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ORIGINAL PAPER

Fairness and efficiency in US Revolutionary War takings and post-war debt redemption

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Abstract Many have noted the debate amongst Hamilton, Jefferson, and others on compensating original versus final US Revolutionary War debt holders upon federal assumption of state debts in 1790. However, to our knowledge the economics literature has not yet proposed a theoretical model of the argument. The purpose of this paper is to propose a simple household-level economic model to capture the most salient aspects of the debate, including the role of military impressment and the emergence of the Takings Clause of the US Constitution.

Keywords Debt redemption · Takings Clause · US Revolutionary War debt

JEL Classification H13 · N41 · P16 · D63

1 Introduction

There is a significant amount of literature surrounding the argument between Hamilton, Jefferson, Madison, Rush and others on the merits of compensating original versus final US Revolutionary War debt holders upon federal assumption of state debts in 1790. However, the economics literature has not yet proposed a theoretical household-level model of the argument. A theoretical model of the argument is useful for more carefully comparing and contrasting the efficiency and fairness concerns raised in that era. Moreover, such a model can be useful for arbitrating more recent debates concerning whether and how governments should

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intervene in financial markets during periods of great fluctuations. That the Hamilton et al. debate still resonates in the modern era is evidenced by its featured reference, for instance, in Sargent (2012) and Hall and Sargent (2014).

The purpose of this paper is to review the economic efficiency and fairness aspects of the Hamilton et al. debate and to propose a simple economic model that will enable further analysis of the sometimes subtle aspects of the debate. In particular, we answer the following three questions. First, we ask "What is the theoretical impact of local foraging for goods by the US Revolutionary War Army upon household welfare?" We show that incomplete local markets generally prevent the government from restoring household welfare to baseline levels (net of tax support for the war), even with IOUs issued to households in the course of the war. This theoretical result regarding market incompleteness, in turn, informs the historical debate between Jefferson, Madison, Hamilton and others regarding the merits of seeking to at least partially compensate original IOU holders who sold the IOUs early in the war to speculators. The second question we ask is "Why did so many original holders sell their IOUs at steep discounts in the secondary debt market?" Our model shows how agents with relatively low subjective probabilities attached to the likelihood of victory by the US Revolutionary War army/government will be relatively more likely to sell debt instruments to other agents who hold relatively higher subjective probabilities of victory (and consequent payoff of war debts). The final question we ask is: "What role may have liquidity constraints played in the decision of many original IOU holders to sell?" Our model shows how agents that are relatively constrained in their budgets will maximize expected welfare by selling debt instruments to agents who are not as tightly budget constrained. Our model illustrates how both of these latter phenomena can be present at once, reinforcing the incentive for some households (namely, budget constrained colonists who are pessimistic about American independence) to sell debt instruments to other households that are either more optimistic about the prospects of victory and/or who are less budget constrained. We conclude by discussing how the Hamilton et al. debate might inform current policy deliberations regarding appropriate government intervention in turbulent financial markets and in takings cases.

2 Historical context

The outcomes of many of America's earliest debates still define the country to this day. Issues concerning states' rights, the role of government, and the proper institutional structure for the American economy were all addressed and partly resolved shortly after American independence was achieved. In our own day, when the outstanding debt of the United States federal government has surpassed the nation's GDP, while at the same time wealth inequality and economic fairness are becoming increasingly important topics of public debate, it may be instructive to look back at one of the most important, yet overlooked, of America's early debates: the redemption of debt from the Revolutionary War.

In its war for independence from one of the world's most powerful empires, the nascent United States of America was woefully short on funding. This was a huge problem for the rebels, and its magnitude was not unknown to them. Alexander Hamilton wrote in 1781: "Tis by introducing order into our finances—by restoring public credit—not by gaining battles that we are finally to gain our object".[1] State governments did what they could to fund the war effort through taxation, but ultimately a number of other fundraising methods were invoked. These methods include the issuance of public debt, paper money, and notes in exchange for property. American soldiers were paid predominantly in promissory notes, while at the same time the American military funded itself in large part by either exchanging certificates for the property of civilians, oftentimes directly confiscating or "impressing" the property when civilians were unwilling to trade at the established prices.[2] Bonds and debt instruments of all kinds were often sold in secondary markets at enormous discounts, since both the durability and reliability of an independent American government was in doubt.[3] That a significant number of these instruments were apparently issued to individuals against their will is of primary interest to us in this paper.

At the end of the war, it was widely believed that government debt had been gobbled up by wealthy investors, who were waiting for the federal government to assume and redeem the debt at or near face value. The war had come with many hardships, not the least of which was a substantial decline in the value of the continental dollar. During this time, the value of American debt certificates exchanged far below par value.[4] This was particularly damaging because even patriotic certificate holders who believed American victory and redemption were certain may well have needed to sell off financial assets during the harsh war years. This meant that regardless of expectations or patriotism, poorer debt holders might often have had to sell off their bonds at a significant loss. Even if, as Wright (2008, 138) argues, many losses on debt trading in the secondary markets accrued to speculators rather to original debt holders, it is nevertheless the case that most original debt holders parted with their IOUs by 1787 at substantial discounts. The debate surrounding the matter of how to redeem this debt, given this difficult context, was an important debate within the new government. George Washington himself declared that "no pecuniary consideration is more urgent, than the regular redemption and discharge of the public debt: on none can delay be more injurious, or an economy of time more valuable".[5]

Within the debate, two major camps emerged, each representing a side in a greater ideological debate in public policy, one that should be familiar to any economist. The champions of one side of the dispute were Madison and Jefferson. The primary spokesperson on the opposing side of the debate was the great federalist Alexander Hamilton, the man who always seemed to be on the opposite

[1] See McConnell (2012, 275).

[2] See Ferguson (1961, 57–66).

[3] See Hall and Sargent (2014, 152).

[4] See Hall and Sargent (2014, 151).

