The Welfare and Labor Market Effects of Occupational Licensing*

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Abstract

Occupational licensing policy affects close to 25% of workers in the United States. The social benefits and costs of licensing policy are topics of much debate as licensing has implications for consumer welfare and labor market outcomes. Licensing policy protects consumers by alleviating an information asymmetry in the market of goods and services. However, it acts as a barrier to entry that prevents individuals from working in licensed occupations. This paper studies the effect of occupational licensing on welfare, the allocation of labor, and the wage premium between licensed and unlicensed workers. I develop a framework with information asymmetries in the product market and occupational choice in the labor market, which are key features to analyze the trade-off generated by licensing policy. In the product market, consumers demand two goods. One of the goods is heterogenous in quality, which is unobservable to the consumers. This information asymmetry carries over to the labor market, affecting the occupational choice of workers, whom also select into occupations based on their ability and the licensing policy. Licensing policy is modeled as a monetary fee and as training, which is costly for workers in terms of effort and time. I calibrate this model to match moments of the US labor market using the 2008 Survey of Income and Program Participation (SIPP) panel and the O*NET database. I find that a counterfactual licensing policy that removes training induces lower ability workers to enter licensed occupations. As a result, consumer welfare falls by 13% since lower quality goods are produced. In addition, I find that the wage premium falls by more than half.

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1 Introduction

Occupational licensing and its impact on the United States economy is at the heart of the current policy agenda. Close to 25% of workers in the US posses a license that is required for them to legally perform their job. Furthermore, as highlighted by Carpenter, Knepper, Erickson, and Ross (2012) and Kleiner and Krueger (2013), the share of licensed workers in the US labor market has increased fivefold since the 1950s. Understanding the social benefits and costs of licensing policy are topics of much debate as this policy has implications for consumer welfare and for labor market outcomes. Licensing policy generates a trade-off. On the one hand, licensing can have a positive effect on consumer welfare by alleviating an information asymmetry in the market of goods and services. In particular, when consumers purchase products from producers, consumers are less informed about the quality of the product relative to the producer. On the other hand, licensing policy acts as a barrier to entry that prevents individuals from working in licensed occupations. Workers that wish to enter licensed professions are typically required to pay a licensing fee and undergo occupation specific training. Hence, licensing lowers incentives for workers to enter licensed occupations as it is costly in terms of money, time, and effort.

This paper studies the effect of occupational licensing on welfare, the allocation of labor, and the wage premium between licensed and unlicensed workers. My first contribution is to develop a framework with the key ingredients that highlight the trade-off generated by licensing policy. I set up a model with information asymmetries in the product market, occupational choice in the labor market, and a licensing policy composed of an entry fee and training. I calibrate this theoretical framework to match moments of the US labor market, focusing only on occupations that are are predominantly made up of workers with less than college education. My second contribution is to estimate the welfare and labor market consequences of reforming occupational licensing in the US. In particular, a licensing policy which eliminates training incentivizes lower ability workers to enter the licensed sector. As a result, consumer welfare falls by 13% since lower quality goods are produced. Moreover, the wage premium between licensed and unlicensed workers falls by more than half since the productivity of workers in licensed occupations falls.

The literature on occupational licensing has not reached a clear consensus on the welfare implications of occupational licensing. Earlier literature pioneered by Leland (1979) and Shapiro (1986) developed theory that qualitatively evaluated the effects of licensing policy on consumer welfare, by explicitly modeling information asymmetries in the product market. More recent work has empirically evaluated the effects of licensing on different measures of product quality, which to some extent are proxies for measures of consumer welfare. These papers have only analyzed specific occupations. I bridge both these strands of literature by providing a quantitative analysis of the implications of licensing on welfare. I build on the earlier theoretical work by including an endogenous occupational choice between licensed and unlicensed occupations. In this manner, I am able to analyze how occupational licensing impacts occupational decisions of workers in the labor market. Moreover, by calibrating a model with information asymmetries in the product market, I provide a quantitative assessment of the effect of licensing on consumer welfare. In addition, this paper contributes to the vast literature on wage differences between licensed and unlicensed workers. Using the model, I am able to decompose the wage premium into components explained by workers' ability differences between sectors, training requirements of licensing, and informational rents. Further, using counterfactual licensing policy analysis, I explain how the wage premium varies with respect to changes in the licensing policy.

To determine the effects of occupational licensing on consumer welfare and labor market outcomes, I set up a static model with the following ingredients. The economy is made up of two sectors. In one of the sectors, the good produced is heterogeneous in its quality, an attribute that is unobserved by consumers. Workers choose between producing in either sector based on their ability. Licensing policy is modeled as an entry barrier workers face when entering the sector with the information asymmetry, which I will refer to as the *licensed sector*. Specifically, workers must incur in an entry fee as well as training. Training is costly in terms of time, which I refer to as the opportunity cost, and in terms of the effort, which I refer to as the effort training cost. The effort training cost is increasing in the amount of training content and decreasing in the ability of workers. Intuitively, workers must exert more effort the greater the training content. Also, given a level of training content, workers of higher ability have to exert less effort in relation to their lower ability counterparts. The training requirement of licensing provides a sector-specific skill that augments workers' productivity in that sector. Moreover, workers in the licensed sector produce goods with a quality that is determined by their ability and also by the sector-specific skill obtained from training. Consumers obtain utility from consuming quantities of the goods from both sectors and from the average quality of the licensed sector good.

In an economy without licensing the standard result of Akerlof (1970) holds: bad quality products are produced in the sector with the information asymmetry. The reason for this is that the information asymmetry in the product market carries over to the labor market. All workers that produce in the sector with the information asymmetry earn the same, regardless of their ability, since the quality of their product cannot be differentiated. Hence higher ability workers are undercompensated and lower ability workers are overcompensated in the licensed sector. On the other hand, workers in the perfect information sector earn according to their productivity. Given this, workers of higher ability choose to produce in the perfect information sector, which fully compensates their productivity. Lower ability workers choose to enter the licensed sector as they are overcompensated. In equilibrium, the licensed sector is characterized by having only low ability workers and low quality goods. When licensing policy is introduced into the economy, it increases consumer welfare by increasing the average quality of licensed goods. Average quality improves through two channels. First, lower ability workers select out of the licensed sector as it is too costly for them to enter given the effort training cost. Second, training content provides a sector-specific skill which improves productivity of all workers in the licensed sector. Hence, licensing policy affects the labor market by determining the allocation of workers based on their ability and also consumer welfare by directly impacting the quality of the licensed good and the quantities of goods produced.

I use 2008 SIPP panel and the O*NET database to estimate the model. More specifically, I analyze occupations that are similar in the education level of their workers, by focusing on occupations that are predominantly made up of workers with less than college education. I refer to these occupations as low-skilled occupations. In this manner, I am controlling for differences in education that may have a clear impact on occupational choice. For workers in these occupations, I document that only 15 percent of them are licensed and on average their wages are 16 percent higher. Next, I decompose this wage premium and find that 9 percentage points are accounted for by skill observables in the data, the skill component.

