MVPF Appendix to:
"Monitoring For Waste: Evidence from Medicare Audits (Shi, 2024)
(Main Text) (Online Appendix)
(Policy Insights)

Summary

The main estimates suggest that most of the impact of RAC audits comes from its effect on government savings and hospital compliance costs, rather than any changes in the quality of care patients receive. We can use the estimates to assess the effect of a *marginal* increase in audit rate: the marginal value of public funds (MVPF) of the RAC program. The MVPF is the ratio of society's (i.e., hospital and patient) willingness to pay for each additional dollar that gets returned to the government budget through the RAC program.

Marginal value of public funds:

$$\text{MVPF} = \frac{\Delta \text{ hosp. revenue} + \Delta \text{ hosp. compliance costs} + \Delta \text{ treatment costs} + \Delta \text{ pt health}}{-\Delta \text{ hospital revenue} + \Delta \text{ monitoring costs}} . \quad (1)$$

The numerator of the MVPF is the societal willingness to pay to *avoid* an increase in auditing. This depends on the change in hospital revenue, the change in hospital compliance costs, the change in treatment costs, and the change in patient health. The denominator of the MVPF is the change in government budget due to an increase in auditing. This depends on the change in hospital revenue (which is equal to Medicare's savings) and the change in government monitoring costs.

Given the the dynamics of hospital responses, the time horizon considered is important. If hospitals incur fixed costs such as a large upfront investment in technology, then these costs should be compared to the discounted value of savings over a multiyear horizon. To remain agnostic about the time horizon for calculating welfare, I calculate the MVPF of RAC audits using the cumulative costs and benefits for each year between 2011 and 2018.

The assumptions and parameters used for the baseline MVPF calculation are listed in Table 1, and the details of the calculation are discussed below. I use the estimates derived from the event study in Figure 5 and Table III to inform the effect on hospital revenue and hospital compliance costs. To calculate the effect on government monitoring costs, I multiply the reclaimed payments in Figure H12 by RACs' contingency fees. At baseline, I assume a contingency fee of 10.75 percent (the average of the range of contingency fees, from 9 and 12.5 percent). For the value of the change in patient health, I assume in the baseline

calculation that it is 0. This is motivated by the null result from the patient-level results.[1]

For the change in treatment costs, I assume at baseline that this does not change and is equal to 0. This would be the case if hospitals substituted inpatient admissions with other care that has the same cost, or used the freed up capacity to treat non-Medicare patients more intensively. In practice, this assumption is likely a lower bound on the treatment cost savings. If hospitals instead incurred *lower* treatment costs after reducing admissions, then the societal savings would be even larger and thus the MVPF would be smaller.

Figure 1a plots the yearly MVPF of a one percentage point increase in the 2011 audit rate. The MVPF in 2011 is relatively high, as the savings from RAC activity in the first year are overshadowed by the compliance costs hospitals incur. It falls over time as more savings accrue and hospital compliance costs decrease. Figure 1b plots the MVPF by 2013 under different assumptions. If RAC audits had no deterrence effect and only reclaimed payments, the MVPF would be much larger at 8.05, as each dollar returned to the government's budget would be extremely costly. If RAC audits did not increase hospital administrative costs, the MVPF would be lower at 1.15. The MVPF is also sensitive to assumptions about the effect on patient health: assuming the marginal admission reduces mortality substantially lowers the MVPF, while assuming that it increases mortality increases it (using the upper and lower bound of mortality estimates reported in Currie and Slusky (2020)).

Comparing the MVPF of a revenue-raising policy like RAC audits to the MVPF of an expenditure policy tells us whether combining the two would be welfare-improving. If the two policies have the same distributional incidence and the former is smaller than the latter, then the combined policy is welfare-improving. In this case, the natural policy to combine RAC audits with would be Medicare expenditure itself. Figure 1a plots the MVPF against two MVPFs: 1.63 (the MVPF of Medicare spending, estimated by Finkelstein and McKnight (2008) and Hendren and Sprung-Keyser (2020)), and 1.3 (a commonly-used benchmark for the MVPF (Finkelstein and Hendren, 2020)).[2] The MVPF of RAC audits crosses these thresholds for the MVPF of Medicare expenditure by 2013, and it crosses this threshold for an MVPF of 1.3 by 2015. Thus, recovering Medicare revenue via RAC audits is welfare

[1]Patient health may not be the only component of patient welfare that is affected by audits; for example, patients could suffer psychological harm if they are denied admission when they believe it is necessary, but they could also be harmed by an unnecessary admission in the form of wasted time spent in the hospital. However, these other components of patient welfare are difficult to measure and it is unclear what their net effect on patient welfare would be. So, I primarily focus on the effects of a deterred hospitalization on patients' physical health.

