allows us to evaluate this additional effect. Finally, this analysis allows us to compare the effects of entry barriers and firing taxes. Hopenhayn and Rogerson (1993) found that firing taxes had somewhat small but negative effects on hours of work. Since the direct effects of entry barriers and firing taxes is similar, in that both distort the allocation of labor across establishments, one might infer that the labor market effects would also be similar. We argue that the Hopenhayn and Rogerson (1993) require an important qualification. Consistent with our previous analysis, we show that the effects of firing taxes on hours of work depend critically on whether the firing taxes represent a real resource cost as opposed to being a source of revenue that leads to a lump-sum transfer. While entry barrier and firing taxes that represent real resource costs do have important effects on allocations and welfare, our quantitative analysis finds that the effect of these policies on hours of work is effectively zero.

## 4.1 Model and Calibration

There is a single household, with preferences over consumption ( $c_t$ ) and leisure ( $1 - h_t$ ) given by:

$$\sum_{t=0}^{\infty} \beta^t [\alpha \log(c_t) + (1 - \alpha) \log(1 - h_t)] \quad (4.1)$$

where  $0 < \beta < 1$  is a discount factor. Note that we have imposed preferences that are consistent with balanced growth, implying that income and substitution effects are offsetting. The household is endowed with one unit of time each period.

As in the static analysis, we assume that there are two production sectors, one that combines intermediate goods into the final output good, and another that uses labor to produce intermediate goods. We assume that the final good sector is competitive with a constant returns to scale technology, and so for simplicity assume that it consists of a single firm, with a production function given by:

$$Y_t = \left[ \int_0^{N_t} y_t(i)^\rho di \right]^{1/\rho} \quad (4.2)$$

where  $N_t$  is the mass of intermediate goods firms at time  $t$ .

Firms in the intermediate goods sector are subjected to persistent idiosyncratic productivity shocks and face two fixed costs. As in the static model we assume that there is a fixed labor cost associated with entry, which we denote by  $h_e$ . In order to generate endogenous exit, we also assume that there is a fixed per period operating cost, which is also expressed in units of labor and is denoted by  $h_f$ . Consider a firm that produced in period  $t - 1$  and had productivity parameter  $A_{t-1}$ . At the beginning of period  $t$ , this firm must decide whether to remain in operation or exit. If it chooses to remain in operation it must pay the fixed cost  $h_f$ . If it pays this cost, it will learn its new productivity, which is described by a density function  $f(A_t, A_{t-1})$ . We assume that a higher value of  $A_{t-1}$  leads to a distribution of  $A_t$  that first order stochastically dominates the previous distribution. The process for the idiosyncratic shocks is the same for all intermediate firms, but the realization of the shocks is iid across firms. If the firm paid the cost  $h_f$  and received a new draw  $A_t$  it then faces a linear production technology given by:

$$y_t = A_t h_t \quad (4.3)$$

If a firm chooses to not pay the fixed cost  $h_f$  then it exits and ceases to exist.

We also need to specify how the initial productivity for new entrants is set. We assume that entry occurs in the beginning of the period, prior to any production decisions. Hence, if a firm pays the entry cost  $h_e$  at the beginning of period  $t$  it will be able to produce in period  $t$  and its idiosyncratic productivity will be a random draw from a distribution with density  $g(A)$ . All of the fixed costs for entrants are captured by  $h_e$ , and so all entrants will produce for at least one period no matter how low their productivity is. All potential entrants draw from the same distribution, but the draws are iid across entrants. We assume that each firm produces a different intermediate good, so that the mass of intermediate goods is the same as the mass of firms. All of the firms (including potential firms) are owned by the household.