[5] See Washington (1793).

side of the table from wherever Jefferson sat. While both sides agreed on the need for federal redemption, Madison and Jefferson argued that the original holders of American debt who were victims of speculation deserved to receive at least a portion of the payments being allotted in the repayment of debt. Thus, patriotic soldiers and civilians who were faced with the impoverished conditions of the war and didn't have access to the same information about the probability of redemption as wealthy investors would still receive some payment.[6] Faced with this state of affairs in the years following the war, Jefferson and colleagues argued with Hamilton and colleagues on whether and how to compensate original bondholders on grounds of equity. Jefferson basically argued for original holders of such IOUs to be compensated in full by the federal government in 1790. Hamilton argued that this would be inefficient interference in debt liquidity markets that could harm the government's ability to borrow in the future. Madison proposed a compromise: "…let [present holders] have the highest price which has prevailed in the market; and let the residue belong to the original sufferers".[7] For illustration, suppose the par value of the instrument was \$100 and at some point in the war, the government carried out a taking of a citizen's property and issued an IOU for \$100. Suppose in the course of the war, the IOU was sold by the original holder for \$30. Then, suppose the highest market price the IOU reached before redemption was \$75. Upon assumption in 1790, Madison's plan would give the holder of the IOU \$75 (for a profit to that agent of \$45) and the original holder of the IOU would receive the residual value of \$100 − \$75 = \$25. This would bring the original holder's total compensation up from the \$30 received in the secondary market earlier in the war to \$30 + \$25 = \$55 upon the redemption of debt. Hence, such an agent would end up receiving \$55 for the original "taking" of \$100 by the government earlier in the war. Madison was eventually disappointed by the fate of his proposal and it was voted down by a vote of 36-13 within the House of Representatives. Whatever the rest of Congress felt about his proposal, Madison viewed it as a compromise that would "do more real justice, and perform more of the public faith, than any other expedient proposed".[8] Indeed, Madison goes so far as to claim that "if a tribunal existed on earth, by which nations could be compelled to do right, the United States would be compelled to do something not dissimilar in its principles to what I have contended for".[9] Quite a bold claim indeed!

On the other hand, Alexander Hamilton believed that payments by the federal government should be issued entirely to the present holders of debt. Hamilton believed that this would ensure that the United States could efficiently fund future wars by creating a liquid market for public debt in the United States.[10] Hamilton structured the case for federal redemption on much the same grounds as modern economists might today: "And as on the one hand, the necessity for borrowing in

[6] See Edling (2007, 289–290, especially footnote 4). See also Beard (1915, 169–170, citing "The Complete Anas of Thomas Jefferson, 1791–1809").

[7] See Madison (1790a, 444), Perkins (1994, 222) and Edling (2007, 290, footnote 4).

[8] Madison (1790a, 444).

[9] Madison (1790a, 446).

[10] Hamilton (1789).

particular emergencies cannot be doubted, so on the other, it is equally evident, that to be able to borrow upon good terms, it is essential that the credit of a nation should be well established. For when the credit of a country is in any degree questionable, it never fails to give an extravagant premium, in one shape or another, upon all the loans it has occasion to make. Nor does the evil end here; the same disadvantage must be sustained upon whatever is to be bought on terms of future payment".[11] In response to alternative plans that called for anything less than full redemption at face value to the present holder, Hamilton called upon the right of contract and the ease of transferability that accounts for much of the value of transferred debt: "[Discrimination in paying off debt] is inconsistent with justice, because in the first place, it is a breach of contract; in violation of the rights of a fair purchaser… The nature of the contract in its origin, is, that the public will pay the sum expressed in the security, to the first holder, or his assignee. The intent, in making the security assignable, is that the proprietor may be able to make use of his property, by selling it for as much as it may be worth in the market, and that the buyer may be safe in the purchase".[12]

Hamilton had three economic reasons why liquid and respected debt instruments would be a boon, not just to the American government, but also to the economy as a whole. On the one hand, Hamilton states both that liquid debt instruments are effectively an expansion of the money supply, and at the same time they allow sellers to withstand bankruptcy for a longer period of time: "Trade is extended by it [the issuance of liquid debt instruments]; because there is a larger capital to carry it on, and the merchant can at the same time, afford to trade for smaller profits; as his stock, which, when unemployed, brings him in an interest from the government, serves him also as money, when he has a call for it in his commercial operations".[13] For his second point, Hamilton goes on to say: "Agriculture and manufactures are also promoted by it: For the like reason, that more capital can be commanded to be employed in both; and because the merchant, whose enterprize in foreign trade, gives to them activity and extension, has greater means for enterprize".[14]

In his final argument for redemption, Hamilton actually argues that since the issuance of liquid debt instruments is tantamount to an increase in the money supply, that it would actually cause the interest rate to fall for lenders, something that is an example of relatively advanced economic reasoning for his time, although it does appear to rest on some shaky ground: "The interest of money will be lowered by it; for this is always in a ratio, to the quantity of money, and to the quickness of circulation. This circumstance will enable both the public and individuals to borrow on easier and cheaper terms".[15] It should be noted that the effect Hamilton is

[11] Ibid.

[12] Ibid.

[13] Ibid.

[14] Ibid. It should be noted that the second statement is effectively a direct extension of the first statement; Hamilton merely separates the second statement by referring to different specific aspects of the greater principle defined in the first statement. It seems that Hamilton either felt that agriculture, manufacturing, and foreign trade were somehow fundamentally different than simply "trade", or he was merely trying to increase the number of major benefits that would result from his plan.

[15] Ibid.

mentioning is almost certainly not enough to bring the interest rate down, at least in the short run, because the entire impetus for the quasi-increase in the money supply is an increase in the demand for loans by the federal government, something that would act to increase the interest rate. While we are noting the economic thought in this debate, it is worth mentioning that Hamilton also argued that the tariffs by which the debt would be redeemed would be effective exactly because demand was inelastic: "It is not however, probable, that this decrease [in the quantity demanded of spirits and certain other goods] would be in a degree, which would frustrate the expected benefit to the revenue from raising the duties. Experience has shewn, that luxuries of every kind, lay the strongest hold on the attachments of mankind, which, especially when confirmed by habit, are not easily alienated from them".

