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ARTICLE

Stamp duty and spatial misallocation

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Abstract

Our spatial general equilibrium model evaluates the impact of stamp duty reforms on social welfare through two channels: the direct positive impact on housing market outcomes and the indirect boost to national productivity due to better labor allocation. Analyzing detailed spatial data from Australia, we find that reducing stamp duties generates welfare gains of 3.57%, with the productivity channel accounting for 95% of these gains. This highlights the significant benefits of stamp duty reforms beyond the housing market.

Keywords: stamp duty; misallocation; labor productivity; welfare

JEL classifications: E23; J24; J31; R23; R31

1. Introduction

Property transaction taxes, commonly known as stamp duty, are a common and important source of tax revenue in many countries, including Australia, Canada, Germany, the UK, and the US, as well as in various US states.[1] Despite their widespread use, stamp duties are considered one of the most economically inefficient ways of raising government revenue, as they adversely affect house prices and transaction volumes (Besley et al. 2014; Best and Kleven, 2018). Reduced housing transactions can have real effects because trading houses typically means moving house. However, there is limited empirical evidence on these potentially highly distortive effects of stamp duties on the economy.

This paper examines these issues in Australia, focusing on the implications of stamp duties on the housing market and the broader economy. Stamp duty has a long history in Australia, dating back to its introduction in New South Wales in 1865 and soon expanding to other colonies. These colonies, which later formed the states and territories of Australia, continue to use stamp duty to fund growing infrastructure and public services. Today, with ever-growing property prices, stamp duty has become one of the most important sources of revenue for the states and territories. According to the Australian Bureau of Statistics, in 2021–22, the states and territories collected more than $35 billion in stamp duty revenue, or 27 percent of total tax receipts.

Despite their revenue importance, stamp duties cause inefficiency in housing, labor, and output markets. Investigating stamp duties' effects on the broader economy is particularly relevant for Australia because, like many OECD countries, Australia has experienced persistent low productivity growth over the past two decades, with labor productivity growth declining from approximately 3 percent in 1995 to 1 percent in 2020.[2] Addressing this productivity slowdown and formulating policies to improve economic performance is a priority for policymakers.

It is important to consider how stamp duties may constrain labor mobility, potentially impacting labor allocation within and across cities, and consequently affecting labor productivity and aggregate output. Could reforming stamp duties boost labor productivity and real wage growth in Australia? How might such reforms affect labor movements across cities and states? Our study aims to provide insights into these crucial questions.

To evaluate the welfare costs associated with stamp duties, we employ a spatial equilibrium model that is based on the seminal work of Hsieh and Moretti (2019). In our economic framework, the economy consists of multiple cities. Each city produces a homogeneous final good by utilizing the available technology and a combination of capital and labor resources. Both capital and labor can move freely between cities, yet the relocation of labor within cities may be hindered by mobility barriers associated with stamp duties. The interaction between intercity migration and local mobility barriers is pivotal in determining the distribution of capital and labor among cities. Households select the city that maximizes their utility, which is derived from the consumption of the final good, housing services, local amenities, and their individual location preferences. Households bear the burden of stamp duties included in the prices they pay for housing services. The supply of housing services in a city is determined by a combination of factors, including housing prices and city-specific characteristics such as land availability and building technology. The model generates precise predictions regarding the impact of stamp duties on both overall output and welfare.

Our model captures the two primary channels through which stamp duties can harm social welfare. The first channel is that stamp duties affect the housing market by creating a discrepancy between the prices paid by households and the prices received by developers. This results in higher housing costs, lower transaction volumes, and a welfare loss to society. Hereafter, we refer to this as the *housing market channel*. While the first channel is well-recognized by Australian policymakers, our study sheds light on a relatively novel second channel. Specifically, by imposing mobility barriers, stamp duties can distort households' decisions about where to live and work, leading to a misallocation of labor resources within and across cities and reduced overall labor productivity for Australia. We refer to this as the *productivity channel*. This channel has important implications for policymakers to consider in their efforts to promote efficient allocation of labor resources and economic growth in the Australian economy.

To illustrate the impact of stamp duties on the allocative efficiency of labor resources and aggregate productivity, let us consider an ideal world without any distortions. In this world, labor would be allocated across cities in a way that equalizes the marginal product of labor, resulting in the highest possible level of aggregate output. However, in reality, we observe significant differences in marginal products of labor across Australian cities, as evidenced by variations in nominal wages. This suggests that labor is not being allocated efficiently across cities. Just as stamp duties can cause misallocation of labor resources across cities, they can also hinder labor usage within cities. High stamp duties may discourage people from relocating as job markets change, forcing them to spend more time commuting or to forgo job opportunities that better match their skills. This reduces the efficiency of labor utilization within cities, dampening overall productivity. By removing distortions like stamp duties, we can improve the allocative efficiency of labor resources within and across cities, thereby increasing aggregate output and welfare for Australian households.

To assess the welfare effects of stamp duties and the relative importance of the two channels, we collected data from various cities across Australia. Our data include key metrics such as output, employment, wages, median housing prices, and average stamp duty rates at the city level. We then calibrated our model using parameter values sourced from existing literature and implemented a counterfactual experiment to better understand the effects of stamp duties.

Our experiment seeks to answer a critical question: What potential gains in welfare could Australia realize by replacing its current stamp duties in all cities with a broad-based annual land

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tax? Our research indicates that this economy-wide stamp duty reform could increase Australia's aggregate labor productivity by approximately 3.38 percent, a quantitatively significant effect. To put it into perspective, consider this: Australia's average labor productivity growth over the past 20 years to 2021 was around 1.2 percent (Duretto et al. 2022). Given this rate, it would take about three years for Australia to reach the same level of productivity that could be achieved by the hypothetical stamp duty reform. Alternatively, if the reform takes twenty years with gains spread evenly, it would boost Australia's annual labor productivity growth by about 14 percent, or 17 basis points per annum.

Furthermore, our analysis suggests that the productivity channel is a significant factor, contributing to 95 percent of the welfare gains, with the remaining portion attributed to improvements in housing market outcomes. It may seem surprising that a housing market tax reform would have such a muted effect on housing markets, but the reason is simple. Following the stamp duty reform, households move to take advantage of the tax reform, leading to endogenous shifts in housing demand. This means that housing prices can change less to rebalance supply and demand in various local markets. Thus, while the benefits from lowering housing costs are relatively limited, stamp duty reforms have a large impact on labor productivity. The combined effects from the productivity and housing market channels are highly significant.

1.1 Selected literature review

This paper relates to the extensive literature on resource misallocation following Restuccia and Rogerson (2008) and Hsieh and Klenow (2009), as recently reviewed by Restuccia and Rogerson (2017). We build on the seminal work of Hsieh and Moretti (2019), who showed that stringent housing supply in productive cities in the United States has limited the number of workers with access to high productivity, resulting in a 36 percent decline in aggregate US growth from 1964 to 2009. Our work complements theirs by highlighting how constraints on housing demand, such as stamp duties, can also impede the efficient allocation of resources across cities, ultimately leading to lower aggregate output and welfare. In addition, we show that the aggregate effects of policy changes can be evaluated precisely using readily available public data, making policy evaluations more reliable and accessible.

Our paper also relates to economic geography and urban economics research on the spatial distribution of economic activities and city behavior. Efforts to synthesize these two fields have been made by scholars such as Redding and Rossi-Hansberg (2017), and our work builds upon their contributions. Particularly related is Monte et al. (2018) who developed a spatial general equilibrium model that captures interactions within and across US cities. They demonstrate that reductions in commuting costs within US counties can generate welfare gains of around 3.3 percent. We generalize their approach by considering local mobility barriers that include physical frictions like commuting costs, as well as opportunity costs like the foregone output caused by people relocating from established suburbs to distant areas with limited job opportunities. Our analysis suggests that these mobility barriers can significantly reduce aggregate welfare for Australian households.

A recent literature has examined the effect of tax changes on housing transactions using microeconometric methods. Studies from the UK (Besley et al. 2014; Best and Kleven, 2018), the US (Slemrod et al. 2017; Kopczuk and Munroe, 2015), Canada (Dachis et al. 2012), and Australia (Davidoff and Leigh, 2013; Malakellis and Warlters, 2021; Garvin et al. 2024) generally find significant price and quantity responses to tax changes. In contrast, our study finds a smaller price effect by employing a general equilibrium approach that accounts for endogenous behavioral responses. We consider household movement across locations in response to wage and employment changes, suggesting that small price adjustments can rebalance supply and demand in local housing markets.[3]

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Another strand of research examines the transfer of housing stock within and between generations using quantitative lifecycle models. These models incorporate household decisions to buy and sell as either owner-occupiers or landlord investors, as well as choices to consume housing services by either renting or buying. Examples include studies for the UK (Han et al. 2022), the US (Imrohoroglu et al. 2018; Sommer and Sullivan, 2018), Germany (Kaas et al. 2021), and Australia (Cho et al. 2024). While these models account for taxes, transaction costs, and credit market constraints in household property decisions, they focus predominantly on the housing market.[4] In contrast, our study examines the implications of tax changes beyond the housing market. We find that the impact of stamp duty reforms on the housing market is relatively limited, but their effects on labor productivity, national output, and welfare are much more significant.