[2]See the Policy Impacts Library (available at www.policyimpacts.org) for an extensive database of MVPF estimates on other forms of government expenditure. The revenue raised from RAC audits could instead be spent, for example, on Medicare Part D (MVPF: 1.98) or to subsidize Medicare Advantage plans (MVPF: 1.0). Note that comparisons of MVPFs depend on one's welfare weights unless the programs have the same distributional incidence.

improving in the medium- to long-run.

Calculations

I next lay out the estimates required to calculate the MVPF in each year. Let θ_t be the estimates on log inpatient revenue in Table III. Let I_{2010} be a hospital's Medicare inpatient revenue in 2010 (Table 1). Define ΔI_T as the value of the change in cumulative inpatient revenue between 2010 and year T due to an exogenous increase in the audit rate in 2011. If θ_t is the estimated percent reduction in inpatient revenue in year t relative to 2010 (that is, Table III, column 2), then:[3]

$$\Delta I_T = \sum_{t=2011}^{T} \theta_t I_{2010}. \tag{2}$$

The total effect on hospital revenue also includes the money reclaimed back from audits. Let λ_t be the coefficient on payments reclaimed back from hospitals in Figure H12. The eventual value of the reclaimed payments also has to be scaled by the share s of reclaimed payments that were refunded to hospitals in later settlements with hospitals, as discussed in Appendix Section A. The value of all the revenue (from deterred admissions and reclaimed payments) returned to Medicare as a result of increasing the 2011 audit rate is:

$$\Delta \text{ hosp. revenue}_T = -\Delta I_T + (1-s) \sum_{t=2011}^{T} \lambda_t. \tag{3}$$

For provider compliance costs up to year T, let K_{2010} be a hospital's 2010 administrative costs (Table 1) and γ_t be the estimated percent increase in compliance costs in year t relative to 2010 (that is, Table III, column 5). Then

$$\Delta \text{ hosp. compliance costs}_T = \sum_{t=2011}^{T} \gamma_t K_{2010}. \tag{4}$$

The effect on government monitoring costs by year T is defined as the contingency fee f multiplied by the payments reclaimed back from audits (λ_t) in each year between 2010 and T. I assume f to be the midway point between 9 and 12.5: 10.75 percent. If RACs are perfectly competitive and make zero profit, then multiplying by f gives the direct *social* cost of monitoring; otherwise it is an upper bound on the social cost.

[3] ΔI_T is a negative number because θ_t is negative, and the effect of increased auditing on hospital inpatient revenue is negative.

$$\Delta \text{ monitoring costs}_T = \sum_{t=2011}^{T} \lambda_t f. \tag{5}$$

The changes in patient health and treatment cost are assumed at baseline to be 0.

$$\Delta \text{ pt health}_T = 0. \tag{6}$$

$$\Delta \text{ treatment costs}_T = 0. \tag{7}$$

The numerator of the MVPF in year T is equal to the sum of the changes in hospital revenue, compliance costs, treatment costs, and patient health, discounted by δ so that it is in terms of 2010 dollars. The denominator is equal to the sum of the changes in hospital revenue (negated) and government monitoring costs, and is also discounted.

Alternative Assumptions

Figure 1b plots the MVPF in 2013 with alternative assumptions.

Compliance Costs The baseline MVPF calculation uses estimates on compliance costs per year, as measured by hospital administrative costs in HCRIS. I also calculate the MVPF assuming no hospital compliance costs ("No compliance costs"). By 2013 the MVPF would be 1.07 if hospitals did not incur compliance costs, compared to a baseline of 1.42. The lower MVPF reflects that, absent hospital compliance costs, hospitals' willingness to pay to avoid an increase in audit rate would be lower.

Medicare Savings The baseline calculation assumes that Medicare saves all the revenue from deterred admissions. Figure 1b shows the results for alternative assumptions about Medicare savings. If there is no deterrence effect and all the savings are from the reclaiming of denied payments ("Savings: denials only"), then the MVPF of RAC audits is very high (8.05 by 2013), making it a much less attractive source of government revenue. I also consider alternate assumptions that Medicare only saves *some* of the revenue from deterred admissions. First, I consider making the assumption that all deterred inpatient stays become observation stays ("Savings: inpt $\rightarrow$ obs"). I assume that each hospitals would be paid \$3,160 for each observation stay that substitutes for an inpatient stay, which I take from a MedPAC report on the difference in Medicare payments for inpatient stays and comparable observation stays (Medicare Payment Advisory Commission (2015), Figure 7-2). This results in a slightly higher MVPF than baseline (1.83 by 2013), as the government's savings are smaller since it has to pay for observation stays. Second, I consider using the estimates on the effect of total inpatient *and* outpatient revenue. This leads to a slightly lower MVPF than baseline (1.35

by 2013), as the estimates on savings from combined inpatient and outpatient revenue are more pronounced than just the savings from inpatient revenue alone.

