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The Elasticity of Demand With Respect to Product Failures; or Why the Market for Quack Medicines Flourished for More Than 150 Years

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0. Introduction

Figure 1 plots spending on patent medicines and GDP per capita from 1810 through 1939.[1] Both series are in constant (US) dollars and are normalized to a value of 1 in 1810. Between 1810 and 1939, real per capita spending on patent medicines grew by a factor of 114; real per capita GDP by a factor of 5. Growing 22 times more than the economy as a whole over this period, individual spending on patent medicines rose from $0.39 per year in 1810, to $2.94 in 1860, to $12.69 in 1889, to $26.07 in 1919, and to $44.89 in 1939 (2009 dollars). This is not a low base effect. Spending grew relatively quickly over the entire nineteenth century; growth slowed only after 1900. Between 1810 and 1939, Americans spent a cumulative $158 billion (2009 dollars) on patent medicines. By 1909, out of 259 industries counted by the Census of Manufactures, the patent-medicine industry ranked 38th (85th percentile) based on the aggregate market value of its products. In this way, it rivaled in size industries such as lead refining, illuminating gas, fertilizers, agricultural implements, paint and varnish, and chemicals.

The magnitude and sustained growth of the patent medicine industry is puzzling when juxtaposed with popular understanding and medical history, which typically portray patent medicines as the fruits of quackery (e.g.,). According to prevailing wisdom, patent medicines promised to cure everything from cancer and epilepsy, to kidney disease and tuberculosis, but left the patient no better off than before treatment, and often had deleterious long-term health consequences. Evidence presented in section 2 supports prevailing wisdom. In light of this, it is not immediately obvious how to reconcile the data and observations presented in the opening paragraph with the sort of economic reasoning that predicts markets based on deceptive advertising and consumer misinformation would be fleeting and minor affairs. Simply put, one

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[1]The phrase “patent medicines” is a misnomer. With a handful of unimportant exceptions, patent medicines were not patented. The phrase is used here only because it is convention; it is, for example, the label used by the U.S. Census and most historical observers to identify the industry. “Proprietary medicines” would be a more accurate descriptor.

does not normally expect strong consumer demand for products that routinely fail to deliver on the promises made by their manufacturers, and more often than not, leave consumers worse off than they were before they purchased the product. Yet, patent medicines flourished in United States for roughly 150 years, rivaling in size industries that had much stronger claims to economic legitimacy.

If one gives historical context to the data plotted in figure 1, the success of patent medicines becomes even more puzzling. Evidence presented below indicates that the market for patent medicines was robust to three interventions that one might otherwise expect to have undermined the industry: competition from legitimate physicians, who became increasingly effective and productive between 1800 and 1950; the rise of the germ theory of disease, a scientific breakthrough that transformed medical understanding regarding the pathogenesis of infectious diseases; and the creation of the Food and Drug Administration (FDA) in 1906, which required manufacturers to label and advertise their medicines accurately and without misrepresentation. Competition from legitimate physicians, even if they were relatively high priced, should have given consumers a viable alternative to quack medicines. Besides leading to the eradication of a whole range of diseases, including cholera, infantile diarrhea, typhoid, smallpox, and diphtheria, the rise of the germ theory should have made patients more discriminating and careful in their health-care choices. The FDA, by promoting the dissemination of more accurate information, should have had similar effects. There is, however, only weak evidence to suggest that any of these innovations posed a significant obstacle to the growth of the patent medicine industry, and in the case of the germ theory, the available evidence suggests that, if anything, popular adaptations of this genuine and significant scientific advance promoted consumer demand for quack medicines.

This paper explains why the market for quack medicines was so robust. The analysis proceeds in three parts. First, a simple model is constructed. The model suggests that patent medicines are distinguished from other products by what might be called an unusually low elasticity of demand with respect to product failure. While consumers in more typical markets stop searching for a viable product after a few failed attempts, consumers of patent medicines keep experimenting with different products, irrespective of the number of failed medicines they try or observe others trying. What drives market expansion in this context is that the stock of people buying potential cures accumulates over time. Because no one is ever cured and consumers possess a highly inelastic demand with respect to product failures, demand is unrelenting. Put another way, patent medicines proliferated and flourished not despite their dubious medicinal qualities, but because of them. If the typical medicine had been as effective in its realm as the typical agricultural implement or unit of illuminating gas had been in theirs, people would have been cured, search would have been reduced, and growth in spending would have been curtailed.

The second part of the analysis applies the model to the history of patent medicines. In so doing, the model rationalizes and explains key aspects of the market's history and development, including the following: that the number of medicines proliferated and grew increasingly bizarre with time; that specific brands of medicine of dubious value had product lives of 100 years or more; that prices did not rise over time; that manufacturers advertised heavily; that advertising was fraudulent and misleading; that older, more established firms advertised as much as, or even more, than new entrants; and that a fairly competitive market existed despite large investments in advertising and product differentiation. The paper also considers a series of alternative explanations for these historical patterns, including the possibility that historians are mistaken in their characterization of patent medicines as quack medicines, and that the products had some medicinal value; the possibility that, because some patent medicines contained morphine, opium, and alcohol, their persistence was the result of addiction or a social convention that would have otherwise discouraged drinking alcohol or taking drugs; and the possibility that with sufficiently large elasticities, changes in prices, the effectiveness of physician care, and consumer income might account for the rapid growth of patent medicines.

The third part of the paper documents, and analyzes the effects of, the three innovations already mentioned: increasing competition from legitimate physicians; the rise of the germ theory of disease; and the creation of the FDA. In exploring how and why quack medicines withstood competition from legitimate physicians, the analysis sheds light on debates regarding medical licensing laws. Some economists maintain that medical licensing laws are unnecessary and inefficient. The argument is that competition weeds out quack providers, and that licensing creates entry barriers that give rise to market power and reduce consumer welfare. There are reasons to question this logic, however. Suppose, for example, that in its most important respects, quality of medical care is difficult for patients to monitor and that high-quality care is costly to provide (perhaps because it requires greater physician training). In this case quack providers might enjoy a competitive advantage. In a complementary line of thought, Spiegler (2006) builds a model of the market for quacks (*MFQ*). The *MFQ* demonstrates that quack physicians can survive in equilibrium because patients randomly recover for reasons independent of the quack's treatment and because patients are boundedly-rational, making decisions based on anecdotes rather than general principles or a full assessment of relative probabilities. If patients adopted a non-anecdotal form of reasoning, they would not be fooled by random, non-treatment based recoveries. But as long as patients are boundedly rational, quacks can withstand competition from legitimate physicians.

A superficial reading of the *MFQ* and the economic history of quack medicines might suggest that the two are unrelated. Except for a brief discussion at the end of the paper, the Spiegler's model is a static, equilibrium construct driven by boundedly-rational decision making and random recovery.[2] In contrast, the analysis here considers a 150-year history of growth and change, and focuses mainly on medicines that claimed to cure diseases from which no one ever recovered, random or otherwise. There are, however, several key aspects of the analysis here that borrow from or build on Spiegler's model. This is especially true if one interprets the random recoveries in the *MFQ* not as recoveries *per se*, but as noise given meaning by actors with limited knowledge—because patients do not know enough about the underlying structure of the world, they are fooled by misleading signals, whatever their form. There are more concrete parallels as well. For example, the *MFQ* predicts that quacks invest heavily in product differentiation, and that up to a point consumer spending rises as the number of quacks increases. The framework here carries similar implications: quack medicines would not have survived had their promoters not been able effectively differentiate their medicines; and market expansion was facilitated by new and increasingly novel products. At a more fundamental level, the history of patent medicines suggests that positive signals (like random recoveries) are endogenous: if producers recognize that consumers use anecdotal reasoning, they might find ways to induce events that mimic recoveries and cures.

The rise of the germ theory of disease is a compelling intervention on two levels. First, it illustrates how scientific advances do not necessarily translate into improved consumer knowledge. Second, it suggests a mechanism through which quack medicines can not only withstand innovations that make legitimate physicians more effective in their (genuine) battle against disease, but could actually benefit from such innovations. The mechanism is simple. The germ theory gave rise to a series of public health initiatives that eradicated, or at least greatly reduced, infectious diseases such as typhoid fever, diphtheria, infantile diarrhea, and

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[2]Spiegler motivates the *MFQ* by citing modern services for which notions of random recovery (or improvement) are well placed, including psychotherapy, alternative medicines, political pundits, management consultants, and financial advice.

influenza. The eradication of these diseases shifted the age distribution upward; the average age of the population rose. Because older individuals had more long-term chronic health problems than younger ones and most quack medicines were marketed as cures for chronic diseases, and because infectious diseases killed relatively quickly before the sick had a chance to search out (and purchase) all possible cures, demand for quack medicines rose as a consequence of the germ theory. This result implies that quack medicines can grow in importance as the median age of the population rises, as it now is in most countries.

Regarding the FDA, there is evidence that in its early years the agency had only limited success in eradicating the market for patent medicines. To the extent that this early incarnation of the FDA failed to eliminate quack medicines, its history provides insight into the agency's more aggressive and interventionist stance in the twenty-first century, and helps resolve an enduring debate among regulatory economists. An older literature maintains that Pure Food and Drug Act (which created the FDA) was the product of rent-seeking and special interest politics, pushed either by big businesses who wanted to credibly signal that their products were of high quality to potential consumers, or by small businesses who wanted to use increased federal regulation and oversight as a means of hampering their larger, interstate competitors. More recent economic research, however, suggests that the creation of the FDA and other efforts to regulate commercial speech, enhanced consumer welfare (e.g., Law 200x; Hansen and Law; Glaeser and Shliefer). In the context of the model developed in section 1, the evidence presented below suggests that, whenever products exhibit a very low elasticity of demand with respect to product failures, stringent regulations like those that followed the initial Pure Food and Drug Act are appropriate. In the absence of such regulations, consumers are vulnerable to misleading and fraudulent advertising claims, in part because consumers do not adequately punish those manufacturers who make baseless pronouncements about the efficacy of their products. On the contrary, consumers desperate to find a cure for what ails them might return to those manufacturers repeatedly in the withering though ever-present hope of finding an efficacious product.

1. A Simple Model of the Patent Medicine Industry

1. The Basic Set-Up

Ex post, it is clear that the market for patent medicines was a mistake; consumers spent a lot of money doggedly pursuing cures that did not exist. But hindsight is always 20/20. The relevant question is whether an exhaustive search for an effective medicine could have been rationalized *ex ante*, and the answer to that question is yes. In a world where the value of a cure was high, the cost of trying and experimenting with various medicines was relatively low, and medical knowledge was limited— even on the part of the most accomplished physicians and scientists— it might well have made good sense to thoroughly and unrelentingly explore the efficacy of otherwise bogus medicines. Furthermore, the notion of a class of goods or services with a very low elasticity of demand with respect to product failures does not preclude consumer learning. Imagine that patients lower their expectations that a particular medicine works as they observe the medicine failing to generate a cure in an increasing number of cases. As long as the price of the medicine is sufficiently low and the value of a cure remains high, patients might rationally decide to purchase the medicine even as the number of failed cures rises and the probability that the medicine is efficacious approaches zero asymptotically.

Consider some patient, i, who is afflicted with a chronic disease. The patient searches for a cure to the disease in sequential periods, trying one new medicine, m, per period. The patient only exits the market if an effective medicine is found (and cures i) or if additional tries are deemed uneconomical. There is no random recovery, and unbeknownst to i, no cure exists. Nor does the patient know that all of the medicines are fundamentally the same product only with different names, promotional strategies, wrappers, and packages. As explained below, most patent medicines contained the same basic set of benign ingredients: alcohol, sugar, and some vegetable matter. The expected net benefit of *m* to the patient is,

(1) $E(b_m) = (\pi_m)V - p_m$,

where, π_m is the probability that *m* would affect a cure; *V* is the value of a cure in monetary units, and is constant across all medicines and patients; and p_m is the price of *m*, where $p_m > 0$. Consumer *i* purchases the medicine if $E(b_m) \geq 0$.

