

NBER WORKING PAPER SERIES

THE WELFARE COST OF AUTARKY:  
EVIDENCE FROM THE JEFFERSONIAN TRADE EMBARGO, 1807-1809

Douglas A. Irwin

Working Paper 8692  
<http://www.nber.org/papers/w8692>

NATIONAL BUREAU OF ECONOMIC RESEARCH  
1050 Massachusetts Avenue  
Cambridge, MA 02138  
December 2001

I wish to thank Earl Grinols, Arvind Panagariya, and seminar participants at Clark and Princeton for helpful comments. The National Science Foundation provided partial research support. The views expressed herein are those of the authors and not necessarily those of the National Bureau of Economic Research.

© 2001 by Douglas A. Irwin. All rights reserved. Short sections of text, not to exceed two paragraphs, may be quoted without explicit permission provided that full credit, including © notice, is given to the source.

The Welfare Cost of Autarky:

Evidence from the Jeffersonian Trade Embargo, 1807-1809

Douglas A. Irwin

NBER Working Paper No. 8692

December 2001

JEL No. F1, N7

## ABSTRACT

The United States came close to complete autarky in 1808 as a result of a self-imposed embargo on international shipping from December 1807 to March 1809. Monthly prices of exported and imported goods reveal the embargo's striking effect on commodity markets and allow a calculation of its welfare effects. A simple general equilibrium calculation suggests that the embargo cost about 8 percent of America's 1807 GNP, at a time when the trade share was about 13 percent (domestic exports and shipping earnings). The welfare cost was lower than the trade share because the embargo did not completely eliminate trade and because domestic producers successfully shifted production toward previously imported manufactured goods.

Douglas A. Irwin

Department of Economics

Dartmouth College

Hanover, NH 03755

and NBER

[douglas.irwin@dartmouth.edu](mailto:douglas.irwin@dartmouth.edu)

## **The Welfare Cost of Autarky: Evidence from the Jeffersonian Trade Embargo, 1807-1809**

### **1. Introduction**

In theory, the gains from international trade are represented by comparing welfare at the free trade equilibrium with welfare at the autarky equilibrium. In practice, such a comparison is almost never feasible because the autarky equilibrium is almost never observed, except in unique cases. One such case is Japan's dramatic opening to the world economy in the 1850s, in which domestic and world prices on comparable commodities exist for the period of Japanese autarky and later free trade.<sup>1</sup> Another exceptional instance is the United States during the period from December 1807 to March 1809, when Congress imposed a nearly complete embargo on international commerce at the request of President Thomas Jefferson. Unlike many trade embargos, this one almost completely eliminated trade and was not compromised by widespread smuggling.

The Jeffersonian trade embargo provides a rare opportunity – a “natural experiment” if you will – to observe the effects of a nearly complete (albeit short-lived) elimination of international trade. The main objective of this paper is to investigate the impact of the embargo on the U.S. economy, such as its effect on the prices of traded goods and the degree of import substitution, as well as provide a rough calculation of its welfare cost. Section 2 provides some historical background on the embargo and describes its effect on trade. Section 3 sets out the simple general equilibrium framework for evaluating the welfare effects of the embargo and describes the data used to provide an estimate of the overall cost of approaching autarky. The

---

<sup>1</sup> See Huber (1971) and Bernhofen and Brown (2000).

results suggest that the welfare cost of the embargo was about 5 percent of GNP in 1807, a time when the ratio of exports to GNP was about 13 percent. Along with the embargo's immediate failure to achieve its objective of softening Britain's policies toward neutral shipping, the high economic cost of the measure helped persuade Congress to repeal it in March 1809, just fourteen months after its imposition. Section 4 concludes the paper.

## **2. Historical Background**

The first decade of the nineteenth century was marred by near constant military conflict between Britain and France in the Napoleonic Wars. As part of the war, Britain sought to blockade the continent and to enforce this blockade by stopping the shipping of neutral countries, especially the United States. The British navy patrolled the eastern U.S. coast and regularly intercepted American vessels, conducted searches and seizures, confiscated ships, cargo, and other property, and even impressed sailors (said to be British subjects) who were evading military service. (France engaged in similar activities, but less intensely than Britain.) American frustration over these actions steadily grew over time, but the United States had few alternatives to deal with the situation. The main options were continued submission to the British actions, declaring war on Britain in an attempt to force them to respect American shipping, or enacting an embargo to safeguard American property and impose an economic penalty on Britain.<sup>2</sup>

After several provocations by Britain, the Jefferson administration opted for an embargo, not only to protect domestic vessels and sailors from possible seizure, but to inflict economic

---

<sup>2</sup> For background, see Hickey (1981).

costs on Britain in the hope of forcing them to change their policy. In December 1807, President Jefferson requested that Congress enact a general embargo, and Congress quickly prohibited all American ships from sailing to foreign ports and foreign ships from taking on any cargo in the United States.<sup>3</sup> Almost all accounts of the embargo considered it to have been effective, at least initially. Very few American vessels appeared in European ports in 1808. Figure 1 presents the tonnage of American ships entering into British ports during the period from 1801 to 1810. While the tonnage entering in 1808 is not zero, that volume fell 80 percent from the previous year.

According to Heaton (1941, p. 189), there was “little effort to indulge in large-scale defiance of the Embargo, at least until the end of 1808, when patience was becoming exhausted and repeal seemed inevitable.”<sup>4</sup> Although the data underlying Figure 1 are not available on a monthly basis, the American tonnage entering Britain is likely to have been concentrated late in 1808. Late in that year, frustration with the embargo was high, its termination was widely anticipated, and merchants were increasingly tempted to ignore it. After carefully comparing U.S. and British price data and considering other quantity measures of direct and indirect trade

---

<sup>3</sup> Although foreign ships were permitted to bring goods to the United States, few did so during the embargo because they would have had to return empty. In addition, the non-intercourse law prohibited the importation of many British manufactured goods.