I calibrate the model to moments from my sample of workers in low-skilled occupations. Using the model, I determine how much of the skill component is explained by differences in the average ability of workers between the licensed and unlicensed sector and how much is explained from the specific skills obtained through training. I refer to the licensing policy in the United States as the benchmark licensing policy. I find that the specific skills obtained from training of the benchmark policy play an important role in explaining the skill component. With the estimated model, I carryout counterfactual licensing policies and measure changes in welfare and the labor market relative to the benchmark policy. I first consider a counterfactual policy in which training is removed from the licensing policy. Under this policy, workers of lower ability enter licensed occupations given that the effort training cost has been removed. Also, licensing policy in this case does not provide sector-specific skill. By shutting off these two channels, the average quality of licensed goods falls relative to the benchmark policy. Given this, consumer welfare decreases by 13 percent. Under the no training policy, the wage premium falls by more than half for licensed workers, relative to the benchmark policy. The majority of this fall is explained by a decrease in the average ability of licensed workers and an increase in the average ability of unlicensed workers. Then, I consider counterfactual licensing policies in which the training content requirement varies. I find that as the training content increases relative to the benchmark, consumer welfare rises as higher quality goods are produced. Also, the wage premium increases because higher ability workers select into licensed occupations and since the sector-specific training is higher.

This paper is organized as follows. Section (2) describes this paper's relation and contribution to the literature. Section (3), develops the theoretical framework. Section (4) presents the data and the calibration strategy used for the quantitative analysis. Section (5), assesses the current licensing policy of the United States and its implications for the allocation of workers between licensed and unlicensed sectors. Section (6) analyzes the welfare and labor market effects of changing the licensing policy in the United States. Last, section (7) concludes.

2 Related Literature

This paper contributes to the growing literature on occupational licensing and its effects on product and labor markets. The traditional argument in favor of a licensing policy is that there exists an informational asymmetry between consumers and producers in the markets of goods and services. In this manner, a licensing policy can improve welfare of consumers if it can raise the quality of goods produced. Theoretical work pioneered by Leland (1979), Shaked and Sutton (1981a, 1981b, 1982a, 1982b), and Shapiro (1983, 1986) develops models to qualitatively analyze product markets associated with information asymmetries in the quality of goods. Moreover, these papers evaluate the welfare and earnings implications of regulating the producers of these goods. In particular, Shapiro (1986) proposes a model with moral hazard, in which professionals underinvest in the quality of goods they produce. By raising investment requirements, licensing alleviates the information asymmetry and raises the quality of products. Leland (1979) sets up a model, in the spirit of Akerlof (1970), in which there is adverse selection in the product market as quality of goods cannot be observed. Under this market structure, he evaluates the welfare implications of introducing a minimum quality standard for products. Furthermore, Leland (1979) points out that licensing standards chosen by a professional group can lead to other inefficiencies, such as market power of the licensing group.

The theoretical framework I develop in this paper most closely relates to Leland (1979), as the information asymmetry implies adverse selection. The main difference between the previous theoretical work and my framework, is that licensing policy not only has implications for the quality of goods that are produced, but also affects the occupational choice of workers. Shaked and Sutton (1981a, 1981b) evaluate the coexistence of competing professions, but in their analysis workers do not endogenously choose to enter the different professions. In my theoretical framework, workers choose to allocate into different occupations based on ability, the licensing policy, and the effects of the information asymmetry that carries over from the product market to the labor market.

More recent work has tried to determine the quantitative implications of licensing for welfare. An extensive list of articles have analyzed the effects of licensing on the quality of goods produced. The main argument is that if licensing policy raises the quality of goods, then consumers' welfare increases.[1] These papers have mainly focused on analyzing the licensing effects on quality for specific occupations and conclusions vary according to each case study. For example, Kleiner and Kudrle (2000) and Wiswall (2007) find that stricter licensing requirements do not improve the quality of dentists and teachers, respectively. On the other hand, Adams III, Ekelund Jr, and Jackson (2003) and Anderson et al. (2016) find opposite results on the quality of services of midwifes. Kleiner and Soltas (2018) develop a richer theoretical framework to try to explain the welfare effects of occupational licensing. They explain that the quantity of labor hours is a sufficient statistic for welfare analysis and find that the welfare costs of licensing offset its benefits.

A caveat of the work highlighted above is that the theoretical framework used for quan-

1. Papers that have analyzed the effects of licensing on quality are Adams III, Jackson, and Ekelund (2002), Adams III, Ekelund Jr, and Jackson (2003), Anderson et al. (2016), Barrios (2018), Carroll and Gaston (1981), Kleiner and Kudrle (2000), Kleiner and Petree (1988), Kugler and Sauer (2005),Larsen (2013), Wiswall (2007), among others.

titative analysis abstracts from modeling any market failure which can be corrected by occupational licensing. I contribute to this literature by explicitly modeling an information asymmetry in the product market. Incorporating an informational problem into the theoretical model is key in exemplifying the role of licensing in the economy and the trade-off it generates. More specifically, the interaction between the informational problem and the licensing policy has a direct impact on the quality of goods produced in the licensed sector as well as the allocation of workers between licensed and unlicensed occupations. To my knowledge, I am the first to quantitatively evaluate this trade-off.

Finally, I contribute to the extensive empirical analysis of the effects of licensing on labor market outcomes. The main consensus is that licensing acts as a barrier to entry that restricts the quantity of goods sold in licensed occupations, as highlighted by Blair and Chung (2018a), Friedman (1962), Gittleman, Klee, and Kleiner (2017),Kleiner (2000), Kleiner and Krueger (2013), Kleiner and Soltas (2018), Thornton and Timmons (2013), among others. Another related topic that has been vastly studied is the wage differential between licensed and unlicensed workers. Work by Blair and Chung (2018b), Kleiner and Krueger (2013, 2010), Kleiner and Soltas (2018), Thornton and Timmons (2013), among others, have estimated a wage premium of licensed workers between 6 and 15 percent, for different datasets. Most studies find that controlling for observables of skills explain some of the wage premium but not all. The remaining difference has been attributed to rents generated by quantity restrictions, Kleiner and Krueger (2013), or by informational asymmetries, Blair and Chung (2018b).

By modeling an endogenous occupational choice, I contribute to the literature by providing a selection mechanism of workers into occupations, which depends on the physical environment and their ability. Hence, I am able to analyze the effect of licensing on the quantity supply of labor and on the quality (ability) supply of labor into licensed occupations. I also complement the wage premium analysis of the literature by decomposing it into components that are attributed to differences in workers' ability between sectors, training requirements of licensing, and informational rents.

3 Theoretical Framework

This section provides a description of the theoretical framework. First I describe the physical environment of the model in absence of licensing. I characterize the equilibrium for this case. Then, I extend the model to include licensing policy and characterize the equilibrium for this case.

3.1 Setting

I consider a static model with adverse selection in the goods market and occupational choice in the labor market. The economy is populated by a continuum measure 1 of identical households. Each household is composed of one shopper and a continuum of measure 1 of workers. There are two productive sectors, $j = 1, 2$, in the economy. Workers are heterogeneous in their ability, a, and choose which sector to produce in based on their ability. Workers in sector 1 produce goods that are differentiated in their quality, x_1, which depends on a worker's specific ability. In sector 2, workers produce a homogeneous good. I will refer as good j to the good produced in sector j. The shopper buys quantities c_j of good j. At the moment of making the purchase, the shopper cannot observe the specific quality, x_1, of each unit he buys of good 1. Households have preferences over the quantities of goods produced in each sector and over the expected quality of all the units of goods purchased in sector 1.