The conflicting plans for redemption were actually symptomatic of what appears to have been a more general argument between the founding fathers in question. This can be seen in the fact that the same founders argued over a similar but related issue. Years after the controversy over the assumption of debt had been resolved, Hamilton stood against Madison and Jefferson on another issue: the usage of federal tariffs. While Hamilton thought that they should be used almost entirely as a source of revenue, and that disturbing this may well harm the future of the United States, Madison and Jefferson were interested in utilizing tariffs as retribution against any nations, namely England and France, who would dare aggress against the United States.[16] While Hamilton clearly felt that he had a moral justification in fully funding the debt, his stance on the usage of tariffs gives us a clear view of a man more interested in ensuring stable financing for the United States than in moral grandstanding. As Hamilton wrote: "Every gust that arises in the political sky is the signal for measures tending to destroy [our] ability to pay or to obstruct the course of payment".[17] The way forward was always a stable and clear approach to economic matters, rather than to upset things by constructing ad hoc rules based on moral and emotional responses. However noble compensation of original holders might be, this would nevertheless present such an ad hoc rule. Thus, on the issue of redemption, after a long period of delineation in which there was actually a point where Madison thought that federal assumption of state debt might fail altogether, America's first Congress finally adopted a stance on the issue.[18] As noted earlier, with a 36-13 vote, Congress ruled in favor of Hamilton's plan over Madison's. We believe that this debate in American history reflected deep concerns for the economic tradeoffs between the ideals of fairness and efficiency, and was one that helped to shape future choices within American history.

3 Literature review

The key references upon which we draw are as follows. Ferguson (1954) presents data from Maryland to assess the concentration of debt within the state during the time of redemption. He determines that slightly over 120 people controlled over

[16] See Irwin (2010, 89–90).

[17] Ibid.

[18] Madison (1790b, 9).

90 % of the state's debt, and that out of this, a mere 16 individuals controlled just over half of all debt holdings. While it may be premature to consider this single example as representative of all 13 states, if such a distribution was in fact usual, then concerns about high debt concentration were indeed valid.[19]

Ferguson (1961) reviews many of the details concerning finance within the Revolutionary War. Among many other useful insights, the author provides insight to the extent of the practice of impressment during the Revolutionary War. Ferguson showed that starting early in the war much of the military's actions were funded through purchase and confiscation of property directly from civilians. Ferguson also gives us a view as to the difficulties that were present when it came time to repay federal debt, and the difficulties that arose over the repayment of soldiers in particular.[20] Importantly, Ferguson also provides data that indicate that while in most states the concentration of the ownership of public debt was not as great as in Maryland, it was still quite significant in most states and at the level of the treasury.[21]

Swanson and Trout (1992) begin their analysis of Hamilton's plans to manage and then reduce the nation's debt by noting the disagreement between Jefferson and Hamilton on discriminating between original and secondary debt holders. However, they do not explore this disagreement further and instead focus upon Hamilton's proposal for limiting the redeemability of the debt.

Perkins (1994) presents a thorough analysis of early American public finance, emphasizing (on pp. 227–229) that agents who sold IOUs early for goods and services impressed by the military—and at substantial discounts—may nevertheless have fared reasonably well, given the great uncertainty at the time that the IOUs would ever be redeemed. This can, nevertheless, be viewed as a testament to how low the immediate real value of many compensatory instruments actually was. Perkins also reviews the data and concludes (on p. 225) that to the extent some speculators captured great gains in debt markets, it was largely at the expense of fellow speculators in the secondary markets rather than at the expense of original debt holders.

Edling (2007) gives us a complete overview of the debates over debt redemption after the Revolutionary War. He documents the different plans at redemption, the details and alterations made to the final plan, and the motivations behind the debate. In particular, Edling points out the extent of the disagreements surrounding the worldviews of Jefferson and Hamilton and how this played into the controversy.

Wright (2008) sheds important light on multiple aspects of how the US Revolutionary War was funded and how the secondary debt markets evolved during the war years to the end of 1790 when the federal government elected to assume state debts. We are sympathetic to Wright's view (on p. 57) that "…impressment, confiscation, and expropriation was simply a form of taxation". He indicates that these drastic steps were carefully taken by a desperate military at a particular point in the war when all other means of funding the war effort had failed. Wright also

[19] See Ferguson (1954, 39–40).

[20] See Ferguson (1961, 155–173 and 180–186).

[21] Ibid 272–284.

describes the various concerns Hamilton and colleagues had regarding Madison's proposal to discriminate between original and final debt holders in assumption. In particular, Wright's analysis clarifies the complexities and impracticalities with debt discrimination that were raised at the time, over and above philosophical views that led some to view debt discrimination with skepticism. The tax-like nature of confiscation does not, however, change the issue of unfairness by which confiscation occurred, nor any damage that the irregular nature of impressment brought about. We shall return to this point below.

Hall and Sargent (2014) look at the policy taken by the United States federal government to finance three of its earliest wars: the Revolutionary War, the War of 1812, and the Civil War. The authors pay particularly close attention to the matter of how paper money was treated over this time period. The authors show that just as more modern models advocate, Hamilton attempted to ensure that the federal government was in a position to finance any future wars by redeeming certain forms of debt for a lower portion of its face value than other types of debt that he expected to be issued at a later date.[22] So, for instance, indents and state debt were redeemed at a much lower percentage of its face value than a loan office certificate. The authors indicate that this ensured that investors felt the chances of American default in later wars to be quite low for debt that was directly issued by the federal government.