<sup>4</sup> “The ships and brigs which carried on the greater part of the transatlantic trade were in general tied up in obedience to the Embargo, or they went down the coast to load goods in readiness for the day when the light would change from red to green, and then returned to anchorage in their home ports. . . . So far as the western hemisphere was concerned, smuggling and embargo-breaking could not be prevented; but against Europe the Embargo was largely effective. And if American ships did not go to Europe, British goods could not be brought back in them.” Heaton (1941), p. 189. Virtually all of U.S. imports from Britain arrived on American vessels during this era.

between the two countries, Frankel (1982, p. 308) concludes that, although smuggling existed, it was small: “the Embargo was well-enforced, so each country [the United States and Great Britain] was reduced practically to autarky vis-a-vis the other.” There are many reports of smuggling activity across Lake Champlain into Canada, but it is not believed that the volume of such traffic was very significant.

The highly controversial embargo was in effect for just fourteen months. Growing domestic opposition to the trade restrictions, particularly in New England, forced Congress to repeal the measure in March 1809.<sup>5</sup> The consensus among historians is that the embargo failed to achieve its objective because Britain and France refused to change their policies regarding American shipping. This was not due to the failure to eliminate trade, but the failure of the trade measures to weaken the political resolve in Britain to suppress neutral shipping in its effort to strangle the French economy.<sup>6</sup>

Although it did not completely eliminate U.S. trade, the embargo succeeded in having a dramatic effect on commerce. Figure 2 shows the value of total U.S. merchandise trade (merchandise exports of domestic produce plus re-exports, and imports) from 1800 to 1815. Table 1 presents more detailed trade data for the years around 1807. The value of merchandise exports of domestic produce fell from \$49 million in 1807 to \$9 million in 1808, a decline of

---

<sup>5</sup> The embargo was replaced by non-intercourse act that continued to prohibit trade with Britain, France, and their colonies and dependencies. Over the next four years, through the War of 1812 until the Treaty of Ghent in 1813, trade was subject to varying degrees of formal restriction, but none as draconian as the earlier embargo.

<sup>6</sup> However, a later non-importation measure in 1811 coincided with an economic downturn in Britain and apparently contributed to the British decision to lift some of its draconian measures regarding American shipping. See Irwin (2002).

over 80 percent. Net shipping earnings fell considerably less, by 45 percent, such that total export earnings dropped 64 percent. Meanwhile, the value of imports for domestic consumption fell from \$85 million in 1807 to \$45 million in 1808, a decline of nearly 50 percent. These figures understate the impact of the embargo, however, because the government's trade statistics were collected for the fiscal year, not for the calendar year. Therefore, the figures for 1808 refer to the period from October 1, 1807 to September 30, 1808, and thus include three months in which the embargo was not in effect.

Exports fell more sharply than imports in 1808 because of the timing of the embargo and its effect on trans-Atlantic shipping (Heaton 1941, p. 190). After December 1807, no American ship was allowed to leave the United States for a foreign destination. However, many American vessels were then in British ports, where they would typically spend the winter months. To encourage these ships to return home, Congress allowed merchants to bring into the country previously purchased foreign goods. Thus, American ships returning from Europe in the spring and summer of 1808 were permitted to unload their cargoes, but were not then permitted to return to Europe. (Most ships involved in the trans-Atlantic trade made two round trips during the sailing season.) As a result, exports fell immediately upon the imposition of the embargo (because there could be no spring exports) and remained low throughout the year. By late 1808 and early 1809, as disregard for the embargo increased, some ships left U.S. ports in violation of the law. On the other hand, imports did not fall as much because of the spring and summer ship arrivals from Europe. But after that, few ships with foreign cargo arrived in the United States.

The embargo had a dramatic impact on prices in the United States, driving down the domestic prices of exported goods and driving up the domestic prices of imported goods. Figure

3 presents the domestic prices of the four leading U.S. commodity exports on a monthly basis from 1807 through 1809. Together, these four commodities – raw cotton, flour, tobacco, and rice – accounted for about two-thirds of U.S. exports of domestic produce in 1807. Their prices fell sharply in early 1808, consistent with the previous discussion of how the embargo affected exports immediately by prohibiting American ships from departing for foreign ports. The export-weighted average of the domestic prices of these commodities fell by about 27 percent between December 1807 to June 1808.<sup>7</sup> Prices bottomed out in the summer of 1808 and even began to recover toward the end of the year. This is consistent with the evidence that merchants were willing to violate the embargo as time went on.

Unlike exports, U.S. imports were highly diversified and were not concentrated in just a few key commodities. Figure 4 presents two price indexes for imported commodities in Boston and Philadelphia during this period. Both indexes show that prices of imported goods failed to rise in the spring of 1808, probably because imports continued to arrive in the port cities. Prices began to shoot up by the fall of 1808, as the number of ships entering U.S. ports fell to a trickle and imports became increasingly scarce. The price of imported commodities rose by about a third as a result of the embargo: the index of wholesale prices rose 33.9 percent in Boston and 31.1 percent in Philadelphia between December 1807 and March 1809.<sup>8</sup> Prices peaked around the time the embargo was lifted in early 1809, and fell rapidly once trade was resumed.

---

<sup>7</sup> The price data are in Cole (1938). The weights are 43 percent for cotton, 33 percent for flour, 17 percent for tobacco, and 7 percent for rice, and come from Pitkin (1816).

<sup>8</sup> In Philadelphia, “The peak of prices for imported commodities occurred in March 1809, the month the embargo was repealed. At the time the index for imported commodities was 34.4 percent above the low of July 1807.” Bezanson, Gray, and Hussey (1936), p. 143.

In terms of its effect on import and export prices, therefore, the embargo was roughly equivalent to at least a 60 percent import tariff, perhaps larger if the United States was not a small country and could affect world prices. Although it did not reach the point of complete autarky as a result of the embargo, the United States was by mid- to late-1808 about as close to being fully shut off from international commerce as it has ever been in its history.<sup>9</sup> How much of the gains from trade were sacrificed in this policy action?