3.2 Workers and Production

Workers are heterogeneous in their ability $a \in [\underline{a}, \bar{a}]$, which is distributed according to $\mu(a)$. A production unit is made up of a single worker with ability a, who acts as an entrepreneur. This worker uses his ability and rents equipment, m, in order to produce. In sector 1, a worker produces a quantity of goods with technology:

$$f_1(m) = m^{\theta}, \tag{3.1}$$

where θ is the output elasticity of equipment. Quality in sector 1 is produced with technology:

$$x_1(a) = a. \tag{3.2}$$

A worker of ability a in $j = 1$, produces $f_1(m)$ units with quality $x_1(a)$. In sector 2, a worker uses both his ability and equipment for quantity production using technology:

$$f_2(a, m) = am^{\theta}. \tag{3.3}$$

3.3 Occupational Choice

A worker of ability a, must choose between producing in sector 1 or sector 2. In sector 1, a worker obtains earnings $y_1(a)$:

$$y_1(a) = \max_m p_1 f_1(m) - rm, \tag{3.4}$$

where r is the rental rate of equipment. It is important to note that since quality is not observed for the sector 1 good, then there exists only one price for the good in that sector, p_1. Hence, workers in sector 1 are not compensated for the specific quality that they produce with technology (3.2). This quality is produced at no cost. In sector 2, a worker obtains earnings $y_2(a)$:

$$y_2(a) = \max_m f_2(a, m) - rm. \tag{3.5}$$

The sector 2 good is the numeraire good of the economy. I denote $m_j(a)$ as the amount of equipment demanded by the production unit with worker of ability a in sector j. A worker's occupational choice is given by:

$$y(a) = \max_{d \in \{1,0\}} d[y_1(a)] + [1-d]\, y_2(a). \tag{3.6}$$

Specifying the quantity production functions as in (3.1) and (3.3) implies that the share of profits of the production unit that corresponds to workers is $1-\theta$.

3.4 Household Problem

Good 1 is differentiated in its quality level $x_1(a)$, while the good 2 is homogeneous. The household's shopper cannot observe the quality of each unit of good 1 ex ante. Hence, he cannot differentiate them according to their quality. Shoppers have beliefs σ about the distribution of qualities of good 1, i.e. the different abilities of workers in sector 1. Preferences are defined by utility function $U(c_1, \mathbb{E}_\sigma(x_1(a)), c_2)$, where $\mathbb{E}_\sigma(x_1(a)) = \int_{\underline{a}}^{\bar{a}} x_1(a)\, d\sigma(a)$. Hence, each household gets utility from the expected quality of good 1 given its beliefs σ and from consuming c_j units from sector j.[2] The sources of income of the household are the earnings of its workers, $y(a)$, and the income from renting equipment. I assume that all households will be able to rent out any amount of equipment that is demanded by all the production units.

The household's problem is given by:

$$\max_{c_1, c_2} \quad U(c_1, \mathbb{E}_\sigma[x_1(a)], c_2) \tag{3.7}$$

$$s.t.$$

$$p_1 c_1 + c_2 = \int_{\underline{a}}^{\bar{a}} y(a)\, \partial\mu(a) + r \int_{\underline{a}}^{\bar{a}} [d(a)\, m_1(a) + [1-d(a)]\, m_2(a)]\, \partial\mu(a).$$

Households choose $\{c_1, c_2\}$ to maximize their utility. By assumption, there is perfect consumption insurance within each household. This is because all workers pay out their earnings

2. In Leland (1979), preferences are also a function of the average quality in the market.

to be shared equally in the household. The combination of this with the law of large numbers across households, allows for the construction of a representative household.

3.5 Assumptions on Preferences

A result of Akerlof (1970) is that in certain cases, markets can completely shut down when there exists adverse selection. The intuition of why this happens is as follows. The price, p_1, reflects the average quality of the goods produced in sector 1. As a result, higher ability workers may not be willing to produce in sector 1, given that they may be underpaid in terms of their ability. Without any assumptions on the demand of good 1, it can be the case that all workers decide to produce in sector 2. In that sector workers are fully compensated for their ability, hence the more abled workers are always willing to go there. But as more abled workers choose sector 2 over sector 1, p_1 falls, since it reflects average quality of workers in sector 1. This pattern can continue until p_1 falls so that all workers find it more profitable to enter sector 2, and sector 1 shuts down completely. To avoid this issue, I make the following assumption on utility:

$$\lim_{c_j \to 0} \frac{\partial U\left(c_1, \mathbb{E}_\sigma\left[x_1\left(a\right)\right], c_2\right)}{\partial c_j} = \infty. \tag{3.8}$$

Given this assumption, the equilibrium will be characterized by having positive amounts of both goods. This is essential for good 1, as it guarantees that this market does not shut down due to the informational frictions.

I also make the following assumptions on the demand of good 1:

$$\frac{\partial c_1^*}{\partial p_1} < 0, \ \frac{\partial c_1^*}{\partial \mathbb{E}_\sigma\left[x_1\left(a\right)\right]} > 0. \tag{3.9}$$

As the relative price of good 1 increases, households substitute away from good 1 and consume more of good 2. Also, as the expected quality of goods in sector 1 increases, the demand for that good also increases. [3]

3. These assumptions allows me to nest Leland (1979)'s analysis.

3.6 Characterization of Equilibrium

Since households are identical, they all demand the same quantities of each good. Given that the measures of households and workers are 1, any household's consumption of c_j is equal to aggregate consumption of good j. Likewise, the demand of equipment for a worker of ability a is equal to the aggregate demand of equipment for all workers with that ability. I denote uppercase letters as aggregate quantities. The competitive equilibrium is defined as follows.

Definition. Given the ability distribution $\mu(a)$, a competitive equilibrium consists of relative price p_1, workers' occupational choice $d(a)$ and equipment choice $m_j(a)$, households' consumption choices $\{c_1, c_2\}$ and beliefs $\sigma(a)$ such that:

1. Given $\sigma(a)$ and p_1, $\{c_1, c_2\}$ solve households' problems.

2. Given p_1, $d(a)$ and $m_j(a)$ solve the workers' problems.

3. Markets clear:

$$C_1 = \int_{\underline{a}}^{\bar{a}} M_1(a)^{\theta} \mathbb{I}_{\{d(a)=1\}} d\mu(a),$$

$$C_2 = \int_{\underline{a}}^{\bar{a}} aM_2(a)^{\theta} \mathbb{I}_{\{d(a)=0\}} d\mu(a).$$

4. Beliefs are consistent:

$$\mathbb{E}_{\sigma}[x_1(a)] = \frac{\int_{\underline{a}}^{\bar{a}} aM_1(a)^{\theta} \mathbb{I}_{\{d(a)=1\}} d\mu(a)}{\int_{\underline{a}}^{\bar{a}} M_1(a)^{\theta} \mathbb{I}_{\{d(a)=1\}} d\mu(a)}.$$

Due to the informational structure, the competitive equilibrium defined above is characterized by having workers of low ability in sector 1 and workers of high ability in sector 2.

Proposition. *Suppose p_1 is the relative price of the competitive equilibrium. Then there exists a cut-off ability, $\tilde{a} \in [\underline{a}, \bar{a}]$, such workers with $a \leq \tilde{a}$ enter sector 1 and workers with*

$a > \tilde{a}$ *enter sector 2.*

Proof. See Appendix. □

The proposition above highlights important implications of the adverse selection problem on the goods and the labor markets. The equilibrium price p_1 determines a cutoff $\tilde{a}$, that defines the allocation of workers between productive sectors. Workers below this cutoff are overcompensated by p_1, since they receive extra rents due to the informational problem. On the other hand, workers above the cut-off $\tilde{a}$ are undercompensated by p_1. For this reason they decide to enter sector 2, where their earnings fully reflect their ability. Hence in equilibrium, sector 1 is characterized by having the least able workers, as predicted by Akerlof (1970).

