Taxes and Telework: The Impacts of State Income Taxes in a Work-from-Home Economy

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Abstract

This paper studies the interstate effects of decentralized taxation and spending when individuals can work from home (WFH). Because WFH decouples population and employment, the analysis of tax impacts on state populations, employment levels, wages and housing prices is radically different than in the standard model where individuals live and work in the same state. Which state can tax teleworkers—leading to either source or residence taxation—matters for tax impacts under WFH. Our main findings, which pertain to the employment and wage effects of WFH, show that a shift from a non-WFH economy to WFH reduces employment and raises the wage in high-tax states, with larger effects under source taxation. Once WHF is established, an increase in a state's tax rate either reduces employment further while raising the wage (source taxation) or leaves the labor market unaffected (residence taxation). The analysis also shows that the residence-taxation equilibrium is efficient, while source taxation is inefficient.

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by

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1. Introduction

State and local governments are limited to taxing people living, or activities occurring, within their borders. With the exception of a relatively small share of workers commuting between states in multi-state metro areas such as New York and Chicago, people live and work in the same state. But telework fundamentally severs the geographic link between the locations of the employer and the worker, in a more fundamental way than for physical interstate commuters. As a result, states may disagree about whether remote work occurs "within" their borders for tax purposes, with either the employer's location or the worker's home plausibly viewed as the place where the economic activity occurs. Such a distinction means that standard models, which assume people live where they work, are no longer able to appropriately characterize the effect of state taxes on migration, labor flows, wages, and housing prices.

In this paper, we show how the economy's locational equilibrium is affected by decentralized taxes and spending when an individual can work for an out-of-state employer from the convenience of his or her home. To do so, we adapt the model of Brueckner, Kahn and Lin (BKL, 2022), who analyze the effect of decoupling residence and work locations in a work-from-home (WFH) economy, showing how telework alters the equilibrating role of wages and house prices.[1] Our model adds differential state taxes and public services (an endogenous amenity)

[1] Brueckner and Sayantani (2022) show that allowing for both remote and non-remote worker types does not change the main qualitative implications of BKL's model. Although such an extension in our context

to BKL's framework. This extension requires specifying which state (the employment or residence state) has taxing rights over the income of a teleworker. To gain intuition, we consider two polar cases, where teleworkers are taxed only by the source (employment) state or taxed only by the state of residence. Toward the end of the paper, we also consider hybrid systems that contains elements of both the source- and residence-taxation regimes. Given the complex variations in tax practices across the states, each of these three systems (source-based, residence-based, and hybrid) may pertain to different subsets of U.S. households as taxed by state or local governments.

With a few exceptions, sourcing rules are ignored in the current public finance literature on personal income taxation, recognizing that most workers lived and worked in the same place prior to the recent pandemic. Although these rules have been a major focus in the analysis of corporate and commodity taxes,[2] we have a limited understanding of how state income tax systems—and the resulting public services—will affect where people live and work in a WFH economy. As telework has made interjurisdictional working arrangements much more common, with economists arguing that they are here to stay (Barrero, Bloom and Davis, 2021), insights on the effect of public policies in the WFH economy are clearly needed. Our paper furthers this goal by showing the effect of tax *rates* on the spatial equilibrium under WFH, while also exposing the importance of tax *rules* in this new telework era.

The appropriate taxation of teleworkers is an important policy issue. A recent Supreme Court lawsuit filed by the state of New Hampshire challenged the ability of Massachusetts to tax individuals working for Massachusetts employers from their New Hampshire homes. Given that the Court declined to hear this case, we are left with a hodgepodge of sourcing rules that differ across states, with legal uncertainty on the power to tax teleworkers expected for the

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would allow for state taxes to potentially influence an additional margin, the added complexity is unlikely to be worthwhile in the current setting.

[2] Where profits should be taxed in the corporate income-tax context has gained much more attention (see, for example, Auerbach and Devereux, 2018 and Suárez Serrato and Zidar, 2018), but the insights from studying multi-nationals engaged primarily in profit shifting rather than relocation of real activities cannot easily be extended to the personal income tax. The same is true for commodity taxes (Lockwood, 1993; Lockwood, 2001), although the parallel between online shopping and telework is a bit clearer. However, individuals who engage in online shopping are unlikely to move across states due to a sales tax increase, in contrast to the current setting.

foreseeable future.[3] Such controversies, combined with limited economic models, means that there is little guidance on the economic consequences of various sourcing rules. We shed light on the effect of these rules for the United States, for other federations, and even supra-national institutions that are struggling with the tax treatment of remote workers.[4] Our theoretical model can provide guidance for policymakers debating where income should be taxed in a digital era and how state-level tax changes will affect employment and population.[5]

The model adds to BKL's framework a public good financed by state-specific ad valorem taxes on earnings. Consumer utility then depends on housing and non-housing consumption, the public good, and amenities, which differ between the two states that comprise the stylized economy. Amenities are high in state h and low in state l. In the absence of WFH, workers work where they live, and the single equilibrium condition requires equal utilities between states h and l, determining the division of population between them. Under WFH, residential utilities must again be equalized, but because workers can be employed anywhere, they must be indifferent between working in state h or l, which requires that net-of-tax wages must be equal across the states. The utility- and net-wage-equalization conditions provide two equations to determine two unknowns: population and employment in state h, which are disconnected under WFH instead of taking values that are identical in the absence of WFH. State-l values

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[3] Many states follow a physical presence rule to determine what share of income is sourced to the employment state (see Agrawal and Stark, 2022, for extensive discussion). Under such a rule, if a worker never sets foot in a state to work, taxes will be effectively residence based. But if the worker needs to be in-person some days, then the employment state has taxing rights on the income proportional to the share of days worked there. But, other states follow the "convenience of the employer" rule, litigated in *Zelinsky v. Tax Appeals Tribunal of the State of New York*. The rule states that "any allowance claimed for days worked outside New York State must be based upon the performance of services which of necessity, as distinguished from convenience, obligate the employee to out-of-state duties in the service of his employer." In other words, for only the residence state to have taxing rights over a teleworker, the worker must be able to show that the work was undertaken outside of the state for business reasons of the *employer*, rather than for her own *convenience*. Such a rule, adopted by New York, implies that income is taxed by the source state under work-from-home arrangements.

[4] These issues raise challenges for other federal systems such as Canada and Switzerland. They also arise within supranational institutions such as the European Union, where cross-border workers are subject to taxation in the source state, but are also subject to taxation in the state of residence on a pro rata basis. At the onset of the pandemic, bilateral measures were put in place to mitigate the complexities of apportionment between two member states. Finally, these issues arise for telework across international boundaries, such as a EU resident teleworking outside the EU. Here bilateral tax treaties determine where income is taxed.

[5] Unfortunately, the WFH revolution is too recent to allow an empirical study of how state tax rates affect employment and population levels. We will conclude with guidance about how such analysis could proceed in the future.

are determined by the overall population constraint.

Tax rules are important. The form of the net-wage-equalization condition depends on whether taxes are paid in the state where the worker is employed (source taxation) or in the state of residence (residence taxation). Under residence taxation, because the same (residential) tax rate is applied to wage income regardless of where it is earned, the tax rate drops out of the net-wage-equalization condition, which reduces to a requirement that wages are equalized across states. Under source taxation, by contrast, the tax rate applied to the wage differs by the state of employment and thus does not cancel from the equalization condition.

The analysis first asks how emergence of WFH affects employment and population in the two states, comparing the impacts under source and residence taxation. This question is answered under the assumption that taxes in the two states are set optimally in the absence of WFH, which implies a higher tax rate in h, the high-amenity state. With tax rates then held fixed at these non-WFH values, as they would be in the short run, we show that the shift to WFH reduces employment in state h relative to the no-WFH equilibrium while increasing it in state l, doing so under both WFH tax regimes. These employment effects raise (lower) the wage in state h (state l). Notably, the employment and wage changes are larger under source taxation than under residence taxation. While the effects of WFH on state populations, and thus on housing prices, are ambiguous under source taxation, WFH leads to an increase in state h's population and housing price under residence taxation, with the reverse effects in state l. Thus, high-tax states are predicted to unambiguously lose employment under WFH while also gaining population when taxation is residence-based. The increase in population arises because WFH allows individuals to move to a higher amenity state without the prior loss in wages.

Turning to the impacts of state taxes, we analyze the impact of an exogenous increase in state h's tax rate, starting from an arbitrary level. Under WFH with source taxation, the tax increase reduces employment and raises the wage in state h. But under WFH with residence taxation, employment and wage effects are strikingly absent, a consequence of wage (as opposed to net-wage) equalization. The tax increase's effects on populations and housing prices are ambiguous in general under the two WFH regimes, but can be signed if labor demand

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is inelastic (source case) or by specifying whether the initial tax rate is below or above the optimum (residence case). This latter ambiguity also applies in the absence of WFH, where the changes in population, and thus in employment, depend on the level of the initial tax rate relative to the optimal rate.

Unambiguous employment effects emerge under the two WFH regimes because population and employment are decoupled when residential and work locations can differ. The ambiguous effects of the tax increase on population are due, however, to the presence of an endogenous amenity in the form of public spending. Under the WFH regime with residence taxation or in the absence of WFH, a higher tax rate makes the state more attractive (thus inducing a population inflow) if the tax rate is initially suboptimal, but vice versa if the tax rate is initially supra-optimal. By contrast, in the WFH regime with source taxation, private consumption is equalized across states via net-wage equalization, so that a higher tax makes state h more attractive if it simply increases the public-good level, an outcome ensured by inelastic labor demand. Population then increases in state h while employment falls. In these ways, the presence of endogenous public amenity precludes simple statements about the effect of a tax increase on state populations. However, if the tax increase raises state h's population, this change in conjunction with the zero or negative employment effects in the state allows us to conclude that the net flow of remote work shifts toward state l.

The main positive conclusions of the analysis thus pertain to the employment and wage effects of WFH. A shift to WFH from a non-WFH regime reduces employment and raises the wage in high-tax states. Once WFH is established, an increase in a state's tax rate further reduces employment and raises the wage if taxes are source based or leaves the labor market unaffected if residence taxation is present.

The analysis also derives an important normative result by showing that the residence-taxation equilibrium under WFH is efficient, while the source taxation is inefficient. The implication is that workers are better off under residence taxation. Intuitively, the residence principle efficiently equates marginal products across states while effectively converting the labor tax into an efficient head tax, which in turn induces individuals to account for public-good congestion costs. As a result, the federal government would want to induce states to

choose the residence principle for state income taxes.

An extension of the model derives further tax impacts by considering a group of (affluent) workers who pay taxes but do not benefit from the public good they finance, while operating in labor and housing markets that are segmented from the rest of the population. For this group, state taxes are a pure negative force, just like low amenities, without the complication introduced by the valuation of public goods. As a result, determinate results can then be stated regarding the tax increase's effects on the rich populations of the states and the housing prices they pay. In particular, with residence taxation, the rich population and the housing price paid fall in state h, being unaffected if taxes are source based.

Finally, we extend the model to include two hybrid systems that currently apply to certain combinations of U.S. states. Under one such system, the source state first taxes the income of teleworkers in the state, and then the residence state taxes the same income but offers a tax credit for taxes already paid. We show that, if such a system were universal among states, only one state's workers can work in both states in equilibrium, with teleworking occurring in only one direction. If these workers turn out to live in state l, we show that the resulting hybrid equilibrium coincides with the source-taxation equilibrium. Otherwise, a new equilibrium emerges distinct from that under either source or residence taxation. However, we show that, under a different hybrid system where one state unilaterally taxes nonresident teleworkers while the other state refuses to offer tax credits, the equilibrium coincides with the residence-based equilibrium.