### 3. Assessing the Gains from Trade

This section sets out the simple general equilibrium framework that will be used to calculate the welfare cost of the Jeffersonian trade embargo. The gains from trade can be represented by the difference in the utility level associated with the free trade consumption bundle and the utility level associated with the autarky production bundle. Following Grinols and Wong (1991), the compensating variation change in welfare from an initial trading situation (subscripted 0) to another (subscripted 1) can be expressed using the expenditure function:

$$(1) \quad W = e(p_1, u_1) - e(p_0, u_0).$$

By the definition of the expenditure function,

$$(2) \quad e(p_1, u_1) / p_1 \cdot \mathbf{x}_1 = p_1 \cdot \mathbf{y}_1 + (p_1 - p_1^*) \cdot \mathbf{B}_1 + B_1,$$

where  $x$  is the vector of consumption,  $y$  is the vector of production,  $m$  is the vector of trade ( $m_i / x_i - y_i$ , such that imports are positive and exports are negative),  $p$  is the vector of domestic prices,

---

<sup>9</sup> Figure 1 shows that the value of trade was lower in 1814 than in 1808, but this was due as much to the war with Britain as to any formal policy measure. The calculations below will focus on the shock between 1807 and 1808, two adjacent years in which the effects of policy can be most clearly identified.

$p^*$  is the vector of world prices,  $B$  is any net transfers or borrowing from foreigners, and ‘@’ denotes the inner product. Equation (2) states that the value of consumption is equal to the value of production plus tariff revenue -- represented by  $(p_1 - p_1^*)@n_1$  -- plus transfers. As Grinols and Wong show, the change in welfare can be rewritten as:

$$(3) \quad W = (p_1 - p_1^*)@n_1 - m_0 + (p_1^* - p_0^*)@m_0 + (B_1 - B_0) + s_C + s_P,$$

where the terms  $s_C$  and  $s_P$  represent the substitution effects in consumption and production as a result of the change in relative prices. Specifically,  $s_C = p_1 @_0 - e(p_1, u_0)$  and  $s_P = p_1 @_y_1 - y_0$ , and these substitution effects are non-negative ( $s_C \geq 0$ ,  $s_P \geq 0$ ) if price-taking consumers optimize subject to a budget constraint and price-taking producers maximize profits. Equation (3) can also be rewritten in terms of domestic prices as:

$$(4) \quad W = (p_1 - p_1^*)@n_1 + p_1 @_m_0 + B_1 + s_C + s_P.$$

In the case where there are no international transfers and where the embargo is completely effective (such that  $m_1$  is zero and the country is in autarky), this expression simplifies to three terms:  $p_1 @_m_0$ ,  $s_C$ , and  $s_P$ . Figure 5 illustrates these three components graphically. The free trade situation consists of production at the point where the initial relative price line  $p_0$  is tangent to the production possibility frontier, and consumption at the point where  $p_0$  is tangent to the indifference curve  $U_0$ . If all trade is eliminated, domestic prices become  $p_1$ , where the utility level  $U_1$  is tangent to the production possibility frontier. The compensating variation welfare cost of eliminating trade and moving to autarky is represented by the distance between the indifference curves  $U_0 - U_1$ , evaluated at domestic prices  $p_1$ .

Thus, the change in welfare is equal to the distance  $BC$ , i.e.,  $W = BC$ . This can be decomposed as  $BC = AD - AB - CD$ , where  $AD$  represents the value  $p_1 @_n_0$ ,  $AB$  is  $p_1 @_y_0 - e(p_1, u_0)$

=  $s_C$ , and CD is  $p_1 @ y_1 - y_0) = s_P$ . In other words, AD is the value of the previous volume of trade at autarky prices, AB is the substitution in consumption and CD is the substitution in production as a result of the change in relative prices. AD represents  $p_1 @ n_0$  because DE is the value of previous exports at autarky prices and AE is the value of previous imports at autarky prices, so that  $AE - DE = AD$  (since by definition imports are positive and exports are negative).

Equation (4) is a general formulation for a change in welfare and does not assume that all trade is eliminated. In principle, each component of the equation can be calculated. In the present case, the subscript 0 will refer to the pre-embargo (1807) situation and the subscript 1 will refer to the embargo (1808) period. Although data on U.S. trade in the early nineteenth century is scanty, let alone data on production and consumption, sufficient data exists to generate an approximate calculation of most components of equation (4). The calculation of each component deserves some discussion.

AD:  $-p_1 @ n_0$

This is the most readily calculated component of the welfare change. We observe  $p_0 @ n_0$ , which is simply the value of trade in 1807. The initial price vector is normalized to unity, such that  $p_0 = (1, 1, 1, 1)$  and  $m_0 = (-48.7, -42.1, 34.0, 51.1)$ , where the vector elements are exports of domestic produce, shipping earnings, imports for consumption paying ad valorem duties, and imports for consumption paying specific duties. (This distinction among imports will be important for reasons that will become clear in the next calculation.) Re-exports have been excluded from the calculation because the gains that accrued to the United States from such trade is reflected solely in shipping earnings.

In the vector  $m_0$ , the values for domestic exports and shipping earnings are taken straight

from Table 1. This table also presents the value of imports for consumption, but government statistics only report the breakdown between ad valorem and specific duties for total imports, not imports for consumption. The difference between total imports and imports for domestic consumption is goods that were re-exported. The working assumption will be that imports for consumption are divided in the same proportion as total imports between those subject to specific duties (40 percent) and ad valorem duties (60 percent). It might be supposed that imports subsequently re-exported consisted mainly of commodities from the West Indies (such as sugar, coffee, etc.) that were subject to specific duties (and then rebated upon re-exportation), but Pitkin (1816) indicates that re-exports also consisted of manufactures from Britain.<sup>10</sup>

As previously noted, the domestic price of imported commodities rose about 33 percent as a result of the embargo, and the domestic price of exported goods fell 27 percent. There is little data available on domestic shipping rates between 1807 and 1808, although as Table 1 indicates shipping receipts fell less than domestic exports between 1807 and 1808.<sup>11</sup> Therefore, in the absence of better information, the maintained assumption will be that the price of shipping

---

<sup>10</sup> “The valuable articles of colonial produce, such as sugar, coffee, spirits, cocoa, pimento, indigo, pepper and spices of all kinds, were carried, either directly to Europe, or were first brought to the United States, and from thence exported in American vessels. . . . The manufactures of Europe, and particularly of Great Britain, as well as the manufactures and produce of the East-Indies and China, have also been imported, and again exported, in large quantities, to the West-Indies, to the Spanish Colonies in South America, and elsewhere. This trade, which has been called the carrying trade, has, in some years, exceeded in value the trade of the United States, in articles of domestic produce.” Pitkin (1816), p. 136.