The remainder of this study is organized as follows. Section 2 presents the model and describes the spatial general equilibrium. Section 3 describes the data and measurement issues. Section 4 presents the potential gains from hypothetical stamp duty reforms. Section 5 presents the sensitivity analysis results. Section 6 discusses the model's simplifying assumptions. Finally, Section 7 concludes the paper.

2. Model

Our study presents a spatial general equilibrium model that builds upon Hsieh and Moretti's (2019) framework to explore the interplay between intercity migration and local mobility barriers. Specifically, we incorporate a crucial element that captures the impact of such barriers on local productivity and labor supply, which can stem from various factors, including high housing costs that discourage residential mobility. By integrating this feature with the intercity linkage, our model provides a comprehensive analysis of the potential effects of stamp duty reforms on labor resource allocation, both within and across cities. Our quantitative approach allows us to identify the impacts of these reforms on key outcomes, such as local employment, wages, and housing prices, as well as on aggregate productivity, output, and welfare.

The economy consists of a number of geographically distinct cities $i \in N$. Each city has its unique blend of technology A_i. Given its technology, a city i produces a homogenous good with the following production function:

$$Y_i = A_i \left(\frac{L_i}{B_i}\right)^{\alpha} K_i^{\eta}, \tag{1}$$

where $\alpha + \eta < 1$, L_i is the local employment and B_i is the local mobility barrier of the city, while K_i is its capital employed. The homogeneous good is the *numéraire*, so that its price is normalized to one.[5] The local mobility barrier captures the idea that many factors can limit the ease and frequency of people moving between locations within a city, such as high stamp duties on property transactions. When these barriers are present, they can discourage people from relocating to areas with better job opportunities, which in turn can reduce the supply of available labor within a city.

For the purposes of our analysis, we make the assumption that the local mobility barrier is a function of the stamp duty rate τ_i:

$$B_i = \overline{B}_i \tau_i^{\phi}, \tag{2}$$

where $\overline{B}_i$ denotes the part of mobility barriers that is unrelated to stamp duties, and ϕ is the elasticity of mobility barriers with respect to stamp duty rates. For simplicity, stamp duty rates are expressed in gross terms as $\tau_i \geq 1$, with $\tau_i = 1$ indicating no stamp duty on property transfers. For example, if the official stamp duty rate is 5%, then $\tau_i = 1.05$. By imposing mobility barriers, stamp duties can reduce the efficiency of how cities utilize their labor resources, thereby potentially decreasing their overall productivity and effectiveness in generating output.[6]

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There is a perfectly elastic supply of capital at rental rate R by the world capital market. Given the cost of capital R and the local nominal wage W_i, the local labor demand of the city is found by equating the marginal product of capital and labor to their respective costs,

$$L_i = B_i \left(\frac{\alpha^{1-\eta}\eta^{\eta}}{R^{\eta}} \frac{A_i}{W_i^{1-\eta}} \right)^{\frac{1}{1-\alpha-\eta}}. \tag{3}$$

Labor demand is increasing in the technology A_i and decreasing in the nominal wage W_i. Moreover, when the local mobility barrier B_i increases, the demand for labor in the area also increases as more labor resources are needed to achieve the same level of output as before.

Labor supply in a city is determined by the choices of workers. The economy comprises a unit measure of workers, with each worker supplying one unit of labor inelastically. Workers are geographically mobile and they differ in preferences over locations. They select the city that maximizes their utility. The preferences of a worker ϵ who lives in city i is defined over the consumption of the final good ($C_{i\epsilon}$), housing services ($H_{i\epsilon}$), local amenities (Z_i), and their individual location preferences (ϵ), according to the Cobb-Douglas form:

$$U_{i\epsilon} = Z_i \epsilon \left(\frac{H_{i\epsilon}}{\beta} \right)^{\beta} \left(\frac{C_{i\epsilon}}{1-\beta} \right)^{1-\beta}, \tag{4}$$

where β is their expenditure share on housing.[7]

Workers allocate their income between consumption goods and housing services, bearing the burden of stamp duty included in the prices they pay for housing services:

$$C_{i\epsilon} + \tau_i P_i H_{i\epsilon} = \frac{W_i}{B_i}, \tag{5}$$

where P_i denotes the local housing price and W_i/B_i represents the worker's labor income.[8] Note that workers are paid for their labor services, reflecting efficiency losses due to mobility barriers. For instance, commuting time is typically not compensated in wage earnings.

Further, the budget constraint shows that stamp duty affects workers' well-being in two ways. First, it reduces their income by causing efficiency losses and acting as a mobility barrier. Second, it distorts the relative price of housing services and consumption, leading to additional welfare losses. As we will see later, our analytically tractable model allows us to disentangle these effects and characterize welfare precisely.

Given our specification of preferences (4), the indirect utility of a worker ϵ residing in city i is

$$V_{i\epsilon} = \epsilon \frac{W_i Z_i}{(\tau_i P_i)^{\beta} B_i}. \tag{6}$$

Indirect utility is a monotonic function of individual location preferences ϵ, which are stochastic, and their specification will be provided later.

Two remarks are in order. First, we assume that wages are the only source of income for workers for simplicity. However, the model is isomorphic to one where workers own the capital stocks and production firms, and receive income equal to the value of output. The reason for this equivalence is that wages are a constant share of the final output in these models. Second, we assume workers differ in their preferences over locations. Different workers make different choices about their residence locations when faced with the same wages and housing prices. *Ex post*, some workers obtain higher utility in their chosen residence than in all other locations, while others obtain less. However, the average worker in the economy is indifferent between locations because free intercity mobility ensures that their utility is equalized across cities.

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Utility maximization implies that a fraction β of worker income is spent on housing services, regardless of location preferences. Thus, the housing demand in city i is given by:

$$\tau_i P_i H_i = \beta \frac{W_i L_i}{B_i}. \tag{7}$$

This demand reflects household property choices in response to employment opportunities (L_i), worker income (W_i/B_i), and taste (ϵ, which endogenously affects L_i). For simplicity, we abstract from additional factors like family demographics and wealth asset portfolio choices. While important in the Australian context, our model does not address their impact on long-term housing prices and transaction quantities.

Following Saiz (2010), we allow for positive housing supply elasticity. Housing supply in city i depends on the housing price P_i and exogenous factors $\overline{H}_i$ such as land availability and building technology:

$$H_i = \overline{H}_i P_i^{\delta}, \tag{8}$$

where δ is the housing supply elasticity. A higher δ indicates that property developers are more responsive to price changes; $\delta \to \infty$ indicates perfectly elastic supply, and $\delta = 0$ indicates perfectly inelastic supply.

Equating housing supply (8) and demand (7) gives the equilibrium housing price in city i:

$$P_i = \left(\frac{\beta W_i L_i}{B_i \overline{H}_i \tau_i} \right)^{\gamma}, \tag{9}$$

where $\gamma \equiv 1/(1+\delta)$ is referred to as the inverse housing supply elasticity for convenience. The housing price depends on the local income level W_i/B_i and city size L_i. Stamp duty creates a wedge between the realized buyer price $\tau_i P_i$ and seller market price P_i, leading to higher buyer prices, lower transaction volumes, and a welfare loss to society. Our model provides a means to quantify the size of such welfare loss in a general equilibrium setting with shifting housing demand and supply.

Each worker's location preferences are drawn from an independent Fréchet distribution:

$$G(\epsilon) = e^{-\epsilon^{-\theta}}, \tag{10}$$

where the parameter $1/\theta$ controls the strength of individual preferences over locations. Conveniently, the indirect utility for worker ϵ also follows a Fréchet distribution $G(v) = e^{-(Q_i B_i)^{-\theta} W_i^{\theta} v^{-\theta}}$, where $Q_i = (\tau_i P_i)^{\beta} Z_i^{-1}$ is the local cost of living. Using the distributions of utility, the average utility of workers in city i is given by

$$V = \frac{W_i}{Q_i B_i L_i^{1/\theta}}. \tag{11}$$

The average worker's utility is independent of the city. This is because workers are freely mobile across cities; thus, their expected welfare is equalized across cities in equilibrium. The average worker's utility is increasing in the worker's income (W_i/B_i), decreasing in local living cost (Q_i), and decreasing in the city size (L_i). When workers have weaker ties to their city of residence (i.e., θ is higher), the average utility of workers in that city is higher, even when accounting for the same level of income and cost of living. This is because workers are more likely to consider moving to other cities in search of higher income and lower costs of living, leading to a higher average utility for those who choose to stay in the same city. The average worker's utility determines the labor supply in a given city.