The most important element of equation (1) is π_m, the patient's ex ante assessment of the efficacy of *m*. The patient formulates this probability assessment based on his or her knowledge of general medical and scientific principals, and by observing the how various patent medicines have worked in earlier periods for *i* and for other patients. More precisely,

(2) $\pi_m = 1/(\kappa + f)$,

where, κ is *i*'s stock of knowledge, with higher numbers indicating greater knowledge and 1 indicating complete ignorance so that $\kappa \geq 1$; and *f* is the frequency with which *i* observes *m* and various other medicines failing to cure patients in earlier periods. For the moment, it is assumed that because patent medicines were devoid of curative power and therapeutic value, the patient observes nothing but failures; this assumption is dropped later in the analysis. The idea here is that the patient's belief in the efficacy of *m* would be reduced more after observing patent medicines fail 100 times out of 100 tries than by observing medicines fail 2 times out of 2 tries. A shortcoming of this approach is that *f* weights all failures identically. For example, if *i* observes medicine *m* failing to cure patient *j* ($j \neq i$), he or she treats that failure the same as medicine *m-1* failing to cure patient *j*. Recall that *i* tries one medicine per period, and has no direct experience of *m* when he or she first purchases it.

Given this functional form, π_m approaches zero asymptotically and the only agents to set π_m equal to zero (the correct assessment) are those with either infinite knowledge ($\kappa = \infty$) or infinite experience ($f = \infty$). Because patient *i*'s willingness to pay for one unit of *m* is simply the product ($\pi_m \times V$), willingness to pay (wtp) behaves identically. Figure 2 illustrates the case where consumers attach a monetary value of 500 to an effective cure, and have minimum knowledge ($\kappa = 1$). See the line labeled "first example"; ignore the other plots for the time being. The first failure cuts *i*'s wtp in half to 250; the second failure cuts it to 167; the third to 125, with the absolute reduction in wtp becoming progressively smaller with each observed failure. That wtp decreases at a decreasing rate with respect to failures suggests it is possible to have a market that persists in the face of millions of failures, so long as the producers can manufacture and distribute *m* at a price at or below the wtp. At $f = 3{,}000$, for example, producers would need to set p_m at or below .167 to induce consumer *i* to purchase *m*. Compare this set up to one where even the least knowledgeable consumer discovers that *m* does not work after a finite number of observed failures:

(3) $$\pi_m = (W - \kappa - f)/(W - \kappa).$$

For example, set $W = 6$ and $\kappa = 1$. In this scenario, patient *i* would conclude that *m* is not efficacious after observing only five failures to cure, and would quickly refuse to purchase any medicine with a non-zero price.

Equation (2) seems a more appropriate set up than (3) for any class of products or services where it is prohibitively expensive for consumers to know and learn, with complete certitude, that the good would not or does not function as promised. In the extreme case of religion, most organized churches promise an eternal life in paradise in return for fidelity to the church's moral teachings and regular financial donations. Whatever scientific discoveries and theological insights are revealed to consumers of religions, it is impossible know, with certitude, whether the church will deliver on its promise of life everlasting. Agnosticism does not seem an unreasonable response to this kind uncertainty. Patent medicines are not radically different. Imagine that patient *i* has observed thousands of different medicines failing to cure millions of different patients. It is difficult for *i* to be 100 percent certain that some new medicine, or even an old medicine already thoroughly tried, would not work in his or her particular case. As explained in the next section, the case for π_m approaching but never reaching zero becomes even more plausible if one allows manufacturers to invest in advertising and brand development strategies that effectively mislead consumers and obfuscate the incidence of product failures. While theory suggests that such strategies are unprofitable (e.g.,), they can be profit-maximizing when consumer demand is not sufficiently responsive to product failures.

There is also a historical rationale for embracing equation (2). For any finite κ, equation (2) is predicated on the idea that consumers before 1950 did not know enough about disease and human physiology to reject quack medicines out of hand. Instead, they had to discover medicinal value through experimentation and first hand observation. Their experimenting took the form of purchasing and ingesting a series of medicines and until they found one that worked. This is not a strong a claim. Arriving at cures through experimentation, without the aid of any theoretical guides, was common practice among physicians for more than a thousand years. From the ancient Greeks through the early 1800s, a branch of medicine known as empiricism ignored discoveries in human physiology and the etiology of disease, and instead studied only how drugs affected the sick (Stancell 1896, pp. 144-45). To assume that consumers adopted the same crude empiricism that physicians had used for centuries does not require a Herculean leap. Indeed, a small literature in health economics indicates that similar exercises in self-medication are rife in the developing world today (e.g.,).

1.b. The Elasticity Parameter, η, and the Origins of Fraudulent and Misleading Advertising

It is useful at this stage to add a parameter to equation (2) that at least loosely defines the elasticity of demand with respect to observed product failures. In this regard, the elasticity parameter, η, determines the rate at which consumers lower the expected probability of success, as well as their willingness-to-pay, in response to failures. Introducing η modifies equation (2) as follows:

(4) $\pi_m = 1/(\kappa + (f^{\eta}))$,

where $\eta > 0$. Consumer priors and willingness-to-pay become more (inelastic) elastic with respect to observed failures as η (approaches zero) increases. Setting $\kappa = 1$, figure 2 illustrates the relationship between willingness-to-pay and product failures for four different values of η (eta): .05, .5, 1, and 2. Assume for the moment that all of the medicines on the market are produced by a single manufacturer. If so, one might think of η as defining the penalty the manufacturer incurs for selling consumers medicines that do not work: the more bogus medicines the producer sells, the more he must discount his price to induce other consumers to buy his product; η specifies the magnitude of those discounts. Larger η's imply larger discounts; smaller η's, smaller discounts.

Because the penalty for misleading consumers rises as η rises—or equivalently, because the reward for misleading consumers falls as η falls—one expects more fraudulent and misleading advertising in markets where demand is inelastic with respect to failures than in those where demand is elastic. More formally, let A indicate the level of fraudulent and misleading advertising in any given industry or market:

(5) $A = a(\eta)$,

and $a_{\eta} < 0$. For purposes of this paper, it assumed that the advertising operates the same way random recoveries do in Spiegler's *MFQ*: advertising creates false positives, sending consumers misleading signals about the efficacy of patent medicines. Historically, these signals came in three varieties. First, marketers published long and largely fictitious letters testifying to the efficacy of the medicine. These testimonials gave consumers the impression that more people were recovering from the product than actually were. Second, the medicines themselves often contained herbal laxatives, cathartics, relaxants, or stimulants. These ingredients, while they did not to actually cure anyone, generated physiological changes that patients sometimes misconstrued as improvement or even recovery. Laxatives and cathartics were common, for example, in medicines that promised to purge the blood of disease-causing toxins. Third, producers can invest in re-branding. If they can convince consumer *i* that medicine m' is a wholly new and original product, distinct from all those a products that he or she has observed fail, *i* might disregard those failures and discount m' less than he or she otherwise would. (Sections 2 and 3 discuss the history of advertising and product composition in detail.)

These observations suggest a second modification to equation (2). Let ε indicate the number of positive signals consumer *i* receives through misleading advertising so that,

(6) $\varepsilon = e(A)$,

where, $e_A > 0$, and $e_{AA} < 0$. The negative second derivative reflects the possibility that with excessive amounts of advertising, consumers eventually come to recognize advertising for what it is (a compendium of empty promises), and begin ignoring it. These positive signals have the potential to nullify the effects of both knowledge and observed product failures so that equations (2) and (4) can be rewritten as follows:

(7) $\pi_m = 1/(\kappa + (f^\eta) - \varepsilon)$,

where, $0 \leq \varepsilon \leq (\kappa + (f^\eta) - 1)$. When ε reaches the upper bound (i.e., $\varepsilon = (\kappa + (f^\eta) - 1)$), the cumulative impact of the misleading signals is to trump experience and knowledge, and the consumer assigns a probability of 1 to medicine *m* working as promised. Allowing for (false) positive signals creates a second avenue through which η can influence the formation of expectations regarding curative and therapeutic efficacy. To see this, note that equation (7) can be rewritten as:

(8) $\pi_m = 1/(\kappa + (f^\eta) - s(\eta))$,

where, $s(\eta) = e(a(\eta))$, $s_\eta < 0$, and $s_{\eta\eta} > 0$.

Once a market characterized by a low η gets going, high-cost, high-quality providers who are honest advertisers would be at a competitive disadvantage relative to the low-cost, low-quality and dishonest providers who dominate the market. This occurs for two reasons. First, the high-cost provider would have trouble signaling high quality through advertising because all providers, even the low-quality ones, are using their advertising to signal high quality. In this way, consumers would probably discount the claims of the high-quality provider just as much as they discount the claims of the low-quality, dishonest provider. Second, if the high-quality provider is also honest his or her advertising might actually signal lower quality. In the case of patent medicines, consider the services of a legitimate, high-cost physician who was honest, well-trained, and understood human physiology and the etiology of disease. Such a physician would have told the patient sick with cancer or kidney disease that the condition was incurable, though medications to ameliorate the pain would have been available and prescribed. (See section PP for a history of the competition between legitimate physicians and patent medicines.) The same physician might have also told the patient: "don't waste your money on patent medicines; they will not be able to cure you either." But absent some independent authority signaling that the physician knew more than the patent-medicine men, it is not clear why the patient should have attached any more meaning to such a statement than he or she attached to the advertisements of patent medicines.

1.c. η, Spending Growth, and the Emergence of Long-Term Brands

A surprising characteristic of markets with a very low elasticity of demand with respect to product failure is that growth in spending can be higher in situations in which the product does not work as promised than in those in which the product functions properly. To illustrate, consider a simple example. There is a population of 4 people, each of whom survives 4 periods. In each period, one of those individuals experiences some sort of a health shock that prompts them to enter the market for patent medicines hoping to find a cure. Once shocked, the patient searches for an efficacious product, purchasing one brand of medicine per period and stopping only if a cure is found. Assume that demand is perfectly inelastic with respect to product failures so that each patient keeps trying different medicines, regardless of how many failures are observed. Assume also that the price of all medicines is 1. If so, total spending would grow fourfold over the four periods, with patient 1 purchasing one unit in the first period, patients 1 and 2 both purchasing one unit in the second period, and so on. On the other hand, if the medicines cured people, spending would be constant because the number of people searching for a cure would not accumulate over time. One patient per period would enter, buy a medicine, experience a cure, and exit the market. Patient 1 (2) would purchase a medicine in the first (second) period, experience a cure, and exit; and so on.[3]

On an intuitive level, it is relative easy to imagine patients regularly trying new and emerging medicines in a tenacious search for an effective cure. It is much harder to understand why patients would continually cycle through old and demonstrably ineffective brands of medicines, medicines that had already failed to cure thousands of other people. But as documented below in section 2, there were many brands of patent medicines that had product life cycles of more than 100 years. One possible explanation for the long-term survival of specific brands is a natural extension of the η-construct built above. Thus far, it has been assumed that patient *i* is considering purchasing *m* for the first time. Accordingly, the preceding discussion has considered patient *i*'s demand for medicine *m* in relation to the failures *i* observes among other patient's using *m*, the failures among other patient's using various medicines not-*m*, and the failures experienced by *i* with various medicines not-*m*. But to explain the emergence and persistence of specific brands of medicine, it is necessary to drop the assumption that *i* has never purchased *m* before, and consider situations where *i* might continue to use *m* despite the fact it has failed to cure *i* on multiple occasions in the past.

To generate long-term brands, one does not need patients using the same medicine for

[3]Presumably, the price of an effective medicine would be higher than the price of bogus medicines. But this only raises the price level; it does not effect the growth rate in spending.

extended periods of time. If persistence on the part of *i* signals to other patients that the medicine *m* might be working only a little persistence—each patient uses *m* across three or four periods rather than abandoning it after just one—is required. A well-designed quack medicine could generate such short-term persistence. As already mentioned, patent medicines often contained herbal components that induced noticeable physiological changes such as drowsiness (alcohol) or increased regularity (herbal laxatives and cathartics). Although these changes did nothing to ameliorate the underlying condition, they might have given the patient the inaccurate impression that the medicine was working and that all that was required was little more time for it to affect a full-blown cure.