We make several contributions to the urban economics literature. First, we extend spatial equilibrium models to study important questions in public finance related to locational sorting across cities due to decentralized taxation.[6] Most closely related to our paper is Albouy (2009), who shows that, because federal taxes are based upon nominal rather than real incomes, even they can influence the location of economic activity in the presence of cost-of-living differences.[7] While the influence of state tax differentials is more transparent, our contribution is to show that the rules over where income is taxed influence how location decisions and prices respond

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[6] See, Suárez Serrato and Zidar (2016) and Fajgelbaum, Morales, Suárez Serrato, and Zidar (2019).

[7] Wildasin (1980) and Wildasin (1986) characterize the efficiency conditions for taxes in a federal system.

to those taxes and that the response depends critically on whether workers are able to work remotely. Second, the literature on spatial equilibrium has recently emphasized the role of endogenous amenities in reinforcing sorting across jurisdictions (see Brueckner, Thisse, and Zenou 1999; Diamond, 2016; Couture, 2019; Almagro, 2019). By considering an endogenously determined level of public services, we introduce a force that can influence whether a state becomes a more attractive place to live even as it becomes a less attractive place to work. Finally, we contribute to the recent set of theoretical papers that have analyzed how telework shapes urban form (Behrens, Kichko and Thisse, 2021; Delventhal, Kwon and Parhomenko, 2022; Delventhal and Parkhomenko, 2021; Gokan, Kichko and Thisse, 2021; Kyriakopoulou and Picard, 2022; Larson and Zhao, 2017) by studying how public policies interact with telework.

In addition, we contribute to the public finance literature. First, in relaxing the common assumption that workers live where they work (Gordon and Cullen, 2012; Lehmann, Simula and Trannoy, 2014),[8] where people are taxed becomes critical. Under certain taxing rules, our model implies that the migration elasticity is no longer sufficient to determine spatial distortions, with researchers also needing to estimate employment elasticities.[9] Critically, in some cases, our model indicates that estimates of residential responses to taxation will incorrectly determine both the magnitude and the *direction* of spatial distortions to the labor market. Second, our paper takes a "tax system" approach to the study of state taxation. As noted in Slemrod and Gillitzer (2014), most of the income tax literature focuses on the effect of tax rates and tax bases, at the expense of other important legal rules that make up our tax systems. We show that the responses to state taxes depend critically on the sourcing rules for income, but the incidence and spatial distortions resulting from various tax rules are quite different from those found in the corporate tax literature (Auerbach and Devereux, 2018). Third, we show that public spending is critical to the new spatial equilibrium. Although most of the literature on tax-generated residential relocation focuses on high-income workers (Kleven

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[8] The exceptions include papers that have studied the presence/lack of reciprocity agreements on interstate commuting or interjurisdictional mobility (Rork and Wagner, 2012; Coomes and Hoyt, 2008; Rohlin, Rosenthal and Ross, 2014; Agrawal and Hoyt, 2018; Agrawal and Tester, 2022).

[9] For papers on tax-induced residential mobility in the United States, see Agersnap and Zidar (2021), Young and Varner (2011), Moretti and Wilson (2017), Bakija and Slemrod (2004), and Young et al. (2016). Giroud and Rauh (2019) study the impact of state taxes on business activity.

et al., 2020), for whom public services hold little value, the migration of individuals who value public services show a richer pattern of responses. Telework under the source principle also raises issues of tax exporting, whereby the labor supply decisions of nonresident teleworkers influence the public services residents receive.

The plan of the paper is as follows. Section 2 presents the model, while the analysis is carried out in section 3. Section 4 presents extensions of the main analysis, while section 5 offers conclusions.

2. Model

2.1. The setup

The economy has two states[10] with fixed unitary land areas but different amenity levels, containing a total population of $2\overline{N}$. The wage earned by workers employed in a state is given by $w(L)$, where L is the employment level and $w' < 0$. The underlying production function is $f(L)$, with $w = f'$ and $f'' < 0$, and it implicitly depends on a fixed factor such as immobile capital or a fixed business land area.[11] The wage is the same for resident and remote workers, with no productivity loss from working remotely.[12]

States levy an ad valorem income or payroll tax t on workers employed in the state (source principle) or residing there (residence principle), with the revenue used to provide a public good z. Assuming that z is a publicly produced private good produced at unitary cost, then $z = tB/N$, where B is the tax base and N is the state population. The expression for the tax base B depends on whether taxation uses the source principle or the residence principle, as

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[10] Although we refer to the jurisdictions as states, the model also could apply to countries or to localities within states that are allowed to levy local income taxes.

[11] BKL assumed that states also differ in productivity, with the wage function depending on a state productivity parameter. However, this extra dimension of asymmetry between the states (beyond the assumed amenity difference) is inessential in making the points we wish to establish in the analysis, though it could be added with relative ease.

[12] While in BKL's model and the present one, worker utility-equalization plays a key role, the models do not explicitly incorporate firm mobility (and hence an equal-profit condition), an important additional feature of the Rosen (1979)-Roback (1982) framework (whose approach partly motivated BKL). Firm mobility in the sense of Rosen and Roback is only tractable in a model with constant returns to scale, and adopting this assumption would obscure the link between wages and employment levels that lies at the heart of our analysis. A different mobility notion would apply to capital, a possible fixed factor in state production. However, capital mobility would cause the wage function to shift as capital relocates, altering the marginal product of labor. Such an extension would complicate the analysis.

seen below. Because z then depends on the tax rules along with a state's wage, employment, and population levels, the level of this publicly-provided is endogenous, in contrast to the exogenous amenity A.

In addition to depending on A and z, consumer utility is determined by consumption of land (housing), denoted q, and a numeraire non-land good, denoted e. The utility function is assumed to take a quasi-linear form:

$$A \; + \; e \; + \; V(tB/N) \; + \; U(q) \;\; = \;\; A \; + \; (1-t)w \; - \; pq \; + \; V(tB/N) \; + \; U(q), \quad (1)$$

where the equality uses the budget constraint $e = (1-t)w - pq$. Note that the increasing functions $U(\cdot)$ and $V(\cdot)$ satisfy $U'', V'' < 0$, and that the coefficients of A and e are identical and equal to unity through choice of units of measurement.

Using the housing first-order condition $U'(q) = p$, the terms $U(q) - pq$ in (1), which give "net housing utility," can be written as $U(q) - U'(q)q \equiv X(q)$, where $X'(q) = -U''(q)q > 0$. But with a state's land area fixed at unity, housing consumption is given $q = 1/N$. Net housing utility can then be written as $X(1/N) \equiv H(N)$, with H decreasing in N because $X' > 0$. This decrease in net housing utility arises because the housing price p, which can be written as $p(N) \equiv U'(1/N)$, is increasing in N given $U'' < 0$ (making X' positive from above and hence $H' < 0$).

Rewriting utility using the H function, it becomes[13]

$$A \; + \; (1-t)w(L) \; + \; V(tB/N) \; + \; H(N). \quad (2)$$

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[13] Two types of income, land rent and profit (or income to the fixed factor, equal to $f(L) - f'(L)L$) are not captured in this utility expression. Although it could be assumed that this non-wage income flows to absentee owners, this assumption is not tenable in a model that is intended to portray an entire economy. Instead, we assume that the total income across both states from these two sources is equally shared among workers, and that this income is not subject to state taxes, so that the utility expression in (3) is then augmented by this non-wage income share (possibly reduced or entirely eliminated by a federal tax that finances a nationally uniform public good). Importantly, since this quantity (which is endogenous) does not depend on the state of residence of the worker, it cancels in all the utility-equalization conditions presented below, which equate worker utilities across states. Non-wage income can thus be ignored since it plays no role in the derivation of the results of the analysis.

This framework implicitly treats a state as a single residence and work location, when in fact cities are the relevant housing and labor markets. To make the model more realistic in this regard, we could assume that population and employment in each state are equally divided among a common number of identical cities, each subject to the state's tax rate. Without loss of generality, we can assume that this common number of cities equals 1.

2.2. Equilibrium conditions

As explained in the introduction, a state's employment level equals its population ($L = N$) in the absence of WFH. As a result, the source and residence principles yield the same expression for the tax base B, which equals $w(N)N$, or total wages earned in the state by its residents, all of whom are employed there. Thus, $z = tB/N = tw(N)N/N = tw(N)$, which equals the tax payment of an individual worker. Substituting this expression in the V function, the single non-WFH equilibrium can be stated, which requires populations to adjust so as to equalize utilities. Adding state subscripts in (2), this condition is

$$
A_h \;+\; (1 - t_h)w(N_h^*) \;+\; V(t_h w(N_h^*)) \;+\; H(N_h^*) \;=\;
$$

$$
A_l \;+\; (1 - t_l)w(N_l^*) \;+\; V(t_l w(N_l^*)) \;+\; H(N_l^*), \tag{3}
$$

where asterisks denote non-WFH equilibrium values. Substituting $N_l^* = 2\overline{N} - N_h^*$ in (3), the condition then determines the equilibrium value of N_h^*, with N_l^* determined residually.

WFH breaks the equality between a state's employment and population. Equilibrium under WFH is thus determined by two conditions: a utility-equalization condition, which makes workers indifferent as to the state of residence, and a net-wage-equalization condition, which makes them indifferent to the state of employment. The form of these conditions depends in part on whether taxation is source or residence based. With source based taxation, the net-wage-equalization condition is

$$
(1 - t_h)w(\widetilde{L}_h) \;=\; (1 - t_l)w(\widetilde{L}_l), \tag{4}
$$

where tildes denote WFH-equilibrium values, and where the wage now depends on employment, not population. Note that, with source taxation, the tax rate is the rate for the state where

employment occurs. The tax base of a state is now total wages paid to workers employed there, given by $B = tw(L)L$. As a result, $z = tw(L)L/N$, with z equal to total taxes collected from workers *employed* in the state divided by the number of workers *residing* in the state.

With the employment choice independent of the residence choice under WFH, and with net wages equalized across states, the net-wage terms drop out of the utility-equalization condition.[14] Inserting the new expression for z and adding state subscripts, this condition is

$$A_h \ + \ V(t_h w(\widetilde{L}_h)\widetilde{L}_h/\widetilde{N}_h) \ + \ H(\widetilde{N}_h) \ = \ A_l \ + \ V(t_l w(\widetilde{L}_l)\widetilde{L}_l/\widetilde{N}_l) \ + \ H(\widetilde{N}_l). \tag{5}$$

Conditions (4) and (5) along with $\widetilde{N}_h = 2\overline{N} - \widetilde{N}_l$ and $\widetilde{L}_h = 2\overline{N} - \widetilde{L}_l$ determine the equilibrium values of population and employment in the two states.

Under WFH with residence taxation, the net-wage-equalization condition for workers living in state h is $(1 - t_h)w(\widetilde{L}_h) = (1 - t_h)w(\widetilde{L}_l)$, with the state-$h$ tax rate applying to income regardless of whether it is earned in state h or state l. Similarly, the condition for workers living in state l is $(1 - t_l)w(\widetilde{L}_h) = (1 - t_l)w(\widetilde{L}_l)$. Since the $1 - t$ expression cancels in each equation, they reduce to the single condition

$$w(\widetilde{L}_h) \ = \ w(\widetilde{L}_l), \tag{6}$$

which requires wage equalization across the states. This condition in turn implies $\widetilde{L}_h = \widetilde{L}_l = \overline{N}$, so that employment is equalized between the states. As a result, the net wage for a resident of state h equals $(1 - t_h)w(\overline{N})$ regardless of the work location, with $(1 - t_l)w(\overline{N})$ giving the corresponding net wage for a state-l resident. Note that net wages *are not* equalized across states despite equalization of wages themselves.