Hall and Sargent (2014) also discuss the damage that was done to the reputation of paper money during this time, claiming that the reputation of paper money was "poisoned". At the time, both politicians and the populace held far less inflation-friendly views than is the case today. With the sharp decline in the value of the continental dollar that occurred over the course of the war, and the unfavorable treatment that the federal government showed to the Continental dollar, it was no surprise that it was a long time until paper money was once again looked on with significant favor. This was such an important event at the time that the issuance of paper money is limited within the Constitution, and a significant number of those at the Constitutional Convention wanted paper money to be banned outright.[23]

4 The model

Our goal is to motivate a simple economic model of the trade in wartime debt instruments that reflects the US Revolutionary War period and theoretically motivates its culmination with the debate between Jefferson, Madison, and others as to who should be paid when the debt is redeemed. While our model is general, we are primarily interested in those debt instruments that were given to citizens during the war in exchange for the forced exchange of goods and services (including military service), as opposed to financial instruments that were sold to investor-citizens and that included interest payments.[24] The former instruments may be fairly

[22] See Hall and Sargent (2014, 149).

[23] See Hall and Sargent (2014, 151–156).

[24] We have in mind here the characterization of impressment and indents in Ferguson (1954, 38), for instance.

characterized as IOUs for goods and services rendered. As described earlier in the paper, a secondary market formed for such IOUs in the course of the war; agents who were liquidity constrained and/or who concluded that the (discounted) secondary market value of the IOU exceeded one's expected value of the IOU sold IOUs to agents who were not liquidity constrained and/or who had expected values greater than the secondary market value.

Suppose that an individual, representative agent has two goods, food F and nonfood N; utility function $U(F, N)$ that is continuous, twice-differentiable in each argument, and strictly quasi-concave; exogenous income or wealth m; and faces constant (competitive) prices for food and nonfood of P_F and P_N, respectively. For simplicity, we assume that by the time confiscation occurs, the representative agent has already contributed what is widely perceived to be a fair share of taxes to support the war effort. This means that the household was already situated at an after-tax level of utility that was less than their pre-tax level. Funding the war is an incurred cost that will harm the citizens of a nation, but within the scenario being described, some were harmed far more than others by discriminatory confiscation. Focusing upon this post-tax scenario enables us to focus upon cases in which the representative agent's personal holdings are differentially confiscated by the army in exchange for IOUs, simply because the representative agent lives closer to battle sites than other agents. In this sense, we are characterizing the representative household as both a taxpayer and a bond (IOU) holder. Prior to army foraging and the issuance of IOUs, the taxpayer agent maximizes utility subject to his or her budget constraint in the usual manner:

$$L = U(F, N) + \lambda[m - P_F F - P_N N] \tag{1}$$

The solution is, of course, to choose F_0 and N_0 such that:

$$\frac{\frac{\partial U}{\partial F}}{\frac{\partial U}{\partial N}} = \frac{P_F}{P_N} \tag{2}$$

Now, given the properties of the utility function and the budget constraint, we can obtain the indirect utility function, $V_0(P_F, P_N, m)$, which can be inverted to yield the expenditure function $e_0\left(P_F^0, P_N^0, V_0\right)$, the minimum expenditure necessary to generate a baseline utility level V_0. This baseline is useful for making welfare comparisons later in our analysis between the compensation proposals offered by Jefferson and Madison, on one hand, and Hamilton on the other hand. In particular, while not commonly framed as such, the compensating surplus concept described by Lankford (1988) and Freeman (2003) and others can be used to illustrate the differential impacts of policy proposals when quantities are constrained or imposed:

$$CS = e_1\left(P_F^0, P_N^0, \bar{F} < F_0, V_0\right) - e_0\left(P_F^0, P_N^0, F_0, V_0\right) \tag{3}$$

Equation (3) says that if the local militia seizes some of an agent's holdings of food F such that the agent is left with $\bar{F} < F_0$, then while market prices may be unchanged at least in the very short run (since the amount of food in the local economy is unchanged, but is rather transferred from some households to the army

quartermaster), the agent will need expenditure $e_1 > e_0$ to afford baseline utility V_0 again. This baseline framework enables us to ask and answer the first question with which this study began: "How much would the government need to pay original holders of IOUs for wartime goods taken over and above a fair share of taxes to support the war, if the government wished to return IOU holders to their pre-takings utility?" The basic answer is illustrated in Fig. 1 below. A "taking" of $\Delta F = F_0 - F_1$ reduces the agent's utility from U_0 to U_-. If the agent is given an IOU with spot market value equal to $P_F \Delta F$, and if the market were quite incomplete such that no additional units of food were available locally, that amount would restore the agent's budget to m, arriving at the coordinates (F_1, N_+) and utility somewhere between U_0 and U_-. If the market for food were only partially incomplete (i.e., households could replace some food from sources that were reasonably nearby), then the IOU would enable the household to travel northeast from bundle (F_1, N_0) as opposed to due north toward the budget constraint. Interestingly, the spot market value of $P_F \Delta F$ *cannot* enable the citizen to reach the baseline utility at the new Bundle 1 in Fig. 1 if the market for food is to any degree incomplete. Figure 1 illustrates the case of extreme market incompleteness, as in that case, the household