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Equating labor supply (11) and labor demand (3) gives the equilibrium employment in a city:

$$L_i = \left(\frac{\alpha^{1-\eta} \eta^{\eta}}{R^{\eta}} \frac{\mathcal{A}_i}{(VQ_i)^{1-\eta}} \right)^{\frac{1}{(1-\eta)(1+1/\theta)-\alpha}}. \tag{12}$$

Here, $\mathcal{A}_i \equiv A_i B_i^{-\alpha}$ represents the city's productivity level, which takes into account its technology and internal allocation of labor resources. The latter is determined by the city's labor mobility barriers, which affect its ability to efficiently allocate its workforce.

To complete the model, assume residential properties are owned by geographically immobile landlords who receive worker expenditure on housing services as income and consume only local goods (Monte et al. 2018). Under this assumption, total spending on consumption goods equals $1 - \beta$ of total worker income plus all landlord income, which is β of total worker income. Since labor income is a fraction α of total output, total local consumption spending by workers and landlords equals a fraction α of the locally produced final good:

$$C_i + \tau_i P_i H_i = \alpha Y_i. \tag{13}$$

The remaining $1 - \alpha$ fraction is consumed by absentee capital and firm owners, clearing the goods markets.

By imposing the condition that aggregate employment is equal to the normalized aggregate labor supply (i.e., $\sum_{i=1}^{N} L_i = 1$), we can derive an expression for aggregate output:

$$Y = \left(\frac{\eta}{R} \right)^{\frac{\eta}{1-\eta}} \left[\sum_{i=1}^{N} \left(\frac{\overline{Q}}{Q_i} \right)^{\frac{1-\eta}{(1-\eta)(1+1/\theta)-\alpha}} \mathcal{A}_i^{\frac{1}{(1-\eta)(1+1/\theta)-\alpha}} \right]^{\frac{(1-\eta)(1+1/\theta)-\alpha}{1-\eta}}, \tag{14}$$

where $\overline{Q} \equiv \sum_{i=1}^{N} Q_i L_i^{1+1/\theta}$ is the average cost of living in all cities, or equivalently, the aggregate price level of the economy. Importantly, normalizing the aggregate supply of labor to one allows us to interpret the aggregate output as both per capita output and *aggregate labor productivity*.

The expression summarizes how the interplay between intercity migration and local mobility barriers affects aggregate output. Specifically, local mobility barriers can reduce the efficiency with which cities utilize their labor resources, directly lowering their productivity and contributing to lower aggregate output. Additionally, differences in local mobility barriers can cause the misallocation of labor resources across cities, leading to higher dispersion of local living costs and further lowering the aggregate output.

Aggregate welfare is given by the ratio of aggregate labor income to the average cost of living across cities. Because the labor share of income is α, aggregate welfare is given by

$$V = \frac{\alpha Y}{\overline{Q}}. \tag{15}$$

The aggregate utility is high when the aggregate output is high and when the aggregate cost of living is low.

The welfare expression highlights two channels through which stamp duties reduce social welfare. First, they distort the relative price of housing services and consumption, raising the aggregate cost of living and lowering social welfare. Their negative impact on the housing market is well known: by acting as a tax on buyers, they increase housing costs, reduce transaction volumes, and create a welfare loss. We refer to this as the housing market channel. Second, stamp duties distort workers' choices about where to live and work, leading to misallocation across cities, lower labor productivity, and reduced aggregate output. To our knowledge, this productivity channel has not been systematically studied in the literature. Together, these two channels fully determine the impact of stamp duties on social welfare in our framework.

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2.1 Welfare effects of stamp duty

We now illustrate the effects of stamp duties on aggregate output and welfare. First, stamp duties increase labor mobility barriers at the city level, resulting in a loss of allocative efficiency and lower productivity. Second, differences in stamp duties across cities drive up the dispersion of living costs across cities, both directly and indirectly through their effects on local mobility barriers. These two effects lead to the misallocation of labor resources both across and within cities, ultimately lowering aggregate output. Third, stamp duties increase the cost of living in all locations, raising the aggregate cost of living in the economy. Consequently, higher aggregate costs of living lead to lower aggregate welfare for any given level of income. The last effect corresponds to the classic economic argument that stamp duties can create welfare loss to society by negatively affecting housing market outcomes.

Our analysis indicates that stamp duties can lead to a decrease in both aggregate output and welfare. Therefore, reforming these taxes could have a positive impact on overall outcomes. One potential solution to this issue is to replace stamp duties with a broad-based annual land tax. Some Australian states, including the Australian Capital Territory (ACT), have begun implementing tax reforms. In 2012, the ACT started a 20-year plan to phase out stamp duty while increasing annual land tax for all properties. This reform is revenue-neutral and over halfway complete. In November 2022, New South Wales (NSW) offered first home buyers a choice between an upfront stamp duty and an annual property tax based on land values. However, a 2023 state election led to the repeal of the property tax option in July 2023 due to revenue uncertainties. In 2023, Victoria announced plans to abolish stamp duty for commercial and industrial properties from July 2024, allowing buyers to pay stamp duty upfront for the last time or spread the payment over a decade with interest. After ten years, an annual property tax of 1% of the unimproved land value will apply. However, Victoria has not yet made inroads on stamp duty reform in the residential space.

Using our model, we can evaluate the potential welfare impact of these reforms.[9] To this end, we use a sufficient statistics approach recently developed in the international trade literature (see Arkolakis et al. 2012). The idea is that to evaluate the welfare impact of any reform, one can compare two equilibria: the actual equilibrium observed in the economy and a counterfactual equilibrium if the reform were implemented. To understand the aggregate impact of such reforms, one needs to know the behavioral responses of the disaggregate units (e.g., cities) and the relative importance of these units in aggregation (i.e., appropriate weights of these cities). The former is guided by structural models detailing the disaggregate units' optimization problems, and the latter is usually accessible from publicly available data.

For example, suppose stamp duty rates change from τ_i to $\tilde{\tau}_i$ for i ranging from 1 to N. How would such a change affect aggregate welfare? These changes can be arbitrary—one state may unilaterally pursue stamp duty reforms, or a national approach may be implemented. The reforms may be revenue-neutral in the long term or revenue non-neutral, requiring federal government assistance. Our model places no restrictions on the post-reform stamp duty rates.

To elaborate, long-term revenue neutrality means that two policies, $\{\tau_i\}_{i=1}^{N}$ and $\{\tilde{\tau}_i\}_{i=1}^{N}$, generate the same revenue in their respective long-run equilibrium, without requiring neutrality during the transition. It applies at the state level for state-based reforms and at the federal level for economy-wide reforms. In the latter case, state-level neutrality can be maintained through federal transfers overseen by the Commonwealth Grants Commission in Australia.

We do not impose government budget constraints, allowing our analysis to accommodate any stamp duty reform options proposed by policymakers, regardless of revenue neutrality in our theoretical model. This is important because unilateral state-level reforms often require federal assistance and may not be revenue-neutral from a theoretical perspective. Moreover, many proposed reforms involve a revenue shortfall during the transition period, even if designed to be revenue-neutral in the long run (see Freebairn, 2017). Imposing government budget balances would rule out these options.

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For simplicity, we use a tilde to denote counterfactual variables, while variables without a tilde represent outcomes in the actual equilibrium.

Using the expressions for aggregate output (14) and welfare (15), we obtain:

$$V = \left[\sum_{i=1}^{N} \left(\frac{\alpha^{1-\eta} \eta^{\eta}}{R^{\eta}} \frac{\mathcal{A}_i}{Q_i^{1-\eta}} \right)^{\frac{1}{(1-\eta)(1+1/\theta)-\alpha}} \right]^{\frac{(1-\eta)(1+1/\theta)-\alpha}{1-\eta}}. \tag{16}$$

This equation applies to post-reform welfare as well, with all variables indicated by tilde. Rearranging terms, we obtain an expression for the (gross) welfare gains:

$$\frac{\tilde{V}}{V} = \left[\sum_{i=1}^{N} L_i \left(\frac{Q_i}{\tilde{Q}_i} \right)^{\frac{1-\eta}{(1-\eta)(1+1/\theta)-\alpha}} \left(\frac{\tilde{\mathcal{A}}_i}{\mathcal{A}_i} \right)^{\frac{1}{(1-\eta)(1+1/\theta)-\alpha}} \right]^{\frac{(1-\eta)(1+1/\theta)-\alpha}{1-\eta}}. \tag{17}$$

Using our structural model, we can evaluate the endogenous responses of each city's housing prices and local productivity to any stamp duty reforms; the relative weights of these cities are given by their size or employment levels. Note that in this instance, city size is a sufficient statistic for computing aggregate welfare gains. Given this statistic, the details of the model become irrelevant for aggregate welfare gains. In other words, any isomorphic models predicting the same responses of housing prices and local productivity to stamp duty reforms should yield the same predictions of welfare gains, regardless of structural details. The simplicity and robustness of policy evaluation are the biggest advantages of the sufficient statistics approach over the conventional structural estimation and simulation approach.

Proposition 1 summarizes the effects of any stamp duty reforms on aggregate output, prices, and welfare, with the proof provided in the Appendix.