3.7 Licensing Policy

As highlighted in section (3.6), workers with ability $a \in [\underline{a}, \tilde{a}]$ allocate into sector 1. Given that households get utility from the average quality of the goods in sector 1, a policy that increases the average ability of workers in that sector has the potential to improve welfare. Therefore, I analyze the effects of introducing a licensing policy into the economy. I assume there exists a government agency that sets up a licensing policy to alleviate the effects of adverse selection on the quality of goods produced in sector 1. Licensing is made up of two components, a fee that a worker must pay to enter the occupation and a training requirement for all workers. Define the licensing policy as $\Gamma = (F, T, \tau)$, where F is the licensing fee, T is per period equivalent of the required amount of time in training, and τ is the per period equivalent of the required amount of training content[4]. Workers that wish to enter sector 1 must pay a cost $\psi(a, \Gamma)$, that depends on their ability and the licensing policy Γ. I explicitly define the cost as:

$$\psi(a, \Gamma) = \underbrace{F}_{Fee} + \underbrace{\psi^o(a, T)}_{\text{Opportunity Cost of Training}} + \underbrace{\psi^e(a, \tau)}_{\text{Effort Cost of Training}}, \tag{3.10}$$

4. Many workers that get a license must earn a certain amount of education or specialized training as well as passing one or multiple exams.

where ψ^o is the flow value of the opportunity cost of training and ψ^e is the flow value of the effort cost of training.[5] I make the following assumptions on the opportunity cost of training: $\psi^o_a > 0$ and $\psi^o_T > 0$. This implies that training is costlier the higher the time requirement and the higher the ability of the worker. Further, I assume that the effort cost of training has the following properties: $\psi^e_a < 0$ and $\psi^e_\tau > 0$. Given a level of training content, the effort workers exert in training falls the higher their ability is. Also, as the required training content increases, then the effort cost of training rises.

Although training is costly, it also has benefits as it improves the productivity of workers within sector 1. More specifically, I assume that a worker that acquires training through licensing augments his ability in sector 1 with an exogenous level of skill, $g(\tau)$, which is only useful in the quality production of sector 1. Hence, equation (3.2) is now:

$$x_1(a,\tau) = ag(\tau). \tag{3.11}$$

Hence, $g(\tau)$ captures the sector specific training that workers obtain due to the licensing process.

3.8 Characterization of Equilibrium with Licensing Policy

In an economy with licensing, workers that enter the licensed occupation must pay $\psi(a,\Gamma)$. As a result, earnings in sector 1 become:

$$y_1(a) = \max_m p_1 f_1(m) - rm - \psi(a,\Gamma). \tag{3.12}$$

Earnings in sector 2 are given by (3.5), and a worker of ability a solves the problem defined by (3.6). I denote $\Psi(a,\Gamma)$ as the aggregate license cost of workers of type a. I assume that the aggregate license cost in the economy, $\int_{\underline{a}}^{\bar{a}} \Psi(a,\Gamma)\,\mathbb{I}_{\{d(a)=1\}} d\mu(a)$, is not rebated back to

5. In the US, workers incur in the costs of licensing before they enter the licensed occupation. Given that I have a static framework, I assume that the cost of licensing is paid once as a flow value. Also, I assume that the the effort cost of training is measured in units of the numeraire good.

the households. In an economy characterized by licensing, the competitive equilibrium is given by the following definition.

Definition. Given the ability distribution $\mu(a)$ and licensing policy Γ, a competitive equilibrium of the economy with licensing consists of relative price p_1, workers' occupational choice $d(a)$ and equipment choice $m_j(a)$, households' consumption choices $\{c_1, c_2\}$ and beliefs $\sigma(a)$ such that:

1. Given $\sigma(a)$ and p_1, $\{c_1, c_2\}$ solve households' problems.

2. Given p_1 and Γ, $d(a)$ and $m_j(a)$ solve the workers' problems.

3. Markets clear:

$$C_1 = \int_{\underline{a}}^{\bar{a}} M_1(a)^{\theta} \mathbb{I}_{\{d(a)=1\}} d\mu(a),$$

$$C_2 + \int_{\underline{a}}^{\bar{a}} \Psi(a, \Gamma) \mathbb{I}_{\{d(a)=1\}} d\mu(a) = \int_{\underline{a}}^{\bar{a}} a M_2(a)^{\theta} \mathbb{I}_{\{d(a)=0\}} d\mu(a).$$

4. Beliefs are consistent:

$$\mathbb{E}_{\sigma}[x_1(a, \tau)] = \frac{\int_{\underline{a}}^{\bar{a}} a g(\tau) M_1(a)^{\theta} \mathbb{I}_{\{d(a)=1\}} d\mu(a)}{\int_{\underline{a}}^{\bar{a}} M_1(a)^{\theta} \mathbb{I}_{\{d(a)=1\}} d\mu(a)}.$$

4 Data and Calibration

The model is calibrated to match features of the labor market for occupations comprised of workers with low education levels. I refer to these occupations as low-skilled occupations. Hence, I use the theoretical model developed in section (3) to study product markets associated with workers of similar skill levels.[6] I use data from the SIPP 2008 panel and from the O*NET 23.0 Database to construct the sample of workers in low-skilled occupations.

6. In this manner, I exclude unreasonable comparisons such as an individual choosing between working as a medical doctor, a licensed occupation, and a waitress, an unlicensed occupation.

Below, I first describe the construction of my sample, and then I explain the calibration of my theoretical model.

4.1 Data

I use three data sources to define the calibration target moments. The first data set I use is the 2008 panel of the Survey of Income and Program Participation (SIPP). This panel is a nationally representative dataset, which was carried out in 16 quarterly waves covering the period between September 2008 and December 2013. The dataset has information on wages, employment and occupations for a large number of individuals. Each wave has a corresponding topical module. I link the core data from wave 13 of the SIPP with the data of its corresponding topical module, the Professional Certifications, Licenses, and Educational Certificates module. This specific wave corresponds to the period between May and November of 2012 and has been used in two empirical pioneering studies of the occupational licensing literature, Blair and Chung (2018b) and Gittleman, Klee, and Kleiner (2017).[7] Using two specific questions from this topical module, I define a worker as licensed in the same manner as Gittleman, Klee, and Kleiner (2017). That is, I classify a worker as licensed if he possesses a professional credential and if this credential was awarded by a federal, state, or local government.[8]

I follow the criterion of Gittleman, Klee, and Kleiner (2017) when constructing my sample. I focus on individuals with ages between 18 and 64 years that are in the civilian labor force. Using data on monthly earnings, weeks worked, and weekly hours worked, I construct hourly wages and include in the sample only respondents with hourly wages between $5 and $100. The SIPP collects information on up to two jobs or up to two businesses for each worker, but does not clarify which of these jobs or businesses is the relevant one for the credential of the worker. I assume that the credential is relevant to the job or business for

7. Gittleman, Klee, and Kleiner (2017) explain with strong arguments the advantages of using this specific data source.

8. The two questions that allows me to identify a worker as licensed are: 1) "Do/Does you/he/she have a professional certification or state or industry license?" and 2) "Who awarded this certification or license?"

which the worker has the highest wage. Last, I exclude from the sample workers with imputed data for wages and worker's who did not provide a response for the credential relevant questions.[9] [10]

To determine whether an occupation is low or high skilled I use the O*NET 23.0 Database. This database describes 968 occupations using 277 descriptors. These descriptors are classified into 9 broad categories.[11] Information for each descriptor is gathered from either a survey of workers or from a survey "occupational analysts". Respondents of the worker survey are asked to report the required level of education for their occupation. I classify an occupation as low-skilled if "less than college" is the most common required level of education for the survey respondents of that occupation, and as high-skilled if "at least college" is the most common response. I link this classification of occupations by education to the panel of workers of wave 13 of the SIPP.[12] Out of the 460 occupations in the SIPP, 325 are low-skilled occupations. These account for 68 percent of all workers.