Assume that patent medicine advertising generate three types of signals, depending on the source of the signal: the medicine might be improving the patient's condition (maybe); the medicine is not improving the patient's condition (no cure); and the patient is cured (cure). Because the medicine possesses no genuine curative power, advertisers can only signal "cure" by publishing fraudulent testimonials in newspaper ads. They can, however, signal "maybe" with genuine patients by putting the correct mix of ingredients in their medicines. No assumption is made about which signal is more effective, though one might imagine situations where a "maybe" from a close friend or relative means more than a miracle cure testified by some unknown individual in a newspaper ad. Whatever the relative effectiveness of printed testimonials and communication with friends and relativeness, a medicine that generates lots of maybes would have an advantage over other medicines that are less able to deceive patients and generate repeated use. Most consumers would eventually learn that while the medicine made them sleepy or more regular, it was doing nothing to cure their cancer or kidney disease. But in the meantime, their repeated use of the product would have signaled maybe to many other potential customers. This process explains why most patent medicines did not simply contain water or some other cheap, inert substance: to generate anything more than a one-shot purchase by the patient, producers had to square their products with consumers' preconceived notions about how a medicine should look, taste, and smell, and the products had to generate physiological changes to get consumers to think they were working.

1.d. What Would a Market With a Low η Look Like?

The central proposition of this paper is that market for patent medicines was characterized by a consumer demand function that was highly inelastic with respect to product failures. The model above predicts that such a market would have had the following characteristics.

Prediction 1: The number of brands of medicine would have proliferated and grown increasingly bizarre with time. In the context of equation (7), by creating new products and new brands of medicines, the promoters of quack medicines raised π_m by increasing ε. A well-devised new brand signaled to consumers that the product was novel and different from its predecessors, and that consumers should ignore all those other failed medicines that they observed others using or tried first hand. With new brands of medicines continually emerging, one also expects that the market for patent medicines grew increasingly competitive with time.

The idea that market was competitive and would grow even more so with time become even more plausible when one considers that developing, producing, and distributing patent medicines demanded no more special skills than those required to build a still and distribute bootleg whiskey, or even less skill. For example, Lydia Pynkham, the inventor of the immensely successful Pynkham's Vegetable, was ordinary housewife with no training in medicine or any other field. All she had was ne're-do-well husband who drove her to search out a successful vocation in an act of financial desperation. Similarly, the inventor of Warner's Safe Cures was in the business of manufacturing safes and bank vaults before he turned to medicine.

Prediction 2: Specific brands of medicine devoid of curative or therapeutic value could have long product lives. Their survival would have been predicated on a set of ingredients that induced physiological changes that fooled consumers, for at least a limited amount of time, into believing that the medicine was curing them. Consumers trying a medicine for multiple periods signaled to other potential consumers that maybe this medicine is working.

Prediction 3: Because markets with a low η do not punish firms for misleading advertising, and on the contrary, positively encourage it, one expects the market for quack medicines to have been rife with fraudulent and exaggerated advertising claims. Why promise to cure just one disease, and unnecessarily limit your market? Promise to cure everything, and more people would try the product. The more vile, painful, and incurable the disease, the better. Similarly, do not just claim to make the patient feel better, promise a full blown cure.

Prediction 4: There are at least two reasons to expect older firms to have advertised as much, or more than, newer firms. First, because older firms had longer histories, they had more failures to overcome. New products had an advantage in this sense. Second, because no one was ever truly cured with these medicines, manufacturers could not rely on their reputations and word-of-mouth to sell their products. They had to continually tell patients that their product was effective. This prediction contrasts sharply with the information model of advertising which predicts advertising expenditures peak when the product is first introduced—to inform consumers of its presence and promote its diffusion—and decay as the product ages. (See Horsky and Simon, 1983, for a model and evidence.)

Prediction 5: Prices would have fallen with time for two reasons. First, because failures (f) accumulated with time, consumers would have steadily reduced expected efficacy (π_m). The extent to which prices fell, however, would have differed across products. For example, medicines for which failures were especially difficult to observe and direct communication across patients was limited (e.g., given the social shame associated with venereal disease, patients probably did not communicate effectively with one another regarding their experiences with various medicines) price reductions would have been smaller than for other products.

Second, as the number of brands and products proliferated (see prediction 1), the market would grown increasingly competitive and drove down prices independent of any effects on consumer updating. In addition, to the extent that consumers attached a very low probability to any given medicine working, prices would have been low relative to potential value (imagine a cure for cancer selling for $200 in 2009 dollars), and fairly uniform across products.

The following two sections present the history of the patent medicine industry. Overall, that history comports well with these five predictions.

2. Were Patent Medicines Really Quack Medicines?

The simplest and most direct way to reconcile the robust market for patent medicines with rational, maximizing behavior is to argue that historians are mistaken in their critical assessments of the industry. The strongest version of this argument maintains that patent medicines had genuine curative power, and that the industry's success was based on this power. If so, one expects that the most popular medicines would have contained ingredients recognized by modern science as powerful curative and therapeutic agents. A close look at the most popular and enduring medicines generates little support for this argument, however.

Table 1 lists some of the best-known patent medicines, their product life, and their main ingredients. A brief survey of table 1 indicates that most of these products were on the market for at least 50 years, and that several had life spans of 100 years of more. One product, Peruna, was on the market for nearly 300 years. Most of these medicines were innocuous mixtures of vegetable compounds and alcohol—Peruna, for example, was nothing more than a combination of whiskey, champagne, wine, and beer. Three medicines, however, contained gasoline and/or turpentine and two of these were intended for ingestion or inhalation. Other medicines contained herbal laxatives such as glycerin and jalap, or herbal pain relievers such as capsicum (chili peppers) which is sometimes used today in topical ointments (not ingested as with Holloway's Pills). Only 3 of the 21 medicines listed in table 1 contained anything more powerful than alcohol. These are Wistar's Balsam of Cherry (on the market at least 77 years), Perry Davis's Painkiller (on the market at least 118 years), and Dr. Pierce's Golden Medical Discovery (on the market at least 83 years), all of which contained opium. Although drugs like morphine and opium were typically found only in trace amounts and were probably used in less than a quarter of all patent medicines on the market in 1879, there were isolated cases where individuals developed addictions (e.g.,).[4]

Consider the following examples in greater detail. In its advertising, Ayer's Sarsaparilla claimed to cure tuberculosis, liver disease, nervous disorders, melancholia, and kidney disease (Ayer 1888), yet the medicine contained sarsaparilla (a root now used to make soda), yellow dock (an herbal laxative), and May apple (a plant which in large amounts is toxic). This medicine was on the market for more than 82 years. Brandreth's Pills claimed similarly diverse and powerful curative powers. Ads touted its ability to cure multiple ailments stemming from impure blood, including tuberculosis, general lethargy, and liver disease *(Tribune Almanac and Political Register* 1874, pp. 107-12). A mixture of aloe, various cathartic herbs, peppermint, cinnamon, and alcohol, this cure was on the market for nearly a century. Holloway's Pills also claimed to purify the blood and thereby purge the human system of constitutional diseases like tuberculosis. Holloway's Pills contained no alcohol, and instead relied on aloe, rhubarb, chili peppers, ginger, and soap.

Day's Kidney Pad promised to "cure by absorption all diseases of the kidneys, bladder, and urinary organs(*Western Christian Advocate*, Jan. 14, 1880, p. 15)." It was, according one

[4]In an article for the Michigan Board of Health, Prescott (1882, p. 157): "Three years ago Professor Richter published a summary of 938 secret remedies analyzed by himself and other chemists. Of these he found 22 percent having some violent or poisonous constituents, 25 percent having medicinally powerful constituents, [and] 52 percent having only harmless or inert constituents."

advertisement, “the only true method of curing and controlling the most prevalent diseases that afflict mankind (*Southern Planter*, Sept. 1880, p. 324).” Coated with a compound of benzine, dried flowers, and juniper berries, the pad was applied on the patient’s back over the kidneys (Oleson 1899, p. 54). This product was on the market for at least 32 years. A mixture of ammonia, turpentine, and other less objectionable ingredients, Hamlin’s Wizard Oil was also applied topically. On the market for nearly 50 years, it was marketed as a cure for host of ailments, ranging from burns and abrasions to rheumatism and diphtheria. A combination of turpentine, sodium, and jalap, Jaynes Vermifuge claimed to cure indigestion, heartburn, and diarrheal diseases *(Medical and Surgical Reporter*, March 15, 1884, p. 350; *New York Observer and Chronicle*, Feb. 27, 1902, p. 284). It survived at least 73 years.

Illustrative of a host of different cancer cures, Kline’s Painless Cancer Cure was a mixture of white wax, fir-tree extract, and chromic acid (used today for chrome plating and glass work) applied directly to the skin over a tumor. In one ad, Kline claimed that his medicine was “preeminently unrivalled [sic] in the treatment” of cancer. The same ad also indicated that Kline’s treatment could eradicate the “largest of cancers or tumors” without a “knife, caustics, loss of blood, or other fearful treatments.”[5] This medicine was on the market over 20 years. In its advertising, the makers of Moxie Nerve Food proclaimed it “the successful enemy of the rum fiend” and the “finest nerve food” ever found (*The Independent*, May 20, 1886, p. 15). Aside from curing alcoholism, one ad described the miraculous and unprecedented case of a Mrs. Bulme, who recovered from “a complete paralysis of both the motory [*sic*] and sensitive nerves of the left side” as a result of her use of Moxie (*Zion’s Herald*, Nov. 24, 1886, p. 373). On the market for nearly half a century, Moxie Nerve Food was a mixture of oats, syrup, sassafras, and

[5]The formulas for the medicines described in this paragraph are from Oleson (1899), pp. 41, 151, and 225. The quotations for Kline’s Cancer Cure are from *Arthur’s Home Magazine*, July 1884, p. A4.

wintergreen.[6] Saul's Catarrh Remedy was an inhalant that purportedly cured tuberculosis. A concoction of benzine, chloroform, sulphur, ammonia, and distilled spirits (Oleson 1899, p. 214), Saul's Remedy was on the market for at least 20 years. Lastly, Swaim's Panacea was marketed as a cure-all, relieving patients of the burdens of heart disease, leprosy, liver disease, rheumatism, scurvy, various skin eruptions, and even melancholia *(Saturday Evening Post*, May 15, 1824, p. 3). On the market for 79 years, it contained herbs, dried flowers, and rhubarb.

It is difficult to see how anyone could legitimately market these medicines as cures for alcoholism, cancer, diarrheal diseases, diphtheria, epilepsy, heart disease, kidney disease, liver disease, rheumatism, tuberculosis, or anything else. Such an argument would imply that oats, sassafras, and wintergreen cure alcoholism; that putting the equivalent of chrome plating over a tumor cures cancer; that external applications of turpentine and ammonia cure rheumatism and diphtheria; that gasoline and juniper berries cure kidney disease; that aloe, herbal laxatives, and soap cure liver disease; and that inhaling ammonia, distilled spirits, and chloroform cures tuberculosis. Even for the three of medications that contained opium, the products did nothing to actually cure the diseases they claimed. For example, Wistar's Balsam of Cherry was said to cure tuberculosis, yet aside from opium, contained only cherries, syrup, sugar, and alcohol. Similarly, Dr. Pierce's Golden Medical Discovery claimed to cure alcoholism, epilepsy, melancholia, and other psychological and neurological disorders. At best, patients who discovered and used Dr. Pierce's drink replaced one form of addiction and psychological

[6]Although I have not located an advertisement for Moxie that explicitly claimed to cure epilepsy, ads for similar products such as Dr. Miles Restorative Nervine and Samaritan Nervine were heavily marketed as epilepsy cures *(Herald of Gospel Liberty*, Jan. 5, 1911, p. 19; and *Michigan Farmer*, July 17, 1883, p. 7). Some nerve foods were useful. Those products contained potassium bromide, a powerful sedative and anti-convulsant. Ordinary physicians used bromides as a matter of course to treat seizures in eclampsia and epilepsy. Although useful as temporary therapeutic, potassium bromide had no power to affect a long-term cure, as the promoters of nerve food claimed. In the United States bromides were abandoned after the discovery of phenobarbital around 1910. But bromides are still used in Germany and in the treatment of epilepsy in dogs.

suffering with another. Some patent medicines were calculated to work just this way. Promoters would advertise the medicine as a cure for alcoholism or opium addictions, but then put large amounts of the addictive agent in the medicine itself. Only after a period of direct experimentation did the patient discover that medicine was not a cure but a more expensive way of feeding his habit (Prescott 1882).