<sup>11</sup> International shipping rates rose during the embargo, due to the added risk of undertaking a voyage. But the relevant data would be the price of domestic shipping services, which presumably fell during the embargo. Pitkin (1816, p. 391) reports that tonnage engaged in the domestic costal trade rose 23 percent in 1808 from the previous year, as ships normally used for overseas trade were transferred to local trade.

services fell the same 27 percent as domestic exports.

Thus, the embargo price vector is  $p_1 = (0.73, 0.73, 1.33, 1.33)$ . The calculated value of  $p_1 \cdot \mathbf{y}_0$ , which is also the estimated distance AD, is therefore \$47 million.

$$CD: s_P = p_1 \cdot \mathbf{y}_0 - y_0$$

This component is somewhat more difficult to estimate. This measures the shift along the domestic production possibilities frontier – producing more of the goods previously imported and producing less of the goods previously exported – as a result of the change in domestic relative prices.

The scope for producers in the United States to start or to increase domestic production of previously imported goods (import substitution) depends upon the type of imported good. The ability of domestic firms to commence or increase production of manufactured goods, such as cotton goods, glass, and iron, as a substitute for imports was quite substantial. Conversely, nearly half of imports consisted of consumption items such as sugar, coffee, tea, spices, wine and spirits, goods in which East Coast producers could not easily initiate production.

Unfortunately, unlike the export statistics, the import statistics of this period do not completely enumerate the types of goods imported, but they can help establish the general range of potential import substitution by domestic producers. Imports subject to specific duties are individually specified and consisted almost exclusively of the consumption goods mentioned above (sugar, coffee, tea, wine, etc.) that domestic producers would have difficulty replicating. All other imports paying ad valorem duties were not separately recorded, but included (among other items) manufactured goods, where the possibility of import substitution was presumably

high. As previously noted, about 40 percent of imports were subject to ad valorem duties.

How much import substitution took place? Not much was possible, given the short duration of the embargo; over a longer horizon, domestic producers would have been able to establish much higher levels of output of previously imported goods. That said, the stimulus of the embargo to domestic manufacturers (particularly around Philadelphia) was widely and favorably noted at the time. The city of Philadelphia apparently did well during the embargo, not just because income lost by merchants was shifted partly to lawyers (who benefitted from the proliferation of maritime-related law suits) but because manufacturing production expanded in such goods as carpets, cloth (from bedspreads to stockings), earthenware, glass, soap, lead and shot, and chemicals (Sears 1921). As Frankel (1982, p. 301) notes, "There is historical evidence that Americans were remarkably successful in 1808 at switching into the production of manufactured goods when they were cut off from their usual source of supply." Sokoloff (1988) reports a wave of patent activity coinciding with the embargo.

Other evidence suggests that domestic manufacturers elsewhere did not necessarily prosper during the short period in which the embargo was in effect. The records of textile manufacturers in New England indicates that they suffered considerably with the sudden collapse of trade. According to Ware (1926, pp. 672, 677), these findings tend "to destroy the theory that it was the embargo which, by cutting off foreign competition and throwing out of employment labor and capital, gave the impetus and protection to the American industry which enabled it to become firmly established. . . . By striking at the prosperity of the commercial elements of the New England coast towns, it destroyed the purchasing power of the cotton manufacturers' chief market."

Perhaps the most direct piece of evidence is from the Davis (2002) series on U.S. industrial production during this period. Davis's overall industrial production index actually collapsed in 1808, falling 17 percent from 1807. However, the collapse was entirely due to the fall in production by commercial and trade-dependent industries (such as merchant shipbuilding, flour refining, fish curing, etc.) with virtually no change in the output of domestic infant industries competing against imports (such as cotton and wool cloth production, etc.).<sup>12</sup> Although this suggests that there was little immediate import substitution by domestic manufacturers, the index fails to capture any increase in output from small producers, such as local blacksmiths and glass blowers, household textile manufacturers, etc.

Thus, information on production substitution is incomplete and the existing evidence is mixed. In terms of calculating the value of production substitution, one extreme assumption is that the United States could replace one-for-one the quantity of the previously imported manufactured goods (i.e., imports subject to ad valorem duties) with domestic production of those goods at the higher autarky prices. We also assume that domestic producers would not be able to produce any imported goods subject to specific duties, including such commodities as sugar, coffee, tea, wine, etc. Symmetrically, domestic production of the exportable goods and shipping services would be assumed to fall one-for-one with the decline in the exports of those items. In this one-for-one replacement case, then  $(y_1 - y_0) = (m_1 - m_0)$  with the non-ad valorem imports zeroed out. Because  $m_1 = (-9.4/0.73, -23.0/0.73, 16.0/1.33, 29.1/1.33)$ , or  $(-12.9, -31.5, 12.0, 21.9)$ , then  $m_1 - m_0 = (35.8, 10.6, -22.0, -29.2)$  and therefore  $(y_1 - y_0) = (35.8, 10.6, -22.0, 0)$ . Then the net gain from the production shift is  $p_1 A(m_1 - m_0) = \$4.7$  million.

---

<sup>12</sup> See Irwin (2002), Figure 5.

This one-for-one replacement assumption is extreme for assuming that domestic production of manufactures could substitute perfectly for imports, and that domestic production of exportables would fall as much as exports declined. An alternative assumption is that domestic producers could only produce half of the quantity of goods previously imported, and were forced to reduce by half their production of goods previously exported. In this case,  $(y_1 - y_0) = 0.5A(m_1 - m_0) = (17.9, 0, 5.3, -20.2, 0)$ , and the net gain from the production shift is  $p_1 A(m_1 - m_0) = \$2.3$  million. This case will be the central assumption, although the bounds on the welfare cost will be explored using both full replacement and zero (substitution) replacement.

$$AB: s_C = p_I Q_0 - e(p_I, u_0)$$

The absence of any consumption data make any estimate of the consumption substitution virtually impossible. The scope for consumption substitution was probably small: it is unlikely that domestic consumption of flour and tobacco would increase significantly because their prices had fallen – and the prices of manufactures increased – due to the embargo. It seems plausible to assume that the scope for substitution in consumption is less than the scope for substitution in production, which means that it would take a value of something less than \$5 million. As an initial guess, we will take the value of \$2.3 million, the same value as the substitution assumed to be achieved by domestic producers.