The state tax base under residence taxation equals the total wages earned by its residents regardless of the place of employment. To write the appropriate expression for state h, let $\widetilde{N}_h^h$

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[14] In other words, the utility from living in state h (state l) is given by the LHS of (5) (RHS of (5)) plus either $(1-t_h)w(\widetilde{L}_h)$ or $(1-t_l)w(\widetilde{L}_l)$, depending on where employment occurs. Since these two terms are equal, they cancel from the two sides of (5), regardless of which one is relevant for a particular worker. Stated differently, the equilibrium conditions (4) and (5) are equivalent to a single condition requiring utilities to be equal for four different combinations of residence and workplace locations: live in h, work in h; live in h, work in l; live in l, work in l; live in l, work in h.

and $\widetilde{N}_h^l$ denote the number of state-h residents employed in states h and state l, respectively. Then, the state's tax base is given by $B_h = \widetilde{N}_h^h w(\widetilde{L}_h) + \widetilde{N}_h^l w(\widetilde{L}_l)$. Since $\widetilde{L}_h = \widetilde{L}_l = \overline{N}$, this expression reduces to $(\widetilde{N}_h^h + \widetilde{N}_h^l)w(\overline{N}) = \widetilde{N}_h w(\overline{N})$. Then $\widetilde{z}_h = t_h \widetilde{N}_h w(\overline{N})/\widetilde{N}_h = t_h w(\overline{N})$, so that the public good level under residence taxation reduces to the tax payment of a worker employed in state h.

Substituting this $\widetilde{z}_h$ expression and a parallel one for $\widetilde{z}_l$ into the V function, and using the net wage expressions from above, the utility equalization under residence taxation can be written:

$$A_h + (1-t_h)w(\overline{N}) + V(t_h w(\overline{N})) + H(\widetilde{N}_h) \; = \; A_l + (1-t_l)w(\overline{N}) + V(t_l w(\overline{N})) + H(\widetilde{N}_l). \quad (7)$$

This condition along with $\widetilde{N}_l = 2\overline{N} - \widetilde{N}_h$ determines the equilibrium state populations. Note that condition (7) resembles the non-WFH utility-equalization condition (3), except that employment in the two states equals $\overline{N}$, with wages also equalized.

3. Analysis

3.1. Cross-state comparisons

As a prelude to further analysis, the first analytical step is to carry out cross-state comparisons under the non-WFH regime and under the two WFH regimes.

The first conclusion is that, under the non-WFH regime, state h has the greater population, with $N_h^* > N_l^*$. To establish this conclusion, we assume that state tax rates are set optimally in the absence of WFH, with these rates chosen conditional on populations. Referring to (3), the first-order conditions for choice of the two tax rates are then $V'(t_h w(N_h^*)) = V'(t_l w(N_l^*)) = 1$ (the wage drops out). Next, assume that the amenity levels A_h and A_l start out equal, which implies $N_h^* = N_l^*$ must hold in (3). Then let A_h increase, which disrupts the inequality, making the LHS of (3) larger. With H' and w' negative, an increase in N_h^* then reduces the LHS and increases the RHS of (3), restoring the equality, with the effects that operate through the tax rates vanishing by the envelope theorem. With $A_h > A_l$ holding by assumption, it then follows that $N_h^* > N_l^*$ must hold. As a result, state h has a lower wage and a higher housing price,

with $w(N_h^*) < w(N_l^*)$ and $p_h^* > p_l^*$. These differences reflect the greater attractiveness of state h, which raises its population with consequent effects on the housing price and wage.[15]

Finally, with the wage lower in state h, the tax first-order conditions from above imply that the tax rate is higher in that state, with $t_h > t_l$. With state h having the larger population, this result is consistent with other models showing that bigger jurisdictions set higher tax rates (Bucovetsky, 1991; Keen and Konrad, 2013).

Cross-state comparisons under the two WFH regimes are more easily derived with tax rates held fixed at the optimal non-WFH levels. Under residence taxation, employment levels and wages have already been seen to be equal across the states. But because it can be shown that the expression $(1 - t_h)w(\overline{N}) + V(t_h w(\overline{N}))$ on the LHS of (7) is smaller than the corresponding expression on the RHS, A_h plus this term could be larger or smaller than corresponding terms on the RHS.[16] As a result, the offsetting population difference between the states required to equalize utilities is unclear, which in turn implies an ambiguous comparison of housing prices.[17]

Under WFH with source taxation, the wage equalization condition (4) implies $\widetilde{L}_h < \widetilde{L}_l$ given $t_h > t_l$, so that employment is smaller in state h. As a result, its wage is higher, with $w(\widetilde{L}_h) > w(\widetilde{L}_l)$. Suppose that the tax base $w(\widetilde{L}_h)\widetilde{L}_h$ is also higher in state h. Then, with its higher tax rate, z will be higher in state h than in state l if $\widetilde{N}_h < \widetilde{N}_l$. With net housing utility then also higher in state h along with amenities, utility equalization is ruled out, implying that $\widetilde{N}_h > \widetilde{N}_l$ must hold instead. The premise of this conclusion, a higher tax base in h, will hold if labor demand is inelastic, so that the higher state h wage more than offsets lower employment. While inelastic labor demand thus implies $\widetilde{N}_h > \widetilde{N}_l$ under source taxation, the population comparison is ambiguous if demand is elastic.

Empirical evidence suggests that inelastic labor demand may be a reasonable assumption.

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[15] These wage and price differences between high- and low-amenity locations match the pattern in the typical equilibrium of the Rosen (1979)-Roback (1982) model. But the present framework differs from that model because a locational equilibrium condition for firms is not imposed.

[16] To establish this conclusion, consider the derivative of $(1 - t_h)w(N) + V(t_h w(N))$ with respect to t_h, which has the same sign as $V'(t_h w(N)) - 1$. With t_h set at the optimal non-WFH value, this derivative is zero when $N = N_h^*$, recalling the previous first-order condition. In addition, as the derivative is increasing in N, it is negative in the vicinity of $\overline{N}$ given $\overline{N} < N_h^*$, implying $(1 - t_h)w(\overline{N}) + V(t_h w(\overline{N})) < (1 - t_l)w(\overline{N}) + V(t_l w(\overline{N}))$.

[17] Note that if the amenity difference between the states is small, then the smaller size of the previous expression in state h would dominate, implying that the population would need to be smaller than in state l (raising net housing utility) for utilities to be equalized.

Hamermesh (1993) indicates that the range of constant-output elasticities of labor demand is $[-.75, -.15]$. A recent meta-analysis (Lichter, Peichl, and Siegloch, 2015) of hundreds of micro-level estimates of the elasticity of labor demand shows that the median is -0.420, with 83% of estimates falling within the interval $[-1, 0]$. Given that telework may change these elasticities, our analysis suggests a need for more estimates of this demand elasticity in the context of the WFH economy.

Summarizing the previous findings yields

Proposition 1. *When tax rates are set at the optimal non-WFH levels in the two states, the following cross-state comparisons apply:*

(i) *In the absence of WFH, population (= employment) is larger in state h than in state l, leading to a lower wage and higher housing price in state h.*

(ii) *Under WFH with residence taxation, employment levels and wages are equalized across the states. But the comparisons of state populations and housing prices are ambiguous.*

(iii) *Under WFH with source taxation, employment is lower and the wage higher in state h than in state l. If labor demand is inelastic, population and the housing price are higher in state h than in state l.*

While population equals employment in both states in the absence of WFH, these quantitites differ under the two WFH regimes given Proposition 1, with $\widetilde{N}_h > \overline{N} \geq \widetilde{L}_h$ holding under source taxation and $\widetilde{N}_l < \overline{N} \leq \widetilde{L}_l$ holding under both WFH regimes, assuming inelastic labor demand. Thus, population exceeds employment in state h under source taxation, while employment exceeds population in state l under both regimes.

With state-h population exceeding employment under source taxation, it may be tempting to conclude that the number of remote workers in the economy equals the excess state-h population, or $\widetilde{N}_h - \widetilde{L}_h$. These workers reside in state h but work in state l, accounting for that state's higher employment level. However, with workers indifferent between working remotely and working in the state of residence, the model does not actually pin down remote-work flows, but only the determines total state population and employment levels. Thus, the number of remote workers living in state h could be increased by F, while the number of remote workers

living in state l could increase from zero (its magnitude from above) to F. These changes leave the employment levels in the two states unchanged at their equilibrium values while increasing the total number of remote workers under source taxation to $\widetilde{N}_h - \widetilde{L}_h + 2F$. Intuitively, because interstate teleworkers can live in both states, the model does not pin down the total number of teleworkers or the number of teleworkers in living in a particular state.

Despite this complication, a simple statement can still be made: $\widetilde{N}_h - \widetilde{L}_h$ equals the *net flow of remote work* in the direction state l. This net flow equals the number of state h residents working in state l (or $\widetilde{N}_h - \widetilde{L}_h + F$) minus the number of state l residents working in state h (or F), which equals $\widetilde{N}_h - \widetilde{L}_h$ regardless of the value of F. Below, we will see how state tax changes can alter this net remote-work flow.

The relationship between population and employment is also informative about the burden of state taxation. In the presence of source taxation, telework allows for the possibility that a state can engage in tax exporting (Wildasin, 1987), shifting the tax burden from residents to nonresidents. To see how, note that the previous inequalities imply that the employment-to-population ratios inside the V function in (5) satisfy $\widetilde{L}_l/\widetilde{N}_l > 1 > \widetilde{L}_h/\widetilde{N}_h$. These inequalities yield the following conclusion regarding tax burdens relative to public consumption under source taxation:

> **Proposition 2.** *If labor demand is inelastic, then under WFH with source taxation, resident-workers in state l pay less in taxes than the dollar value of public goods they receive, while the reverse is true for resident-workers in h.*

This claim follows because the individual tax payment in state h, $t_h w(\widetilde{L}_h)$, is multiplied by the ratio $\widetilde{L}_h/\widetilde{N}_h$ to get $\widetilde{z}_h$, while $t_l w(\widetilde{L}_l)$ is multiplied by the ratio $\widetilde{L}_l/\widetilde{N}_l$ to get $\widetilde{z}_l$. By contrast, with residence taxation, (7) indicates that residents pay the same amount in taxes as the dollar value of public goods they receive, indicating that tax exporting in the sense of Proposition 2 does not occur. In this case, the income tax acts as a benefit tax.[18]

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[18] Under the "central-city fiscal exploitation thesis," (Bradford and Oates 1974) suburban commuters imposed costs on central cities in the form of added public service provision costs, but did not necessarily contribute to city revenues commensurately. In our model, nonresidents may contribute tax revenue, but do not consume public services in the location of employment.