Proposition 1. *A hypothetical reform that replaces stamp duties* $\{\tau_i\}_{i=1}^{N}$ *with a broad-based annual land tax* $\{\tilde{\tau}_i\}_{i=1}^{N}$ *would induce changes in welfare, aggregate output, and aggregate price as follows:*

$$\frac{\tilde{V}}{V} = \left[\sum_{i=1}^{N} L_i \left(\frac{\tau_i}{\tilde{\tau}_i} \right)^{\frac{\alpha\phi(1-\beta\gamma)+\beta(1-\gamma)(1-\eta)}{(1-\alpha-\eta)(1-\beta\gamma)+(\beta\gamma+1/\theta)(1-\eta)}} \right]^{\frac{(1-\alpha-\eta)(1-\beta\gamma)+(\beta\gamma+1/\theta)(1-\eta)}{1-\eta}}, \tag{18}$$

$$\frac{\tilde{Y}}{Y} = \frac{\sum_{i=1}^{N} \varphi_i \left(\frac{\tau_i}{\tilde{\tau}_i} \right)^{\frac{\alpha\phi(1+1/\theta)+\alpha\beta(1-\gamma)}{(1-\alpha-\eta)(1-\beta\gamma)+(\beta\gamma+1/\theta)(1-\eta)}}}{\left[\sum_{i=1}^{N} L_i \left(\frac{\tau_i}{\tilde{\tau}_i} \right)^{\frac{\alpha\phi(1-\beta\gamma)+\beta(1-\gamma)(1-\eta)}{(1-\alpha-\eta)(1-\beta\gamma)+(\beta\gamma+1/\theta)(1-\eta)}} \right]^{\frac{\alpha}{1-\eta}}}, \tag{19}$$

$$\frac{\tilde{\overline{Q}}}{\overline{Q}} = \frac{\sum_{i=1}^{N} \varphi_i \left(\frac{\tau_i}{\tilde{\tau}_i} \right)^{\frac{\alpha\phi(1+1/\theta)+\alpha\beta(1-\gamma)}{(1-\alpha-\eta)(1-\beta\gamma)+(\beta\gamma+1/\theta)(1-\eta)}}}{\left[\sum_{i=1}^{N} L_i \left(\frac{\tau_i}{\tilde{\tau}_i} \right)^{\frac{\alpha\phi(1-\beta\gamma)+\beta(1-\gamma)(1-\eta)}{(1-\alpha-\eta)(1-\beta\gamma)+(\beta\gamma+1/\theta)(1-\eta)}} \right]^{\frac{\alpha\beta\gamma+(1-\eta)(1+1/\theta)}{1-\eta}}}, \tag{20}$$

where L_i *represents the employment share of city i, and* φ_i *is its output share.*

Proposition 1 demonstrates that the aggregate effects of stamp duty reforms can be calculated straightforwardly if employment and output shares at the city level are available. Fortunately, this information is often publicly available in many countries, such as Australia. It is worth noting that employment and output shares are sufficient for calculating the welfare gains resulting from any

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stamp duty reform, eliminating the need for additional data sources. Furthermore, it is important to highlight that the aggregate effects of stamp duty reforms can be precisely calculated, rather than being estimated as first-order approximations. This precision is particularly valuable in policy evaluations, where accuracy is essential.

3. Data

The main data we use is the Data by Region administrated by the Australian Bureau of Statistics (ABS). This data provides a number of key economic and social indicators, including population, employment, and housing characteristics for the period 2014–19. It is available at various geographic levels in Australia. For the purpose of our analysis, we focus on the Statistical Areas Level 2 (SA2). According to the ABS, SA2s are general-purpose areas of medium size that are formed by combining complete Statistical Areas Level 1, which represent the smallest geographic areas for which disaggregated Census data is available. Their purpose is to represent a community that interacts together socially and economically. Conceptually, each SA2 area corresponds to a city in our model. The main variables we use include employment, average wage, and median housing price for each SA2 area. We supplement these data by collecting historical stamp duty rates from the official websites of Australian State Governments. Our analysis is conducted on the year 2017, which represents the most recent year for which the necessary variables are available. There are 2,310 SA2 regions covering all of Australia without gaps or overlaps. After excluding 18 non-spatial SA2 special purpose codes (Migratory–Offshore–Shipping and No Usual Address for each state and territory) and 171 SA2 regions lacking labor or housing data, we work with a subsample of 2,121 observations.

3.1 Calibration

We calibrate our model using parameter values sourced from existing literature. There are a total of 6 parameters in the model: the production elasticities α and η, the share of housing in consumer expenditure β, the housing supply elasticity δ, the degree of local preferences $1/\theta$, and the elasticity of mobility barriers to stamp duties ϕ.

Table 1 reports the values of these parameters. For our baseline analysis, we follow Hsieh and Moretti (2019) and assume the production elasticities take the values of $\alpha = 0.65$ and $\eta = 0.25$, which implies a residual share of income of $1 - \alpha - \eta = 10$ percent. Following Monte et al. (2018), we set the share of housing in household expenditure to $\beta = 40$ percent. This value may seem large for Australia, but our model, like Monte et al.'s, focuses on households' disposable labor income rather than total gross income, making this value plausible. Additionally, the importance of the productivity channel relative to the housing market channel decreases with β, so we made this choice conservatively. Later, we consider a lower value of 30 percent and a higher value of 50 percent as a sensitivity check.

We use the empirical estimates of long-run housing supply elasticities from Saiz (2010). His study indicates that the United States has a population-weighted average housing supply elasticity of 1.75 in metropolitan areas (2.5 unweighted). Arguably, Australia may have a smaller supply elasticity than the United States because land use regulations make housing supply less elastic, especially in large urban areas. However, we are unaware of any comparable studies for Australia, so we set the housing supply elasticity parameter to $\delta = 1.75$, based on Saiz's estimates. Later, we consider the lower value of 1 and the higher value of 2.75 as a robustness check. Of course, this supply elasticity varies across regions, so our single δ is a strong simplifying assumption.

For the heterogeneity in location preferences, we follow Hsieh and Moretti (2019) and Monte et al. (2018) and assume $\theta = 3.3$. This estimate implies a high degree of intercity labor mobility in equilibrium. For the one remaining parameter, the elasticity of local mobility barriers with respect

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Table 1. Parameters of the model

Parameter	Description	Value
α	Labor share of income	0.65
η	Capital share of income	0.25
β	Share of housing in household expenditure	0.40
δ	Housing supply elasticity	1.75
θ	Heterogeneity in local preferences	3.30
ϕ	Mobility barriers elasticity	1.02

Notes: Parameter ϕ is calibrated using the Data by Region from the Australian Bureau of Statistics. The remaining parameters are calibrated externally.

to stamp duty rates, we directly estimate it using the data we have. The estimation produces a value of $\phi = 1.02$, as detailed at a later stage.

3.2 Identifying key variables

We now explain how we identify the key variables for the cities from the data by utilizing the model's structure. Local employment, wages, housing prices, stamp duties, amenities, total factor productivity (A_i), and mobility barriers are among the key variables.

Data on employment, average wages, and median housing prices are available at the city level from the Data by Region provided by the ABS. We use those variables directly from the regional dataset. Data on stamp duty rates are collected from the official websites of state governments. We apply historical statutory rates to houses with the median price in each city, for each year.

To impute local amenities, we use the standard approach in urban economics. Specifically, we impute local amenities as the residual of the local wage after controlling for the housing price and local employment: $Z_i \propto P_i^{\beta} L_i^{1/\theta} / W_i$. Following Albouy (2008), we do not infer the absolute level of amenities in each city. Instead, we use the relative level in each city as our measure of amenities. In doing so, we also multiply wages by 0.52 to account for taxes and transfers. The measure of amenities obtained through this method has been shown to be highly correlated with local amenities that can be measured, such as weather, crime, school quality, number of restaurants, and various indices of the quality of life (see Albouy, 2008).

To impute the local mobility barriers, we utilize the average utility of workers (11): $B_i = W_i Z_i / V \, (\tau_i P_i)^{\beta} \, L_i^{1/\theta}$. As welfare V is unobserved, we normalize it to one in the initial equilibrium and derive the local mobility barriers accordingly. The normalization of the initial welfare level is not essential, as our findings only rely on the percentage changes of the variables rather than their absolute levels. By using the measure of mobility barriers, we are able to estimate the parameter ϕ in a regression of log mobility barriers on log stamp duty rates. The estimated value of ϕ, 1.02, indicates a significant negative effect of stamp duties on the mobility of individuals between different locations within cities.

In the final stage, we estimate the total factor productivity of each city using the labor demand equation (3): $A_i \propto (L_i / B_i)^{1-\alpha-\eta} \, W_i^{1-\eta}$. This concludes our description of the data identification process. The summary statistics of the key variables, both from the data directly and those imputed, are presented in Table 2.

Of particular interest is the distribution of effective stamp duty rates across Australian cities. Table 2 shows that the average stamp duty rate is approximately 3 percent, with substantial variation—a standard deviation of about one-third of the mean, at around 1 percent.