As stated before, I limit my sample to only workers in low-skilled occupations. On average workers in the sample earn \$3,986 per month. Table 1 presents a set of descriptive statistics for the observations in my sample, separately for licensed and unlicensed workers. On average licensed workers have higher wages and are older and more educated, relative to their unlicensed counterparts. Also, licensed workers have a higher participation of women and have a higher number of workers in a service industry, in the government and in unions. These patterns are consistent to those found by Blair and Chung (2018b) and Gittleman, Klee, and Kleiner (2017).

9. Including imputed wages in the estimation of the wage premium and the skill component in section (4.2) would bias estimates of these premiums towards 0 as explained by Hirsch and Schumacher (2004).

10. The non-respondence rate of workers for questions about credential status is 3.3 percent.

11. The categories are: Knowledge, Skills and Abilities; Education, Experience, and Training; Interests, Work Values, Work Styles; Tasks; Tools & Technology; Work Activities; Work Context; Related Occupations; Green Occupations.

12. Occupations in the O*NET are classified according to the Standard Occupational Classification - SOC. On the other hand, occupations in the SIPP 2008 are classified with the 2002 Census Code Classification. Using a crosswalk between these two different occupation code systems, I am able to link my my classification of occupations by education to the worker data of the SIPP panel.

Table 1: Descriptive Statistics

	Licensed	Unlicensed
Number of Observations	8,696	47,831
Mean - Monthly Wage	4,523	3,886
Age	42.8	41.0
Share:		
Men	0.49	0.53
Government Workers	0.22	0.11
Services	0.82	0.74
Less than College	0.76	0.83
Union	0.18	0.11

Source: Wave 13 of the SIPP Panel 2008.
Number of observations: 56,527

Note: This table reports summary statistics by licensing status using data from wave 13 of the SIPP Panel 2008. I restrict the sample to workers with age between 18 to 64 and with hourly wage from $5 to $100. Observations with imputed wages are dropped.

Carpenter et al. (2012) carry out an in depth analysis of licensing burdens and costs for 102 occupations. They choose occupations that earn less than the national average of income and are at least licensed in one state. For each of these occupations they gather information on the different measures of licensing burdens. In particular, they gather information on different burdens of licensing like fees, amount of time spent on training, number of exams, and minimum age requirements. Using this database along with my sample of the SIPP, I am able to back out the fee and opportunity cost component of the license cost specified in equation (3.10). On average, licensed workers in low-skilled occupations pay a fee of $91 and train for an average for 9 months before they can enter the licensed occupation.

4.2 Wage Premium Decomposition

The empirical literature on occupational licensing has focused a great deal in understanding the differences in wages between licensed and unlicensed occupations. Studies such as Blair and Chung (2018b), Kleiner (2000), Kleiner and Krueger (2013, 2010), Kleiner and Soltas (2018), among others have documented a wage premium for licensed workers, even after controlling for skill observables. They explain these differences as coming from monopoly or informational rents. I document that for low-skilled occupations the average wage of licensed workers is 16 percent higher than the average wage of their unlicensed counter parts. Similar to Kleiner (2000), I decompose this wage difference using a Oaxaca-Blinder decomposition. Specifically, I regress monthly wages, $w_{i,j}$ on skill observables, $x_{i,j}$ separately for licensed, $j = L$, and unlicensed, $j = NL$, workers:

$$w_{i,j} = x'_{i,j}\beta_j + u_{i,j}. \tag{4.1}$$

The skill observables which I control for are gender, education, age, and indicators for union membership, government workers, and service workers. I decompose the average wage premium into a skill component and a residual component. The skill component accounts for differences in skills between licensed and unlicensed workers that are accounted for by the skill observables. Hence, this component is explained by differences in the general ability of workers and by the specific skills that licensed workers acquire through the training requirements of licensing. On the other hand, the residual component accounts for monopoly rents, informational rents, and any unobservable skill differences between licensed and unlicensed workers:

$$\bar{w}_L - \bar{w}_{NL} = \underbrace{\left(\bar{x}'_L - \bar{x}'_{NL}\right)\beta_L}_{\text{Skill Component}} + \underbrace{\bar{x}'_{NL}\left(\beta_L - \beta_{NL}\right)}_{\text{Residual Component}}. \tag{4.2}$$

Table 2 presents the average wage decomposition results. Of the 16 percent difference in average wages between licensed and unlicensed workers, 54.3 percent is explained by differences in skill observables between licensed workers and unlicensed workers.

Table 2: Wage Premium Decomposition

Wage Premium	0.164
	(0.007)
Skill Component	0.089
	(0.003)
Residual	0.075
	(0.003)

Source: Wave 13 of the SIPP Panel 2008.
Number of observations: 56,527
Estimates are significant at the 1% confidence level. Standard errors in parentheses.
Note: This table reports the Oaxaca-Blinder decomposition of the average wage premium between licensed and unlicensed workers. The unit of observation is person-month. The dependent variable is monthly wage. The skill regressors are gender, education, age, and indicators for union membership, government workers, and service workers. I restrict the sample to workers with age between 18 to 64 and with hourly wage from \$5 to \$100. Observations with imputed wages are dropped. Wages are normalized by the mean wage of unlicensed workers.

4.3 Calibration

4.3.1 Functional Forms and Assigned Parameters

To calibrate the model, I first specify the ability distribution of workers as a non-standard beta distribution, betacdf $\left(\frac{a-\underline{a}}{\bar{a}-\underline{a}};\alpha_a,\beta_a\right)$, with shape parameters α_a and β_a. The advantage of the beta distribution is that it has a bounded support as well as being flexible in the shapes it can take, regardless of only depending on two parameters. Next, I choose functional forms for households' utility $U\left(c_1,\mathbb{E}_\sigma\left(x_1\left(a,\tau\right)\right),c_2\right)$, the ability augmenting training technology $g\left(\tau\right)$, and the license cost $\psi\left(a,\Gamma\right)$. I choose a utility function that satisfies assumptions (3.8) and (3.9):

$$U\left(c_1,\mathbb{E}_\sigma\left[x_1\left(a,\tau\right)\right],c_2\right)=\rho\mathbb{E}_\sigma\left[x_1\left(a,\tau\right)\right]\log\left(c_1\right)+\log\left(c_2\right). \tag{4.3}$$

Parameter ρ determines how important sector 1 good is for the household. I define the ability augmenting training technology for quality production as:

$$g(\tau) = \max\{\tau^{\nu}, 1\}. \tag{4.4}$$

This functional form implies that the quality produced by a worker in a licensed occupation cannot be lower than his ability a, as can be see from (3.2). I define the opportunity cost and the effort training cost as:

$$\psi^{o}(a, T) = w_2(a)\, T, \tag{4.5}$$

$$\psi^{e}(a, \tau) = \tau \left(\frac{\bar{a} - a}{\bar{a}}\right)^{\gamma}. \tag{4.6}$$

The opportunity cost is the product of a worker's wage in sector 2, the unlicensed sector, and the per period equivalent of the training time requirement. The effort training cost is decreasing in ability, a, and increasing in the per period equivalent of the training content, τ. Parameter γ governs how much more effort a worker of ability a must exert in training relative to the highest ability worker, $\bar{a}$.