We focus on the steady state equilibrium for this model, assuming that intermediate goods producers behave as monopolistic competitors in the product market, and that all other markets are competitive. There is an unlimited number of potential entrants into the intermediate goods sector, so that in equilibrium the net profit from entering must equal zero. Some notation will help to outline the specifics in more detail. Normalize the wage rate to one and let  $p_c$  be the equilibrium price of the final good. Because our intermediate producers are no longer symmetric there will no longer be a single price for intermediate goods. We let  $p(A)$  denote the price charged by an intermediate producer who has current productivity  $A$ . Given a mass of intermediate goods producers equal to  $N$ , the problem of the final good producer reduces to a sequence of static problems, and as is standard, the demand for each input is a constant elasticity demand function with own price elasticity equal to  $1/(1-\rho)$  and scale parameter  $B$ , i.e., demand is given by  $Bp^{1/(\rho-1)}$  for some constant  $B$ . In equilibrium,  $B$  will be a function of the mass of firms,  $N$ , the outputs of each of the

firms ( $y_j$ ), and the price of the final good  $p_c$ , given by:

$$B = p_c^{1/(1-\rho)} \left[ \int_0^N y_j^\rho dj \right]^{1/\rho} \quad (4.4)$$

Let  $\mu(A)$  denote the measure of firms in the current period after the fixed operating costs have been paid (i.e., after the exit decision has been taken) the new realizations of productivity have been realized, and entry has taken place. The mass of intermediate goods producers is given by  $N = \int \mu(A) dA$ . Recalling that we have normalized the wage to be one, the value function for a firm at this point in time is given by:

$$V(A) = \max_{p,h} \{ pAh - h \} + \beta \max \{ 0, -h_f + \int V(A') f(A', A) dA' \} \quad (4.5)$$

subject to taking the demand function for its product as given. Note that the only dynamic decision involves whether to exit at the beginning of next period. Independently of whether the firm plans to exit at the beginning of the next period, the optimal decision for price and labor input are determined by maximizing current period profits, since the operating cost paid earlier in the period represents a sunk cost at this point. It follows that the optimal pricing decision will be a markup over marginal cost, so that the equilibrium price for an intermediate goods firm with current productivity  $A$  will be  $p(A) = \frac{1}{\rho} \frac{w}{A}$ . Let  $h(A)$  be the optimal decision rule for labor demand, and let  $X(A)$  denote the optimal decision rule for the exit decision at the beginning of the next period with the convention that  $X = 1$  denotes exit. Given our assumption that higher  $A$  today leads to a distribution of  $A$  tomorrow that is first order stochastically higher, it is straightforward to show that the function  $V$  is weakly increasing in  $A$  and hence that the optimal exit rule will be described by a reservation rule:

exit if  $A < \bar{A}$ . For future reference we note that it is also straightforward to show that the value function  $V$  is increasing in the scale parameter  $B$ .

Next consider the problem of a potential entrant. The expected value from entering the market is given by:

$$-h_e + \int V(A)g(A)dA \tag{4.6}$$

If there is entry in the steady state equilibrium then this value must equal zero.<sup>7</sup> Since the value function  $V$  is increasing in the scale of demand for intermediate goods, it follows that the zero profit condition will uniquely pin down the value of  $B$ . Given the value of  $B$ , one can solve for the optimal decision rules  $h(A)$  and  $X(A)$ .

There are two remaining equilibrium values to be determined: the level of entry,  $E$ , and the price of the final good,  $p_c$ . In general these values need to be solved for jointly, but our assumption that utility from consumption takes the form of  $\log c$  implies that the values of  $E$  and  $p_c$  can be determined sequentially. In particular, the steady state equilibrium level of entry is determined by the labor market clearing condition. To see this, note first that the household labor supply decision in steady state reduces to a static problem of maximizing current period utility taking the price  $p_c$  and current profit flow, which we denote by  $\pi$ , as given. The choice of  $\log c$  for the utility function implies that labor supply is independent of  $p_c$  so we can write the optimal labor supply choice as  $H^S(\pi)$ . Note that although free entry implies that the net discounted profit from entry is equal to zero in equilibrium, it does not follow that the current flow of profit is equal to zero, since the interest rate is positive. Given our preference specification, leisure is a normal good and this function is decreasing in  $\pi$ .

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<sup>7</sup>As in the analysis of Hopenhayn and Rogerson (1993), it is possible that there does not exist a steady state equilibrium with entry. Given that we calibrate the model to be consistent with entry in the steady state equilibrium, we focus only on this case.