3.2. The effects of WFH

While the previous analysis attempted to compare employment levels, populations, wages and housing prices across states within a given WFH regime, what happens to the levels of these variables in a given state when the economy shifts from a regime without WFH to a WFH regime? As above, we answer this question assuming that tax rates are fixed at their non-WFH levels, as they would be in the short run. Eventually, however, states will adjust their tax rates to suit the new WFH regime, as discussed further below. Using the preceding analysis, we can establish the following conclusions:

Proposition 3. *Under either residence or source taxation, a shift to WFH with tax rates held fixed at non-WFH levels reduces employment in state h while increasing employment in state l. As a result, the wage rises in state h and falls in state l. The magnitudes of these effects are larger under source taxation than under residence taxation. While the changes in state populations and housing prices are ambiguous under source taxation, a shift to WFH increases the population of state h and its housing price under residence taxation, with the reverse effects in state l.*

The first statement in the proposition follows from the inequalities established in the previous analysis. The inequalities $N_h^* > \overline{N} > N_l^*$ describe the employment (= population) relationships without WFH, while the WFH inequalities $\widetilde{L}_h \leq \overline{N} \leq \widetilde{L}_l$ describe the employment relationships, which hold as equalities under residence taxation and as strict inequalities under source taxation. With state-h employment larger than $\overline{N}$ without WFH and no larger than $\overline{N}$ under WFH, it follows that WFH reduces state-h employment, raising it in state l. The greater magnitude of the WFH effects under source taxation follows because the strict inequalities then apply. Deriving the population and house-price effects under residence taxation requires further steps, but it can be shown that state-h population rises.[19]

The employment and wage effects of shifting to WFH under residence taxation match those in BKL's model, where state h gains population and loses employment. With wages equalized

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[19] To establish this conclusion, (3) and (7) are rearranged so that $H(N_l^*) - H(N_h^*)$ and $H(\widetilde{N}_l) - H(\widetilde{N}_h)$ are on the respective right-hand sides. The left-hand sides of the new equations are then $A_h + (1 - t_h)w(N_h^*) + V(t_h w(N_h^*)) - [A_l + (1 - t_l)w(N_l^*) + V(t_l w(N_l^*))]$ and $A_h + (1 - t_h)w(\overline{N}) + V(t_h w(\overline{N})) - [A_l + (1 - t_l)w(\overline{N}) + V(t_l w(\overline{N}))]$. Since $N_h^* > \overline{N}$ and $N_l^* < \overline{N}$, it follows that first expression is smaller than the second, which implies that $H(N_l^*) - H(N_h^*) < H(\widetilde{N}_l) - H(\widetilde{N}_h)$ and thus $H(N_h^*) - H(N_l^*) > H(\widetilde{N}_h) - H(\widetilde{N}_l)$ must hold, yielding $\widetilde{N}_h > N_h^*$ and $\widetilde{N}_l < N_l^*$. The housing price then rises in state h under WFH and falls in state l.

under WFH (as in BKL's zero-tax model), workers can move to enjoy state h's amenities without the previous wage sacrifice. In addition, wage equalization implies an increase (decrease) in z in state h (l) (see the previous footnote), further incentivizing relocation. The similar forms of (3) and (7) allow derivation of this population effect, but the different form of (5) (where z depends on both N and L), precludes a similar result. The culprit is thus the presence of the public good, an amenity whose level is endogenous, in contrast to the exogeneity of A_h and A_l. In the source-taxation case, this endogeneity means that the relative attractiveness of the two states (and thus the population effects of WFH) is no longer clear cut. The resulting ambiguity implies that it is critical for researchers thinking about the empirical effects of telework to consider the totality of amenities across states, both exogenous and endogenous.

3.3. The impacts of state income taxes

This section derives the effects of an increase in state h's tax rate on populations, employment levels, wages and housing prices in both states, with and without WFH. The tax rates start at some arbitrary levels, and we derive the effect of an exogenous increase in the tax differential by raising t_h.

In the absence of WFH, an increase in t_h has no effect if the rate is initially set optimally. When t_h is instead set arbitrarily, then (3) determines an equilibrium population that, in conjunction with t_h, may or may not satisfy the optimality condition $V'(t_h w(N_h^*)) = 1$. If this V' expression exceeds 1, then t_h is suboptimal conditional on population, while t_h is super-optimal conditional on population if V' is less than 1.

If t_h is suboptimal, then an increase the rate raises the LHS of (3), requiring an increase in N_h^* and a corresponding decrease in N_l^* to reestablish the inequality. The increase in N_h^* reduces all three terms on the LHS of (3), with the opposite effect on the RHS terms. In this case, by moving t_h toward optimality, the rate increase makes state h more attractive, spurring a population (= employment) increase, a decrease in the wage, and an increase in the housing price, with opposite effects felt in state l.

Tax impacts are radically different under WFH because employment and population are decoupled. With residence taxation, a higher t_h has no effect on employment or wages in either state because wage equalization fixes both employment levels at $\overline{N}$. Evaluating the effect of t_h

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on population in this case raises similar issues as in the absence of WFH. In particular, from (7), the increase in t_h makes state h more (less) attractive as the initial value is below (above) the optimal t_h, where the optimum is now specific to the WFH case with residence taxation. The relevant first-order condition is $V'(t_h w(\overline{N})) = 1$, which differs from the non-WFH condition by substitution of $\overline{N}$ in place of N_h^*. Therefore, an increase in t_h raises population $\widetilde{N}_h$ and the housing price $\widetilde{p}_h$ if the initial rate is suboptimal, reducing population and the housing price when the initial rate is super-optimal (no effect arises when the tax rate is initially optimal). The opposite impacts are felt in state l.

Turning to WFH with source taxation, an increase in t_h reduces employment in state h while raising it in state l, given (6). If labor demand is inelastic, the employment increase raises the tax base in state h, with tax revenue then rising given the higher t_h. From (5), the resulting increase in z makes state h more attractive, yielding an increase in $\widetilde{N}_h$ that reduces both $\widetilde{z}_h$ and net housing utility, with opposite effects felt in state l, all of which lead to a re-equalization of utilities. The housing price also rises in state h while falling in state l.

It is important to note that, in contrast to the non-WFH case and the WFH case with residence taxation, the incidence effects under WFH with source taxation are fully independent of the initial level of the tax rate. This independence arises due to the absence of a net-wage term in the equal-utility condition (5), which means that the relationship between the tax burden and the benefits from the public good is immaterial, in contrast to the two other cases, where the sub- or super-optimality of t_h matters for incidence.[20]

The preceding results are summarized as follows and in the first part of Table 1:

Proposition 4. *An increase in the tax rate in state h has the following effects on population, employment, housing prices and wages:*

    (i) The tax increase reduces state h's employment and raises its wage under the WFH regime with source taxation while leaving employment and the wage unchanged under the WFH regime with residence taxation, with opposite effects in state l.

    (ii) Population and housing price effects are less clear cut. Under the WFH regime

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[20] Under WFH with residence taxation, employment and wage incidence effects (which are zero) are independent of the level of the tax rate, although population and housing-price changes are not.

with source taxation, the tax increase raises state h's population and housing price if labor demand is inelastic, with opposite effects in state l. The same population and price effects are felt under WFH with residence taxation and in the absence of WFH only if the initial tax rate is below optimal, being opposite otherwise.

(*iii*) *In cases where the tax increase raises the population of state h, the net flow of remote work shifts toward state l.*

Thus, if taxes are residence-based, an increase in state h's tax rate has no effect on employment or wages in the two states, while populations and housing prices adjust in some fashion depending on the optimality of taxes. But if taxes are source-based, then employment and wages are affected along with populations and housing prices, falling and rising in state h, respectively. While population movements could be in either direction under all the regimes, part (*ii*) of the proposition provides conditions for the direction to be toward state h.

The radical difference between tax impacts with and without WFH is clearest in this latter case, where population moves toward state h under each regime. In the absence of WFH, the tax increase *raises employment* in state h (in step with population), but under WFH, the tax increase either *reduces employment* in state-h (with source taxation and inelastic demand) or *leaves it unchanged* (with residence taxation). These radically different employment effects are due to the decoupling of residence and employment locations.

In cases where the population of state h increases, the fact that employment falls or stays constant under WFH means that $\widetilde{N}_h - \widetilde{L}_h$ rises regardless of whether taxes are residence or source-based. This change indicates a shift in the net remote-work flow toward state l, recalling the previous discussion.

Increasing the number of jurisdictions in the model has no effect on the qualitative results in Proposition 3. Suppose that instead of a single state l, state h coexists with many symmetric alternative states, each with low amenities. Then, the impacts on those other states individually from an increase in state h's tax rate would become smaller as the number of other states rises, converging to zero in the limit. But the directions of the changes would be the same as those outlined in the proposition.

Proposition 4 has important implications for empirical researchers seeking to study the effect of state tax changes. First, the incidence of taxes is dramatically different in the presence

of telework. Wages may move in opposite directions in response to a tax increase when workers can work remotely compared to when they cannot, which suggests the need to estimate heterogeneous tax effects in the pre- and post-WFH eras. In addition, although the wage incidence of state taxes was born by resident-workers prior to WFH, the wage incidence of source-based taxes post-WFH is born both by residents and non-residents. As a result, empirical research must exploit information on the location of work to estimate wage incidence.

Second, because telework decouples residential and employment locations, researchers must distinguish between tax-induced residential relocations and tax-induced employment shifts. The latter are especially important in the case of source-based taxation, where changes in jobs by remote workers (holding constant their residence) can be viewed as spatial tax arbitrage. If labor demand is inelastic, employment and population in the high-tax state may move in *opposite* directions in response to a tax increase, suggesting that residential relocations are no longer sufficient to determine the pattern of spatial distortions from taxation.

Finally, our analysis points to the importance of sourcing rules on outcomes and incidence. Our model is flexible enough to encompass residence-based tax systems, such as those in the European Union but also in the hodgepodge of rules in the United States, where teleworkers can be taxed in the source state if convenience of the employer rules are adopted or in the residence state if states rely on physical presence rules for determining tax liability. Given ample variation in the tax rules in the United States, and given a sufficient number of state tax rate changes in the coming years, the empirical predictions of our model could be tested. In the meantime, our theoretical model is valuable for both researchers seeking to assemble datasets necessary to study tax arbitrage with telework and for policymakers seeking to determine the consequences of taxing remote workers.

Tax sourcing rules also have important implications for tax revenue and public-good levels. Recall tax revenues equal the tax rate times wages times either employment or population depending on whether taxes are source or residence based. With inelastic labor demand, wages rise (fall) in state h (l) under both tax regimes, but they rise (fall) by more under the source-taxation regime. The effect on taxable earnings, however, is ambiguous because population under residence-taxation is larger (smaller) than employment under the source-

based taxation regime for state h (l). As a result, the relative responses of population and employment will determine under which regime tax revenues are higher. But, given that the effects move in opposite directions for the respective states, if the source regime revenue-dominates the residence regime for state h, the reverse will be true for state l. Intuitively, this outcome results from the differential ability to engage in tax exporting across jurisdictions and regimes.