Effective stamp duty rates reflect both the statutory rates set by each state and house prices in each city. While stamp duties are progressive across all states and territories, their bracket structures vary. For example, in 2017, properties transacted in Victoria below $25,000 attracted a

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Table 2. Summary statistics

	Mean	SD	p5	p50	p95	*N*
Employment	8.56	0.66	7.50	8.61	9.54	2,121
Wage	10.99	0.22	10.69	10.96	11.42	2,121
Housing price	9.26	0.67	8.23	9.26	10.41	2,121
Stamp duty	0.03	0.01	0.00	0.03	0.05	2,121
Amenities	−0.06	0.33	−0.53	−0.08	0.54	2,121
Mobility barriers	9.57	0.15	9.40	9.55	9.85	2,121
Total factor productivity	6.63	0.18	6.36	6.62	6.95	2,121

Notes: Data on total employment, average wage, and median housing prices at the city level for Australia in 2017 are sourced from the Australian Bureau of Statistics' Data by Region. Stamp duty rates for median housing in each city in 2017 are gathered from official state government websites. The remaining variables are imputed within the model's framework. Local amenities are derived as the residual of the local wage after controlling for housing price and employment. Mobility barriers are determined using equation (11) for the average utility of workers. The total factor productivity of each city is estimated using the labor demand equation (3). All variables are logged.

stamp duty of 1.4%. For properties valued between $25,000 and $130,000, the duty was $350 plus 2.4% of the dutiable value exceeding $25,000. Properties valued between $130,000 and $960,000 incurred $2,870 plus 6% of the dutiable value exceeding $960,000, while those over $960,000 were subject to a flat rate of 5.5%. Other states have different bracket structures, which contribute to the overall variation in effective stamp duty rates across the country.

Incidentally, Victoria had the highest top statutory rate, with several regions of expensive houses reaching the maximum effective stamp duty rate in our data, 5.5%. In contrast, South Australia had the lowest statutory rates, with properties below $353,000 incurring no stamp duty. Several rural regions with low property prices in South Australia had zero effective stamp duty rates in our data.

Variation in effective stamp duty rates also reflects differences in house prices across cities, both within and across states. Many factors contribute to these price differences, including demand, land availability, income levels, and investment activity. Large cities like Sydney and Melbourne, with strong population growth and job opportunities, attract higher housing demand, leading to increased house prices. Limited land supply—due to Australia's unique urban density patterns, where small urban centers are surrounded by large, low-density areas—along with geographical constraints and zoning regulations, further increases price pressures in desirable areas. Higher average incomes and stronger local economies in these cities also push prices higher, as households can afford to pay more. Additionally, growing domestic and international investment in Australian housing has further inflated prices in sought-after regions, amplifying regional price variations.

To better understand the dispersion of stamp duty rates, particularly across cities within states, Figure 1 displays their distribution. It plots the log deviation of each city's stamp duty rate from its state average, weighted by house prices in each city. Stamp duty rates generally follow a normal distribution but are somewhat left-skewed, indicating that most small cities have lower effective rates due to their relatively low house prices. The median stamp duty rate is below the state-weighted average, which is normalized to 0 by design, reflecting the large number of small cities. In contrast, large cities with effective stamp duty rates above the state average, though fewer in number, play an important role in aggregating the benefits of stamp duty reforms due to their economic size.

Figure 2 depicts the relationships between local total factor productivity levels and various city characteristics. Panels (a) and (b) show that cities with higher levels of productivity generally employ more workers and pay higher nominal wages. The significant variation in nominal wages observed across cities suggests that labor resources may not be allocated efficiently, potentially due to a range of factors. This highlights the potential for Australia to improve aggregate output

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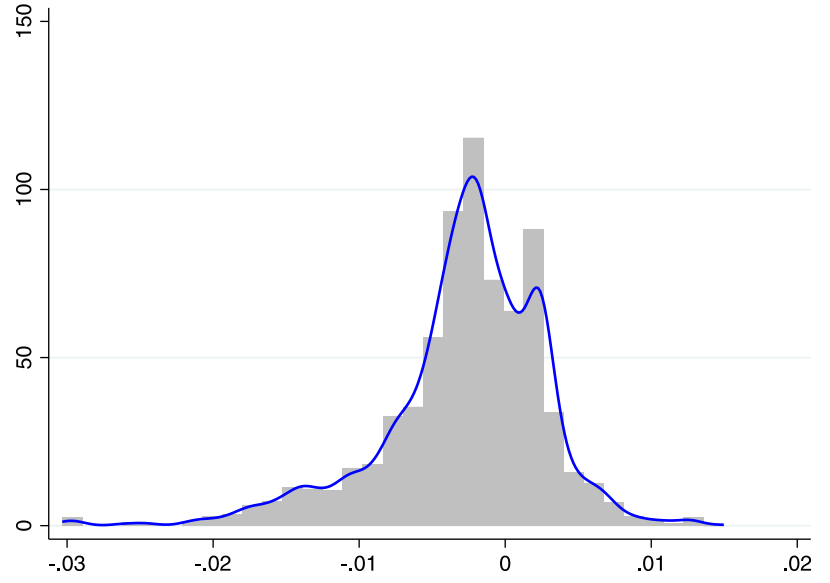

Figure 1. Distribution of stamp duty rates.
Note: This figure shows the distribution of the log deviation of each region's stamp duty rate from its state average.

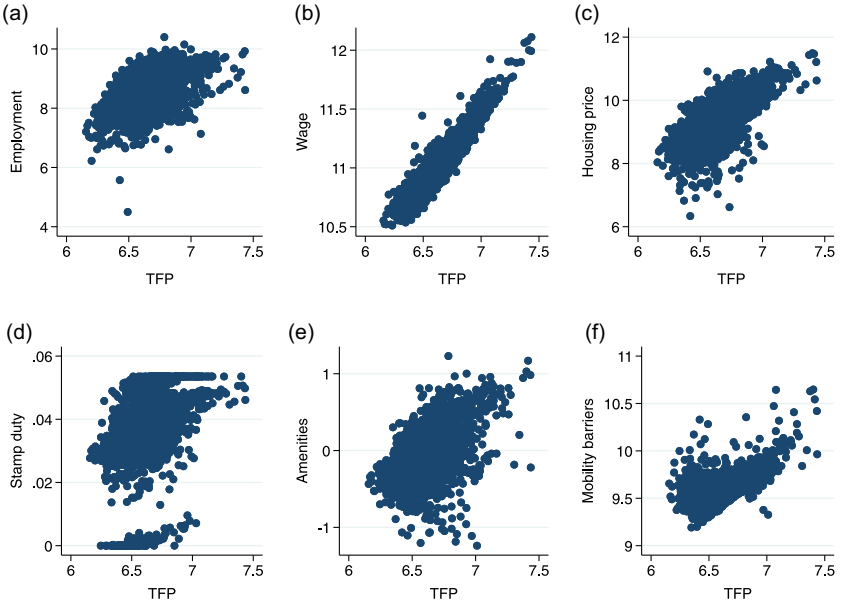

Figure 2. City characteristics.
Notes: This figure displays the correlations between local total factor productivity (TFP) levels and a range of city characteristics. All variables are in log terms.

by reallocating labor resources between cities. Panels (c) and (d) provide evidence that cities with greater levels of productivity typically have higher housing prices and higher stamp duty rates.

The data in panel (e) further suggests a positive correlation between productivity levels and local amenities. Differences in housing prices across cities are an important contributing factor to the variation in nominal wages observed across cities. A number of factors can contribute to

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the differences in housing costs, such as differences in the availability of land, the housing supply elasticity, and the provision of local amenities. We argue that stamp duties are also critical factors for house prices. Specifically, differences in stamp duties across cities amplify the differences in housing prices across cities, leading to a wider variation in nominal wages.

Panel (f) reveals a positive correlation between high productivity levels and mobility barriers among cities. While various factors contribute to these barriers, we emphasize that high stamp duties may impede intra-city allocative efficiency by hindering people's ease of movement within cities. We have already seen in panel (d) that high-productivity cities tend to have high stamp duties, and thus, high mobility barriers, *ceteris paribus*. What's more interesting is that panel (f) suggests that even the mobility barriers unrelated to stamp duties tend to positively correlate with total factor productivity. This indicates untapped opportunities for cities to enhance productivity, which is worthy of future investigation.

In the following analysis, we will show that stamp duty reforms can improve the allocative efficiency of labor resources across cities and within them, thereby increasing the welfare of Australian households.