The labor market clearing condition in steady state equilibrium can be written as:

$$\int (h(A) + h_f)\mu(A)dA + E(h_e - h_f) = H^s(\pi) \quad (4.7)$$

Note that we multiply  $E$  by  $(h_e - h_f)$  since we assumed that the fixed operating cost is included in the entry cost. Given decision rules  $h(A)$  and  $X(A)$ , one can easily show that the resulting invariant distribution  $\mu(A)$  is scaled proportionately by  $E$ , as is the aggregate profit flow  $\pi$ . It follows that this equation uniquely determines steady state entry. Having determined entry, and given that we know the steady state value of  $B$ , it follows that we can determine the steady state value of  $p_c$  from equation (4.4).

There are a few properties of the steady state equilibrium that one can infer from the above constructive argument that are worth noting in terms of the future analysis. First, changes in taxes will affect the labor supply function  $H^S$ . But they will not affect the steady state value of  $B$  that emerges from the free entry condition, and hence will not affect the decision rules  $h(A)$  and  $X(A)$ . It follows that taxes will affect the scale of the steady state distribution  $\mu$  but not its shape. As a result many statistics will not change, such as average firm size and the exit rate. While the productivity of intermediate goods producers will not be affected, there will be an aggregate productivity effect associated with the change in  $N$ . Similarly, in the case of a change in  $h_e$ , the effect on firm decision rules will be independent of whether the increase represents a real resource cost or is used to fund a transfer payment to households. It follows that variables such as the entry rate and average firm size will not be affected by this difference.

Having laid out the model and qualitatively described some features of the equilibrium, we will next turn to a quantitative analysis of the effect of product market regulations. To

do this it is necessary to choose functional forms for the stochastic elements of the model and to assign parameter values. To facilitate comparison with earlier work, we follow the choices of Hopenhayn and Rogerson (1993) where possible. Although the values of many of the parameters are jointly determined, it is useful to describe the calibration procedure as linking specific parameter values and targets. As in Hopenhayn and Rogerson, we set the time period equal to five years. The preference parameter  $\alpha$  is chosen so that total hours of work in the steady state is equal to .3, and the resulting value is .3042. The discount factor is the five year equivalent of .96 per year, which equals .80. We assume that the constant term  $B$  in the demand for intermediate goods by the final good producer is equal to one in equilibrium. This is equivalent to normalizing the price of the final good, which is tantamount to a choice of units. We assume that the idiosyncratic shock process follows an  $AR(1)$  process on  $\log(A)$ , with persistence  $\rho_A$  and log normal innovations, and that the distribution for entrants is uniform. As in Hopenhayn and Rogerson, based on data from the LED we set the persistence parameter equal to .93 and the standard deviation of the innovations to be .2621. With  $B$  normalized to one, the free entry condition determines the calibrated value of  $h_e$ . The mean of the innovation influences the mean productivity, and  $h_f$  influences the reservation productivity value. These two values are chosen so as to match a five year exit rate of .37 and an average firm size of 61.<sup>8</sup> For our benchmark specification we set  $\rho = 5/6$ , implying that markups will be 20% in equilibrium. This value is at the upper end of what many studies assume, but in terms of the effects on hours of work we found that

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<sup>8</sup>Our model only says how many hours a firm hires. We convert this to workers by assuming that a worker works 40 hours a week for 52 weeks a year for five years, and express this relative to the time endowment which assumes 100 hours per week. Our model is homogeneous of degree one in population, so the number of firms is linear in the size of the population. While normalizing the population size to be one and having an average firm size equal to 61 may sound peculiar, it simply implies that we have a small mass of firms operating in equilibrium. But assuming population of 300 million would have zero effect on all of our reported results.



the results are basically the same for smaller values so will only report results for this case. The one dimension that is affected by the value of  $\rho$  is the size of the aggregate productivity effects, since the policies that we consider will typically influence the mass of firms operating in the steady state equilibrium, and the magnitude of how this affects aggregate productivity is very much dependent on  $\rho$ .