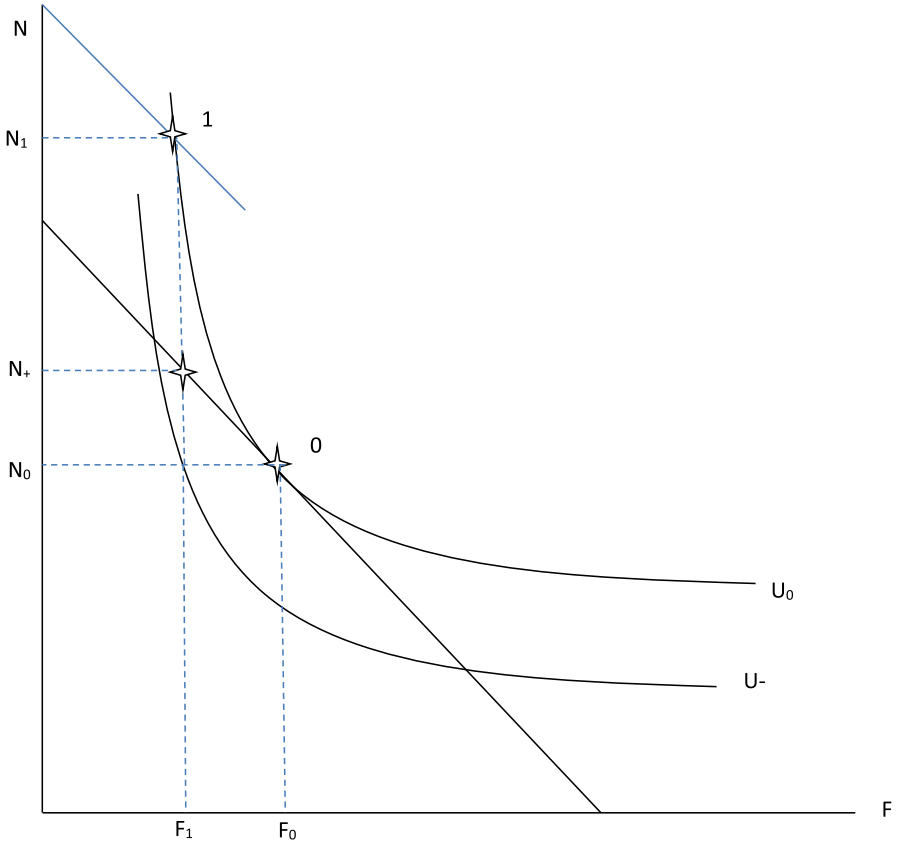

Fig. 1 Optimal choices of food and nonfood

would need compensation so as to move all the way from bundle (F_1, N_0) to bundle (F_1, N_+). Thus, our first observation is that even if the IOU were to fully restore an agent's exogenous income or wealth m, such a restoration of wealth in the presence of imposed quantities cannot restore an agent's utility. The difficulty is that in the event that the financial instrument provided to the agent received for services rendered was actually worth the confiscated goods then no confiscation would have taken place at all and the military could simply have purchased the quantity of $F_0 - F_1$ either on the market or directly from households without need for confiscation. This would have been particularly important during this period of great shortages and monetary inflation.

To complete our baseline model and to facilitate our exposition, it is useful to invoke a particular functional form for either utility, indirect utility, or expenditure. Suppose preferences are given by the Cobb-Douglas form $U(F,N) = F^{0.5}N^{0.5}$. To start the ball rolling, let us assume that $P_F = \$1$, $P_N = \$1$, and that the consumer has a \$1000 in exogenous wealth invested in food and non-food. One can show, via Eq. (2) and the budget constraint that the consumer would optimally hold 500 units of each good and would derive 500 units of utility. Hence, $F_0 = N_0$ and $U_0 = 500$. Now, if half of the agent's food is impressed by government troops, $F_1 = 250$, and this reduces the agent's wealth by $P_F(250) = \$250$ so he or she is left with \$750 distributed between financial assets, food, and non-food goods. The amount of N the agent would need in order to remain at U_0 is $N_1 = 1000$ (from $500 = \sqrt{250}\sqrt{N_1}$), while the agent would have in hand at that point \$750. However, the total cost of achieving Bundle 1 in Fig. 1 is \$1250 (\$250 for F_1 plus \$1000 for N_1). So by Eq. (3), our agent would need to receive compensation of \$500 (\$1250–\$750) in order to preserve baseline utility. Note the difference between a *restriction* or *quota* on F, as opposed to a *taking*. If the agent faces a quota on F, he or she can redirect the full \$1000 of exogenous wealth to the consumption of more N to compensate for the limit on F [arriving at bundle (F_1, N_+)]. This is not privately optimal, but it is feasible. In that case, the agent would need compensation of \$250 at these prices (so that total expenditure is \$1250) to afford baseline utility under the quota [i.e. to move from (F_1, N_+) to (F_1, N_1)]. In contrast, with the taking, the agent's wealth is reduced by the quota, so that the agent must simultaneously reallocate consumption toward N *and* deal with a reduction in purchasing power. By this logic, the agent can only reach baseline utility if \$250 of compensation is forthcoming for the reduction in wealth (an IOU for \$250 that is actually paid off, bringing the agent from N_0 to N_+), and if an additional \$250 of compensation is forthcoming for the reallocation necessary away from F and toward N. This would bring the agent from N_0 to N_+ to N_1, and hence all the way back to U_0. From this analysis, we can conclude that if the government had been interested in beginning to provide its citizens with adequate compensation, then it must pay significantly more than the "normal" peacetime price of the goods. Inevitably, however, any price below what the agent in question will accept will decrease that agent's utility.

Before considering extensions to the baseline model, it is important to take stock of how Madison's plan for compensating original holders of IOUs who sold them in secondary markets compared with Hamilton's view that only final holders of IOUs

should be compensated at war's end. As described earlier, Madison's plan was designed to restore some of the utility lost by original holders who sold IOUs in the secondary markets. Our analysis above derived the upper bound on such restoration of original holder utility; at the theoretical upper bound, baseline utility would be restored. It is important to note that Madison's plan was not designed to restore baseline utility; in contrast, his plan would raise the original holder's utility from as low as $U_{\text{-}}$ to a level of utility between $U_{\text{-}}$ and U_0. Hamilton was not in favor of any compensation to original holders of IOUs; hence, his plan would leave original holders at relatively lower levels of utility, including possibly $U_{\text{-}}$. Indeed, the salience of the lower bound on original IOU utility in the above comparison raises the issue as to the possible social welfare improvement that could have been achieved had the government been able to raise more revenue via a fair distribution of taxes and reduce if not eliminate the need to forage unequally across the landscape and issue IOUs of uncertain value. Our model suggests that the government's ability to carry out a fairer tax plan to fund the war would have left the representative household at a utility level between $U_{\text{-}}$ and U_0, with $U_{\text{-}}$ as the lower bound. That is, the representative household could not have been worse off with higher, equally distributed taxes (a parallel downshift in its budget constraint) than sustaining foraging by the army.[25]

We now turn to a second question that we are interested in modelling, and that is "Why did so many of the original holders of IOUs sell?" Ferguson (1961) and Wright (2008) and others suggest that IOUs were typically sold at significant discounts because many citizens were not sanguine about the prospects of victory in the Revolutionary War. Thus, an IOU that may have had spot market value of $P_F \Delta F$ typically sold at a discount $\pi_W P_F \Delta F$, where $\pi_W < 1$ is the probability that the war is won and debts are paid (i.e. that IOUs held to "maturity"—that is to war's end—will be paid in full and not repudiated). Of course, in order for this to obtain in equilibrium, different agents must have different subjective probabilities over possible outcomes of the war. Here, we are thinking of the result in Harrison and Kreps (1978) in which relatively optimistic investors and relatively pessimistic investors can co-exist in the financial markets, and that there exists an equilibrium point in such a market in which different beliefs about the market's prospects can perpetuate for a long time.