My calibration is monthly. The list of assigned parameters are given in Table 3. I set the r, the real interest rate, so that it implies a discount rate of 0.996. Therefore, I am assuming that the monthly price of renting equipment is equal to 0.003. I set the output elasticity of equipment so that the share of earnings of a worker in a productive unit is equal to $1 - \theta$. I set θ to match the average of the labor income share between 2010 and 2016 for the United States. Using my sample from the SIPP and the database provided by Carpenter et al. (2012), I measure the average fee and average training time requirement for workers in low-skilled occupations. I obtain F and T by discounting my measures of average fee and average training time requirement using the real interest rate r.

Table 3: Assigned Parameters

Parameter	Value	Description	Source
r	0.003	Real interest rate	Implies discount rate of 0.996
$1-\theta$	0.54	Labor income share	BEA 2010-2016
T	0.04	Training time requirement	SIPP, Carpenter et al. 2012
F	0.35	License fee	SIPP, Carpenter et al. 2012

r is monthly real interest rate. F is the per month equivalent of a one-time payment licensing fee and and T is the per month equivalent of the training time requirement, respectively.

4.3.2 Internally Calibrated Parameters

I calibrate the parameters associated with the ability distribution, the utility function, and training to match wages and employment moments from my sample. I report the parameter values from the calibration in Table 4. Although parameters are jointly calibrated, there are some data moments that are more informative about specific parameters. The ability distribution parameters, α_a and β_a are pinned down primarily by the mean and standard deviation of wages from my sample. The term $\rho\mathbb{E}_\sigma\left[x_1\left(a,\tau\right)\right]$ determines the weight that the sector 1 good has in the utility function. Thus, the quantity demanded of good 1 is directly related to the amount of workers that produce that good. For this reason, this parameter is primarily pinned down by the share of licensed workers.

Parameter τ is the training content requirement of licensing. This parameter, along with ν, determine the quality a worker can produce, as can be seen from equations (3.2) and (4.4). Parameter τ also has a direct impact on the cost of licensing through the effort training cost, (4.6). The cost of licensing along with the relative price of good 1, p_1, jointly determine the allocation of workers between sector 1 and sector 2 based on their ability. Hence, differences in earnings, skills and how much licensed workers account for total labor income are directly affected by the parameters associated with training. For this reason, I use the wage premium and the skill component between licensed and unlicensed workers along with the labor income share of licensed workers to pin down parameters τ, ν, and γ.

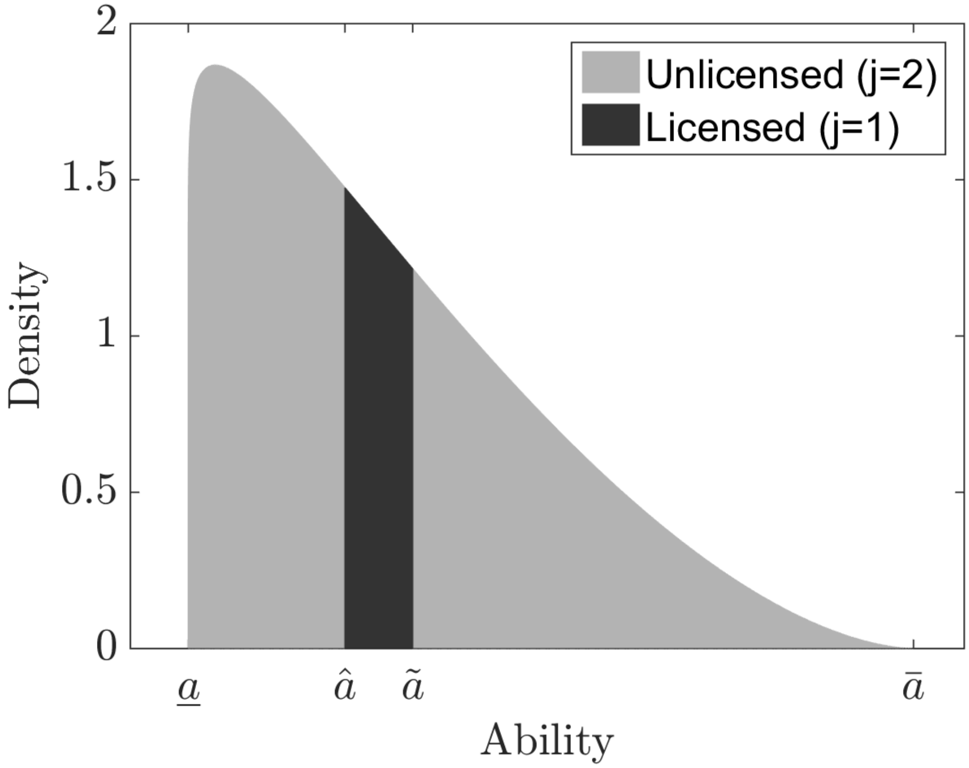
Table 4: Internally Calibrated Parameters

Parameter	Value	Target Moments	Model	Data
Distribution:				
α_a	1.07	Mean - wages	3,986	3,986
β_a	2.71	St. Dev. - wages	2,194	2,194
Utility:				
ρ	0.24	Share of lic. workers	0.154	0.154
Training:				
τ	874	Wage premium	1.164	1.164
ν	0.02	Skill component	1.089	1.089
γ	7.50	Income share of lic. workers	0.212	0.212

5 Licensing Policy in the US

As I explained in section (4), I set parameters of my model to match labor market moments of low-skilled occupations. Using this calibration, I am able to characterize the allocation of workers between licensed and unlicensed occupations for the United States. For the following sections, I will also refer to sector 1 and sector 2 of the theoretical model as the licensed and unlicensed sectors, respectively. Figure 1 portrays the distribution of ability for my model calibration. Workers with ability $a \in [\hat{a}, \tilde{a}]$ are allocated in the licensed sector, ability interval that accounts for 15 percent of all workers. Workers below ability $\hat{a}$ are those for which obtaining the license is too costly. Hence, the licensing policy excludes workers of very low ability from entering the licensed sector, as licensing is more costly for them in terms of effort. On the other hand, workers with ability above $\tilde{a}$ enter the unlicensed sector. The reason for this is that, in the licensed sector, the earnings of these workers do not not fully compensate them for their high ability. Thus, they choose to enter the unlicensed sector where their earnings fully reflect their productivity.

Figure 1: Distribution of Ability and Allocation of Workers



The current licensing policy ameliorates the effects of the information asymmetry on the quality of licensed sector goods, in comparison to a no licensing policy. It does this through two channels. First, it improves the quality of licensed goods in the market by excluding the low ability workers from entering the licensed sector and by incentivizing higher ability workers to enter that sector. Of the workers in the licensed sector, 27 percent have ability that is higher than the average ability of all workers. Second, quality improves due to the specific skills obtained through the content of training, which augments ability of workers in the licensed sector in 13 percent.

In my calibration strategy, I match the skill component between licensed and unlicensed sector, which I estimate in section (4.2). Using my model, I decompose how much of the skill component is explained by differences in the ability of workers between the licensed and unlicensed sector and how much is explained by the specific skills obtained through training.

When focusing only on general ability, a, the average ability of workers in the licensed sector is 14 percent lower than the average ability of unlicensed workers. The specific skills obtained through training improve the productivity of workers in the licensed sector by 23 percent, which explains the skill component of 9 percent between licensed and unlicensed workers.

6 Counterfactual Policy Analysis

In this section, I evaluate the effects of changing the current licensing policy on welfare, the allocation of labor and the wage premium. First, I explain the measure of welfare I use. Then, I study different levels of training and characterize the effects of these policies on welfare and labor market outcomes.