Alternatively, we can crudely simulate the value of consumption substitution with a simple Cobb-Douglas utility function in which consumption is assumed to be 80 percent of GNP and the expenditure share on imported manufactures is 30 percent. Under Cobb-Douglas, the elasticity of substitution is one, a higher value than is commonly used in computable general

equilibrium models. This gives us an upper bound estimate on consumption substitution. In this case, the change in relative prices brings about consumption substitution valued at \$3.2 million.

### *Other Components*

The last two components of equation (4) are tariff revenue and net transfers in period 1. Tariff revenue -- expressed as  $(p_1 - p_1^*)@n_1$  -- is not zero because some imports were allowed into the country in early 1808. The government reported tariff revenue to be \$7.7 million in 1808, as noted on Table 1.<sup>13</sup> Net transfers ( $B_1$ ) is derived from the constraint in equation (2):  $p_1(y_1 - x_1) + (p_1 - p_1^*)@n_1 + B_1 = 0$ . Solving for  $B_1$  in the year 1808 yields the figure of \$1.5 million. This helps correct for any distortion of the magnitude of the previous calculations due to imbalanced trade.

Table 2 presents the combined estimates of these various components of the welfare cost. Column (1) presents the benchmark case using the figures calculated above. The components sum to \$33 million dollars. This welfare cost may be more usefully expressed as a percent of GNP. Gallman (2000, p. 7) reports a figure of \$680 million for nominal GNP in 1807, which is somewhat higher than other estimates but otherwise seems reasonable.<sup>14</sup> Taking this figure as a rough benchmark, the welfare cost of the embargo was about 5 percent of GNP.

---

<sup>13</sup> Recall as well that the customs figure for 1808 refer to October 1807 to September 1808 and cover a period when there was no embargo and when imports were still allowed in despite the embargo. The figure for 1809 (October 1808 to September 1809) cover six months when the embargo was effective.

<sup>14</sup> Berry (1988) estimates that nominal GNP was \$561 million in 1807. Contemporaries put the number much lower, as Niles has a 1814 estimate of \$642 for 1814 and Beaujour has an estimate of \$197 to \$350 million for the period 1800 to 1810.

What is a plausible range for this welfare cost? The first component ( $p_1 m_0$ ) is a best guess and does not change; this also applies to tariff revenue and to  $B_1$ . The production and substitution components are subject to greater uncertainty. Columns (2) and (3) present lower and upper bound calculation based on assumptions about substitution. Column (2) presents a lower bound calculation in which domestic manufacturers can fully produce what was previously imported and domestic farmers fully reduce production by the amount that exports decline. This increases  $s_p$  from \$2.3 to \$4.7 million, decreasing the welfare cost to \$28 million, or 4 percent of GNP. Columns (3) an alternative, higher bound calculations on the magnitude of the welfare loss in which there is no production or consumption substitution at all. This increases the welfare cost to \$38 million, or 5.5 percent of GNP.

These alternative calculations provide some plausible bounds on the likely true welfare cost of the embargo. The welfare cost appears to be centered around 5 percent of GNP, but could be as low as 4 percent or as high as something closer to 6 percent. In 1807, merchandise exports and net shipping receipts were about 13 percent of GNP.

In two classic papers on the cost of protection, Johnson (1960, 1965) presents some different calculations that lend some support to these magnitudes. Johnson (1965) used a constant elasticity of substitution utility function and a general specification for the production transformation curve to arrive at the costs of self-sufficiency (autarky) in a computable two-sector general equilibrium model. In the case where the share of national income spent on importables under free trade is 0.20 and the elasticity of substitution in consumption between importables and exportables is 0.5, for example, then a tariff of 76 percent would be sufficient to induce autarky at a welfare loss of 5.2 percent of free trade utility level. If the elasticity of

substitution is 1.0, then the self-sufficiency tariff is 53 percent and the welfare loss is 4.0 percent. These figures are remarkably close to the actual findings in this paper. Given that the calculation is performed in a similar general equilibrium setting, perhaps this should not be too surprising.

Johnson (1960) also derived the commonly used partial equilibrium measure of the cost of protection as a percent of GDP as  $\frac{1}{2} " O (J/(1+J)^2$ , where " is the ratio of imports to GDP in the (initial) equilibrium, O is the absolute value of the arc elasticity of import demand, and J is the average ad valorem tariff rate. In the present case, the ratio of imports to GDP is approximately 0.13, and if we assume that the absolute value of the elasticity of import demand is 2 and that the tariff rate is 70 percent, then the cost of protection is 2.2 percent of GDP. As is commonly pointed out, this partial equilibrium formula yields relatively small figures for the cost of protection.

Thus, the massive disruption of trade caused by the embargo imposed a substantial one-year loss on the U.S. economy, one that was not just a small fraction of a percent of GNP. There is no doubt that 1808 was a difficult year for the U.S. economy. Berry's (1988) real GNP estimates fall 4.7 percent between 1807 and 1808. The year has been called a "depression" by Thorp (1926, p. 116), who gives it the following description: "rigid embargo causes paralysis on coast, gradually spreading inland; severe distress in New England; further sharp decline in commodity prices to low point, third quarter; foreign trade completely checked."

It is difficult to consider the policy of embargo a success, given the cost it imposed on the economy while failing to achieve its objective of changing British and French policy toward American shipping. One person who almost perfectly anticipated the results of the embargo was Alexander Hamilton, the first Secretary of the Treasury. Writing in 1794, Hamilton was

prescient about the potential impact of any trade embargo: “The consequences of so great and so sudden a disturbance of our Trade which must affect our exports as well as our Imports are not to be calculated. An excessive rise in the price of foreign commodities – a proportional decrease of price and demand for our own commodities – the derangement of our revenue and credit – these circumstances united may occasion the most dangerous dissatisfaction & disorders in the community and may drive the governt. to a disgraceful retreat – independent of foreign causes” (Syrett 1961, Vol. 16, p. 275).