While we assumed a static model in the above analysis, let us now consider the case in which agents face risks. Suppose there are two representative agents (a buyer and a seller of debt) and a government that issues debt to fight a war that provides national defense to the agents. One agent is given a certificate in exchange for goods and services needed to provide national defense in the short run, redeemable after the war with some probability. The second agent can provide liquidity to the first agent (replacing some of the goods and services borrowed by the government at beginning of war) by buying debt certificates at a discount, thereby assuming the risk that the government will lose the war and default on, or repudiate, the debt. Suppose the agents are risk-averse, and for concreteness and simplicity, suppose

[25] We are grateful to an anonymous reviewer for calling our attention to the latter two points in this paragraph.

their utility functions over money assets M are $U_i(M_i) = \sqrt{M_i}$. We are interested in accounting for an agent's willingness to pay for and willingness to sell a bond with face value equal to B if held to maturity (in this case, held until a victory in war). While preferences may be the same, suppose, however, that the agents differ according to the subjective probabilities they attach to winning the war. Thus, let the subjective probabilities of victory v be given by $\pi_1^v > \pi_2^v$, so that the subjective probabilities of defeat (and default on the bond) are given by $\left(1 - \pi_1^v\right) < \left(1 - \pi_2^v\right)$. Each agent will be happy to hold a bond if the expected utility from holding the bond is greater than the expected utility of not holding the bond (instead holding cash). During the war, the bonds trade at a discount, given the possibility that the war may be lost and default occurs.

For illustration, suppose a bond with face value $B = \$100$ is trading at a discounted market value of \$40, given market awareness that the war may be lost and bond default may occur. Optimistic Agent 1 thinks that the probability that the government will win the war and pay the holder of the bond \$100 is $\pi_1^v = 0.7$ with $\left(1 - \pi_1^v\right) = 0.3$. Pessimistic Agent 2 thinks that the probabilities are $\pi_2^v = 0.2$ and $\left(1 - \pi_2^v\right) = 0.8$. Agent 1's expected value for the \$100 bond is \$70, while Agent 2's expected value for the bond is \$20. If both agents have risk-neutral preferences, Agent 1 would prefer to hold the \$100 bond than to hold \$40 cash (<\$70) and Agent 2 would prefer to hold \$40 cash than to hold the \$100 bond (since \$40 > \$20). If the agents each have risk-averse preferences such as $U_i(M_i) = \sqrt{M_i}$ illustrated in Fig. 2, then Agent 1 will still wish to hold the bond, since the expected utility from holding the bond exceeds the expected utility of holding \$40 cash: $0.7\left(\sqrt{100}\right) + 0.3\left(\sqrt{0}\right) > \sqrt{40}$ (i.e., since $7 > 6.32$). Agent 2 would still prefer to hold cash rather

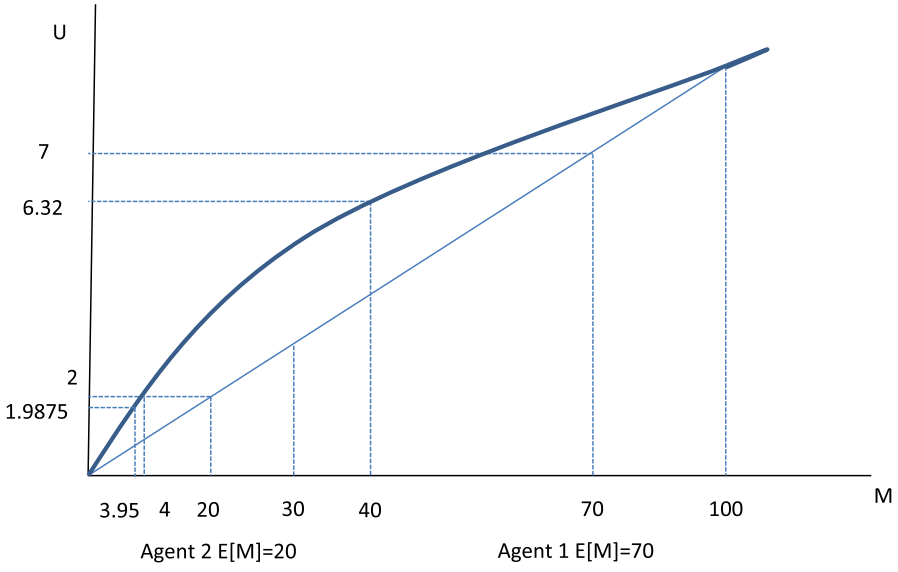

Fig. 2 Optimal choice with risk

than the \$100 bond, since the expected utility from holding the cash exceeds the expected utility of holding the bond: $\sqrt{40} > 0.2\left(\sqrt{100}\right) + 0.8\left(\sqrt{0}\right)$ (i.e., since $6.32 > 2$). Observe that the spot value of the \$100 bond would need to fall from \$40 to below \$4 before pessimistic Agent 2 would prefer to hold the bond rather than to sell it and hold cash instead. This can be seen by comparing the expected utility of holding the bond $0.2\left(\sqrt{100}\right) = 2$ with the expected utility from holding a spot value of \$4 cash instead (since $\sqrt{4} = 2$). If the spot value of the bond falls below \$4 in cash—say, to \$3.95—the expected utility of holding this amount of cash is $\sqrt{3.95} = 1.9875$, which is less than the expected utility of 2 from holding the risky bond. Thus, the pessimistic agent in this simple scenario would continue to hold the bond.