## 4.2 Results

We are now ready to evaluate some of the policies examined earlier in the paper in the static version of the model. But before we do so it is important to note one feature of the steady state equilibrium. As noted earlier, although free entry implies that the expected present discounted value of profits for an entrant is equal to zero, it does not follow that the one period aggregate profits are equal to zero in steady state. Nonetheless, the aggregate one period profit flow is very small, amounting to only 2% of labor income.

We begin by considering the effects of an increase in labor taxes when they are used to fund a lump-sum transfer. As is standard in this literature, we focus on the comparison of what happens when taxes are increased from .30 to .50, since this reflects the typical values for the US versus countries in continental Europe. Table 1 presents the results, where all values are values for the high tax economy relative to the lower tax economy.

Outcomes for $\tau = .5$ Relative to $\tau = .3$					
$H$	$E/N$	$Y/H$	$\pi$	$N$	$H/N$
.76	1.00	.95	.77	.76	1.00

The effect of a twenty percent increase in the tax rate used to fund a lump sum transfer reduces steady state hours of work by about 1/4. We note that this is effectively the same

prediction that one would obtain from the static analysis carried out earlier in the paper. Relative to the static model, and as noted previously, this model has one additional margin that could influence the labor supply response, and that is the effect on profits. Although the tax and transfer policy has a substantial impact on profits in percentage terms, because profits are small relative to labor income, the effect of this change on labor supply is very small. Consistent with earlier comments on the construction of the steady state equilibrium, taxes have no effect on the entry rate or on average firm size. The large decrease in  $N$  produces substantial effects on productivity, though we note that if markups were 10% instead of 20%, this effect would be less than one-half as large.

We now turn to an analysis of the effect of entry barriers. We consider the case of an increase in entry costs  $h_e$  due to license fees, which we denote by  $\kappa$ . As in the earlier analysis, we assume that  $\kappa$  is measured in units of labor so that the effective entry cost becomes  $h_e + \kappa$ . We then consider two separate cases, depending upon what is done with the revenue that is raised by the fees.<sup>9</sup> Table 2 reports the results for the case in which revenues are discarded. Once again, all values are relative to the initial steady state.

Effects of Entry Fee, Proceeds Discarded						
$\kappa/h_e$	$H$	$E/N$	$Y/H$	$\pi$	$N$	$H/N$
.20	.999	.96	.99	1.05	.88	1.14
.50	.998	.93	.98	1.10	.73	1.35
1.00	.997	.86	.96	1.16	.61	1.64
3.00	.996	.67	.88	1.30	.39	2.50

<sup>9</sup>As in the static analysis, the case in which the revenues are discarded is equivalent to the case in which the higher entry fee represents a real resource cost, so we do not report separate results for the case of an increase in real resource costs.

The simple message from this table is that such a policy has virtually no effect on hours of work. As expected, the policy reduces the entry rate, leading to fewer firms that are on average larger. Whereas the increase in labor taxes lead to a significant decrease in the steady state profit flow, an entry fee leads to a significant increase in this flow. But once again, although this policy produces a sizeable increase in profits in percentage terms, the change is small relative to labor income and as a result the effect on hours of work is virtually nonexistent.

Table 3 considers the case where the entry cost is rebated to consumers.

Table 3

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Effects of Entry Barrier, Proceeds Rebated

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	$H$	$E/N$	$Y/H$	$\pi$	$N$	$H/N$	$T/wH$
$\kappa/h_e = .20$	.98	.96	.99	1.03	.86	1.14	.022
$\kappa/h_e = .50$	.97	.93	.98	1.07	.71	1.35	.047
$\kappa/h_e = 1.00$	.95	.86	.95	1.11	.57	1.64	.073
$\kappa/h_e = 3.00$	.92	.67	.87	1.20	.37	2.50	.117

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In this case we now see that there is a noticeable effect on hours of work if the change in entry costs is sufficiently large. But the key point here is the final column of the table, which shows the value of the transfer generated by the entry fees, relative to labor income. What it shows is that an entry fee that is sufficiently large so as to fund a transfer payment equal to more than 10% of labor income would indeed reduce steady state hours of work by 8%. In fact, this is effectively the same response that one would find from a labor tax that lead to a transfer payment equal to this fraction of (after-tax) labor income. That is, the differential effect associated with the different effects on the steady state profit flow is virtually negligible in terms of its effect on hours of work.