Hamilton proved correct not just about trade and revenue effect of the embargo, but about the domestic disorder it caused and the eventual retreat of the government: New England grumbled about secession and the growing domestic discontent with the embargo, and the increasing willingness of merchants to violate it, led to its repeal without it having accomplished any change in British policy. The political opposition generated by the embargo can be illustrated by studying Congressional votes on the embargo. Table 3 shows the pattern of voting across regions on the imposition and retention of the embargo in the House of Representatives. The partisan division on the issue is readily apparent: Federalists completely opposed the measure, while the Jeffersonian Republicans initially supported it but later opposed it. The table shows that Republican support for the embargo was completely lost in New England and the Mid-Atlantic states. New England merchants were most vocal in opposing the embargo, while in the Mid-Atlantic the losses to merchants and the farming community (in terms of foregone income and lower land prices) surely exceeded the gains to those starting manufacturing establishments.

Given that the major export crops came from the South, one might have expected strong

opposition to the embargo in that region. Yet in the February 1809 vote, members from the South were evenly divided about whether to retain the embargo or not. Jennings (1921) notes several factors that may have muted Southern opposition to the embargo: the suspension of bankruptcy laws, the non-perishability of Southern crops, and the deep seated hatred of Great Britain. Despite these factors, there was little support in Congress for continuing the embargo in early 1809.

#### **4. Conclusions**

This paper has used the “natural experiment” of America’s trade embargo of 1807-1809 to calculate the total static losses from forgoing virtually all international trade. While the United States did not achieve complete autarky in 1808, it came as close to economic isolation as it ever has in its history. The best guess calculation of the static welfare cost of the embargo is about 5 percent of GNP. The cost does not represent the total gains from trade, however, because the initial trading equilibrium was one of restricted trade. Still, the embargo inflicted substantial costs on the economy while it was in effect.

## References

- Benzanson, Anne, Robert D. Gray, and Miriam Hussey. Wholesale Prices in Philadelphia, 1784-1861. Philadelphia: University of Pennsylvania Press, 1936.
- Bernhofen, Daniel M., and John C. Brown. "A Direct Test of the Theory of Comparative Advantage: The Case of Japan." Unpublished working paper, Clark University, June 2000.
- Berry, Thomas Senior. "Production and Population Since 1789, Revised GNP Series in Constant Dollars." Bostwick Papers No. 6. Richmond, VA: The Bostwick Press, 1988.
- Cole, Arthur H. Wholesale Commodity Prices in the United States, 1790-1861: Statistical Supplement. Cambridge: Harvard University Press, 1938.
- Davis, Joseph. H. "A Quantity-Based Annual Index of U.S. Industrial Production, 1790–1915." Unpublished working paper, Duke University, 2002.
- Frankel, Jeffrey A. "The 1807-1809 Embargo Against Great Britain." Journal of Economic History 42 (June 1982): 291-308.
- Gallman, Robert E. "Economic Growth and Structural Change in the Long Nineteenth Century." In Stanley L. Engerman and Robert E. Gallman (eds.), The Cambridge Economic History of the United States. Vol. II: The Long Nineteenth Century. New York: Cambridge University Press, 2000.
- Grinols, Earl L., and Kar-yiu Wong. "An Exact Measure of Welfare Change." Canadian Journal of Economics 24 (May 1991): 428-449.
- Heaton, Herbert. "Non-Importation, 1806-1812." Journal of Economic History 1 (November 1941): 178-198.
- Hickey, Donald R. "American Trade Restrictions during the War of 1812." Journal of American History 68 (December 1981): 517-538.
- Huber, J. Richard. "Effect on Prices of Japan's Entry into World Commerce after 1858." Journal of Political Economy 79 (May-June 1971): 614-628.
- Irwin, Douglas A. "The Early Trade Policy Experience of the United States, 1790-1815." Unpublished working paper, Dartmouth College, September 2002.
- Jennings, Walter W. The American Embargo, 1807-1809. University of Iowa Studies in the Social Sciences. Iowa City: University of Iowa, 1921.
- Johnson, Harry G. "The Cost of Protection and the Scientific Tariff." Journal of Political

Economy 68 (August 1960): 327-345.

Johnson, Harry G. "The Cost of Protection and Self-Sufficiency." Quarterly Journal of Economics 72 (August 1965): 356-372.

North, Douglass C. "The Balance of Payments of the United States, 1790-1860." In Trends in the American Economy in the Nineteenth Century. Studies in Income and Wealth, Vol. 24. Princeton: Princeton University Press for the NBER, 1960.

Pitkin, Timothy. A Statistical View of the Commerce of the United States of America. Hartford: C. Hosmer, 1816.

Sears, Louis M. "Philadelphia and the Embargo of 1808." Quarterly Journal of Economics 35 (February 1921): 354-359.

Smith, Walter B., and Arthur H. Cole. Fluctuations in American Business, 1790-1860. Cambridge: Harvard University Press, 1935.

Sokoloff, Kenneth L. "Inventive Activity in Early Industrial America: Evidence From Patent Records, 1790-1846." Journal of Economic History 48 (December 1988): 813-850.

Syrett, Harold C. (ed.). The Papers of Alexander Hamilton. New York: Columbia University Press, 1961.

Thorp, Willard. Business Annals. New York: National Bureau of Economic Research, 1926.

Ware, Caroline F. "The Effect of the American Embargo, 1807-1809, on the New England Cotton Industry." Quarterly Journal of Economics 40 (August 1926): 672-688.

**Table 1: Selected U.S. International Transactions, 1807-1809**

Figures in millions of dollars.

Year	Exports			Imports				Customs Receipts
	Domestic Merchandise	Net Shipping Earnings	Total	Paying Ad Valorem Duties	Free or Paying Specific Duties	Re-Exported	Total (for domestic consumption)	
1807	48.7	42.1	90.8	57.8	86.9	59.6	85.1	17.0
1808	9.4	23.0	32.4	21.2	36.9	13.0	45.1	7.7
1809	31.4	26.2	57.6	28.5	32.5	20.8	40.2	7.4

Source: North (1960), p. 600; Pitkin (1816), pp. 36, 252; Irwin (2002), Table 1.