A skeptic could still argue that these medicines had some benefit because they induced inebriation, placebo effects, or had some value as laxatives. This line of thought suggests that people chose to purchase patent medicines to get drunk or high, despite the fact those medicines cost orders of magnitude more per unit of alcohol than beer or ordinary distilled spirits. As for using them as a means of acquiring harder drugs, as already mentioned, more than 75 percent of medicines did not contain such drugs, and in most states, opium and morphine could be purchased from a druggist without a prescription, and without the advertising expenses that came with patent medicines. If Americans used patent medicines as placebos, they spent *more* money in 1909 on a massive act of self delusion than they spent on agricultural tools and machinery— at this time, about 1/3 of the American labor force was engaged in agriculture.

These observations highlight the difficulty of explaining the rise of the patent medicine industry by focusing solely on price, cross-price, and income elasticities. Given the evidence above, the objective value of the typical patent medicine was zero, and the puzzle that should interest economists is why consumers did not reject patent medicines outright. Increases in consumer demand, whether or not they were driven by income growth and price reductions, were predicated on the belief that patent medicines *might* work, and that tentative belief is the interesting part of the story. Furthermore, elasticity arguments can not account for many of the anomalous features of the patent medicine industry documented below, including the proliferation of different brands of medicine, the behavior of prices over time and across brands, and a heavy reliance on advertising and investments in product differentiation.

Finally, even if one sets aside these concerns and adopts the elasticity framework, the elasticities implied by the available data far exceed those estimated in the current literature on health-care spending. For example, per capita spending on patent medicines grew at an annual rate of .041 between 1800 and 1900, while real wages grew at annual rate of .01 over the same period. Ignoring all other possible factors, these data suggest an income elasticity of demand of 4. To appreciate the implausibility of this estimate, consider a close parallel to the market for patent medicines in nineteenth-century America: the market for self medication in the developing world today. Self-medication is commonplace in poor countries and involves patients seeking out and purchasing medicines from drug vendors without any professional supervision. In wealthier countries such medicines would be acquired through prescriptions. The available evidence indicates that self-medication is a normal good for the very poorest segments of the developing world, and an inferior good for everyone else (Chang and Trivedi 2003; Hjortsberg 2003). For the United States, which by 1870 was already much wealthier than places like Zambia today (Helpman 200b, p.), this suggests an income elasticity of demand less than one.

3. Advertising, Prices, and Market Structure

3.a. On the Centrality and Persistence of Advertising

More than a century ago, the prominent physician George F. Shrady wrote: “Man is sick; he wants to live; he sees a statement that such a medicine will surely cure him. He half believes it, entirely hopes it, and buys the bottle (*Medical Record*, July 8, 1882, p. 42).” Shrady’s pithy insight, which encapsulates much of the analysis here, is based on a simple assumption: that advertising, even if people did not completely believe it, or even if they mostly disbelieved it, might have induced patients to purchase medicines of little or no value. All patent medicines promoters had to do was to the raise the probability that their medicine would work above zero. According to Shrady, more than any other industry, patent medicines depended on advertising: "It is admitted that no industry depends so much upon advertising as does that of patent medicines. Here, indeed, is where the business is shown in its most lurid aspect." Similarly, in a survey of 35 pharmacists in New England and the Midwest, Lowden (1906, p. 35) asked, "what sells patent medicines?" There was "but one answer." "Patent medicines are sold wholly through the susceptibility of people to advertising." Other observers were equally convinced of the centrality of advertising to the patent medicine business. Clarke (1891, p. 45), for example, wrote: "Their chief first cost and ultimate measure of their sale depends upon the liberality or profuseness with which they are advertised in newspapers."

Shrady went on to argue that success required more than just a large, one-time investment in advertising. Producers had to keep on advertising, regularly cajoling people into purchasing their medicines, otherwise demand quickly subsided:

> We are told that the moment a new drug ceases to be advertised the demand for it fails. If, after judicious advertising for ten years, the advertisement is stopped, the demand falls about seventy-five percent. There will then continue for several years a steady call for the drug equaling about twenty-five percent of that which originally existed (*Medical Record*, July 8, 1882, p. 42).

Other observers concurred, arguing that advertising "must be continuous, first to start the trade and then to hold it (*Printers Ink*, May 18, 1910, p. 84)." A clear example of the importance of continual advertising is afforded by Wistar's Balsam of Cherry. As indicated in table 1, this patent medicine contained opium and might therefore have possessed addictive qualities, yet when the manufacturers of Wistar's stopped advertising during the mid-nineteenth century the company's business was nearly destroyed, and did not pick up again until a strong advertising campaign was resumed.[7] There is also anecdotal evidence that as firms grew and aged over

[7]Rowell (1870, p. 144) described the fortunes of the owner of Wistar's Balsam of Cherry, a man named Seth W. Fowle, this way: "Having established a large sale for the Balsam, and

time, advertising expanded, suggesting that older firms advertised more than new entrants. MacDonald (1902, p. 286), for example, wrote that:

> Perry Davis began his great Pain Killer business by peddling bottles of Pain Killer from door to door. When he got a little ahead he began advertising—his sales than began to increase with the better knowledge of his Pain Killer and in proportion to the increase of business Mr. Davis enlarged his advertising appropriation. I believe Dr. J.C. Ayer started in about the same way.

Note that both Perry Davis's Pain Killer and Ayer's Sarsaparilla are listed in table 1. Other sources also indicate that spending on advertising expanded as firms and products aged ( ).

Although it is hard to know how much of this was hyperbole, the idea that the patent medicine industry was unusual in terms of advertising expenditures receives support from data in the *Census of Manufactures* for 1899/1900. With information on 333 industries, figure 3 plots the log of the industry's advertising expenditures (for most industries the largest expense included under the rubric "miscellaneous expenses") against the log of the total value of the industry's output. Two patterns stand out. First, the patent medicine industry, denoted by the black triangle, was relatively large in terms of the value of its output. Second, given its size, its advertising expenditures were unusually high. These data suggest that the only other industries with larger expenditures, given their size, were malt liquors, distilled liquors, and oleomargarine. Two regressions, reported in table 2, indicate that after controlling for industry output or expenses in other areas (wages, salaries, raw materials, and capital) spending on advertising in the patent medicine industry was 62 to 73 percent greater than predicted.

Advertising served two functions. First, it positioned the medicine in a product space. Some medicines were marketed as safe and benign so that even if they did not affect a cure,

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knowing it to be an article of great real worth, he thought it would continue to sell upon its own merits, and consequently withdrew all his advertising. When Mr. Fowle withdrew his advertising the sale of the Balsam fell off, as new medicines were introduced, and they being extensively advertised the sale of these articles soon in a great measure supplanted that of Wistar's Balsam."

they would not harm the patient.[8] Other brands were marketed as traditional cures based on Eastern or Native American medicines.[9] Still other medicines created whole new systems and theories of medicine, sometimes publishing books that ran into the thousands of pages, and based their advertising on those new theories.[10] Some medicines were marketed as cathartics on the idea that regular internal cleansing purged the system of disease-causing pathogens (Clarke 1891, pp. 42-43). Homeopathy and Thompsonian medicine were popular during the nineteenth century, and some patent medicines were marketed as herbal and natural remedies. Prominent examples include Kilmer's Swamp Root and Lydia Pinkham's Vegetable Compound (citations).

But the most popular method of product positioning tapped into the widespread belief that all diseases were caused by impure blood. At least seven of the medicines described in table 1, for example, were marketed as blood purifiers, including, Ayer's Sarsaparilla, Brandreth's Pills, Holloway's Pills, Hood's Sarsaparilla, Hop Bitters, and Hostetter's Stomach Bitters, and Swaim's Panacea. The following ad for Ayer's Sarsaparilla illustrates:

> This compound . . . purifies the blood, and purges out the lurking humors in the system that undermine health and settle into troublesome disorders. . . . When [the humors] are gone the disorders they produce disappear: such as, ulcerations of the liver, stomach, kidneys, lungs, St. Anthony's Fire (epilepsy), boils, tumors,

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[8]See, for example, advertisements for Warner's Safe Remedies, which characterized the medicines of this company as "pure, harmless, and effective." See *Western Christian Advocate*, Jan. 14, 1880, p. 15; and *Once a Month: An Illustrated Australian Magazine*, July 15, 1885, p. xvii.

[9]Examples include the Himalya, a cure for asthma (see *The Cosmopolitan*, April 1895, p. 866) or Kickapoo Indian Remedies, which included a range of medical products that claimed to cure everything from eczema to turberculosis (see *Beckwith's Almanac*, 1889, p. 93, or any of the almanacs published directly by the Kickapoo Indian Medicine Company). While there was an Indian Nation known as the Kickapoo, the medicines were produced by a man of European ancestry and the medicines had no connection, whatsoever, to the Kickapoo. See (citation).

[10]One example of this the Pulmonary Chemical Company of Columbus, Ohio, which created something called the Pneumo-Chemic System to cure tuberculosis, bronchitis, asthma, and hay fever. See *The Cosmopolitan*, April 1895, p. 863. Another example . . . Book,

> neuralgia, and general debility (*Western Christian Advocate*, Jan. 14, 1880, p. 47).

Similarly, an advertisement for Hood's Sarsaparilla claimed that the medicine "builds up the shattered system, by giving vigorous action to the digestive organs, creating an appetite, and purifying the blood." One costumer testified: "Hood's Sarsaparilla is the best medicine I have ever taken for a blood purifier (*The Outlook*, October 27, 1894, p. 676).

Second, advertising functioned as a misinformation campaign; it sent misleading signals to consumers, making it appear that more people were recovering from patent medicines than truly were. For example, patent medicine companies regularly published long and largely testimonials in newspapers, often cleverly disguised as editorials or articles.[11] It was also not uncommon for manufacturers to appropriate the names of deceased physicians in creating fictitious endorsements. On other occasions, they paid preachers, ministers, businessmen, and politicians to endorse the medicines as having cured members of their own families. The connection between patent medicines and the clergy was particularly strong, as the following excerpt from an editorial in the *Cincinnati Lancet and Observer* (November 1875, p. 683) suggests:

> No other class of persons have ever done so much to promote the interests of quackery as the clergy. Time and again have we heard them advocate the remarkable power of infinitesimal doses, and of the evil effects of mercurials, in any form, on the human system. Pick up almost any patent medicine almanac, and you will find the virtues of patent pills and potions eulogized, ad nauseam, by reverends and [Doctors of Divinity]. Take up almost any religious newspaper (there are two or three honorable exceptions) and you will generally find about two-thirds of their advertising patronage made up of quack nostrums.

The *American Journal of Medical Sciences* (Jan. 1842, p. 262) argued that endorsements and testimonials by the clergy had an especially powerful effect because nineteenth-century

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[11]Examples of ads disguised as newspaper articles, include *Christian Union*, June 1881, p. 526; *Puck*, Feb. 14, 1883, p. 373; and *Scribner's Monthly Magazine*, April 1881, p. 22.