6.1 Welfare Measure

To study the effects of different licensing policies on welfare I consider the following welfare measure. I define the licensing policy in the US as Γ^B, the benchmark licensing policy. I compare all the counterfactual results to this benchmark. Let Γ^N be any counterfactual licensing policy. I measure the difference in welfare between the two economies using a consumption equivalent transfer, ω, in terms of the unlicensed good:

$$\rho\mathbb{E}_{\sigma}\left[x_1\left(a,\tau\right)\right]^B \log\left(c_1^B\right) + \log\left(c_2^B\left(1+\omega\right)\right) = \rho\mathbb{E}_{\sigma}\left[x_1\left(a,\tau\right)\right]^N \log\left(c_1^N\right) + \log\left(c_2^N\right).$$

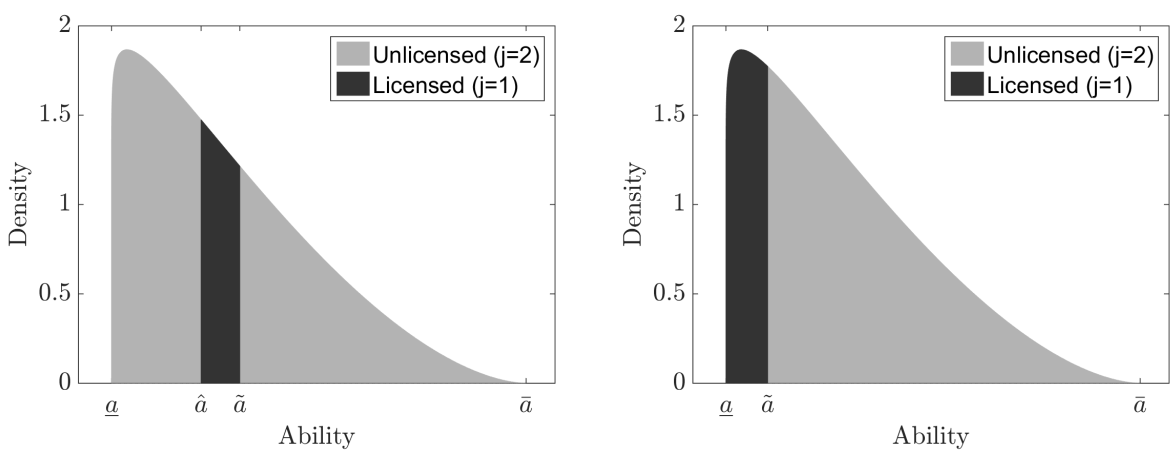
The interpretation of ω is the following. Consider two economies, one under the benchmark policy, Γ^B, and another under the new licensing policy, Γ^N. Welfare between the two economies would be equal if the households' consumption of the unlicensed good changed in $\omega \times 100$ percent for the economy that corresponds to the benchmark licensing policy, Γ^B. In the model, the license cost is paid in terms of the numeraire good, which is the unlicensed good. For this reason, I choose the consumption equivalent to be in terms of this good.

6.2 No Training

In this section, I evaluate the effects of abolishing training from the licensing requirements. That is, I set the training time requirement to $T = 0$ and the training content requirement to $\tau = 0$. Figure 2 shows the ability allocation of workers for the benchmark policy and for the counterfactual policy. For the counterfactual licensing policy, workers with ability $a \in [\underline{a}, \tilde{a}]$ enter the licensed sector. Eliminating the training content requirements of licensed workers, makes it less costly for lower ability workers to enter the licensed sector relative to the benchmark policy. As a result, lower ability workers become licensed since they only have to incur in the licensing fee, which is very small. On the other hand, since the cost to become licensed is smaller, the relative price is also lower in equilibrium. Specifically, given the demand of the sector 1 good, the relative price does not need to be as high in order to compensate workers into entering sector 1 and producing that good. As a result of this, higher ability workers are fully not compensated anymore in the licensed sector, and decide to produce in the unlicensed sector.

Figure 2: Distribution of Ability and Allocation of Workers: Γ^B vs. Γ^N

(a) Benchmark **(b) No Training**



Given that the license fee is small and affects all workers homogeneously, only the workers of lower ability produce in the licensed sector. Hence, an homogenous fee cost is not able to alleviate the negative effect that the information asymmetry has on quality of the licensed good. A licensing policy with training alleviates the informational problem on quality through two channels. First, costly effort in training excludes the bad ability workers and incentivizes higher ability workers to enter the licensed sector. Second, training improves the quality produced by providing sector specific skills. This counterfactual policy has shut off these two channels.

Moving from the benchmark policy to the counterfactual policy leads to a 13 percent drop in consumer welfare as shown in Table 5. Under the no training policy, welfare drops due to changes in the average quality of the licensed good, $\mathbb{E}_\sigma\left[x_1\left(a,\tau\right)\right]$, and also due to changes in the consumption quantities of both goods, $\{c_1, c_2\}$. The elimination of the two channels described above yields a reduction in average quality that implies a 20 percent drop in welfare when moving from the benchmark to the no training policy. On the other hand, the quantities consumed of both goods increase. For the licensed sector good, c_1 increases since there is a larger number of workers producing in the licensed sector, as can be seen in the first column of Table 6. Although there is a larger number of units consumed of the licensed good, this quantity effect has a small effect on welfare and does not offset the fall in the average quality on welfare. On the contrary, consumer welfare improves by 7 percent through a higher consumption of good 2. In equilibrium there is a higher quantity of good 2 because demand and supply is higher for that good. Since average quality falls the weight of good 2 in the utility increases, which implies a higher demand for that good relative to the benchmark policy. Supply for that good increases since higher ability workers are now allocated in sector 2, which implies that output is larger.

Table 5: Change in Welfare (%)

ω	$\mathbb{E}_\sigma\left[x_1\left(a,\tau\right)\right]$	c_1	c_2
-13.13	-20.32	0.05	7.14

There are large effects on the labor market from eliminating training from the licensing policy as can be observed from Table 6 and Table 7. There is an increase in 7 percentage points in the share of licensed workers. Since lower ability workers allocate into the licensed sector, average ability of that sector falls in 38 percent. Furthermore, licensed workers' average productivity falls even more, in 51 percent, since a no training policy implies that there is no ability augmenting specific skills. On the other hand, as workers of higher ability enter sector 2, the average ability of its workers improves which implies a higher production of sector 2 goods.

Table 6: Change in Labor Allocation (%)

Share of Workers $j = 1$	Average Ability in $j = 1$	Average Ability in $j = 2$
38.03	-38.43	8.86

The fall in the wage premium is large, when moving from the benchmark policy to the no training policy. Under this counterfactual policy, workers in the unlicensed sector are paid more than twice as much as their licensed counterparts. The fall in the wage premium is mainly driven by a considerable drop in the skill component. Furthermore, 78% of the reduction in the skill component is accounted for by lower ability workers and the other 22% corresponds to elimination of ability augmenting specific skills. On the other hand, informational rents increase in 13 percentage points, mainly driven by the fact that lower ability workers are overcompensated more in the absence of training.