**Table 2: Welfare Effects of the 1808 Trade Embargo**

Figures in millions of dollars. Negative numbers in parenthesis.

Component	Central Estimate (1)	Low Estimate (2)	High Estimate (3)
$p_1 @ n_0$	(46.9)	(46.9)	(46.9)
$(p_1 - p_1^*) @ n_1$	7.7	7.7	7.7
$B_1$	1.5	1.5	1.5
$s_p = p_1 @ y_1 - y_0$	2.3	4.7	0
$s_c = p_1 @ y_0 - e(p_1, u_0)$	2.3	4.7	0
Total	(33.1)	(28.3)	(37.7)
As Percent of GNP	4.9%	4.2%	5.5%

Source: See text for calculations. Nominal GNP in 1807 is assumed to be \$680 million, from Gallman (2000), p. 7. The share of domestic exports and shipping earnings in GNP was 13.4 percent in 1807; the share of imports for domestic consumption in GNP was 12.5 percent in that year.

**Table 3: Voting in the House of Representatives on the Embargo**

**A. The Imposition of the Embargo, December 21, 1807**

Region	Republicans		Federalists		Total	
	Yea	Nay	Yea	Nay	Yea	Nay
New England	19	0	0	15	19	15
Mid Atlantic	27	7	0	9	27	16
South	28	10	0	2	28	12
West	8	2	0	0	8	2
Total	82	19	0	26	82	45

**B. The Retention of the Embargo, February 24, 1809**

Region	Republicans		Federalists		Total	
	Yea	Nay	Yea	Nay	Yea	Nay
New England	1	13	0	15	1	28
Mid Atlantic	10	27	0	6	10	33
South	18	16	0	2	18	18
West	4	3	0	0	4	3
Total	33	59	0	23	33	82

Note: This vote is on an amendment to eliminate all passages from a bill that would repeal the embargo. A vote in favor is thus a vote to retain the embargo. The final bill that actually repealed the embargo replaced it with non-intercourse restrictions on trade and was passed in a partisan vote, with Federalists opposing the continuation of any restrictions on trade. Source: Voteview, from [www.princeton.edu/~voteview/](http://www.princeton.edu/~voteview/)

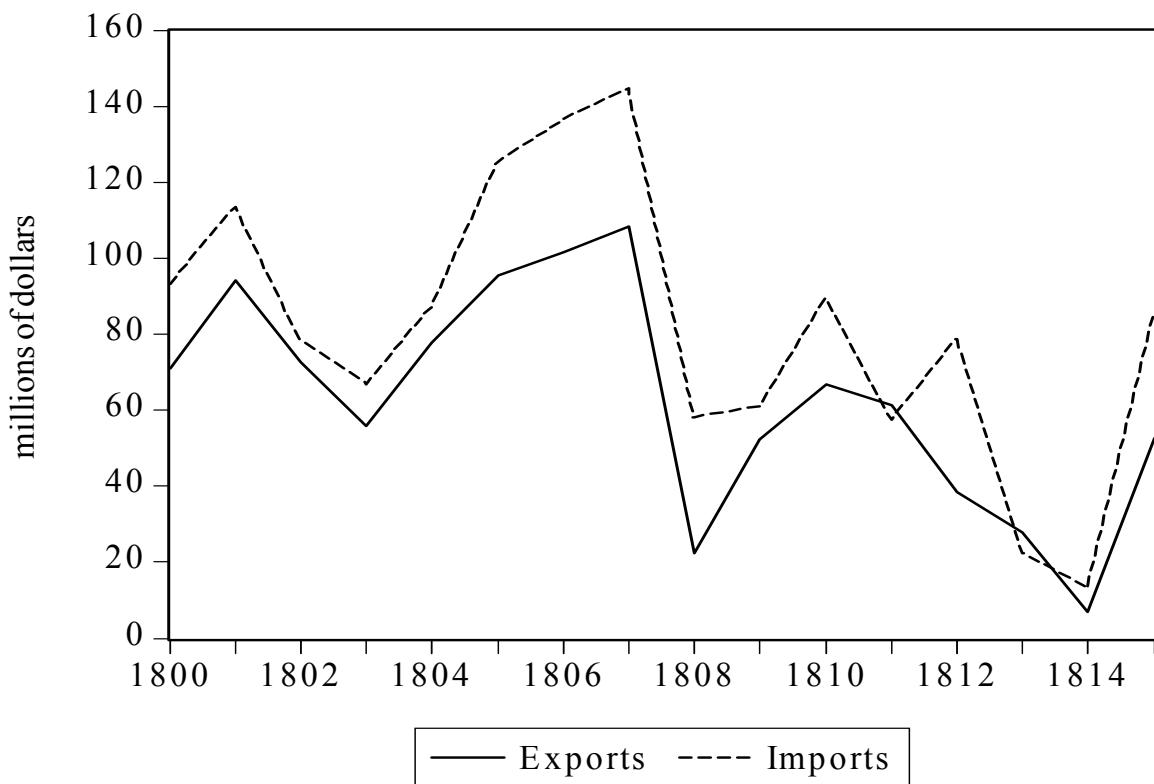
Classification: New England includes Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut. Mid Atlantic includes New York, Pennsylvania, New Jersey, Delaware, and Maryland. South includes Virginia, North Carolina, South Carolina, and Georgia. West includes Ohio, Kentucky, and Tennessee.