Patient Health Effects The baseline calculation assumes that there are no patient health effects for the marginal patient denied a hospital admission. I relax this assumption by considering two possible scenarios: first that the marginal admission increases patient mortality ("Patient health ↑"), and second that it decreases patient mortality ("Patient health ↓"). I take the estimates of the effect of the marginal hospital admission on mortality from Currie and Slusky (2020), which reports a (statistically insignificant) 0.457pp *increase* in 7-day mortality and a 0.488pp *decrease* in 15-day mortality for the marginal hospital admission. Using a value of a statistical life of $1 million, I find that the MVPF calculations are sensitive to the assumption made about effects on patient health. However, given that neither my nor Currie and Slusky's (2020) analysis finds a statistically significant effect on patient health, so I assume at baseline no effect on patient health effects.

Treatment Cost The baseline MVPF calculation assumes, conservatively, that there is no change in treatment cost when inpatient stays are deterred by RAC audits. I relax this assumption two ways: first, by assuming that Medicare payments for inpatient stays are a constant markup of the costs ("Treatment costs: "markup") , and second, by assuming that inpatient stays become observation stays, and Medicare payments for observation stays are a markup of the treatment costs ("Treatment costs: obs"). The first scenario assumes that Medicare inpatient payments are a 1.55x markup of hospital costs, which is based on estimates of markups for one-day stays by MedPAC (2015). The second scenario assumes that Medicare payments for observation stays are 30 percent that of payments for inpatient stays,[4] and the Medicare payments for observation stays are a 1.55x markup of the hospital's costs to provide an observation stay. Both scenarios are less conservative than the baseline assumption of no changes in treatment costs and result in lower MVPFs than baseline.

[4]The ratio between the average 2010 payment for an inpatient stay ($5640) for hospitals in the border sample and the average payment for an observation stay in the same sample ($1671) is 0.296.

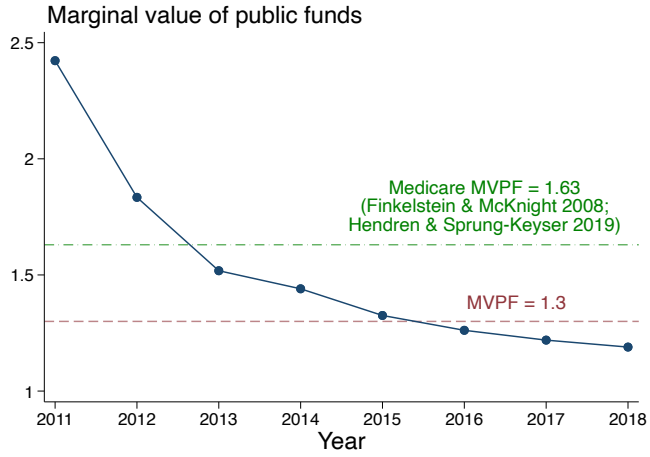
Table 1. Marginal Value of Public Funds Baseline Parameters

	A. Estimates
Effect on admissions	2011-2015: estimates after 2015: 2015 estimate
Effect on compliance costs	2011-2015: estimates after 2015: 0
Payments demanded	2011-2015: estimates after 2015: 0
Avg 2010 inpatient revenue	$15,029,306
Avg 2010 compliance cost	$12,822,887
	B. Parameters
RAC contingency fee	10.75%
Marginal value of public funds	1.3
Discount rate	2%
Share of demanded pmts refunded	68%

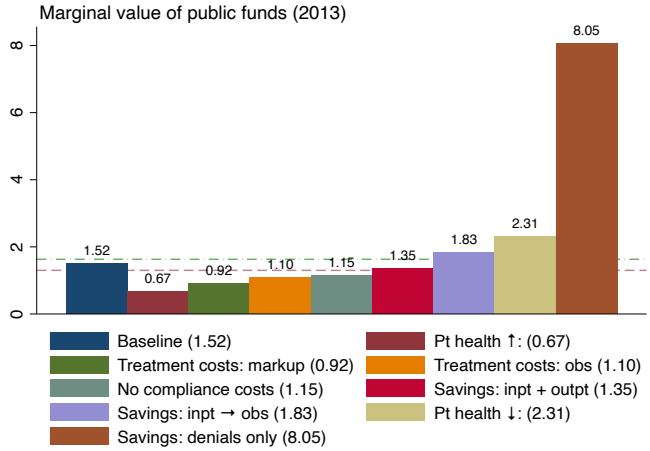
This table lists the parameters and assumptions for the MVPF calculation depicted in Figure 1a. Effects on admissions and compliance costs are from Table III. Payments demanded are from Figure H12. The 2010 hospital revenue and hospital compliance costs are the median values for hospitals in the border hospital sample.