3.4. Efficiency analysis

A natural question is whether either of the WFH equilibria is efficient. As shown in the appendix, efficiency requires equalization of the marginal products of labor across the states, equality between the marginal benefit of z and its unitary marginal cost, and adjustment of the populations so that the amenity plus net housing utility is equalized across states. It is easy to see that these conditions are satisfied under residence taxation when the tax rates in both states are chosen optimally. First, wage equalization across states implies equality of marginal products, and second, optimal choice of tax rates yields $V'(t_i w(\overline{N})) = 1$ for $i = h, l$, yielding $t_i = \widehat{t}$ and $z = \widehat{z} \equiv \widehat{t} w(\overline{N})$, with $V'(\widehat{z}) = 1$. With the tax rates and z levels equalized, the net wage and V terms on both sides of the utility equalization condition (7) then cancel, so that the condition requires that equality of the amenity plus net housing utility across states, as required for an efficienct allocation of population. Efficiency emerges because WFH under residence taxation leads to equality of marginal products, and because the resulting equalization of employment levels makes the wage tax function as an efficient head tax.[21]

The source-tax equilibrium is, by contrast, inefficient. While marginal products would be equalized across the states if tax rates were equal, satisfying one efficiency condition, states

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[21] The efficiency result can be related to Wildasin's (1980) condition for efficient interstate locational equilibrium, which governs the location of the population holding public-good levels constant. His condition requires that the sum of labor's marginal product plus public-good benefits minus public-sector congestion costs should be equalized across states. As we have seen, the first two elements in this sum are equalized given equality of wages and the z's. To induce individuals to account for congestion costs, a public-good congestion tax must be levied, and in the case of a publicly produced private good, this charge amounts to a head tax. With wages fixed at $w(\overline{N})$, the labor tax in our model is effectively a head tax, and with the z's equal, the level of this tax is the same across the states, implying that all three elements in Wildasin's locational equilibrium condition are the same across states, guaranteeing its satisfaction. See also Boadway and Flatters (1982) and Boadway and Tremblay (2012).

will not choose equal tax rates given the form of the optimality condition for rates.[22] This inefficiency implies that workers are better off under residence taxation, an important conclusion. As a result, the federal government would want to induce states to adopt the residence principle over the source principle. Summarizing yields

> **Proposition 5.** *While the source-taxation equilibrium is inefficient, the residence-taxation equilibrium satisfies the social planner's optimality conditions. The efficiency of residence taxation means that workers of better off under this regime than under source taxation.*

4. Extensions

4.1. High-income households

A recent literature has explored the effects of taxes on superstars and other high-income individuals (Scheuer and Slemrod, 2020; Scheuer and Werning, 2016), and empirical evidence suggests that the impacts on these groups differ from those on the less well-off (Zidar 2019). In this section, we consider this possibility. Suppose that the economy consists of a second type of household that receives no benefit from the public goods financed by the taxes it pays. These households might be high-income households that are unlikely to consume state public goods or, in a less extreme variant, households that are net-payers into the tax system due to progressivity. Data from the Current Population Survey indicate that high-income households also have the highest propensity to work remotely, thus being most affected by the decoupling of residence and employment. To simplify the analysis, we assume that both the housing and labor markets are segmented, with the housing prices paid by the rich depending only on the rich population, and the wages earned by the rich depending only on their own employment.

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[22] Inefficiency of source taxation can be seen by showing that, if some of the optimality conditions were satisfied in the equilibrium, the remaining equilibrium condition would be violated. Equality of marginal products would require $L_h = L_l = \overline{N}$, which will hold under source taxation if the tax rates are equal. The condition for optimal choice of the tax rate under source taxation is $V'(tw(L)L/N)(L/N) = 1$, which becomes $V'(tw(\overline{N})\overline{N}/N)(\overline{N}/N) = 1$. For this condition to yield equal tax rates across states, as required for equal marginal products, equalization of $\overline{N}/N$ across states is required, yielding $N = \overline{N}$ in each state. The V terms then cancel in the utility-equalization condition (5), but the resulting condition (which then matches the planner's condition) is not satisfied when populations are equal. Therefore, the planner's optimality conditions cannot be satisfied in the source-taxation equilibrium.

In this section, we focus solely on the effect of tax changes on rich populations and employment and on the wages earned and housing prices paid by this group.[23]

The equal utility condition for the rich is characterized by a modified variant of (3), (5) or (7) that excludes the $V(\cdot)$ terms and where all quantities and prices correspond to those of the rich. The net-wage equalization conditions given by (4) and (6) are unchanged, except that they involve wages for rich workers.

In the absence of WFH, an increase in the tax rate t_h decreases the LHS of the modified version of (3), requiring an offsetting decrease in the rich population (equal to employment) in state h, which reduces the rich housing price and raises their wage (opposite effects are felt in state l). This outcome is similar to the effects of a decrease in state-h amenities in the standard Rosen (1979)-Roback (1982) framework, although the model structures are different.

With WFH and residence taxation, an increase in t_h has no effect on rich employment or the wage, given that tax rates are absent from (6). While V does not appear, the presence of the net-wage term in (7) means that the tax increase reduces the attractiveness of state h for the rich, so that their population and the housing price they pay fall.

With WFH and source taxation, an increase in t_h reduces the net wage in (4). As a result, employment of the rich falls in state h and their wage rises, with opposite effects felt in state l. But because the modified equal-utility condition (now (5)) is again unaffected by the tax increase, the population of the rich in state h and the housing price they pay are unchanged, reflecting their zero valuation of public services.

The preceding results are summarized as follows and in the second part of Table 1:

Proposition 6. *For rich households who do not value public goods, an increase in the tax rate in state h has the following effects:*

> *(i) The tax increase reduces state-h employment of the rich and raises their wage under both the WFH regime with source taxation and the non-WFH regime, while zero employment and wage effects emerge under the WFH regime with residence taxation. Effects in state l are in opposite directions.*

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[23] The effects on low-income households depend on whether the tax changes affect the rates they pay or only alter top marginal rates. In the latter case, a tax change will affect low-income households only through the level of the public good.

(*ii*) *The tax increase leads to a decrease in the rich population of state h and the housing price they pay under both the WFH regime with residence taxation and the non-WFH regime, while zero population and price effects emerge under the WFH regime with source taxation. Opposite effects are felt in state l.*

(*iii*) *Under source taxation, the tax increase shifts the net flow of remote work toward state l, while the net flow shifts toward state h under residence taxation.*

Under WFH with residence taxation, an increase in state h's tax rate has no effect on the employment of the rich in either state, matching the general conclusion from Proposition 4. However, a focus on the rich allows population effects that were previously ambiguous to be pinned down, while maintaining the previous employment effects. Now, with residence taxation, the tax increase causes high-income workers to move *out* of state h, depressing their population and the housing price they pay. Notably, these changes are in the *opposite* direction to the ones that may arise in the previous analysis with valued public services. Under WFH with source taxation, employment and the wage for rich workers change as in the general case (falling and rising, respectively, in state h), but the tax increase now leaves the population of high-income workers and the housing price they pay unaffected. Clear population effects now emerge because endogenous public goods are not a complicating factor in determining the residential locations of rich workers.[24]

As for part (*iii*) of the proposition, because rich employment falls in state h and its population stays constant under source taxation, $\widetilde{N}_h - \widetilde{L}_h$ increases, so that the tax increase shifts the net flow of remote work toward state l, as occurs in the cases discussed above. However, because employment of the rich in state h is unchanged while their population falls, $\widetilde{N}_h - \widetilde{L}_h$ decreases, so that the tax increase shifts the net flow of remote work toward state h, the reverse of the impact under source taxation.

It is interesting to note that impacts like those in Proposition 6 can arise from a change in the federal tax rate holding state tax rates fixed, with the effects applying to *all* workers, not just high-income workers who do not value state public goods. Suppose that federal taxes are levied through a flat rate t_f and that the revenue is spent on a public good consumed equally

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[24] Increasing the number of low-amenity states has no effect on the results in Proposition 6, as was true for Proposition 4.

across states (and valued in an additional subutility function). State taxes are deductible in paying federal taxes, so that net income in state h equals $(1 - t_h - t_f(1 - t_h))w(L_h) = (1 - t_h - t_f + t_f t_h)w(L_h)$. Now consider the effects of an increase in the federal tax rate. The state public good levels are unaffected, and because the federal subutility function cancels from the equal-utility conditions, no federal public-consumption effects appear either. Just as in the case of rich workers, the only effect arises in the net-wage expressions, where the state plus federal tax rate on wage income rises. As the combined rate rises less in state h than in state l because of federal deductibility, the federal tax-rate change has the same effect as a simultaneous increase in t_h and t_l, with t_h rising by less. Under the federal change, it is as if t_h falls relative to t_l, which leads to results opposite to those in Proposition 6 and the last part of Table 1. However, if the federal rate were to fall instead of rise, the effects would parallel those in the proposition. This extension makes it clear that, a federal tax change can spur interstate mobility because it interacts with state tax rates.

A recent empirical literature has focused on the effect of taxes on the location decisions of high-income households. Prior to WFH, our analysis shows that relocation of the rich in response to a state tax increase leads to tax incidence on both rich wages and housing prices. But after WFH, under source taxation, rich population movements are absent and housing-price incidence vanishes, while employment and wage effects are felt only under source taxation. These stark predictions for high-income households provide clear empirical hypotheses regarding the impacts of possible tax-induced mobility under WFH. With source taxation, a tax increase is capitalized into high-income wages, which rise as workers seek remote employment elsewhere. But under residence taxation, capitalization is only in housing prices. These results show that employment, even in the absence of any residential relocation, can be spatially distorted by state taxes in a telework economy.

4.2. A hybrid system with tax credits

The previous focus on source- and residence-based taxation masks the actual variability across U.S. states in the tax treatment of interstate teleworkers.[25] Under one possible case,

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[25] In the pre-WFH era, some adjacent states that contain parts of a large metro area straddling their border (Pennsylvania and New Jersey, for example) adopted reciprocal agreements. These agreements allow income

two states both levy source-based taxes on teleworkers as well as residence-based taxes, with tax credits limiting the double taxation of teleworkers. In particular, a worker living in the first state (R) and teleworking in the second state (T) would pay a source-based tax to state T. The residence state R would then give a tax credit to the worker equal to source-based taxes already paid, reducing the worker's residence-based tax liability (although it cannot become negative). This "hybrid" system would pertain to actual pairs of states where state T's tax rules include a source-based tax on teleworkers (there are 7 such states), where state R levies a residence-based tax (only the 9 states without income taxes do not), and where state R offers tax credits for all source-based taxes paid to another state. Since not all states with income taxes fall into this latter group and because not all states tax nonresident teleworkers, the hybrid system cannot be viewed as broadly representative of current practice, which is actually better approximated by the residence-based system (though there is substantial uncertainty over tax rules in the future).[26] Nevertheless, the following analysis formalizes the hybrid system and derives some of its properties.

First, we derive the net wage for different combinations of residence and work locations under a hybrid system, assuming that $t_h > t_l$. Consider first workers who live in state h. For those who also work in state h, the net wage equals $(1 - t_h)w(L_h)$. Workers living in h and working in l pay a tax of $t_l w(L_l)$ to state l, and they pay to state-h a tax on remote income at the local rate t_h less a credit for taxes already paid to state l. The state-h tax liability then equals $\max\{0, t_h w(L_l) - t_l w(L_l)\} = t_h w(L_l) - t_l w(L_l)$, where $t_h > t_l$ is used and the max operator captures non-refundability of credits (ruling out negative taxes). Summing the two tax payments yields $t_h w(L_l)$ and a net wage of $(1 - t_h)w(L_l)$. For state-h residents to be indifferent to their place of employment, the two net-wage expressions must be equal, yielding

$$(1 - t_h)w(L_h) \quad = \quad (1 - t_h)w(L_l). \tag{8}$$

earned by workers commuting across the state border to the other state's part of the metro area to be taxed in the state of residence, agreements that now presumably apply to remote workers. In effect reciprocity makes it so these states bilaterally are operating under the residence-taxation regime.

[26] Note that a teleworker working in one the 7 states that taxes nonresident teleworkers in the employer's state and living in a state without an income tax would pay only a source-based tax.