America was such a religious society:[12]

> We can scarcely open a newspaper, without meeting with the advertisement of one more quack medicines, recommended, and avouched [sic] by clergymen. Now such is the confidence of the mass of the people in their spiritual pastors, that these certificates have in them a power even greater than the forged testimonials of eminent, deceased physicians, so often attached to the same advertisements.

According to an article in the *Boston Medical and Surgical Journal* (*BMSJ*), there was even a vibrant second and third hand market for letters and testimonials. One letter broker claimed to have seven million letters on hand, broken down by categories for consumption cures (55,000), female complaints (95,000), paralysis (7,000), deafness (65,000), cancer (3,000), and other diseases and chronic conditions. Echoing and expanding on Shrady's criticisms, the *BMSJ* (March 1, 1906, p. 244) wrote: "Of course, a letter would not have second, third, and fourth hand value unless the dupes, like lambs in the stock market, return to the temptation over and over again. After trying one medicine they go to another and so on." Quoting a particularly forthcoming letter broker, the journal continued:

> As one broker said: 'To be sure, they have all tried one remedy or more; but that is all right; they will keep on trying new remedies until they die. Buy or rent a few thousand of those letters from me, at a few dollars a thousand, and tackle them with a new proposition—something new, something with a new name—jolly 'em along a little, and they'll come up with the money for a new treatment.'

3.b. Prices, Market Structure, and the Proliferation of New Brands

Despite heavy investments in advertising and product differentiation, there was remarkable uniformity in prices across brands, classes of medicines, and over time. Consider first prices as reported in nominal dollars. Between 1840 and 1900, five cures for gonorrhea sold for $1 per unit (box, tube, or bottle). These were Dr. Sorm's Specific Compound, Cross's Specific Mixture, Charleston Whitewash, Macqueen's Matico Injection, and the Two-Day

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[12]For other statements on the connection between the clergy and the patent medicine industry, see for example, *Medical and Surgical Reporter*, Sept. 1858, p. 614; and *Puck*, April 28, 1897, p. 1.

Injection Cure. Over the same period, Sarsaparilla cost $1 per bottle, whatever the brand: Ayer's, Hood's, Sand's or Scoville's.[13] If one plots prices over time in real terms all variation is driven by changes in the general price level, and with the exception of the Civil War and the years immediately following, the long-term trend in real prices was flat, or exhibited a mild downward trend. For example, in constant 1870 dollars, a bottle of sarsaparilla cost around $1.10 during the 1840s, and around $0.99 during the 1890s. See figure 4. The picture changes somewhat if the price of three popular medicines—Brandreth's Pills, Holloway's Pills, and Swaim's Panacea—are plotted in constant dollars. As figure 5 shows, all three series exhibit a steep downward trend, moving in tandem and falling by around 70 percent between 1810 and 1900. It is notable that products that contained opium exhibit the same basic pattern in prices. As figure 4 shows, the price of a bottle of Wistar's Balsam of Cherry also fell by around 70 percent between 1840 and 1900.

It useful to ask why sarsaparillas and gonorrhea cures were able to maintain prices better than the other medicines. In the case of the gonorrhea cures one imagines that failures across patients would been communicated poorly, it at all, among patients. This disease carried a largely social stigma and it is difficult to imagine patients openly discussing the disease and the treatments they used in an attempt to cure it. In the case of sarsaparillas, nearly all brands of sarsaparilla contained potassium iodine. Potassium iodine is useful in treating at least some cases hypothyroidism, and helps stimulate thyroid function. For those patients who unknowingly suffered from hypothyroidism, and experienced the subsequent bouts of irritability, drowsiness, and fatigue, and were susceptible to treatment with potassium iodine, sarsaparillas represented an effective treatment, though not a cure. Nevertheless, because sarsaparillas promised to cure just about every human ailment imaginable, promoters were able

[13]These price observations are based on data gathered from survey of advertisements found in journals and periodicals contained in the *American Periodical Series Online*.

to parlay the medicines usefulness in the treatment of a fairly narrow class of diseases into a bull blown panacea and cure all.

While one cannot rule out the possibility of price-fixing and market power, the available evidence suggests the market for patent medicines was fairly competitive and grew more competitive with time. In contrast to other industries, where reports of cartels and trusts were commonplace, no such reports can be found for patent medicines. On the contrary, anecdotal reports emphasized frequent entry, failures, and exits, and claimed that “not one in a thousand patent medicine men has succeeded” (e.g., *Southern Practitioner* 1886, p. 423; Cantley 1898). Census data indicate that the number of establishments producing patent medicines grew tenfold between 1860 and 1900, while the number of establishments in all industries grew fourfold over the same period (see section ?, figure ?). While increased demand undoubtedly drove the growth in the number of firms, those increases in demand were not met with expansions in average firm size, as was the case in other industries. As will be shown in detail later in the paper, in absolute terms, firm size in the patent medicine industry remained constant between 1810 and 1910, and relative to firm size in other industries, fell sharply during the late nineteenth century (see section ?, figure ?).

The rapid entry into the patent medicine industry over the course of the nineteenth century brought with it a proliferation of new and increasingly bizarre products, often based on new technologies and scientific discoveries. Examples include electro-belts and vibrating chairs. Introduced during the late 1800s and early 1900s, products like these claimed to cure cancer, heart disease, tuberculosis, and a host of other afflictions (e.g.,). Other new patent medicines exploited and distorted genuine discoveries in the germ theory of disease. Prominent examples include the Carbolic Smoke Ball, the Pillow Inhaler, and Radam’s Microbe Killer. The subject of a court case known to most first year law students, the Carbolic Smoke Ball worked just as is its name implied (Simpson 1985). The patient ignited the ball and inhaled the smoke which contained phenol (carbolic acid). Although phenol has antiseptic qualities, there is no evidence that it cures influenza, tuberculosis, or other diseases of the respiratory system, as promoters of the smoke ball claimed.

Similarly, the Pillow Inhaler was a "pillow containing receptacles filled with an inhalant mixture, the fumes of which [were] breathed at night (*Christian Union*, June 1, 1881, p. 526)." Promoter's claimed that the antiseptic fumes emitted by the inhaler destroyed the pathogens that caused asthma, tuberculosis, whooping cough, bronchitis, and a host of other respiratory ailments (*Scribner's Monthly Magazine*, April 1881, p. 22). Finally, to manufacture Radam's Microbe Killer, a gallon of water was combined with a few drops of muriatic acid, a little red wine, and four ounces of sulphuric acid. While such a concoction might serve as a useful household cleanser or disinfectant, Mr. Radam intended that patients drink the mixture to kill the germs that were making them sick (Oleson 1899, p. 141).

3.c. Raw Materials and Product Differentiation

In his aforementioned critique of the patent medicine industry, Shrady argued that competitive pressures encouraged firms to substitute more expensive, and potentially effective ingredients, with cheaper and clearly ineffective ones (*Medical Record*, July 8, 1882, p. 42): "The greed of money is at the root of the patent medicine failure. The proprietor wants to make his medicine at less cost, and after a while puts in cheaper ingredients. The mixture which costs fifteen cents, and sells for a dollar, is finally made for five cents." There were a few products that took this thinking to its logical extreme, such as Poor Richard's Eye Water. This medicine was purported to "refresh and strengthen the eye, and cure inflamation, blindness, etc.," but apparently contained nothing more than ordinary tap water (*School*, June 6, 1895, p. 343). However, the long-term viability of the Carbolic Smoke Ball, the Pillow Inhaler, and many of the medicines listed in table 1, suggests that the incentives to substitute increasingly cheaper ingredients for more expensive ones were limited. Producers did not only differentiate their medicines by advertising; they also differentiated them by the raw materials they used. This might help explain why medicines grew increasingly bizarre over time. As the number of medicines proliferated, it might have grown harder and harder to differentiate products through advertising alone so that the medicines themselves had to appear wholly new and original.

Sections 4-8 forthcoming.

Product	First obs'd	Last obs'd	Min life	Main ingredients
Ayer's Sarsaparilla	1824	1906	82 yr's	sarsaparilla, yellow dock, May apple, sugar, potassium
Brandreth's Pills	1827	1920	93	aloe, herbs, peppermint, cinnamon, alcohol
Hamlin's Wizard Oil	1864	1920	46	ammonia, chloroform, sassafras, turpentine, cloves
Holloway's Pills	1823	1920	97	aloe, rhubarb, capsicum (chili peppers), ginger, soap
Hood's Sarsaparilla	1884	1915	31	sarsaparilla, sassafras, sugar, maple syrup, alcohol
Hop Bitters	1873	1920	47	alcohol (16-20 percent)
Hostetter's Stomach Bitters	1853	1958	105	roots, Peruvian bark (quinine), orange peels, alcohol
Jayne's Vermifuge	1863	1920	57	sodium, turpentine, pink root, jalap (a cathartic plant)
Kilmer's Swamp Root	1880	1959	79	water, alcohol, willow bark, sugar
Moxie Nerve Food	1870s	1910s	≈45	oats, syrup, sassafras, wintergreen
Pinkham's Vegetable Comp.	1873	1958	85	alcohol, aloe, glycerin (a laxative), tansy, lovage (plants)
Peruna (later called Ka-tar-no)	1638	1927	289	whiskey, champagne, claret, beer
Old Hinkley's Bone Liniment	1856	1959	103	wormwood, hemlock, thyme, turpentine, capsicum
Perry Davis's Painkiller	1840	1958	118	opium, camphor, capsicum
Dr. Pierce's Golden Med. Disc.	1875	1958	83	opium, May apple, guaiacum (tree extract)
Dr. Sanford's Liver Invigorator	1858	1911	65	unknown
Swaim's Panacea	1820	1899	79	worm-seed, valerian, cloves, agaric, rhubarb, tansy
Wistar's Balsam of Wild Cherry	1843	1920	77	opium, cherries, syrup, sugar, alcohol

Table 1. Long-Lasting Patent Medicines

Variable	Mean (std. dev.)	Log(misc. exp.) (1)	(2)
Log(total value)	6.888	.972*	—
	(.826)	(.017)	
Log(capital)	6.737	—	.336*
	(.840)		(.058)
Log(salaries)	5.466	—	.426*
	(.772)		(.052)
Log(wages)	6.125	—	.204*
	(.827)		(.046)
Log(raw materials)	6.550	—	.062
	(.893)		(.247)
= 1 if patent medicine industry	—	.725*	.621*
		(.267)	(.247)
Adjusted R^2	—	.902	.918
Number of observations	—	333	333

Table 2. Determinants of Advertising Expenditures at the Industry Level

Notes: * - indicates significance at the .01 level or higher. Constant included but not reported.