4. Potential gains from stamp duty reform

We now turn to our empirical estimates of the effects of stamp duty reforms. In this hypothetical reform, we replace the current stamp duties for residential properties in all Australian cities with a uniform broad-based annual land tax. The annual land tax is based on the current tax rate that the NSW government is imposing on a residential house with a median price. According to the NSW government, the tax rate for owner-occupied residential properties for 2022-23 and 2023-24 is \$400 plus 0.3 percent of land value.[10] During this period, the median price of Sydney houses is approximately 1.2 million dollars. Assuming that the land value is three quarters of the property value, the effective annual land tax rate is roughly 0.26 percent.[11]

We assume that this tax rate will apply to all Australian cities in the hypothetical reform. Admittedly, this assumption is oversimplified because state governments must consider revenue neutrality in the long term when designing any stamp duty reform. Such annual land tax rates would be different across states. However, our purpose is to get a sense of the magnitude of welfare gains from an economy-wide stamp duty reform, so this assumption will suffice for our purpose.[12]

Figure 3 illustrates how the economy-wide stamp duty reform leads to labor reallocation across cities. Three facts stand out. First, there is substantial variation in labor movements across cities and across states. The city with the largest inflow of labor expands nearly 3 percent of its workforce. In contrast, the city with the largest outflow shrinks by more than 6 percent. The economy-wide tax reform thus has implications for labor movements, infrastructure, housing, and industry at least in the long run. Second, within each state, workers relocate from cities with relatively low productivity to ones with relatively high productivity. This phenomenon occurs because cities with high productivity typically face higher housing prices and stamp duties. Therefore, the elimination of stamp duties has a larger impact on these cities, as it disproportionately reduces their housing costs and reduces barriers to intra-city mobility. Third, workers tend to migrate from states with currently low stamp duties to those with high stamp duties. Again, the reason for this phenomenon is that the hypothetical reform disproportionately reduces the housing costs of the states which currently have high stamp duties. In addition, the reform lowers barriers to intra-city mobility, especially for states with high taxes, which makes them more appealing to households. The interplay between intercity migration and intra-city mobility barriers determines the aggregate outcomes of the hypothetical stamp duty reform.

Proposition 1 summarizes the effects of this hypothetical reform on aggregate output, aggregate price, and welfare. These effects can be calculated using readily available data, specifically the employment and output shares of each city. Moreover, the formulas in Proposition 1 are robust

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Table 3. Effects of replacing stamp duties with a board-based annual land tax

	Percentage gains
Welfare	3.57
1. Increases in aggregate output	3.38
2. Decreases in costs of living	0.19

Notes: This table shows the welfare effects of replacing current stamp duties in all Australian cities with a broad-based annual land tax. The annual land tax is based on the current tax rate that the NSW government is imposing on a house with a median price.

Figure 3. Intercity migration.
Notes: This figure illustrates the changes in employment across cities following a stamp duty reform that impacted the entire economy. State and territory abbreviations: ACT – Australian Capital Territory, NSW – New South Wales, NT – Northern Territory, QLD – Queensland, SA – South Australia, TAS – Tasmania, VIC – Victoria, WA – Western Australia.

to various levels of disaggregation. For instance, this study has defined cities over Statistical Area Level 2, but one can redefine cities at other levels such as Significant Urban Areas and Statistical Area Level 3. These formulas remain applicable, as long as the appropriate employment and output shares are used.

Table 3 presents the overall impact of the hypothetical tax reform. According to our analysis, a reform implemented across the entire economy would increase the welfare of Australian households by approximately 3.57 percent. Since household welfare is equalized across cities in the equilibrium, the welfare gain applies to all cities, regardless of their current levels of productivity, housing prices, and stamp duty rates. This is of particular significance because, as we have previously observed, some cities will acquire additional labor while others will lose labor. Nevertheless, intercity migration will balance out these gains across cities, allowing all cities to benefit from the reform.

It is important to note that while the dispersion of welfare gains is a strong theoretical result, it may not hold exactly in real life due to various economic and political frictions not captured by the model. Nonetheless, our findings indicate that average households in any city will benefit from a nationwide stamp duty reform, regardless of their awareness or whether the effects are felt directly through housing markets or indirectly through changes in employment and income.

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However, our model is too simple to account for the distributional effects of stamp duty reforms. In reality, those who frequently buy and sell property will benefit more, paying less in annual land tax compared to the avoided stamp duty (see Clifford and Freebairn, 2021). Understanding these distributional effects is crucial for designing more equitable and politically feasible reforms, but this is beyond the scope of our current study.

The welfare gains from removing stamp duties can be broadly decomposed into two components. Firstly, eliminating stamp duties enhances the allocative efficiency of labor resources, both across and within cities. Within cities, tax removal would lower the barriers to intra-city mobility, enabling workers to relocate to areas with more job opportunities and better public transportation. Consequently, the city would be able to utilize its labor resources more effectively, resulting in increased output. In addition, eliminating stamp duties would have a positive impact on the allocative efficiency of labor resources across cities. By removing stamp duties, intercity migration would be encouraged, resulting in a reduction in the variation of housing costs across different cities. This would ultimately lead to less disparity in labor productivity across cities, resulting in better allocative efficiency for the entire economy. Improving allocative efficiency within and across cities can boost the labor productivity of the entire economy, resulting in higher output levels. Therefore, the reduction in misallocation can be quantified by measuring the increase in aggregate output in the economy. Our analysis indicates that the hypothetical reform would lead to an approximate increase of 3.38 percent in aggregate output, making up a substantial portion of the overall welfare gain.

Secondly, the elimination of taxes would remove the inefficiency associated with buyer taxes. Buyer taxes create a wedge between the prices paid by buyers and received by sellers, leading to a reduction in the quantity of products available in the market and a corresponding loss to society. The removal of this inefficiency would increase household welfare, and the magnitude of this effect can be measured by changes in aggregate prices or the average cost of living across all cities. Our model predicts that a comprehensive stamp duty reform would lower the aggregate cost of living, resulting in an increase in household welfare by approximately 0.19 percent. The second effect is relatively small because, although eliminating stamp duty reduces housing prices for home buyers, the resulting shifts in housing demand partially offset the initial gains from lower prices. For example, cities experiencing immigration after the reform see increased housing demand, leading to higher prices despite the removal of stamp duties. As a result, the gains from the reform are smaller than expected. Nonetheless, these findings confirm that stamp duties have significant overall welfare implications and underscore the potential benefits of stamp duty reform to enhance overall economic well-being.

After comparing the magnitudes of the two effects, we have concluded that the productivity effect of stamp duties is more significant than the housing market effect. Our analysis shows that the productivity channel accounts for approximately 95 percent of the overall welfare gains, while the housing market channel only accounts for the remaining 5 percent. This finding implies that the productivity channel is 18 times more important than the housing market channel. Our results hold significant implications for the current debate over stamp duty reforms, as prior studies have largely overlooked the productivity channel, and the economic significance of this channel has not been estimated. By quantifying the overall welfare gains and highlighting the importance of the productivity effect of stamp duties, we contribute to the current debate and underscore the potential benefits of stamp duty reform for enhancing economic welfare.

5. Sensitivity analysis

Replacing stamp duties with a broad-based annual land tax in Australia's economy is shown to significantly impact long-term welfare. While Australian data is used for the analysis, most parameter values are derived from international literature. To assess result sensitivity to key parameters, we stress-test the model with a range of alternative values.

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Table 4. Sensitivity

	Lowest	Lower	Baseline	Higher	Highest
Panel A: Labor share of income (α)					
Parameter value	0.55	0.60	**0.65**	0.70	0.75
Welfare	3.15	3.36	**3.57**	3.78	3.99
1. Increases in aggregate output	2.81	3.09	**3.38**	3.68	4.00
2. Decreases in costs of living	0.34	0.27	**0.19**	0.10	−0.01
Panel B: Capital share of income (η)					
Parameter value	0.15	0.20	**0.25**	0.30	0.35
Welfare	3.25	3.40	**3.57**	3.76	3.99
1. Increases in aggregate output	2.94	3.15	**3.38**	3.66	4.00
2. Decreases in costs of living	0.31	0.25	**0.19**	0.10	−0.01
Panel C: Share of housing in household expenditure (β)					
Parameter value	0.30	0.35	**0.40**	0.45	0.50
Welfare	3.46	3.51	**3.57**	3.62	3.68
1. Increases in aggregate output	3.39	3.38	**3.38**	3.38	3.38
2. Decreases in costs of living	0.07	.013	**0.19**	0.24	0.30
Panel D: Housing supply elasticity (δ)					
Parameter value	1.00	1.25	**1.75**	2.25	2.75
Welfare	3.20	3.35	**3.57**	3.72	3.83
1. Increases in aggregate output	3.35	3.36	**3.38**	3.40	3.41
2. Decreases in costs of living	−0.15	−0.01	**0.19**	0.32	0.42
Panel E: Heterogeneity in local preferences (θ)					
Parameter value	2.00	2.50	**3.30**	5.00	10.00
Welfare	3.56	3.56	**3.57**	3.57	3.58
1. Increases in aggregate output	3.34	3.35	**3.38**	3.42	3.48
2. Decreases in costs of living	0.22	0.21	**0.19**	0.15	0.10
Panel F: Mobility barriers elasticity (ϕ)					
Parameter value	0.80	0.90	**1.02**	1.10	1.20
Welfare	2.97	3.24	**3.57**	3.77	4.04
1. Increases in aggregate output	2.64	2.97	**3.38**	3.64	3.97
2. Decreases in costs of living	0.33	0.27	**0.19**	0.13	0.07

Notes: The middle column (in bold) presents baseline results for each parameter. Left columns display lower parameter values, while right columns show higher values. The table reports overall welfare gain and its components, derived from increased aggregate output, and reduced living costs due to stamp duty removal.