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Now consider workers who live in state l. For those also working in state l, the net wage is $(1 - t_l)w(L_l)$. Those working in state h pay $t_h w(L_h)$ to that state while paying $\max\{0, t_l w(L_h) - t_h w(L_h)\} = 0$ to state l. This expression is zero because the state-h tax payment exceeds the local payment, meaning that no additional tax is paid to state l, which yields a net wage of $(1 - t_h)w(L_h)$. For state-l residents to be indifferent to their place of employment, these two net wage expressions must again be equal:

$$(1 - t_h)w(L_h) \quad = \quad (1 - t_l)w(L_l). \tag{9}$$

Inspection of (8) and (9) shows that both equations cannot be satisfied. If (8) holds, then $w(L_h) = w(L_l) = w(\overline{N})$, which means that the RHS of (9) exceeds the LHS given $t_h > t_l$. Thus, if state h residents work in both states (if (8) holds), then state l residents will only work in state l ($<$ replaces $=$ in (9)). Conversely, if (9) holds, then $w(L_h) > w(L_l)$, and the LHS of (8) exceeds the RHS. Thus, if state l residents work in both states (if (9) holds), then state h residents will only work in state h ($>$ replaces $=$ in (8)).

This discussion raises the possibility that the wage-equalization condition in the WFH models without tax credits may not hold as an equality, as has been assumed so far. In this case, all workers in the economy, regardless of their residence state, would work in just one of the two states, the one with the higher net wage. However, considering only outcomes where each state has jobs, as is done above, the analysis of the hybrid regime in the previous paragraph implies that *residents of one of the two states work only in that state.*

When equality holds in (9) rather than in (8), the hybrid equilibrium would appear to match the previous one with source-based taxation, while the equilibrium would appear to coincide with the residence-based equilibrium when (8) holds as an equality. However, to verify these claims, it must be checked that the utility-equalization condition remains the same as before, which requires the same expressions for $\widetilde{z}_h$ and $\widetilde{z}_l$. The appendix shows that this coincidence of equilibria occurs only in the case when (9) holds as an equality. Instead, if (8) holds as an equality, the system of tax credits changes which states receive the tax revenue relative to the purely residence based system, resulting in a new type of equilibrium. Summarizing the preceding results yields

Proposition 7. *Under WFH with a hybrid regime in which each state contains jobs, residents of one of the two states work only in that state. If residents of state l work in both states, then the hybrid equilibrium coincides with the equilibrium under source taxation, having the same comparative-static properties. But if residents of state h work in both states, the hybrid equilibrium is different from those considered so far.*

Note that, because it appears impossible to rule out one of the two cases delineated in the proposition, a WFH economy under a hybrid regime evidently can have multiple equilibria.

If residents of l work in both states, the hybrid equilibrium (and its comparative statics) correspond to those with source taxation. With cross-border telework only in one direction, we can now sharpen part (*iii*) of Propositions 4 and 6. Recall that with inelastic labor demand, the net flow of remote work, $\widetilde{N}_h - \widetilde{L}_h$, rises when t_h increases. Because commuting is only in one direction with tax credits, this expression simplifies[27] to $\widetilde{N}_h - \widetilde{L}_h = -\widetilde{N}_l^h$, which is the negative of the total amount of interstate workers in the economy. Then, because the net flow rises, we conclude that a higher state-h tax rate deters telework arrangements, so that the total number of interstate teleworkers falls.

If residents of h work in both states, then the net flow of remote work becomes $\widetilde{N}_h - \widetilde{L}_h = \widetilde{N}_h^l$. In this case, because tax credits influence which jurisdiction receives the tax revenue, a tax increase in h may have different effects than a tax decrease in l. Regardless, any tax change that raises the net flow of remote work will increase the total number of interstate teleworkers.

4.3. Unilateral taxation of nonresident teleworkers

Given that the pure source-based equilibrium can arise under a hybrid system with tax credits, one may wonder whether there exists an alternative hybrid system that gives rise to the purely residence-based equilibrium. To answer this question, we study a case with unilateral adoption of particular tax rules.[28] Consider an alternative "hybrid" system where, following the example in the prior section, state T's tax rules allow it to tax its residents while also applying a source-based tax on nonresident teleworkers (convenience of the employer rule),

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[27] Using the notation defined previously, where the number of individuals working in j and living in i is $\widetilde{N}_i^j$, we have $\widetilde{N}_h - \widetilde{L}_h = \widetilde{N}_h^h + \widetilde{N}_h^l - \widetilde{N}_h^h - \widetilde{N}_l^h = \widetilde{N}_h^l - \widetilde{N}_l^h$, which equals $-\widetilde{N}_l^h$ when $\widetilde{N}_h^l = 0$ (recall that state h residents work only in state h in the case being considered).

[28] The recent corporate tax literature has considered the effects of a country unilaterally adopting a destination based cash-flow tax (e.g., Bond and Gresik 2020; Becker and Englisch 2020).

where state R levies a tax only on its residents while *refusing* to offer tax credits for its residents who telework in other states because it does not recognize state T's assertion of a right to levy taxes on those workers. Several states, including Vermont, do not offer tax credits for taxes paid to the seven states with convenience-of-the-employer rules.

To determine the nature of the unilateral-taxation equilibrium, we follow the same steps as under the tax-credit case, by first deriving the net wage equalization condition. Again, it can be shown that the teleworkers will live in only one of the two states. With this information, we can construct government revenues and the equal-utility condition. The appendix formally yields the following conclusions:

> **Proposition 8.** *When one state taxes nonresident teleworkers under WFH but the other refuses to offer tax credits, residents of one of the two states work only in that state. If residents of the state taxing nonresident teleworkers work in both states, then the unilateral-taxation equilibrium coincides with the equilibrium under residence taxation, having the same comparative-static properties. But if residents of the state that does not tax nonresident teleworkers work in both states, the equilibrium is different from those considered so far.*

Together, Propositions 7 and 8 imply that, under the hybrid and unilateral-taxation regimes, equilibria can correspond to either of the polar cases considered previously. These alternative regimes, combined with the purely residence-based tax system studied previously, encompass the bulk of the tax regimes arising between various pairs of U.S. states. However, while the model considers only a single pair of states, thus assuming that the pair constitutes the entire economy, a fully realistic analysis would need incorporate a larger number of states, each with potentially different tax rules. But, even in that more complex setting, the *pairwise flows* of labor and population following a tax increase would presumably show qualitative patterns similar to those in our model.

5. Conclusion

The last two years have seen a dramatic increase in WFH, which survey evidence indicates will persist into the future (Barrero, Bloom, and Davis 2021). The surge of telework has resulted in workers being able to move from expensive high-productivity metropolitan areas to less expensive lower-productivity areas or alternatively, to high-amenity areas without chang-

ing jobs. Our analysis also suggests that telework can allow workers to keep their residence fixed while shifting employment to other, perhaps more productive but differentially taxed, states. These structural changes in the economy pose important policy challenges for state and local governments that are reliant on income taxes, yet the effect of decentralized taxation in the presence of WFH is unknown. We provide the first theoretical guidance that informs policymakers on the mobility and incidence responses to decentralized taxation and spending.

To tackle this question, we use a model that is rich enough to capture the necessary features of taxation in the presence of WFH, but simple enough to yield sharp insights into the central questions facing current policymakers. Our main positive findings, which pertain to the employment and wage effects of WFH, show that a shift from a non-WFH economy to WFH reduces employment and raises the wage in high-tax states, and that once WHF is in place, an increase in a state's tax rate either reduces employment further while raising the wage or leaves the labor market unaffected, depending on whether source or residence taxation is present. The paper also generates an important normative conclusion by showing that residence-taxation under WFH is efficient, a result of the equalization of employment and hence marginal products across states, which in turn converts the labor tax into an efficient head tax.

We see two possible extensions of the model. A first extension, which would amount to an entirely new paper, would be an analysis of tax competition using our framework. In keeping with the tradition in such models, employment and population would no longer be viewed as parametric in the choice of tax rates, with states instead taking account of tax impacts on these variables when setting tax policy. A comprehensive model of these decisions could consider a multi-stage game where states first pick the tax regime and then pick tax rates. Researchers could also consider an additional stage where, conditional on the tax regime, states can decide whether to offer tax credits for remote workers. However, telework poses challenges for modeling tax competition in the presence of more than two jurisdictions. Traditional models of tax competition usually assume that jurisdictions interact strategically with spatially proximate jurisdictions (Eugster and Parchet 2019), but telework makes the tax base globally mobile, meaning the competition for workers and population need not be localized.

Second, our model abstracts away from a possible effect of WFH on agglomeration economies (Rosenthal and Strange, 2008). With remote work possibly lessening interactions by remote workers with their coworkers and as well as with employees in other firms, both own productivity and the extent of overall agglomeration forces could be weakened. These individual and aggregate effects may have important implications for how employment and populations respond to taxes, as in Brülhart, Jametti, and Schmidheiny (2012).

Our paper provides an ambitious agenda for future empirical research. Although we would like to empirically test the model, there have been too few major state tax reforms since the surge in telework, and the last two years have many other confounding events. In the coming years, states will change income tax rates and, given the lack of legal consensus on state taxing rights over teleworkers, may change the sourcing rules governing how those teleworkers are taxed. These changes, combined with the expected persistence of WFH, will provide ample variation to identify the heterogeneous effects on mobility and prices featured in our model.

The subsequent empirical analysis of interjurisdictional mobility might consider the following factors. First, researchers should allow different effects for states that tax teleworkers at their residence versus states that rely on source taxation, also taking account of any tax credits. Second, "endogenous amenities" (public goods) funded by taxes are important: the extent to which individuals value spending influences both population and employment mobility, as seen in our analysis.[29] Third, because telework decouples employment and residence, unless taxes are purely residence-based, the elasticity of residential mobility is no longer sufficient to gauge the extent of tax-related spatial distortions in the economy (employment mobility and wage impacts under WFH must also be considered). Finally, our paper provides a call for new data sources and distinct measurement of the location of the employer and individual. While current surveys such as the Census and the Survey of Income Program Participation (SIPP) ask questions about telework, questions about the location of where the work occurred could be interpreted by the respondent as either the location of residence or the employer.[30] Researchers

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[29] Monte, Redding and Rossi-Hansberg (2018) estimate how migration and commuting influence the local employment elasticity in response to local demand shocks.

[30] The SIPP asks "What is the address of the main location where (person) work(s)(ed) at (employer name)?" while the American Community Survey asks "At what location did this person work last week?".

might instead find alternative datasets such as administrative tax data or the Longitudinal Employer-Household Dynamics (LEHD) to study the relevant locations for teleworkers.

Public-sector impacts of WFH that are not directly connected to the present model also deserve investigation. Hybrid WFH arrangements, where workers remain in the same city but commute fewer days per week, lead to a reduction commuting costs and thus create an incentive for further decentralization of cities. By putting downward pressure on residential property values in downtown areas, this decentralization is likely to depress property-tax bases in central cities across the country, creating fiscal pressure. This pressure is likely to be compounded by the falling rents (and hence values) of office buildings as commercial tenants unload unneeded space in the face of WFH. Negative spillover effects for restaurants and other businesses serving downtown workers will depress rents and values for such space while also cutting sales tax revenue. All these WFH-related developments could spell fiscal trouble for U.S. central cities, and they are topics ripe for further research.

Appendix

A.1. A hybrid regime with tax credits

To derive tax revenues in the WFH tax-credit regime, define (as in section 2.2) $\widetilde{N}_h^h$ and $\widetilde{N}_h^l$ as the number of state-h residents employed in states h and l, respectively, and $\widetilde{N}_l^h$ and $\widetilde{N}_l^l$ as the number of state-l residents employed in states h and l, respectively. We can then write total employment in state-h as $\widetilde{L}_h = \widetilde{N}_h^h + \widetilde{N}_l^h$ and total population in state h as $\widetilde{N}_h = \widetilde{N}_h^h + \widetilde{N}_h^l$, with similar relationships for state l.