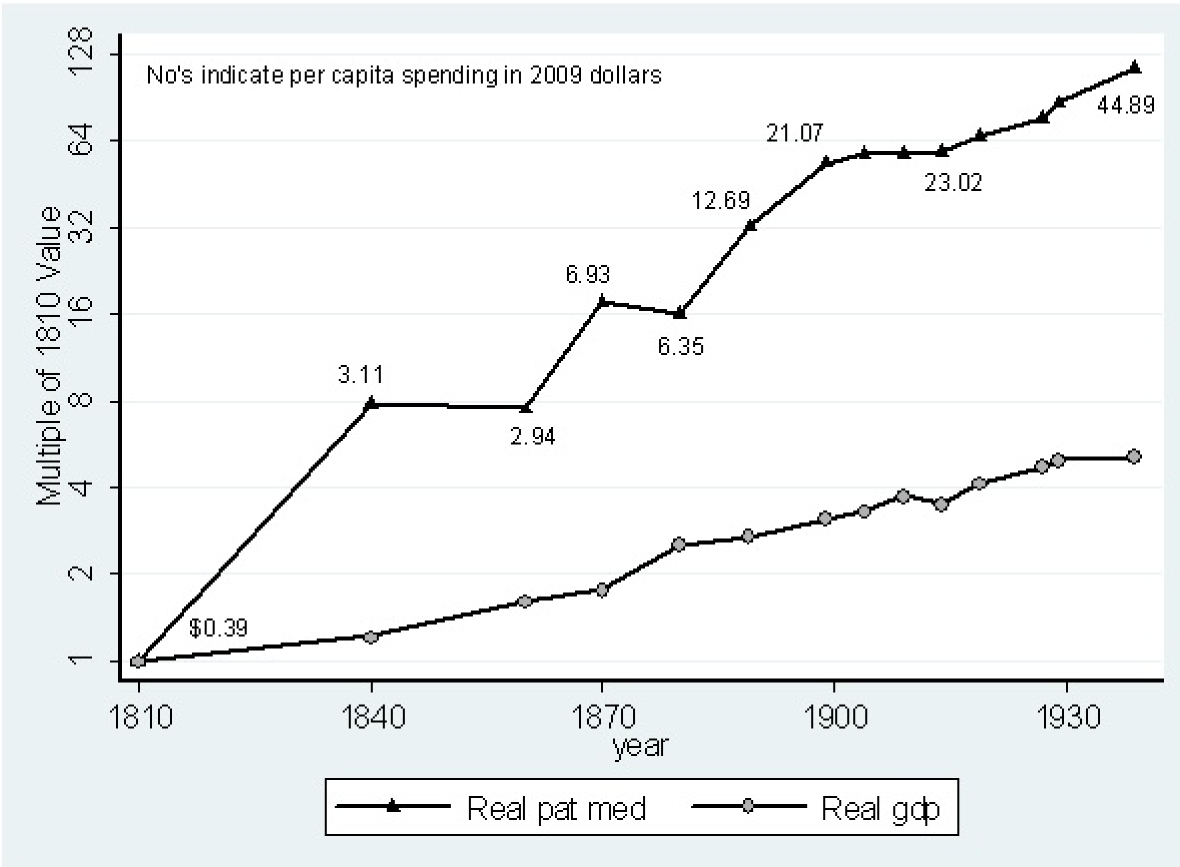


Figure 1. Growth in Spending on Patent Medicines and GDP per Capita

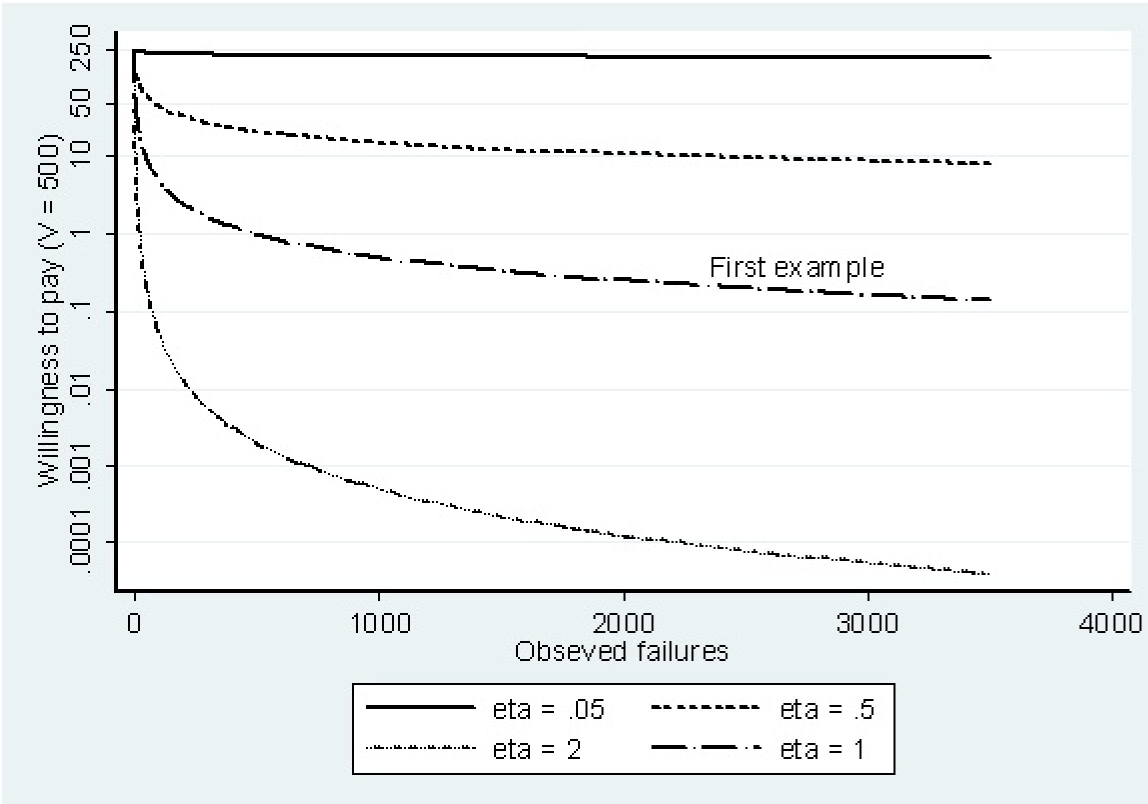


Figure 2. Willingness to Pay and the Elasticity of Demand with Respect to Product Failures