To summarize our answer to our second question—"Why did so many holders of original IOUs sell?"—in the spirit of Harrison and Kreps (1978), one way to conceptualize why some agents will want to hold financial instruments and some will prefer to hold cash is based upon their differing and persistent subjective beliefs about the likelihood of bond default. While differences in subjective estimates concerning the probability of debt redemption are important to the economic events of this time period, the concern is separate from the matter of fairness in all but one important respect. It was widely believed, during the debate concerning redemption, that wealthy investors who held large quantities of bonds were both able to influence the outcome of the legislation and had long been far more cognizant of the probability of federal redemption than the public at large. This would indicate that more accurate expectations were formed by political connections and power, something that many would consider unfair.

Another aspect we wish to consider is concern in those days regarding relative wealth differences between agents. Thus, the third question we wish to pose and answer is: "What role may have liquidity constraints played in so many original holders of IOUs choosing to sell?" As Ferguson (1954, 1961) and Edling (2007) and others describe, there were concerns during and after the war that relatively wealthy speculators took advantage of relatively poor farmers, shopkeepers, and soldiers. While modern scholarship by Perkins (1994, 227–229) argues that this was not as prevalent as many contemporaries believed, our model sheds light on this dynamic in those areas it did occur. There is certainly evidence that a good number of original debt holders (as a result of military impressment) were cash-constrained in the ensuing years, such that selling their financial instruments in the secondary market became attractive. Our model can illustrate this aspect of the buy/sell decision by letting Agent 1 have household wealth of \$100,000 and letting Agent 2 have household wealth of \$10,000. In this case, Agent 1 prefers the bond to a \$40 spot market value of the \$100 bond in cash according to $0.7(\sqrt{100,100}) + 0.3(\sqrt{100,000}) > \sqrt{100,040}$ (as $316.338 > 316.291$). Agent 2 prefers the spot market value (cash) to the bond according to $\sqrt{10,040} > 0.2(\sqrt{10,100}) + 0.8(\sqrt{10,000})$ (as $100.20 > 100.10$). Then consider the particulars of impressments, by which the relatively less wealthy were given a financial instrument with face value B in exchange for goods and services, and agents were forced to accept the exchange. This brings the representative Agent 2 from \$10,000 to \$9900 in the first

stage; in the second stage, the market value of the instrument drops because of market pessimism over default; and Agent 2's liquidity is further constrained. As our exercise above shows, even if Agent 2 is greatly optimistic about being paid back after the war, the opportunity to secure $40 cash with certainty for an instrument with uncertain face value of $100 is very attractive (because of his or her liquidity constraint). This provides us with an answer to the question as to what role liquidity constraints can play in the decision to sell an IOU, and it provides a formal yet simple explanation of how these instruments became clustered in the hands of the wealthy.

Our framework can be extended to make a general statement about takings by governments. Seizure of property during the Revolutionary War is only a specific example of impressment by a government, and similar welfare principles rule whenever confiscation occurs. The good that we have discussed so far is food. While such an occurrence may have been rare during the war, we can imagine the confiscated good being a personal possession such as a musket or land that had been owned by a family for generations. (Land may be impressed by the military for use as a cemetery, for instance, constituting a fairly irreversible use of the land.) The moral context of owning land or a rifle in the family for multiple generations quite likely creates an even larger wedge between the theoretical willingness to accept compensation for the good and the competitive market compensation the government might offer for it. Within our model, a high sentimental attachment is easily represented with a higher marginal rate of substitution and a much steeper indifference curve. During and even after the war it was likely to be unfeasible to fully fund individuals for the full subjective value of what was confiscated from them, just as in many cases today it would be unfeasible for full reparations from takings to be made whenever property is confiscated. But this is still another reason to believe that generally original holders would have been undercompensated.

The Takings Clause of the Fifth Amendment of the Constitution was first proposed by Madison in this historical era of our interest. Indeed, Treanor (1995, 831–832, 835–836, 865–866) argues persuasively that the Takings Clause arose primarily as a result of military impressments during the Revolutionary War. This aspect of our framework is as of much interest in contemporary legal scholarship and public discourse today as it was in the Revolutionary War years. For instance, Boudreaux et al. (1995) describe how citizens have increasingly called for new legislation in several states to offset perceived weaknesses in federal enforcement of the Takings Clause. Serkin (2005, 700) writes: "Sentimental attachments, or a unique business enterprise, may prevent the market from accurately reflecting the value of property to its owner. Nevertheless, in a supposedly bright line, but actually porous rule, the Supreme Court has precluded awarding just compensation based on the subjective value of property taken". Chang (2012) argues that the state should be required to pay the agent's subjective value for the good rather than the market value as takings compensation, although he acknowledges that trying to pay the subjective value introduces theoretical difficulties—namely, moral hazard—and the remainder of his paper proposes some alternative ways forward.

A final aspect of impressment and corresponding compensation is the utility lost through impressment itself. If we assume that no parties attempt to negotiate a price above or below what would increase their own utility, then any "forced transaction" where one party forces another to accept the conditions of a transaction necessarily results in an ex ante loss in utility. In the context we are speaking of, citizens who had their property seized must have felt as though they were made worse off by the transaction. It is not unrealistic to assume that these individuals would have felt that their dignity and autonomy had been violated by being forced into an exchange under these conditions. To many it would have only made matters worse that the means of confiscation was far more personal, irregular, and indeed undemocratic than normal taxes would have been. Therefore, it is not unrealistic to assume that the means by which the transaction took place would have further decreased the agent's utility. This is very much in line with the concept of "procedural utility" developed by Frey et al. (2004).[26] Procedural utility is the concept that not only outcomes, but the ways that outcomes are reached, are important. While an actor may feel positively about a market exchange that the actor agrees to, that same actor might feel negatively if the property is confiscated. In the situation we are discussing, a representative actor would experience a greater fall in utility if the situation we have described in our model occurred through confiscation rather than by regular taxation or a random act of nature such as pests consuming half of the agent's food holdings.