Tax revenues in the two states (equal to $\widetilde{r}_h$ and $\widetilde{r}_l$) are given by

$$\widetilde{r}_h \;=\; t_h w(\widetilde{L}_h)\widetilde{N}_h^h \;+\; t_h w(\widetilde{L}_h)\widetilde{N}_l^h \;+\; \max\{0, (t_h - t_l)w(\widetilde{L}_l)\widetilde{N}_h^l\} \qquad (a1)$$

$$\widetilde{r}_l \;=\; t_l w(\widetilde{L}_l)\widetilde{N}_l^l \;+\; t_l w(\widetilde{L}_l)\widetilde{N}_h^l \;+\; \max\{0, (t_l - t_h)w(\widetilde{L}_h)\widetilde{N}_l^h\}. \qquad (a2)$$

Each equation contains three terms. Focusing on the state-h revenue, the first term in $(a1)$ is tax revenue from resident workers. The second term is revenue from state-l residents who telework in state h. The third term is revenue from state-h residents who telework in state l. Because these workers pay taxes to the source state (state l) first, the revenue they generate equals zero if $t_h \leq t_l$ and reflects the state's tax rate net of credits for state-l taxes, equal to $t_h - t_l$, if $t_h > t_l$. Revenue in state l is similarly derived.

In our model, we assume $t_h > t_l$ and, as shown in the text, only residents of one state can engage in telework. Suppose that equality holds in (9), so that state-l residents work in both states while state h residents work only there. Then, a state-l resident working in state h will pay taxes to state h but will owe no additional taxes to state l because $t_l < t_h$. Using $(a1)$ and $(a2)$, tax revenues in the two states then simplify to

$$\widetilde{r}_h \;=\; t_h w(\widetilde{L}_h)\widetilde{N}_h^h \;+\; t_h w(\widetilde{L}_h)\widetilde{N}_l^h \;=\; t_h w(\widetilde{L}_h)\widetilde{L}_h \qquad (a3)$$

$$\widetilde{r}_l \;=\; t_l w(\widetilde{L}_l)\widetilde{N}_l^l \;=\; t_l w(\widetilde{L}_l)\widetilde{L}_l. \qquad (a4)$$

Note that $\widetilde{N}_l^l = \widetilde{L}_l$ holds in $(a4)$ because $\widetilde{N}_h^l = 0$. The tax revenue expressions in $(a3)$ and $(a4)$ are then the same as those inside the V terms in (5) (where division by population then occurs), which implies that the tax-credit equilibrium where state-l residents work in both states is the same as the source-taxation equilibrium.

Now suppose that equality holds in equation (8) in the text, so that state-h residents work in both states while state-l residents work only there. Now, tax credits matter, with the revenue expressions given by

$$\widetilde{r}_h \;=\; t_h w(\widetilde{L}_h)\widetilde{N}_h^h \;+\; (t_h - t_l)w(\widetilde{L}_l)\widetilde{N}_h^l \;=\; t_h w(\overline{N})\widetilde{N}_h \;-\; t_l w(\overline{N})\widetilde{N}_h^l \qquad (a5)$$

$$\widetilde{r}_l \;=\; t_l w(\widetilde{L}_l)\widetilde{N}_h^l \;+\; t_l w(\widetilde{L}_l)\widetilde{N}_l^l \;=\; t_l w(\overline{N})(\widetilde{N}_h^l + \widetilde{N}_l^l) \;=\; t_l w(\overline{N})\overline{N}. \qquad (a6)$$

In moving from $(a1)$ to $(a5)$, note that the second term in $(a1)$ is zero given $\widetilde{N}_l^h = 0$ and that the second term in $(a5)$ reflects that the tax credit given by state h to its residents who work in state l, which reduces its revenue by the amount of taxes already paid to state l.

To get z values, these revenue expressions must be divided by $\widetilde{N}_h$ and $\widetilde{N}_l$, respectively. Inspection of $(a5)$ and $(a6)$ shows that the expressions do not reduce to the z values on the two sides of (7), which equal $t_h w(\overline{N})$ and $t_l w(\overline{N})$, respectively. Therefore, the tax-credit equilibrium when state-h residents work in both states is not the same as the residence-based equilibrium analyzed above. Note that, while the analysis of residence and source taxation focused on comparative statics of an increase in t_h, recognizing that equivalent results would emerge with a change in t_l, the the identity of which tax rate changes matters in this new tax-credit equilibrium, given the appearance t_l in the state-h expression $(a5)$. Given this added complexity, we leave comparative-static analysis of this equilibrium to future work.

A.2. Unilateral taxation of teleworkers

In this section, we consider the case where one state unilaterally taxes nonresident tele-workers, but where the other state does not tax teleworkers and thus refuses to offer tax credits to its own residents who work in other states. This case is quite common in the United States, as it involves pairs of states where one state has a convenience-of-the-employer rule (7 such states) and where the other state does not have such a rule (all remaining states with income

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taxes) while also refusing to offer a tax credit to residents. Not all of the remaining states fall into this latter category, but there are several states that do not offer tax credits to resident teleworkers (Vermont is one).

First, we derive the net wage for different combinations of resident and work locations, assuming without loss of generality that state h taxes nonresident teleworkers, but that state l does not. Consider first workers who live in state h. For those who also work in state h, the net wage equals $(1 - t_h)w(L_h)$. Workers living in h and working in l are taxed only in the resident state because state l does not tax teleworkers, receiving a net wage of $(1 - t_h)w(L_l)$. For state h residents to be indifferent to their place of employment, the two net-wage expressions must be equal, yielding

$$(1 - t_h)w(L_h) \quad = \quad (1 - t_h)w(L_l). \tag{a7}$$

Now, consider workers living in state l. For those also working in state l, the net wage is $(1 - t_l)w(L_l)$. Those working in state h now pay $t_h w(L_h)$ to that state because it taxes teleworkers, but they receive no credit in state l, thus owing $t_l w(L_h)$ to state l, reflecting double taxation of income. Their net wage thus equals $(1 - t_h - t_l)w(L_h)$. For state l residents to be indifferent to their place of employment, these two net-wage expressions must again be equal:

$$(1 - t_l)w(L_l) \quad = \quad (1 - t_h - t_l)w(L_h). \tag{a8}$$

As before, both equations cannot be satisfied. If $(a7)$ holds, then $w(L_h) = w(L_l) = w(\overline{N})$, which means that the LHS of $(a8)$ exceeds the RHS. In this case, residents of h work in both states but residents of l do not, with uncredited taxation of teleworkers discouraging nonresidents from working in the state that adopts such a rule. Conversely, if $(a8)$ holds, then $w(L_h) > w(L_l)$, and the LHS of $(a7)$ exceeds the RHS. Thus, residents of state l work in both states, but residents of h do not. The wage needs to be sufficiently high in the state that taxes teleworkers to incentivize nonresidents to work there, but its own residents will then not want to work in the other state.

With this information, tax revenues can easily be computed. If $(a7)$ holds, so that state-h

residents work in both states, then tax revenues are given by

$$\widetilde{r}_h \quad = \quad t_h w(\overline{N})\widetilde{N}_h^h \; + \; t_h w(\overline{N})\widetilde{N}_h^l \quad = \quad t_h w(\overline{N})\widetilde{N}_h \tag{a9}$$

$$\widetilde{r}_l \quad = \quad t_l w(\overline{N})\widetilde{N}_l^l \quad = \quad t_l w(\overline{N})\widetilde{N}_l, \tag{a10}$$

where the last equality holds because $\widetilde{N}_l^h = 0$. After dividing by population, these tax revenues yield the z expressions in (7). Therefore, with the net-wage equalization condition being the same, the equilibrium and comparative statics in this case match those under purely residence-based case.

Now suppose that $(a8)$ holds with equality, so that state-l residents work in both states. Then, the expressions for tax revenue become

$$\widetilde{r}_h \quad = \quad t_h w(\widetilde{L}_h)\widetilde{N}_h^h \; + \; t_h w(\widetilde{L}_h)\widetilde{N}_l^h \quad = \quad t_h w(\widetilde{L}_h)\widetilde{L}_h \tag{a9}$$

$$\widetilde{r}_l \quad = \quad t_l w(\widetilde{L}_l)\widetilde{N}_l^l \; + \; t_l w(\widetilde{L}_h)\widetilde{N}_l^h. \tag{a10}$$

While state-h tax revenue in $(a9)$ matches revenue in the source-taxation case, $(a10)$ does not match the state-l revenue expression under source taxation, implying that the resulting equilibrium differs from those analyzed previously. Thus, we again leave comparative-static analysis of this case to future work.

A.3. Efficiency analysis

Suppose that a social planner chooses the optimal allocation of population and employment and the optimal public-good levels in our WFH economy. The problem is to maximize a common utility level u under the assumption that both states achieve this utility level, which is a horizontal equity condition that must be satisfied in equilibrium. The Lagrangean expression for this problem is

$$u \; + \; \lambda_h(A_h + e_h + V(z_h) + U(1/N_h) - u)$$

$$+ \; \lambda_l(A_l + e_l + V(z_l) + U(1/N_l) - u)$$

$$+ \; \mu[N_h e_h + N_l e_l + N_h z_h + N_l z_l - (f(L_h) + f(L_l))], \tag{a11}$$

with last constraint being the economy's resource constraint.

Using $N_l = 2\overline{N} - N_h$ and $L_l = 2\overline{N} - L_h$, the first-order conditions are

$$u: \quad 1 - \lambda_h - \lambda_l \;=\; 0 \tag{a12}$$

$$e_h: \quad \lambda_h + \mu N_h \;=\; 0 \tag{a13}$$

$$e_l: \quad \lambda_l + \mu(N_l) \;=\; 0 \tag{a14}$$

$$z_h: \quad \lambda_h V'(z_h) + \mu N_h \;=\; 0 \tag{a15}$$

$$z_l: \quad \lambda_l V'(z_l) + \mu N_l \;=\; 0 \tag{a16}$$

$$L_h: \quad \mu(f'(L_h) - f'(N_l) \;=\; 0 \tag{a17}$$

$$N_h: \quad \lambda_h U'(1/N_h)(-1/N_h^2) + \lambda_l U'(1/N_l)(1/N_l^2) + \mu(e_h - e_l + z_h - z_l) \;=\; 0 \tag{a18}$$

Eqs. $(a13)$-$(a16)$ yield $V'(z_h) = V'(z_l) = 1$, which implies $z_h = z_l = \widehat{z}$. Using $(a17)$ yields $f(L_h) = f(N_l)$, so that $L_h = L_l = \overline{N}$. Subtracting the utility constraints in $(a11)$ yields $e_h - e_l = A_l - A_h + U(1/N_l) - U(1/N_h)$, and inserting in $(a18)$ while canceling the z's and using $(a13)$ and $(a14)$ to eliminate the multipliers, the condition becomes

$$A_h + H(N_h) \;=\; A_l + H(N_l). \tag{a19}$$

Thus, at the optimum, employment is equally split between the states, the z's equal $\widehat{z}$, and the state populations satisfy $(a19)$. It is easy to see that these conditions are the same as the equilibrium conditions under the residence-taxation regime when the tax rates are set optimally at the value $\widehat{t}$ in both states, which satisfies $\widehat{t}w(\overline{N}) = \widehat{z}$. Then, the V's and the net wage terms on both sides of (7) cancel, so that the equation reduces to $(a19)$, indicating that the optimal and equilibrium state populations coincide.

