

Legend

formalized
result

formalized
lemma

formalized
definition

Sections 2–3
slots, click rates, values,
GSP and VCG pay-
ments, truthfulness and
equilibrium predicates

Definition 4
locally envy-
free equilibrium

Remark 1
same-bid GSP per-
click payment weakly
dominates VCG by a
generic ranked tail-
payment induction

Remark 2
VCG-style position
mechanisms are
dominant-strategy
truthful from the welfare-
maximization/externality-
tax certificate

Remark 3
truth-telling is not
dominant under GSP,
by the paper’s three-
bidder/two-slot deviation

Sections 2.2–2.3
concrete GSP wit-
ness; running example
Nash, LEF, payments,
and VCG-minimality

Lemma 5
locally envy-free
equilibrium outcomes
are stable assignments

Lemma 6
stable assignments
are implementable
as locally envy-
free GSP outcomes

Theorem 7
the B^* GSP profile
gives VCG-equivalent
positions and payoffs and
is revenue-minimal among
locally envy-free equilibria

Theorem 8
full-history Bayes-consistent
legal-history ex-post PBE;
arbitrary-continuation
optimality, effective
dropout uniqueness, and
VCG-equivalent outcome