Table 4 presents the results of the sensitivity analysis. The middle column, which is in bold, displays results using the baseline calibrated value for each parameter. The columns to the left show results with lower parameter values, while the columns to the right show results with higher values. The table reports the overall welfare gain and its breakdown for each value. As previously mentioned, the welfare gain stems from improved allocative efficiency, resulting in increased aggregate output, and the reduction of housing prices for households, leading to reduced living costs.

Panel A presents results while varying the labor share of income from its lowest value (0.55) to its highest (0.75). The welfare gain from the hypothetical reform increases with a higher labor share of income. When labor becomes more vital in final goods production, the labor reallocation resulting from the removal of stamp duty becomes more effective in boosting output.

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Simultaneously, with higher labor remuneration, households are more inclined to move to productive cities for better wages. This increases housing demand and subsequently housing prices in those productive cities, partially counteracts the cost reduction due to the removal of stamp duties. As a result, the welfare gain from reduced living costs diminishes as the labor share of income increases.

Panel B reveals the results as we modify the capital share of income from 0.15 to 0.35. Given the complementarity between capital and labor in production, an increase in the capital share of income also benefits workers supplying labor. Consequently, we observe similar effects as when altering the labor share of income. Indeed, the results indicate that as the capital share of income increases, the overall welfare gain from the hypothetical reform rises. When breaking down the welfare gains into two components, we note that the contribution from increased aggregate output becomes more significant with an increasing capital share of income, while the contribution from reduced living costs diminishes.

In Panel C, we explore the results as we vary the share of housing in household expenditure from 30 percent to 50 percent. The findings reveal that as housing services become a larger share of total household spending, the overall welfare gains from reforming stamp duties increase. This is expected, as households derive greater benefits from stamp duty reforms when housing services services are a larger share of total consumption. What is particularly intriguing is the breakdown of welfare gains. The results highlight that as households allocate more of their expenditure to housing rather than non-housing consumption goods, additional welfare gains mainly come from further reduced living costs, while the welfare gains from improved labor allocation efficiency remain stable. Thus, the parameter representing the household expenditure share in housing is crucial for assessing overall welfare gains but has a minimal impact on the gains achieved by reducing labor misallocation.

Panel D displays the results as we vary housing supply elasticity from 1 to 2.75. As expected, overall welfare gains increase with higher housing supply elasticity. As housing supply becomes more elastic, replacing stamp duties with a broad-based annual land tax leads to a larger increase in housing supply in productive cities, facilitating household reallocation to those areas. With more households moving to productive cities, these cities expand at the expense of less productive ones, resulting in better labor allocation and higher aggregate output. Although this influx exerts upward pressure on housing prices, partially offsetting the reduction in costs from removing stamp duties, the increase in prices would be smaller as developers respond more to housing prices. This is evident from the fact that gains from decreased living costs tend to increase with higher housing supply elasticity. The key takeaway from this sensitivity exercise is that the benefits of stamp duty reforms depend critically on policies that determine housing supply; policies that encourage housing supply will lead to higher gains from stamp duty reforms.[13]

Panel E presents results when household local preference heterogeneity changes. As this parameter increases, households become less attached to their current cities and more willing to relocate for higher wages. We examine the results as θ increases from 2 to 10. Surprisingly, the welfare gain from the reform remains relatively insensitive to the level of inter-city mobility. We observe that weaker city ties, due to the reform of stamp duties, encourage more households to migrate to productive cities. This increased migration leads to greater gains in aggregate output but reduced benefits from lower living costs. These two effects roughly balance out, resulting in overall welfare gains that remain largely unchanged.

Panel F displays results when we adjust the mobility barrier elasticity of stamp duty. Using Australian data, we estimate this parameter at 1.02. We test the sensitivity of results by varying this parameter from 0.8 to 1.2. A higher value for this parameter indicates that a city's local mobility barrier is more responsive to its stamp duty rate. The results indicate that as the sensitivity of the mobility barrier increases, the potential welfare impact of reforming stamp duty in Australia grows. In simple terms, eliminating stamp duty in a city enhances its ability to utilize labor resources within the city, resulting in increased productivity and output. The more labor

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utilization improves (with decreasing local mobility barriers as stamp duty rates drop), the greater the output gains. With increased mobility barrier elasticity, nationwide stamp duty reform yields higher gains in aggregate output. However, as cities with initially high stamp duty rates experience greater productivity gains, more households relocate to these cities, partially offsetting the reduction in housing costs and leading to lower gains from decreased living expenses. Nevertheless, overall welfare gains increase when local mobility barriers are more sensitive to stamp duty rates.

In summary, our baseline estimate of welfare gains from a nationwide stamp duty reform increases as capital and labor become more significant in final goods production, as housing services play a larger role in household consumption, as developers respond more to housing prices, and as local mobility barriers respond more to stamp duty rates. The baseline estimate of welfare gains remains relatively stable with household location preferences, although the composition of these gains may vary with the parameter's values. Overall, welfare gains are not highly sensitive to this parameter. Based on the sensitivity analysis, we find that the benefits from an economy-wide stamp duty reform fall within a range of 3 to 4 percent. When comparing productivity and housing market effects, the former is approximately ten to twenty times larger than the latter, depending on the parameter values. To provide a more precise assessment of the relative importance of these two channels, future studies should calibrate the model using Australian data.

6. Discussion

In calculating the welfare gains, we made several simplifying assumptions. First, we assumed that every worker in the economy owns and lives in a residential property. In reality, however, nearly a third of Australian households rent their homes. Renters can more easily move to accommodate changes in their lifestyles and job opportunities. They are only indirectly affected by stamp duty when landlords pass on some of the burden through higher rents. To the extent that renters do not bear the full burden of stamp duty, our quantitative results may overstate the welfare benefits of stamp duty reforms.

Second, we also abstracted from the behavior of property investors (landlords). Property investors typically have a shorter holding period for properties than owner-occupiers, resulting in a larger burden of stamp duty compared to ordinary homeowners. This means that stamp duty may partially suppress investment activities in property markets, improving housing affordability for home buyers—a benefit not captured by our simple model. However, this benefit also comes with a cost to renters, as lower investment activities mean fewer rental properties available in the market, potentially deteriorating housing affordability for renters. The overall welfare effects from this channel remain unclear.

Third, our long-run analysis only measures one-off welfare gains from stamp duty reforms and ignores the ongoing evolution of reasons to buy and sell properties, such as changes in household demographics, technology, and job opportunities. By doing so, our analysis underestimates the repeated efficiency and productivity gains, thereby underestimating the overall welfare gains from stamp duty reforms.

To better capture the welfare effects of stamp duty reforms and understand the distributive effects on different members of society, our framework needs to be extended to a dynamic general equilibrium setting with heterogeneous households and more detailed modeling of the property and rental markets. We will address these in our future studies.

7. Conclusion

Our study uses a spatial general equilibrium model to assess the overall impact of stamp duty reforms in Australia. We consider two key channels through which stamp duties can diminish social welfare. The first, well-established channel involves the efficiency loss in housing markets

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due to stamp duties acting as a buyer tax. The second, novel channel involves the inefficient allocation of labor resources within and between cities caused by stamp duties, leading to reduced aggregate productivity and output. Analyzing detailed spatial data, we find that reducing stamp duties can generate welfare gains of approximately 3.57 percent. Most of these gains come from the productivity channel, with the rest from the housing market channel. Our findings suggest that the traditional focus on housing market outcomes in discussions of stamp duty reform may be misleading, as it overlooks the significant problems caused by these taxes beyond their impact on the housing market.

Our findings echo the view of Freebairn (2020) that reforming state taxes is among the low-hanging fruits for increasing national productivity. The gains from the hypothetical nationwide stamp duty reform are equivalent to three years of labor productivity growth at the current rate of 1.2 percent per annum. If spread over two decades, the reform could boost annual labor productivity growth by approximately 14 percent. This is a much-needed boost for Australia's productivity after the prolonged slowdown of the past two decades.

Drawing on current findings, we identify several promising avenues for future research. Firstly, our simple model measures only one-off welfare gains from stamp duty reforms. However, in reality, there is a continued evolution of reasons to buy and sell properties, leading to repeated efficiency and productivity gains over time from the reform package. For the labor market, the number of jobs and their composition in a given city change with technology, international trade, and shifts in domestic demand. Additionally, household demographics, income, tastes, and wealth portfolio preferences fluctuate annually, prompting residential relocations. Stamp duty reforms enable households to adapt better to these demographic and technological changes. Extending the current static framework to a dynamic setting could estimate the cumulated annual benefits of such reforms more accurately.

Secondly, extending the model could assess the redistribution effects of reform packages by disaggregating households by income, house value, tenure (whether they are owner-occupiers, landlords, or renters), and frequency of property transfers. These investigations could aid policymakers in designing more equitable reform packages.

Thirdly, the model could study the transitional dynamics of various reform options. Several transition options, such as the cold turkey approach, gradual reductions of stamp duties, or offering buyers a choice between stamp duty and land taxes, could be analyzed for their budget impacts over transition periods.