If we were to visually represent this by modifying Fig. 1, U_{-} is the indifference curve our representative agent would reach in the event that the *means* of the reallocation of wealth (confiscation) resulted in no additional disutility (e.g. regular and democratically levied taxation, or pests consuming half of the food). If, in contrast, the agent has $F_0 - F_1$ food confiscated, this would result in even lower utility (to the southwest of U_{-}). This in turn strengthens our conclusion that individuals whose property was confiscated during the war were in fact undercompensated; indeed this is necessarily true in all cases where individuals who refused to sell their goods weren't simply posturing in attempt to gain a higher price, something that is probably unlikely in circumstances where confiscation is likely.

An objection that might be levied against our model and its conception of fairness is simply that the American government was trying to promote a fairer system of government—fairer in the sense of better respecting legal and political rights than the alternative of the British government. From this perspective confiscation could simply be viewed as a type of taxation that was only desperately resorted to at the darkest points of the war.[27] Overlooking the sticky questions of how one's preferences would change if one was a British loyalist or an American

[26] See Frey et al. (2004, 379–383, 391, 397)

[27] While Wright (2008, 57) notes that impressment could or perhaps should be considered a form of taxation, and was only undertaken in the war years because other funding mechanisms had failed, our view is that comparison of these two public finance approaches would hinge on the degree to which impressments in lieu of taxes were uniformly applied across the population in order to fund the public good of national defense. Moreover, in that case, the government might have considered foregoing the issuance of IOUs to a subset of the population and instead considered impressing a more or less equal portion of goods and services from all households in lieu of taxes.

patriot, it is nevertheless clear that to many the American army was performing a service. Within our model this could be expressed with another variable within the utility function representing desire for security and legal reform.

There are three important factors that dissuade us from accepting the point of view that the impressments during the war are fair and directly analogous to taxes. The first, and perhaps the most salient point, is simply the behavior of the American military itself. If the American military commanders viewed their actions as tax collection then a simple question emerges: why issue compensatory instruments at all? Such irregular behavior seems to betray the fact that the American military believed itself to be engaging in irregular behavior that warranted additional compensation, both in spite of, and partially because of, how dire the war had become. If the confiscated goods were effectively taxes then it seems probable that no compensatory instruments would have been issued. Our second major point is that wherever confiscation occurred during the war, the original property owner did not value the combined personal benefit he received from the financial instrument offered to him, patriotism he felt for supporting the war effort, or what he saw as his marginal impact on the war effort. The final essential aspect of this phenomenon is that even if we consider the confiscation payment for a public good, payment for the war was in no way symmetric. Based upon arbitrary conditions of geography and routes that American armies took, certain Americans were forced to pay a highly disproportionate share of their income towards the war effort. It is certainly true that war is neither kind nor fair, and that many paid a far higher price than merely property in the Revolutionary War. This does not imply, however, that a nation devoted to fairness and justice would not do all it could to aid those who had been unfairly targeted and compelled to part with important parts of their property during such dire times.

The take-away point that we would like to emphasize regarding recent Takings Clause scholarship is that even Jefferson's inclination to fully compensate original holders of IOUs for goods and services like food and shelter would not restore baseline utility and would therefore violate concepts of economic fairness that require preservation of the agent's baseline utility. Our simple model enables a variety of policy mechanisms one might propose in takings situations to be compared and contrasted—both those far back in history as well as those in the future.

5 Conclusions and directions for future research

The purpose of our paper was to set forth a basic economic model of the efficiency and equity aspects of mechanisms Jefferson, Madison, Hamilton and others proposed in the 1780s just prior to federal assumption of state debts in 1790. We were motivated to consider this topic by the historic importance of assumption in its own right, but also because of persistent interest in the topic, even in current affairs. In the monetary dimension, scholars such as Swanson and Trout (1992) and Hall and Sargent (2014) feature this historic debate in their more general analysis of fiscal discrimination in US history. We have concluded that no major proposal

discussed in the debate surrounding the redemption of war debt would have resulted in fully compensating citizens whose property had been confiscated during the war. The very fact that the agents themselves had to be forced into the transaction suggests that the agents found the terms of the transaction unfavorable. As it occurred, agents were undercompensated, forced to bear more risk than they desired to, and were treated in a way contrary to what many would consider fair.

Our analysis posed three specific questions and presented a baseline economic model and two extensions to answer those questions. The first question was: "How much would the government need to pay original holders of IOUs for wartime goods taken over and above a fair share of taxes to support the war, if the government wished to return IOU holders to their pre-takings utility?" Our baseline model answered this question by showing the size of compensating surplus that would be necessary, depending upon the degree of local market incompleteness. Our second question was: "Why did so many holders of original IOUs sell?" and one answer to that question is that buyers and sellers typically assign different subjective probabilities that the IOU will eventually be paid; sellers with lower subjective probabilities can optimally sell to buyers with higher subjective probabilities. Our third question was: "What role may have liquidity constraints played in so many original holders of IOUs choosing to sell?" An extension of our baseline model answers that question by showing how a rational household in original possession of an IOU can be made better off in expected utility terms by selling the IOU to an agent who is relatively less liquidity-constrained.

In the legal dimension, contemporary legal scholars trace the Fifth Amendment Takings Clause to widespread military impressments during the Revolutionary War, and some argue that contemporary takings compensation should ideally reflect a property owner's subjective value rather than market value. Our observation is that this current discussion over subjective versus market value is none other than a continuation of the debate engaged by Hamilton et al. at the founding of the United States. To the extent that this is true, our simple model is helpful for organizing important features of the problem and the model could be extended in future research to carefully consider a wide range of alternative takings compensation mechanisms that have desirable efficiency and/or equity features.

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