Figure 1. Marginal Value of Public Funds Calculation

(a) MVPF By Year, Baseline Calculation



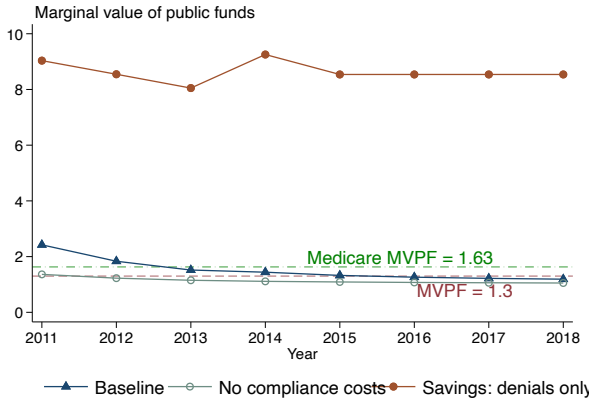
(b) MVPF By 2013 Under Different Assumptions



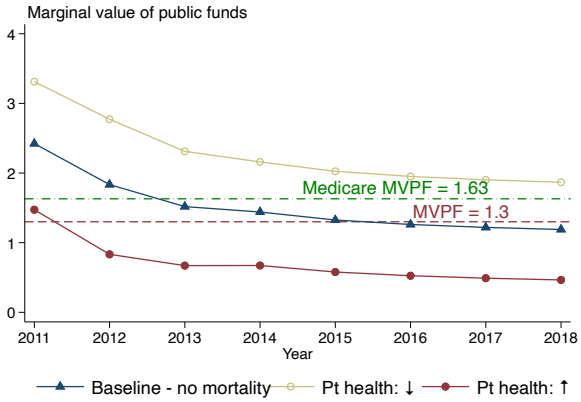
This figure plots the marginal value of public funds (MVPF) of an increase in the 2011 RAC audit rate. Panel (a) plots the MVPF of savings between 2011 and a given year under the baseline assumptions, compared to MVPF values of 1.3 and 1.63 (Finkelstein and McKnight, 2008; Hendren and Sprung-Keyser, 2020). Panel (b) plots the MVPF by 2013 under different assumptions detailed in Appendix Section . "Patient health ↑:" and "Patient health ↓:" assume that patient mortality decreases or increases from the marginal admission, respectively. "Treatment costs: markup" assumes that treatment costs are a constant markup of inpatient payments, and "Treatment costs: obs" assumes that treatment costs are a constant markup of observation stay payments. "No compliance costs" assumes there is no increase in hospital admin costs. "Savings: inpt + outpt" uses estimates on the effects of inpatient and outpatient revenue, "Savings: inpt → obs" assumes all deterred inpatient stays become observation stays, and "Savings: denials only" assumes there is no deterrence effect.

Figure 2. Marginal Value of Public Funds by Year, Alternative Assumptions

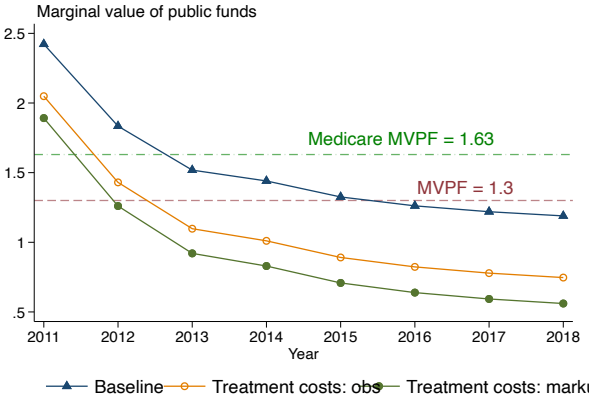
(a) No Compliance or No Deterrence



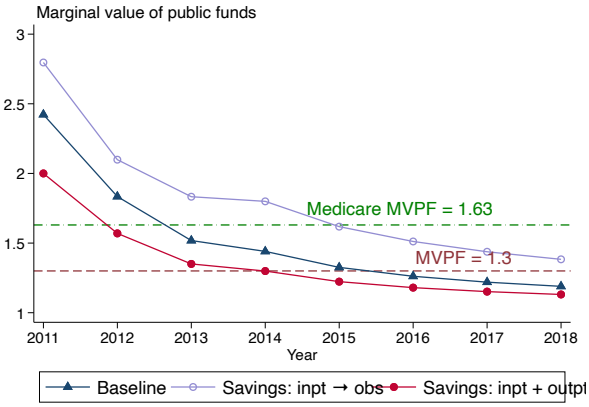
(b) Patient Health Effects



(c) Treatment Costs



(d) Medicare Revenue



This figure plots the marginal value of public funds of a one percentage point increase in the RAC audit rate under different assumptions (a) on compliance costs and deterrence effect, (b) patient health effect, (c) treatment costs, and (d) Medicare revenue savings, as summarized in Figure 1b.

References

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