Lastly, in addition to households, stamp duty is paid by businesses, causing distortions in business buy and sell decisions. Extending the model to estimate the impact of stamp duty reforms on commercial properties, as pursued by South Australia, the ACT, and Victoria, would be valuable.

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Notes

1 According to Best and Kleven (2018), 27 countries in the OECD imposed property transaction taxes as of 2010; within the US, 38 states had a property transaction tax in 2012.

2 See the article about Australia's productivity slowdown on the Parliament of Australia website.

3 A related strand of literature explores the effects of transaction taxes on home ownership (reviewed in Warlters, 2023), tax revenue (e.g., Cao et al. 2015; Freebairn, 2020), and equity (see Clifford and Freebairn, 2021). While these aspects of stamp duty are important, they are outside the scope of this paper.

4 The only exception we are aware of is a few recent studies that use computable general equilibrium models to examine the macroeconomic effects of property tax reforms (Nassios et al. 2019; Nassios and Giesecke, 2024). Compared to these studies, our specialized model is more spatially disaggregated, capturing the effects of stamp duties on labor movements

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within and across finer geographical areas. Our model is also analytically tractable, enabling closed-form solutions to evaluate tax changes.

5 The model is isomorphic to one with monopolistic competition and increasing returns to scale or perfect competition and constant returns to scale. We chose the Lucas span-of-control specification for simplicity: the output price for all cities is unity, so we can focus on housing prices.

6 A recent survey conducted by Infrastructure Victoria lends strong support to this argument. According to the survey, Victoria's high stamp duties are causing people to relocate from established suburbs to more distant ones with fewer job opportunities, schools, and limited public transport options. This, in turn, forces them to spend more time commuting in their cars. In fact, one in five households surveyed indicated that they would be willing to trade their detached home in a distant suburb for a townhouse or apartment that is located closer to city centers for the same price.

7 While we excluded public goods from our model, revenue-neutral stamp duty reforms would not significantly impact public good provision in the long term.

8 We consider a one-off relocation game in which all workers, upon realizing their location preferences, move to their optimal locations given the property tax schemes. The time required for this process depends on housing turnover—that is, the percentage of properties that change hands each year. For instance, if turnover is 5%, as it was in Australia over the past decade, the process takes 20 years to complete. Since our model is static, we interpret the gains from relocation as unfolding over two decades.

9 We focus on stamp duty reforms for residential properties. Like households, firms relocate in response to state tax changes, which in turn impacts the spatial allocation of economic activity (see Fajgelbaum et al. 2019). For example, Victoria's 2024 stamp duty reform on commercial and industrial properties may influence firms' location decisions. However, assessing such impacts is beyond this paper's scope.

10 For a detailed discussion of the NSW government's 2020 stamp duty reform proposal, including its aim for long-term revenue neutrality, please refer to Warlters (2023).

11 The annual land tax as a share of the property value is $(400 + 900000 * 0.003)/1200000 = 0.0026$.

12 Our estimate of welfare gains from a nationwide stamp duty reform remains relatively stable, as long as the hypothetical annual land tax rate is significantly lower than the effective stamp duty rate. For instance, doubling the counterfactual annual land tax rate only slightly reduces the estimated welfare gain from 3.57 percent to 3.30 percent.

13 Hsieh and Moretti (2019) find that increasing housing supply elasticity in U.S. cities could enhance output and welfare by facilitating labor relocation to more productive cities. Our results show that higher housing supply elasticity can enhance welfare gains from other housing policy reforms, such as stamp duty reforms.

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Appendix 1. Proof of Proposition 1

First, we derive an expression for welfare gains from stamp duty reforms. Using the expressions for aggregate output (14) and welfare (15), we obtain:

$$V = \frac{\alpha Y}{\overline{Q}} = \left[\sum_{i=1}^{N}\left(\frac{\alpha^{1-\eta}\eta^{\eta}}{R^{\eta}}\frac{\mathcal{A}_i}{Q_i^{1-\eta}}\right)^{\frac{1}{(1-\eta)(1+1/\theta)-\alpha}}\right]^{\frac{(1-\eta)(1+1/\theta)-\alpha}{1-\eta}}. \tag{A1}$$

The counterfactual welfare can be expressed as:

$$\frac{\tilde{V}}{V} = \left[\sum_{i=1}^{N} L_i\left(\frac{Q_i}{\tilde{Q}_i}\right)^{\frac{1-\eta}{(1-\eta)(1+1/\theta)-\alpha}}\left(\frac{\tilde{\mathcal{A}}_i}{\mathcal{A}_i}\right)^{\frac{1}{(1-\eta)(1+1/\theta)-\alpha}}\right]^{\frac{(1-\eta)(1+1/\theta)-\alpha}{1-\eta}}. \tag{A2}$$

Substituting the expression of indirect utility (11) to replace wage in housing price (9) gives:

$$P_i = \left(\frac{\beta V L_i^{1+1/\theta}}{Z_i \overline{H}_i \tau_i^{1-\beta}}\right)^{\frac{\gamma}{1-\beta\gamma}}. \tag{A3}$$

This substitution into the local living costs yields:

$$Q_i = \frac{(\tau_i P_i)^{\beta}}{Z_i} = \frac{\tau_i^{\beta}}{Z_i}\left(\frac{\beta V L_i^{1+1/\theta}}{Z_i \overline{H}_i \tau_i^{1-\beta}}\right)^{\frac{\beta\gamma}{1-\beta\gamma}}. \tag{A4}$$

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Further, using this expression and the one for equilibrium employment (12), we obtain:

$$\frac{\tilde{Q}_i}{Q_i}=\left(\frac{\tilde{\tau}_i}{\tau_i}\right)^{\frac{\beta(1-\gamma)[(1+1/\theta)(1-\eta)-\alpha]}{(1-\alpha-\eta)(1-\beta\gamma)+(\beta\gamma+1/\theta)(1-\eta)}}\left(\frac{B_i}{\tilde{B}_i}\right)^{\frac{\alpha\beta\gamma(1+1/\theta)}{(1-\alpha-\eta)(1-\beta\gamma)+(\beta\gamma+1/\theta)(1-\eta)}}\left(\frac{V}{\tilde{V}}\right)^{\frac{\alpha\beta\gamma}{(1-\alpha-\eta)(1-\beta\gamma)+(\beta\gamma+1/\theta)(1-\eta)}}, \tag{A5}$$

which when substituted into the welfare ratio (A2) gives the desired expression (18).

Next, we derive an expression for output gains. Given that $\alpha Y_i = W_i L_i/B_i = VQ_i L_i^{1+1/\theta}$, we use equilibrium employment (12) to express aggregate output as:

$$\alpha Y=\sum_{i=1}^{N}\frac{W_i L_i}{B_i}=\sum_{i=1}^{N}\left(\frac{\alpha^{1-\eta}\eta^{\eta}}{R^{\eta}}\mathcal{A}_i\right)^{\frac{1+1/\theta}{(1-\eta)(1+1/\theta)-\alpha}}(VQ_i)^{-\frac{\alpha}{(1-\eta)(1+1/\theta)-\alpha}}. \tag{A6}$$

Using this expression, one can write the aggregate output ratio as:

$$\frac{\tilde{Y}}{Y}=\sum_{i=1}^{N}\varphi_i\left(\frac{\tilde{V}\tilde{Q}_i}{VQ_i}\right)^{-\frac{\alpha}{(1-\eta)(1+1/\theta)-\alpha}}\left(\frac{\tilde{\mathcal{A}}_i}{\mathcal{A}_i}\right)^{\frac{1+1/\theta}{(1-\eta)(1+1/\theta)-\alpha}}, \tag{A7}$$

which, when using expressions (A2) and (A5), yields the desired expression (19).

Lastly, to derive an expression for the aggregate price ratio, we note that:

$$\frac{\tilde{\bar{Q}}}{\bar{Q}}=\sum_{i=1}^{N}\varphi_i\frac{\tilde{Q}_i}{Q_i}\left(\frac{\tilde{L}_i}{L_i}\right)^{1+1/\theta}. \tag{A8}$$

Utilizing the above expression and expressions (A4) and (A5), we have

$$\frac{\tilde{\bar{Q}}}{\bar{Q}}=\sum_{i=1}^{N}\varphi_i\left(\frac{\tau_i}{\tilde{\tau}_i}\right)^{\frac{\alpha\beta(1-\gamma)}{(1-\alpha-\eta)(1-\beta\gamma)+(\beta\gamma+1/\theta)(1-\eta)}}\left(\frac{B_i}{\tilde{B}_i}\right)^{\frac{\alpha(1+1/\theta)}{(1-\alpha-\eta)(1-\beta\gamma)+(\beta\gamma+1/\theta)(1-\eta)}}\left(\frac{V}{\tilde{V}}\right)^{\frac{\alpha\beta\gamma+(1-\eta)(1+1/\theta)}{(1-\alpha-\eta)(1-\beta\gamma)+(\beta\gamma+1/\theta)(1-\eta)}}. \tag{A9}$$

When combined with expression (18), it provides the desired expression (20).

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