Table 7: Change in Wage Premium (%)

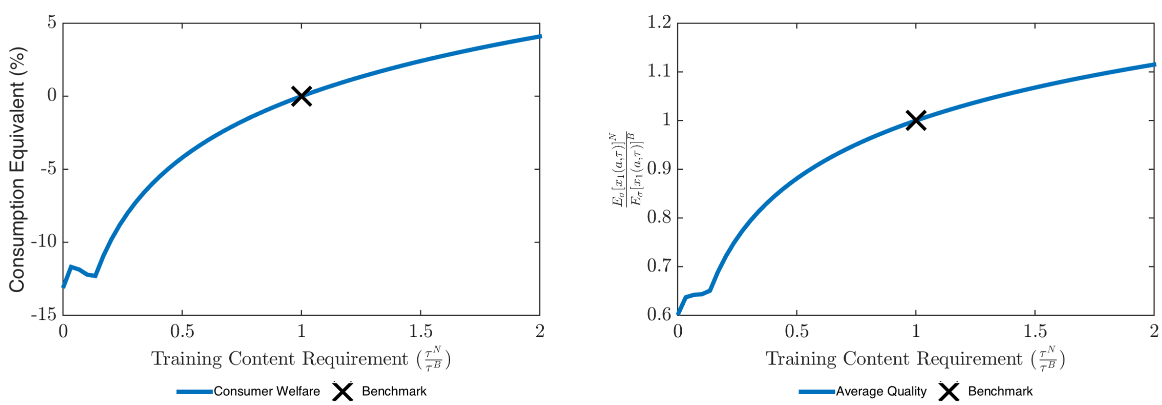
Wage Premium	Skill Component	Informational Rents
-94.97	-107.66	12.69

6.3 Different Levels of Training Content, τ

In this section, I consider different counterfactual licensing policies that vary on the training content τ^N, while keeping the training time requirement and the license fee fixed relative to the benchmark policy. The effects of changing the training content requirement on the product markets and the labor market follow the same intuition as in section (6.2). For very small levels of τ^N, welfare is not monotonically increasing in the training content requirement, as can be observed from panel (a) in Figure 3. The main reason for this is that the training content is not high enough to exclude low ability workers from entering the the licensed sector, hence $\mathbb{E}_\sigma\left[x_1\left(a,\tau\right)\right]$ does not increase very much at first, as is illustrated in panel (b) of Figure 3. Furthermore, there is a non-monotonicity in the consumption equivalent that is driven by the fact that the small increase in average quality is offset by a larger fall in the quantities of consumption, specially for the licensed good.

Figure 3: Effect of τ on Consumer Welfare

(a) Consumption Equivalent **(b) $\mathbb{E}_\sigma\left[x_1\left(a,\tau\right)\right]$**



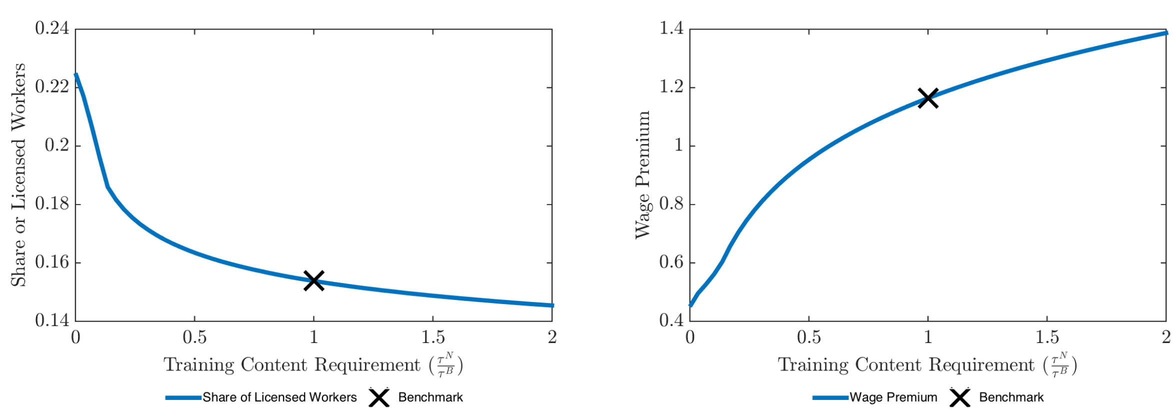
Eventually, higher training content excludes low ability workers from entering the licensed sector and incentivizes higher ability workers into entering. This raises the average quality.

The change in consumer welfare as τ^N increases is driven by changes in the average quality of licensed goods. Therefore, the positive effect that the training content has on consumer welfare is through increasing the average quality of licensed goods. If the content requirement was to double, then consumer welfare would rise in 4% relative to the benchmark economy.

There is a monotonically decreasing relationship between the training content requirement and the share of licensed workers, as can be observed in panel (a) of Figure 4. For very small levels of τ^N, there is a sharp drop in the share of licensed workers, which explains the non-monotonicity of the consumption equivalent. This sharp drop in the share of licensed workers implies a lower quantity output of good 1. As the training content requirement rises, the share of licensed workers drops but at a slower rate. If the content requirement was to double, then the share of licensed workers would decrease in 5 percent. The wage premium shows a monotonically increasing relationship with the training content requirement. This relationship is driven by the fact that the difference in the average ability of workers in the licensed sector widens relative to the unlicensed sector. The ability augmenting skills plays a smaller role in explaining this relationship. The wage premium would increase to 39% if the content requirement would double relative to the benchmark.

Figure 4: Effect of τ on the Labor Market

(a) Share of Licensed Workers **(b) Wage Premium**



7 Conclusion

The objective of this paper is to evaluate the effects of occupational licensing on welfare and labor market outcomes. To do this, I set up a theoretical framework with information asymmetries in the product market and occupational choice in the labor market. Workers choose occupations based on their ability and the physical environment of the model. By explicitly modeling the information asymmetry, there is a potential welfare improving role for licensing in the economy. In the model, licensing is modeled as an entry fee and as costly training. I calibrate the model to match specific moments of the US using the 2008 SIPP panel and the O*NET database. I control for differences in education, by calibrating the model to only occupations composed mainly of workers with less than college education. Using the calibrated model, I carry out counterfactual licensing policy analysis. I find that policies that increase the training content of licensing improve welfare by increasing the quality of licensed goods that are produced. Furthermore, the wage premium between licensed and unlicensed workers increases driven by the fact on average licensed workers are more productive. When a no training policy is implemented, welfare falls by 13 percent and the wage premium drops by more than half, driven by the same mechanisms highlighted above.

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A Model

Proposition. *Suppose p_1 is the relative price of the competitive equilibrium. Then there exists a cut-off ability, $\tilde{a} \in [\underline{a}, \bar{a}]$, such workers with $a \leq \tilde{a}$ enter sector 1 and workers with $a > \tilde{a}$ enter sector 2.*

Proof. Let p_1 be the equilibrium relative price of the economy. Given assumption (3.8), in equilibrium there are workers producing in both sectors. Earnings in sector 1 and 2 are given by:

$$y_1(a) = \left(\frac{\theta p_1}{r}\right)^{\frac{1}{1-\theta}} \left(\frac{r}{\theta} - r\right) \text{ and}$$

$$y_2(a) = \left(\frac{\theta a}{r}\right)^{\frac{1}{1-\theta}} \left(\frac{r}{\theta} - r\right).$$

Define $\tilde{a}$ as the worker which is indifferent between sector 1 and sector 2:

$$\left(\frac{\theta p_1}{r}\right)^{\frac{1}{1-\theta}} \left(\frac{r}{\theta} - r\right) = \left(\frac{\theta \tilde{a}}{r}\right)^{\frac{1}{1-\theta}} \left(\frac{r}{\theta} - r\right)$$
$$\Longrightarrow \tilde{a} = p_1.$$

Hence, for workers $a \leq \tilde{a} = p_1$, $d(a) = 1$ since $y_1(a) \geq y_2(a)$. On the other hand, for $a > \tilde{a} = p_1$, $d(a) = 0$ as $y_2(a) > y_1(a)$. $\square$