Next we consider the case where the product market regulation takes the form of restricting entry, but occurs directly instead of via changes in the entry cost. This case is of interest quantitatively because one would expect that this is the case that will lead to the largest increase in profits, and thereby the largest effect on hours of work. Table 4 displays the results. We use  $E^*$  to denote the level of entry in the benchmark steady state equilibrium.

Direct Restriction on Entry						
	$H$	$E/N$	$Y/H$	$\pi$	$N$	$H/N$
$E/E^* = .80$	.98	.97	.99	2.52	.81	1.21
$E/E^* = .60$	.96	.90	.96	4.03	.64	1.51
$E/E^* = .40$	.94	.80	.92	5.56	.47	2.02

The basic pattern of results here is similar to that in the previous table, except that now the key channel is profits as opposed to the transfer funded by the entry fee. Specifically, one can see from the fourth column that this policy has a dramatic effect on profits. Even though profits in the initial steady state are very small relative to labor income, the fact that profits increase more than fivefold when entry is reduced by 60% relative to the initial steady state implies that the effect becomes substantial. By way of comparison we note that the increase in profits relative to labor income for the case in which  $E/E^* = .40$  is roughly 10%, and that the effect on hours worked is effectively identical to that which results from the case in which the entry fee leads to a transfer payment equal to 10% of labor income. That is, in terms of assessing the effects on hours of work, it is sufficient to know the size of the increase in non-labor income relative to labor income.

For completeness we also consider the effect of a change in  $\rho$ . Blanchard and Giavazzi (2003) argued that some product market regulations could be understood in a reduced form

sense as effectively changing  $\rho$  to the extent that product market regulation might impact on markups, and in equilibrium  $\rho$  is the markup. In their analysis they abstracted from productivity effects associated with variety, whereas we have not, so we add an additional qualification up front that the productivity effects associated with a change in  $\rho$  should probably not be taken seriously if one is interpreting the change in  $\rho$  as being due to a change in product market regulation whose direct effect is a change on markups. Table 5 shows the results.

Table 5

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Effect of Changes in  $\rho$

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	$H$	$E/N$	$Y/H$	$\pi$	$N$	$H/N$
$\rho = 1/1.15$	1.001	1.19	2.24	.89	.64	1.57
$\rho = 1/1.25$	.997	.86	.46	1.21	1.40	.71
$\rho = 1/1.3$	.993	.67	.22	1.46	2.03	.49

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The main result here is that this change has virtually no impact on steady state hours of work.

### 4.3 Comparison with Firing Taxes

While the focus of our analysis has been on the effect of product market regulation on hours of market work, it is of interest to compare the results that we obtain here with those obtained by Hopenhayn and Rogerson (1993) in their analysis of firing taxes. In particular, they report that a firing tax equal to one year's wage leads to a reduction in hours of work of roughly 2.5%. At first glance one might conclude that firing taxes have larger effects on hours of work than do entry barriers. However, a closer analysis reveals that this conclusion is not warranted. In particular, one of the key messages of the analysis that we have undertaken above is that the

effects of entry barriers on hours of market work depends critically on what is done with the revenue that is generated from the regulation, or more specifically, on the size of the effect of the regulation on income transfers relative to labor income. Hopenhayn and Rogerson assumed that the revenue from the firing taxes was used to fund a lump-sum transfer to all households. In light of the preceding analysis, we think it is interesting to ask to what extent the Hopenhayn and Rogerson results are affected by changing the assumption regarding the nature of the firing taxes. We note that both interpretations of the firing tax are reasonable, in the sense that one interpretation of the tax is that it reflects additional resources that a firm must expend in order to reduce the size of its payroll, either by hiring lawyers, meeting with government officials, preparing reports to justify the reduction in workforce etc... The other interpretation is that it reflects a lump-sum payment to workers. In this case it is critical that it reflect a lump-sum payment and not deferred compensation. We carry out an analysis of firing taxes in the context of our calibrated model, which differs slightly from Hopenhayn and Rogerson because of the assumption of differentiated intermediate goods and monopolistic competition in the intermediate good sector. Table 6 reports the results.