**Figure 1: Tonnage of American Ships Entering Great Britain, 1801-1810**



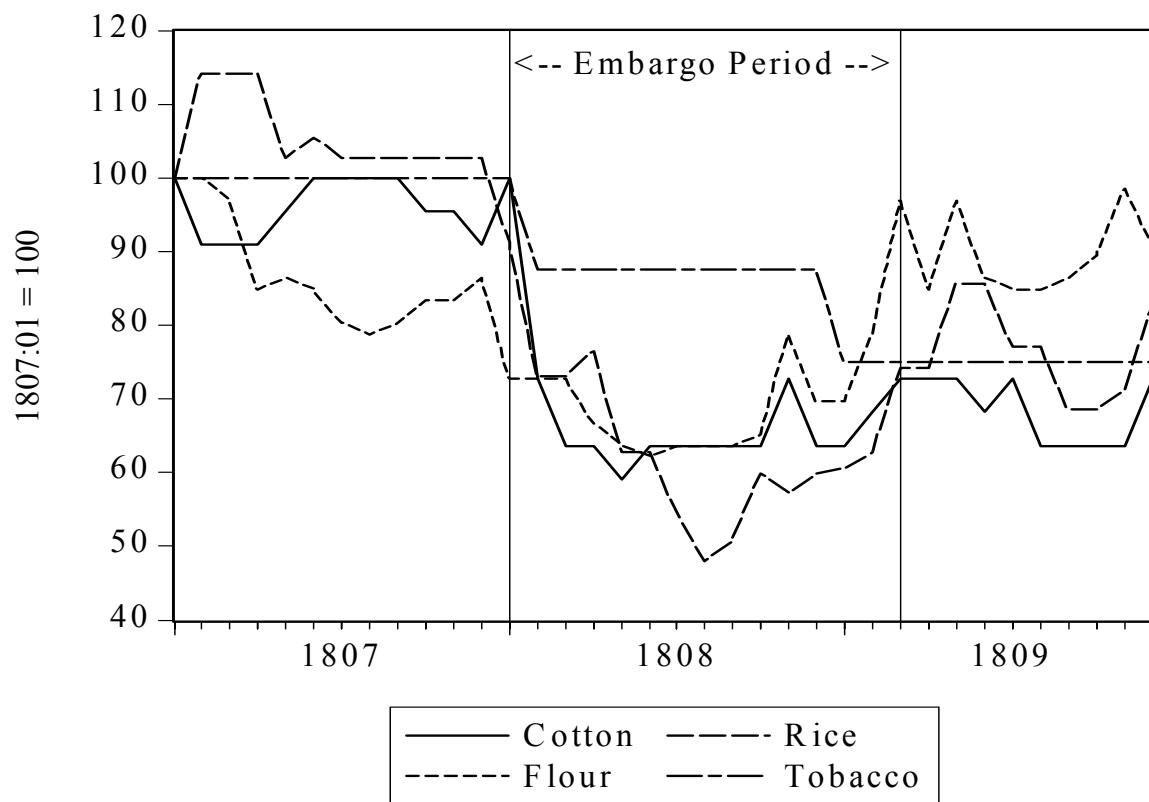
Source: Great Britain. "An Account Relating to Imports and Exports," February 18, 1812, Parliamentary Papers, Vol. 10, 1812, p. 5.

**Figure 2: U.S. Merchandise Trade, 1800-1815**



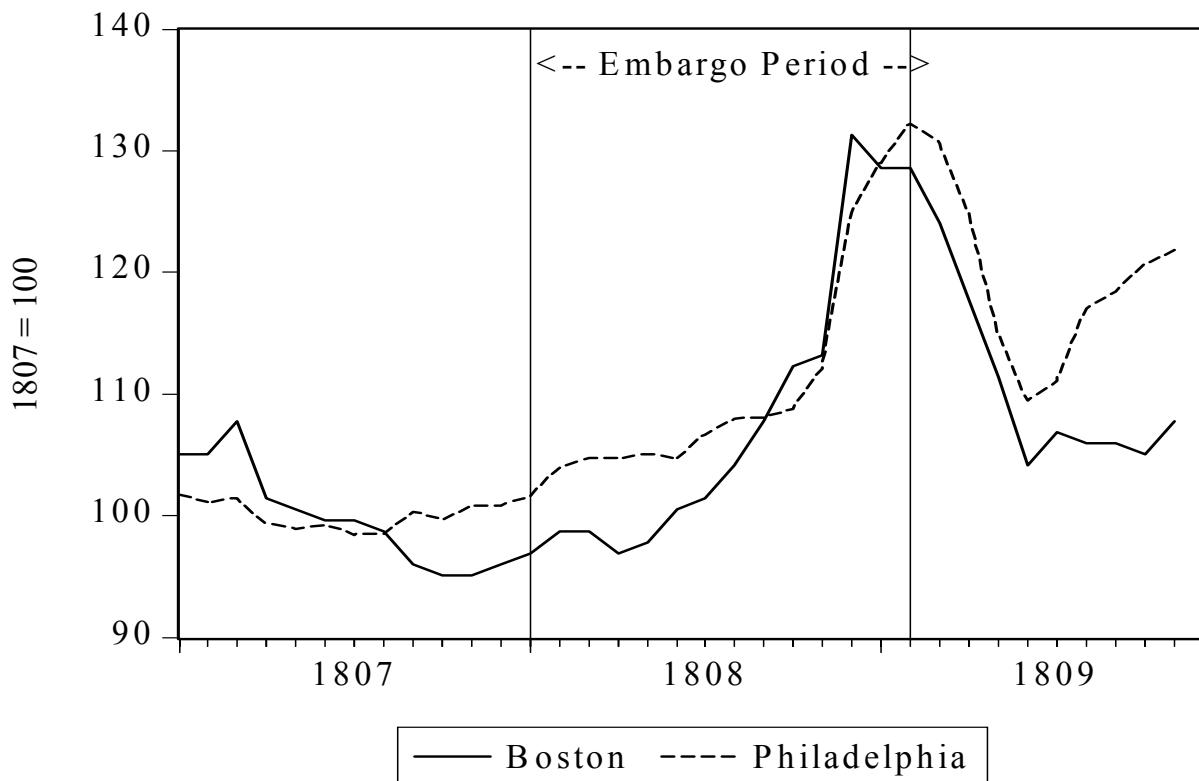
Source: North (1960), p. 600.

**Figure 3: Domestic Wholesale Prices of Exported Commodities, Monthly 1807-1809**



Source: Cole (1938). Prices are of Georgia upland cotton at New York, superfine flour at New York, tobacco at New York, and rice at Philadelphia.

**Figure 4: Domestic Wholesale Prices of Imported Commodities, Monthly 1807-1809**



Sources: Smith and Cole (1935), p. 147, and Bezanson, Gray, and Hussey (1936), p. 353. The Boston index is a weighted average of prices on 18 imported commodities. The Philadelphia index is a weighted average of prices of 59 imported commodities.

**Figure 5: The Gains from Trade**