Table 1: Effect of a Tax Increase in State h on its Prices and Quantities

	General Model			Rich Households		
	no-WFH	WHF/source	WFH/res	no-WFH	WHF/source	WFH/res
Population	$+^{**}$	$+^{*}$	$+^{**}$	$-$	0	$-$
Employment	$+^{**}$	$-$	0	$-$	$-$	0
Housing Price	$+^{**}$	$+^{*}$	$+^{**}$	$-$	0	$-$
Wage	$-^{**}$	$+$	0	$+$	$+$	0
Net Remote-Work Flow	0	$+^{*}$	$+^{**}$	0	$+$	$-$

*Assuming inelastic labor demand

**Assuming the initial tax rate is suboptimal

References

AGERSNAP, OLE, AND OWEN ZIDAR. 2021. "The Tax Elasticity of Capital Gains and Revenue-Maximizing Rates." *American Economic Review: Insights* 3(4): 399-416.

AGRAWAL, DAVID R., AND KENNETH TESTER. 2021. "The Effect of Taxes on Where Superstars Work." Working Paper.

AGRAWAL, DAVID R., AND KIRK J. STARK. 2022. "Will the Remote Work Revolution Undermine Progressive State Income Taxes?" *Virginia Tax Review* 42(1).

AGRAWAL, DAVID R., AND WILLIAM H. HOYT. 2018. "Commuting and Taxes: Theory, Empirics and Welfare Implications." *Economic Journal* 128(616): 2969-3007.

ALBOUY, DAVID. 2009. "The Unequal Geographic Burden of Federal Taxation." *Journal of Political Economy* 117(4): 635-667.

ALMAGRO, MILENA, AND TOMAS DOMINGUEZ-IINO. 2021. "Location Sorting and Endogenous Amenities: Evidence from Amsterdam." Unpublished paper.

AUERBACH, ALAN J., AND MICHAEL P. DEVEREUX. 2018. "Cash-Flow Taxes in an International Setting." *American Economic Journal: Economic Policy* 10(3): 69-94.

BAKIJA, JON, AND JOEL SLEMROD. 2004. "Do the Rich Flee from High State Taxes? Evidence from Federal Estate Tax Returns." NBER Working Paper 10645.

BARRERO, JOSE MARIA, NICHOLAS BLOOM, AND STEVEN J. DAVIS. 2021. "Why Working from Home Will Stick." NBER Working Paper 28731.

BECKER, JOHANNES AND JOACHIM ENGLISCH. 2020. "Unilateral Introduction of Destination Based Cash-flow Taxation." *International Tax and Public Finance* 27: 495-513.

BEHRENS, KRISTIAN, SERGEY KICHKO, AND JACQUES-FRANÇOIS THISSE. 2021. "Working from Home: Too Much of a Good Thing?" SSRN Working Paper 3768910.

BOADWAY, ROBIN AND FRANK FLATTERS. 1982. "Efficiency and Equalization Payments in a Federal System of Government: A Synthesis and Extension of Recent Results." *Canadian Journal of Economics* 15(4): 613-633.

BOADWAY, ROBIN AND JEAN-FRANÇOIS TREMBLAY. 2012. "Reassessment of the Tiebout Model." *Journal of Public Economics* 96: 1063-1078.

BOND, ERIC W. AND THOMAS A. GRESIK. 2020. "Unilateral Tax Reform: Border Adjusted Taxes, Cash Flow Taxes, and Transfer Pricing." *Journal of Public Economics* 184: 104160.

BRADFORD, DAVID F. AND WALLACE OATES. 1974. "Suburban Exploitation of Central Cities and Governmental Structure" in *Redistribution through Public Choice*, editors Harold M. Hochman and George E. Peterson.

BRUECKNER, JAN K., MATTHEW E. KAHN, AND GARY C. LIN. 2022. "A New Spatial Hedonic Equilibrium in the Emerging Work-from-Home Economy?" *American Economic Journal: Applied Economics*, forthcoming.

BRUECKNER, JAN K., AND S. SAYANTANI. 2022. "Intercity Impacts of Work-from-Home with Both Remote and Non-Remote Workers." Unpublished paper.

BRUECKNER, JAN K., JACQUES-FRANÇOIS THISSE, AND YVES ZENOU. 2022. "Why is Central Paris Rich and Downtown Detroit Poor? An Amenity-based Theory." *European Economic Review* 43: 91-107.

BRÜLHART, MARIUS, MARIO JAMETTI, AND KURT SCHMIDHEINY. 2012. "Do Agglomeration Economies Reduce the Sensitivity of Firm Location to Tax Differentials?." *The Economic Journal* 122: 1069-1093.

BUCOVETSKY, SAM. 1991. "Asymmetric Tax Competition." *Journal of Urban Economics* 30(2): 167-181.

COOMES, PAUL A., AND WILLIAM H. HOYT. 2008. "Income Taxes and the Destination of Movers to Multistate MSAs." *Journal of Urban Economics* 63(3): 920-937.

COUTURE, VICTOR, CECILE GAUBERT, JESSIE HANDBURY, AND ERIK HURST. 2019. "Income Growth and the Distributional Effects of Urban Spatial Sorting." Unpublished paper.

DELVENTHAL, MATTHEW J., EUNJEE KWON, AND ANDRII PARKHOMENKO. 2022. "JUE Insight: How Do Cities Change When We Work from Home?" *Journal of Urban Economics* 127: 103-331.

DELVENTHAL, MATTHEW J., AND ANDRII PARKHOMENKO. 2021. "Spatial Implications of Telecommuting." Unpublished paper.

DIAMOND, REBECCA. 2016. "The Determinants and Welfare Implications of US Workers' Diverging Location Choices by Skill: 1980-2000." *American Economic Review* 106(3): 479-524.

EUGSTER, BEATRIX AND RAPHAËL PARCHET. 2019. "Culture and Taxes." *Journal of Political Economy* 127(1): 296-337.

FAJGELBAUM, PABLO D., EDUARDO MORALES, JUAN CARLOS SUÁREZ SERRATO, AND OWEN ZIDAR. 2019. "State Taxes and Spatial Misallocation." *Review of Economic Studies* 86(1): 333-376.

GIROUD, XAVIER AND JOSHUA RAUH. 2019. "State Taxation and the Reallocation of Business Activity: Evidence from Establishment-Level Data." *Journal of Political Economy* 127(3): 1262-1316.

GOKAN, TOSHITAKA, SERGEY KICHKO, AND JACQUES-FRANÇOIS THISSE. 2021. "On the Impact of Telecommuting on Cities." Unpublished paper.

GORDON, ROGER H., AND JULIE BERRY CULLEN. 2012. "Income Redistribution in a Federal System of Governments." *Journal of Public Economics* 96(11-12): 1100-1109.

HAMERMESH, DANIEL S. 1993. *Labor Demand.* Princeton University Press, Princeton, NJ.

KEEN, MICHAEL, AND KAI A. KONRAD. 2013. "The Theory of International Tax Competition and Coordination." *Handbook of Public Economics* 5: 257-328.

KLEVEN, HENRIK, CAMILLE LANDAIS, MATHILDE MUÑOZ, AND STEFANIE STANTCHEVA. 2020. "Taxation and Migration: Evidence and Policy Implications." *Journal of Economic Perspectives* 34(2): 119-142.

KYRIAKOPOULOUY, EFTHYMIA, AND PIERRE M. PICARD. 2022. "The Zoom City: Working From Home and Urban Land Use." Unpublished paper.

LARSON, WILLIAM, AND WEIHUA ZHAO. 2017. "Telework: Urban Form, Energy Consumption, and Greenhouse Gas Implications." *Economic Inquiry* 55(2): 714-735.

LEHMANN, ETIENNE, LAURENT SIMULA, AND ALAIN TRANNOY. 2014. "Tax Me If You Can! Optimal Nonlinear Income Tax Between Competing Governments." *Quarterly Journal of Economics* 129(4): 1995-2030.

LICHTER, ANDREAS, ANDREAS PEICHL, AND SEBASTIAN SIEGLOCH. 2015. "The Own-Wage Elasticity of Labor Demand: A Meta-Regression Analysis." *European Economic Review* 80: 94-119.

LOCKWOOD, BEN. 1993. "Commodity Tax Competition Under Destination and Origin Principles." *Journal of Public Economics* 52(2): 141-162.

LOCKWOOD, BEN. 2001. "Tax Competition and Tax Coordination Under Destination and Origin Principles: A Synthesis." *Journal of Public Economics* 81: 279-319.

MONTE, FERDINANDO AND STEPHEN J. REDDING AND ESTEBAN ROSSI-HANSBERG. 2018.

"Commuting, Migration, and Local Employment Elasticities." *American Economic Review* 108(12): 3855-3890.

MORETTI, ENRICO, AND DANIEL WILSON. 2017. "The Effect of State Taxes on the Geographical Location of Top Earners: Evidence from Star Scientists." *American Economic Review* 107(7): 1858-1903.

ROBACK, JENNIFER. 1982. "Wages, Rents, and the Quality of Life." *Journal of Political Economy* 90(6): 1257-1278.

ROHLIN, SHAWN, STUART S. ROSENTHAL, AND AMANDA ROSS. 2014. "Tax Avoidance and Business Location in a State Border Model." *Journal of Urban Economics* 83: 34-49.

RORK, JONATHAN C., AND GARY A. WAGNER. 2012. "Is There a Connection Between Reciprocity and Tax Competition?" *Public Finance Review* 40(1): 86-115.

ROSEN, SHERWIN. 1979. "Wage-Based Indexes of Urban Quality of Life." In Peter Mieszkowski and Mahlon Strazheim, eds., *Current Issues in Urban Economics.* Baltimore: Johns Hopkins University Press.

ROSENTHAL, STUART S., AND WILLIAM C. STRANGE. 2008. "The Attenuation of Human Capital Spillovers" *Journal of Urban Economics* 64(2): 373-389.

SCHEUER, FLORIAN AND JOEL SLEMROD. 2020. "Taxation and the Superrich" *Annual Review of Economics* 12: 189211.

SCHEUER, FLORIAN AND IVÁN WERNING. 2016. "The Taxation of Superstars" *Quarterly Journal of Economics* 132(1): 211-270.

SLEMROD, JOEL, AND CHRISTIAN GILLITZER. 2014. *Tax Systems.* MIT Press.

SUÁREZ SERRATO, JUAN CARLOS, AND OWEN ZIDAR. 2016. "Who Benefits from State Corporate Tax Cuts? A Local Labor Markets Approach with Heterogeneous Firms." *American Economic Review* 106(9): 2582-2624.

SUÁREZ SERRATO, JUAN CARLOS, AND OWEN ZIDAR. 2018. "The Structure of State Corporate Taxation and Its Impact on State Tax Revenues and Economic Activity." *Journal of Public Economics* 167: 158-176.

WILDASIN, DAVID E. 1980. "Locational Efficiency in a Federal System." *Regional Science and Urban Economics* 10(4): 453-471.

WILDASIN, DAVID E. 1986. *Urban Public Finance,* Routledge Press.

WILDASIN, DAVID E. 1987. "The Demand for Public Goods in the Presence of Tax Exporting." *National Tax Journal* 40: 591-601.

YOUNG, CRISTOBAL, AND CHARLES VARNER. 2011. "Millionaire Migration and State Taxation of Top Incomes: Evidence from a Natural Experiment." *National Tax Journal* 64(2): 255-284.

YOUNG, CRISTOBAL, CHARLES VARNER, ITHAI Z. LURIE, AND RICHARD PRISINZANO. 2016. "Millionaire Migration and Taxation of the Elite: Evidence from Administrative Data." *American Sociological Review* 81(3): 421-446.

ZIDAR, OWEN. 2019. "Tax Cuts for Whom? Heterogeneous Effects of Income Tax Changes on Growth and Employment." *Journal of Political Economy* 127(3): 1437-1472.