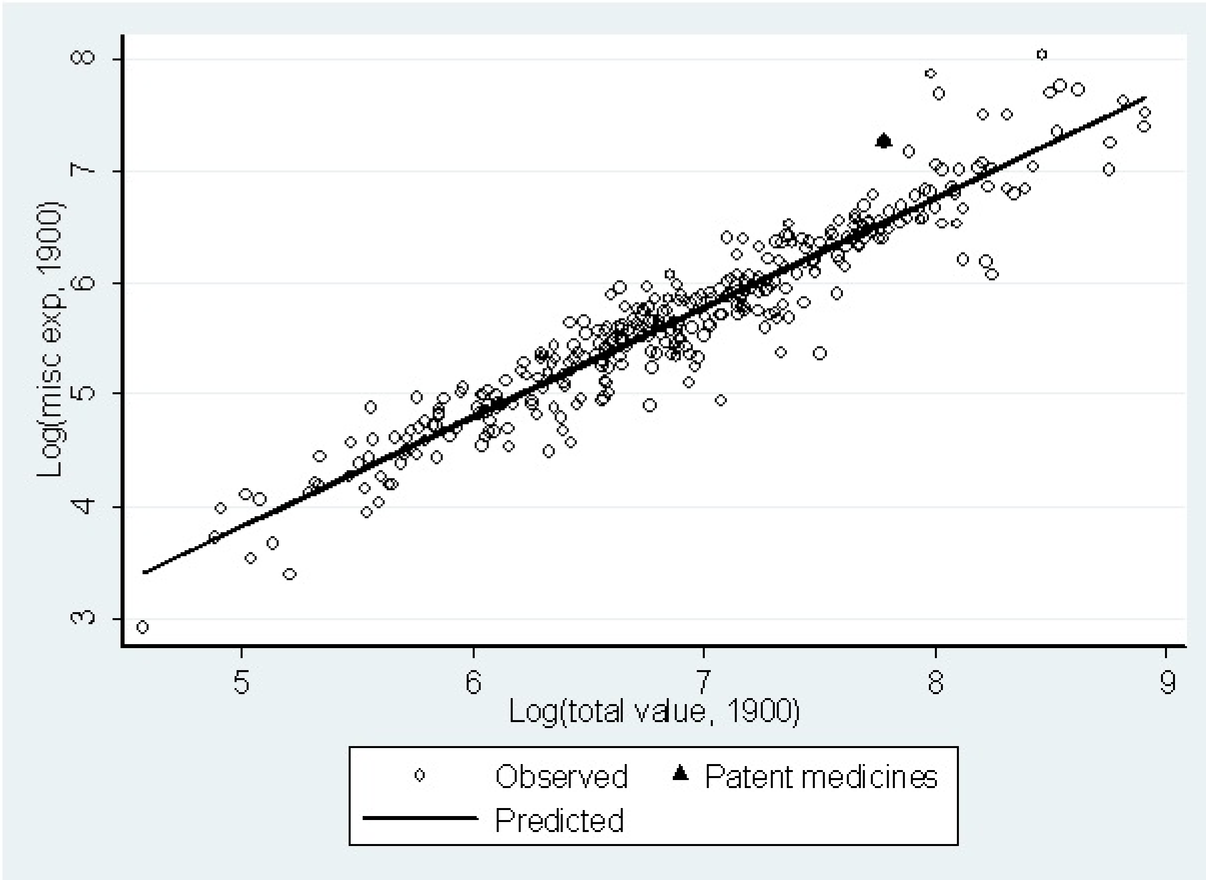


Figure 3. Advertising Expenditures and Market Value of Industry Output

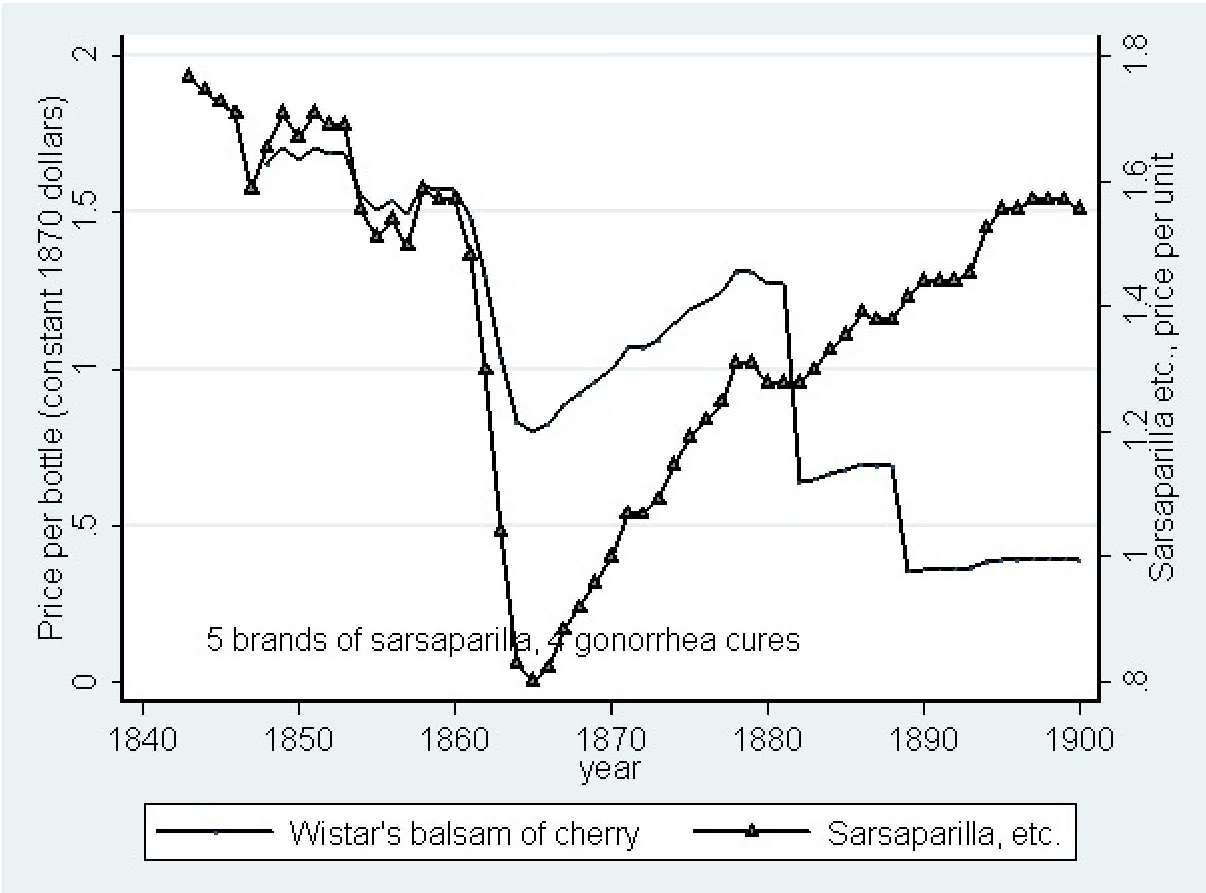


Figure 4. Prices of Patent Medicines

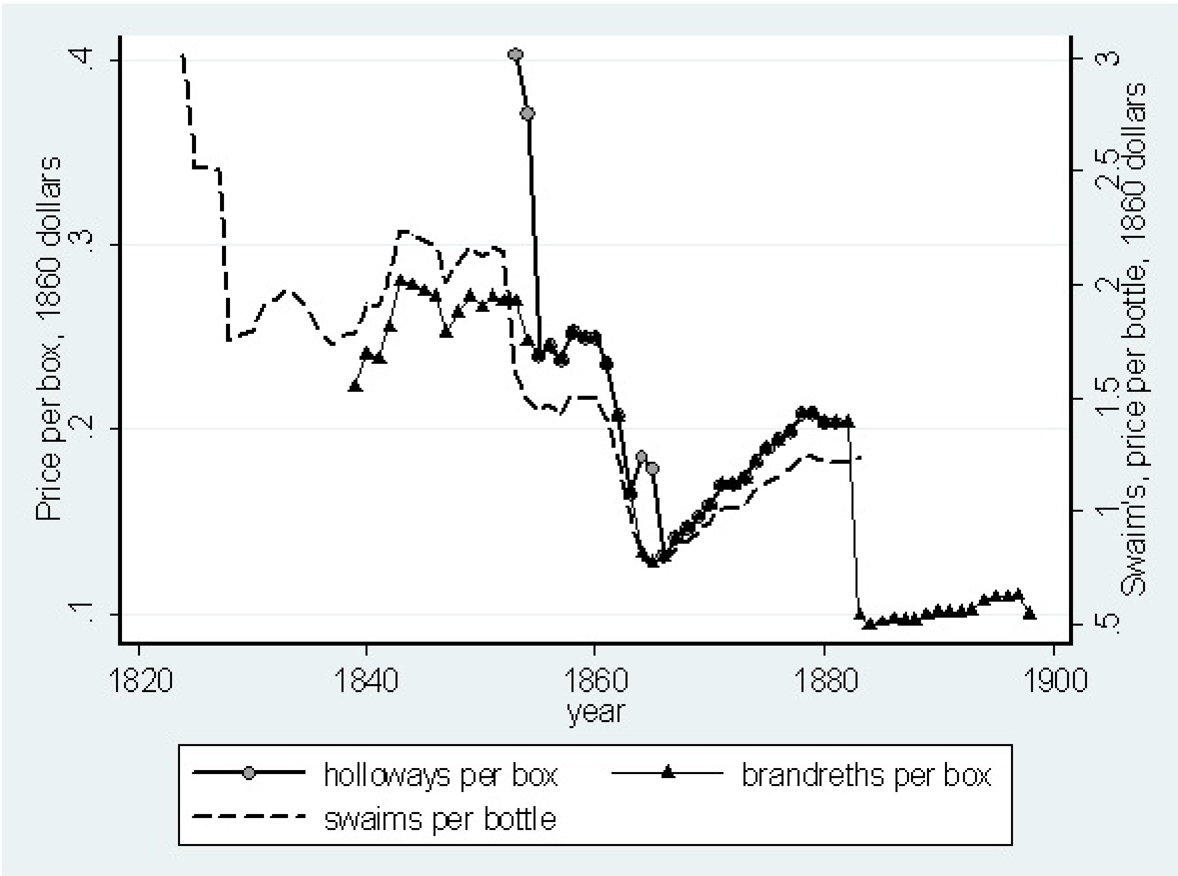
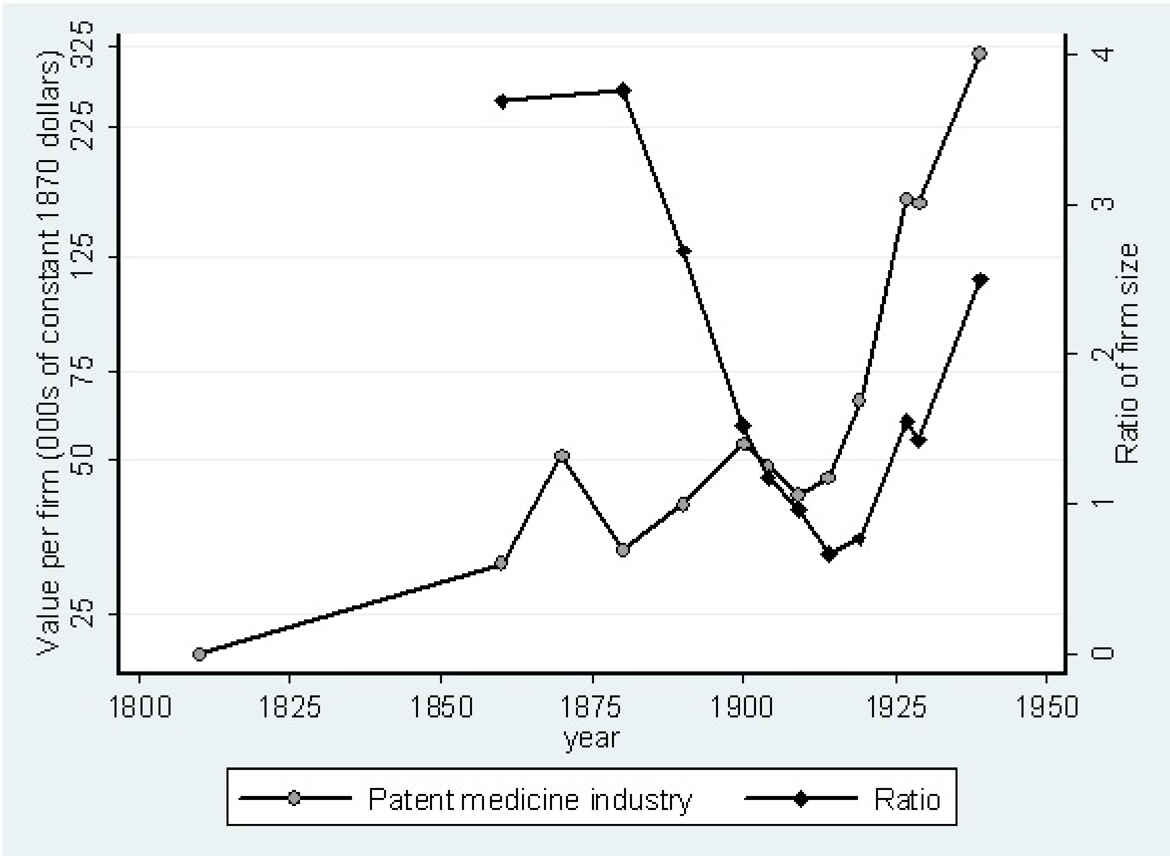


Figure 5. Prices of More Patent Medicines



Value per firm (000s of constant 1870 dollars)
325
225
125
75
50
25
4
3
2
1
0
Ratio of firm size
1800
1825
1850
1875
1900
1925
1950
year
Patent medicine industry
Ratio

Figure 6

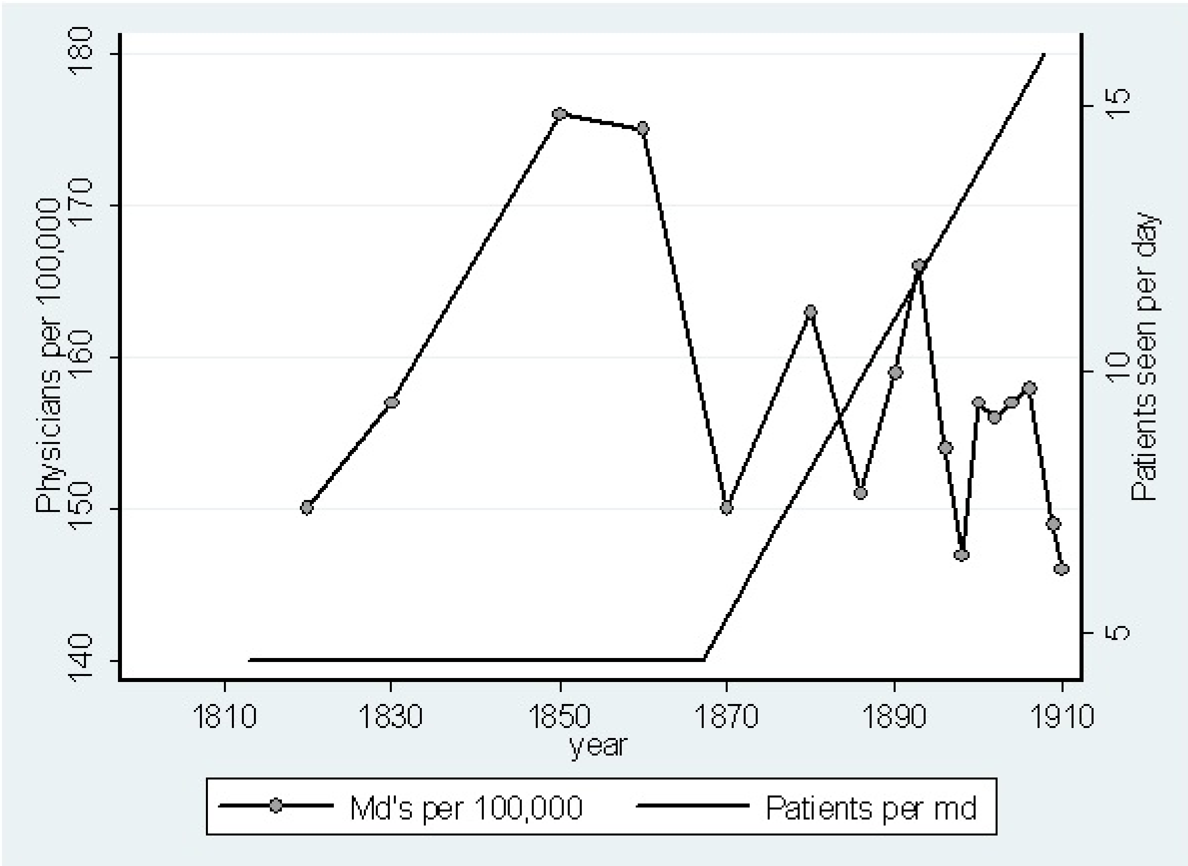
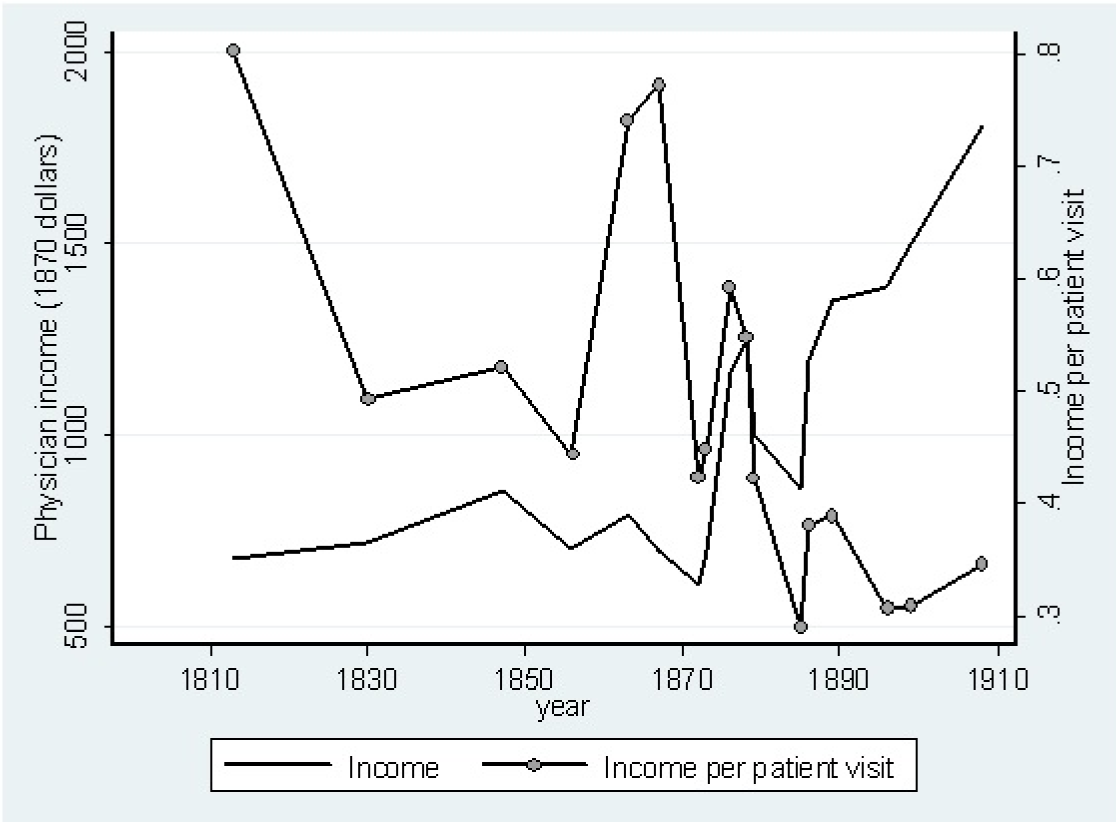