Effect of Firing Tax of 1 Year's Wage						
	$H$	$E/N$	$Y/H$	$\pi$	$N$	$H/N$
Rebated	.96	.90	.98	.26	.86	.90
Not-Rebated	1.01	.90	.99	.28	.91	.90

If one compares the results in the first row with those in Hopenhayn and Rogerson, one sees that the presence of monopolistic competition and the intermediate goods sector does alter the precise quantitative effects, though not the general nature of their results.<sup>10</sup> In

<sup>10</sup>In Hopenhayn and Rogerson, the key curvature affecting firm level demand for labor comes from the assumption of decreasing returns to scale in production, whereas in the analysis here, the key curvature

particular, we find that productivity decreases by 2% and hours worked decrease by 4%, in contrast to values of 2.1% and 2.5% in Hopenhayn and Rogerson. But the key point is that when we look at the case where the revenues are not rebated, the results for productivity are similar (reducing by 1% instead of 2%), but the change in hours is now of a different sign: an increase of 1% versus a decrease of 4%. The reason for the increase in hours is that firing taxes lead to a significantly lower steady state profit flow. However, as was the case in the analysis of entry barriers, because profits are small relative to labor income, even a large percentage change in profits leads to a relatively small effect on hours of work.

#### 4.4 Summary

The main result that we want to emphasize from the above simulations is that the results from our static analysis continue to hold in a dynamic model with ore realistic processes for firm level dynamics, particularly for the processes of entry and exit. While the dynamic models do feature some additional effects relative to those in the static model, these effects turn out to be very small in our calibrated model. We also show that the results of Hopenhayn and Rogerson (1993) need to be interpreted with caution, since the same basic point applies equally well to the analysis of labor market regulations such as firing taxes. That is, the key mechanism that leads to changes in hours worked in their model is changes in non-labor income associated with the revenues from the firing taxes.

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comes from the substitutability among intermediates. The calibrations imply different degrees of curvature and hence the effects of firing taxes differ somewhat.

## 5 Conclusions

The goal of this paper was to assess the effect of product market regulations which take the form of increased entry costs on time allocated to market work in the context of a standard aggregate model of time allocation. Several results have emerged. The effect of product market regulation on time allocated to market work can be understood in exactly the same way as the effect of labor or consumption taxes on the time allocated to market work. The key driving force in both cases is the implicit transfer of resources to households as a fraction of total labor income, and the key feature of the model that influences the propagation of this driving force is the labor supply elasticity. A direct implication of this is that regulations which increase the real resource costs associated with entry have no impact on time devoted to market work given standard assumptions about preferences. Measures of the differences in the magnitude of entry barriers associated with regulation are by themselves not very informative about the impact of regulations on market work, since large differences in regulatory barriers may be associated with small differences in effective transfer payments. Our results were robust to allowing for endogenous markups, a particular form of imperfect competition in the labor market, and to having multiple final goods. The multi-sector model also indicates that analysis of outcomes in individual sectors are unlikely to yield information regarding the effect of labor market regulation on total market work. Taken at face value, our results indicate that stories which stress product market regulation rather than taxes as a key driving force face a key challenge. Since the propagation mechanisms are identical, the relative importance of the two is determined by the relative importance of the implied transfer payments. We are aware of no evidence that suggests that differences in implicit transfers or economic profits associated with product market regulation are comparable to



the differences in revenues associated with either labor or consumption taxation.

Our analysis of a two sector model does suggest one channel which seems promising for future research. If product market regulation leads to higher prices of market produced goods and services, then they encourage individuals to substitute from market produced services to home produced services when good nonmarket substitutes are available. This suggests that future work should focus on identifying product market regulations in those sectors for which good nonmarket substitutes do exist and examine the patterns of market work and time spent in home production in these categories of goods. This would complement the analysis of Davis and Henrekson (2004), who carried out such an exercise for the effect of taxes on various market activities.

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