Physicians per 100,000
140
150
160
170
180
Patients seen per day
5
10
15
1810
1830
1850
1870
1890
1910
year
Md's per 100,000
Patients per md

Figure 7



Physician income (1870 dollars)
500
1000
1500
2000
Income per patient visit
.3
.4
.5
.6
.7
.8
1810
1830
1850
1870
1890
1910
year
Income
Income per patient visit

Figure 8

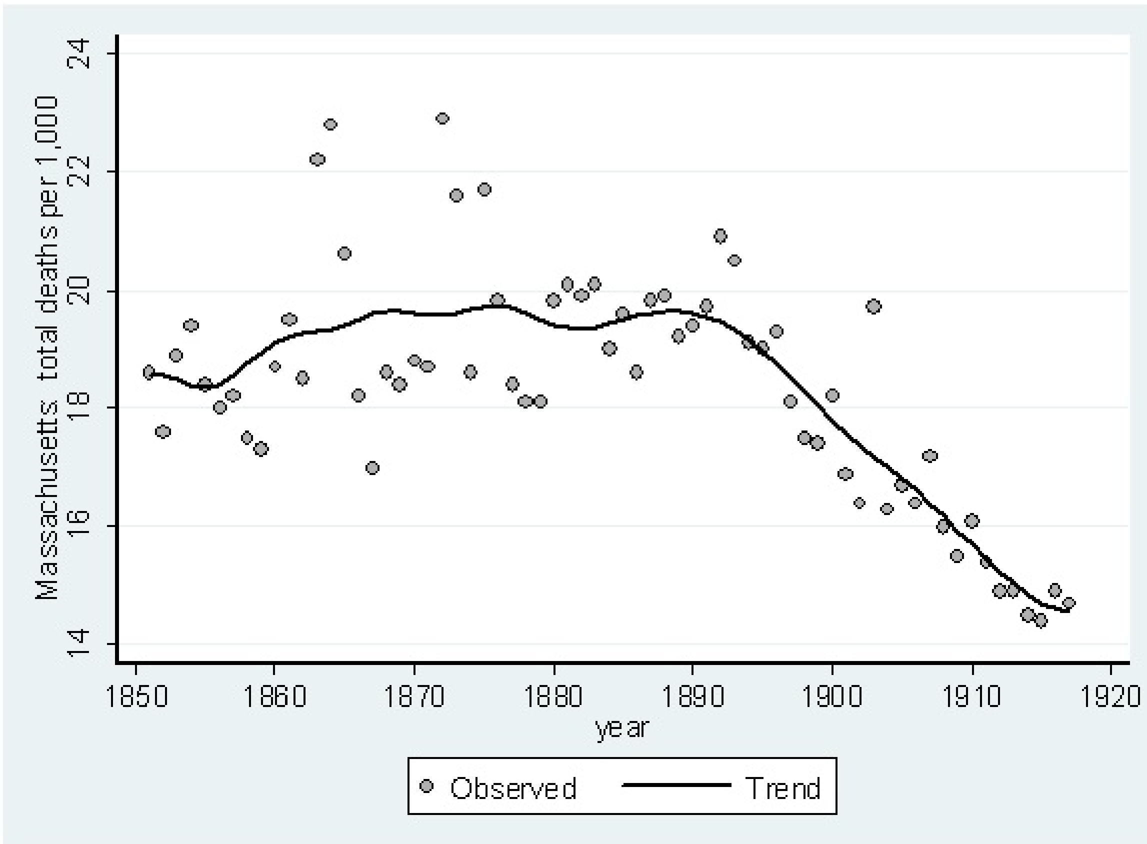

Massachusetts total deaths per 1,000
24
22
20
18
16
14
1850
1860
1870
1880
1890
1900
1910
1920
year
Observed
Trend

Figure 9

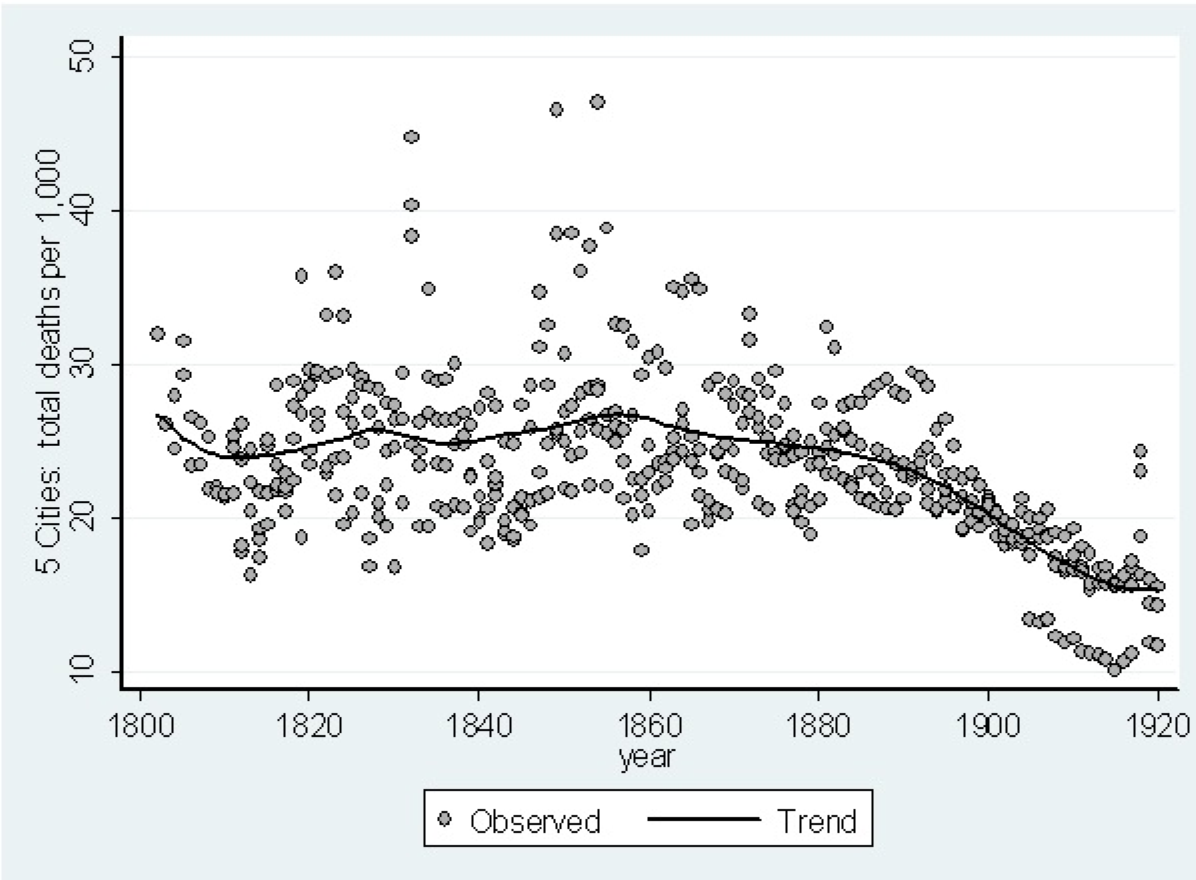

5 Cities: total deaths per 1,000
10
20
30
40
50
1800
1820
1840
1860
1880
1900
1920
year
Observed
Trend

Figure 10

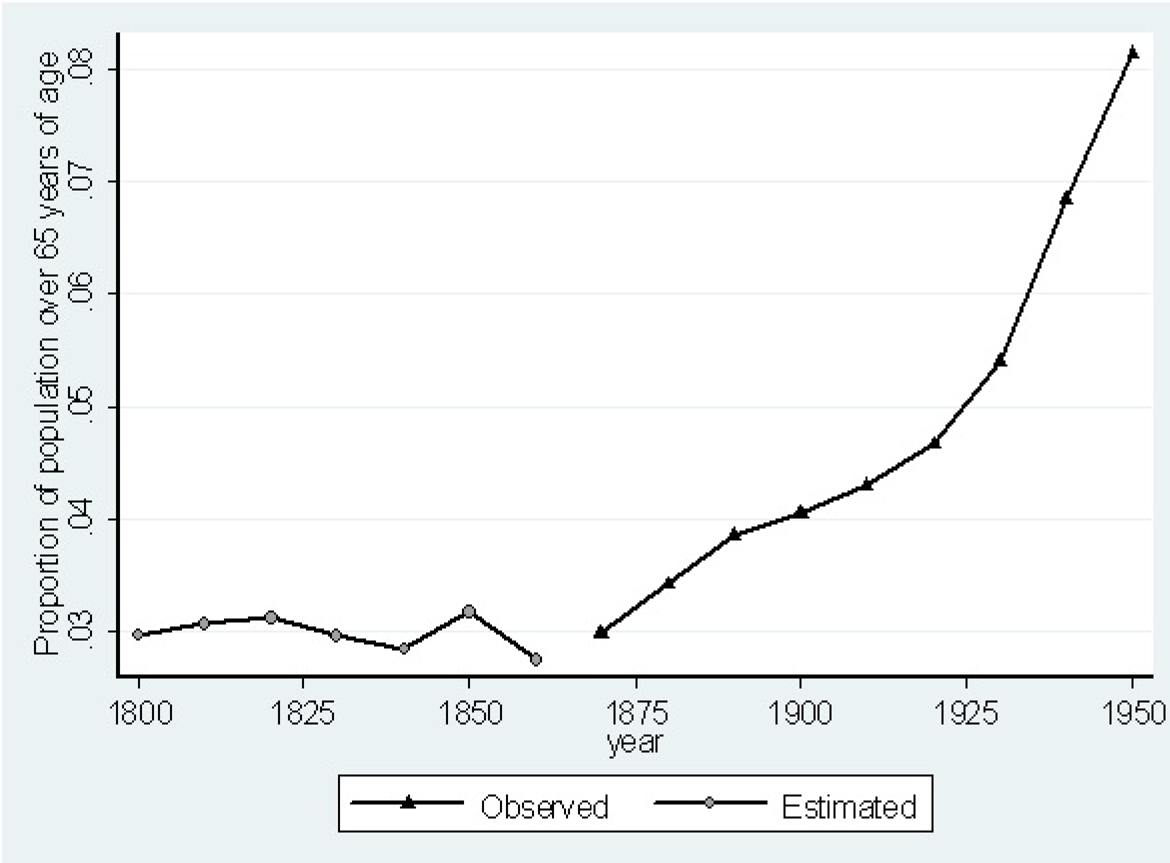

Proportion of population over 65 years of age
.03
.04
.05
.06
.07
.08
1800
1825
1850
1875
1900
1925
1950
year
Observed
Estimated

Figure 11