Place-based Policy, Migration Barriers, and Spatial Inequality*

Nghiêm Q. Huỳnh†

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Abstract

This study quantifies the effects of two policies on spatial inequality in Vietnam, place-based tax incentives and the Ho Khau reform, which reduces migration barriers. To this end, I develop a dynamic spatial general equilibrium model incorporating workers' and entrepreneurs' choices. The model yields ambiguous effects of these policies on spatial inequality. Tax incentives attract firms but can reduce public services, while eased migration barriers can both offset and amplify the effects of place-based policies. I combine two decades of firm and household data with difference-in-differences designs to identify two key factors governing policy effects, the firm entry elasticity and migration costs associated with the Ho Khau reform. I find that place-based incentives have a minimal impact on spatial inequality, while migration reform significantly lowers migration costs to poorer areas, boosting labor supply and firm entry, and increasing welfare by 4% there, versus a 1.5% rise in wealthier areas.

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†Yale University. nghiem.huynh@yale.edu

1 Introduction

Persistent inequality across regions motivates two common policies: place-based incentives for firms to enter disadvantaged regions and migration barrier reductions. However, the effectiveness of these policies on a large scale remains uncertain, with limited research on their combined impact in addressing spatial inequality.

This paper aims to quantify the effects of two policies on spatial inequality in Vietnam, the unique context where both policies were implemented at scale and together. In 2003, Vietnam introduced tax incentives for new firms to enter economically disadvantaged areas, with decreasing benefits as firms mature. Districts in Vietnam were grouped into three groups (A, B, C) based on increasing poverty levels, with greater tax reductions in poorer regions. In 2005, Vietnam eased household registration (*Ho Khau*) restrictions that limited regional migration, with a milder relaxation for migration to centrally-administered provinces (A^*) compared to the rest of Vietnam (R).

To study the welfare effects of each and both policies, I first use micro establishment and household data, spanning two decades and including periods before and after policy changes, to examine how the distribution of firms and workers across regions changed following the policy adjustments. I document three facts. From 2000 to 2015, spatial inequality in Vietnam, measured by the regional labor income Gini coefficient, decreased. Second, while migration increased post-reforms, it differed based on migrant origins and destinations. Third, while most firms displayed limited response to incentives in disadvantaged regions, manufacturing firms did, boosting local employment in this sector. The latter two facts underscore the role of spatial frictions in the movement of people and goods.

I then develop a dynamic spatial general equilibrium model, focusing on the location and occupational decisions of entrepreneurs and workers, with three novel features. First, workers can respond to migration cost changes due to the Ho Khau policy similarly to households in Caliendo et al. (2021). Second, to capture how tax rates varied with firm age, I build on the work of Caliendo and Parro (2020) by introducing entrepreneurs holding firms that differ in their stages of maturity. These entrepreneurs select business locations based on tax schedules and local factors, including productivity and trade costs, consuming locally with their net profits, which in turn engenders an agglomeration effect. Third, drawing inspiration from Lucas (1978), the model incorporates the cost of entrepreneurship as forgoing wage employment opportunities.

The model presents ambiguous effects of policies on spatial inequality. On the one hand, place-based incentives draw firms, but they also reduce local revenue, impacting public services. When combined, these policies might counteract each other. Place-based incentives can stimulate labor demand and possibly elevate wages in disadvantaged areas. Yet, when migration barriers drop, more workers might flock to these improving regions, negating wage boosts from the incentives. The increase in labor supply, however, can suppress wages, luring even more firms. Thus, these policies can perpetuate a cycle, potentially alleviating spatial inequality. To understand these intricate interactions between workers and firms, a quantitative exercise is necessary.

Bringing the model to Vietnamese data is essential to estimate the general equilibrium effects of each and both policies. However, solving a dynamic multi-region model requires estimating a multitude of fixed and time-varying external factors and policy values. To overcome this computational challenge, I extend the "hat algebra" approach used in Caliendo et al. (2019) and Eaton et al. (2016). By expressing the equilibrium conditions of the actual economy and a counterfactual one with policy changes, I can overcome the need to estimate a large number of exogenous state variables and policies.

In the context of Vietnam, where significant changes occurred during the study period, this solution method avoids assuming that the observed economy is already in a steady state. Instead, it allows all economic fundamentals and other policies to evolve as they actually did during the study period. In essence, this approach enables me to answer counterfactual questions of interest such as, "What would have happened to the Vietnamese economy had the only change been the policy, while everything else evolved exactly as it did?"

However, this method still hinges on identifying two crucial factors that drive policy effects: the elasticity of firm entry regarding spatial factors and the migration costs associated with the Ho Khau policy reform. In the third step of my analysis, I derive reduced-form equations from the model and use policy variations to estimate these objects separately. To estimate the firm entry elasticity, I leverage the model's prediction that lower tax rates for startups, compared to older firms, increase the likelihood of entry relative to the likelihood of older firms continuing to operate in a local economy. To test this prediction and identify the firm entry elasticity, I employ a triple difference-in-difference design, taking advantage of tax variations over time, across space, and firm ages.

To estimate changes in migration costs associated with the Ho Khau reform over time and between A^* and R, I exploit the timing and spatial variations of the Ho Khau reform. I use data on migration flows to construct the Head-Ries (HR) index (Head and Ries, 2001). Changes in the HR index for migration flows from R to R provinces over time allow me to identify time-varying shifts in migration costs. Additionally, to identify spatial variations following the Ho Khau reform between A^* and R provinces, I compare the difference in HR changes between the HR indexes of A^*A^* and RR flows. Essentially, this approach is akin to a triple difference-in-difference design, taking advantage of variations in migration across destination, origin, and time.

With estimates of elasticities and changes in migration costs, I evaluate the migration and place-based policies as well as perform counterfactual exercises. Focusing on place-based tax incentives, B and C provinces see a rise in firm entry but lose workers to A due to diminished public services, even net of central government redistribution. As a result, this policy lowers welfare across the board and amplifies spatial inequality.

The Ho Khau reform increases overall welfare by reducing barriers to workers' movement. However, it also lowers entrepreneurship because easier mobility makes wage employment more attractive. This result is consistent with the literature on Lucas' occupational choice models with distortions, as seen, for instance, in Allub and Erosa (2019). Recent findings by Mobarak et al. (2023) also support this mechanism, showing that Bangladeshi households with lottery winners working in Malaysia were less inclined to start nonfarm businesses than those with lottery losers.

This drop in entrepreneurship mainly impacts the wealthier region A, which houses most firms. Furthermore, as many workers move to A for job opportunities after the restrictions are relaxed, real wages in A decline more than in B and C in the short run following the reform. Furthermore, as the Ho Khau reform reduced migration barriers more towards poorer regions, migrating to poorer regions B and C became more appealing after the reform leading to a substantial increase in employment and welfare in these regions.

The combination of both policies favors the effects of the Ho Khau policy whereby employment and welfare in poorer places increase by 4% on average and the increase in welfare of advantaged places by 1%. I also examine a counterfactual policy where tax rates remain the same across firm ages, unlike the actual place-based policy, which reduces tax breaks as firms mature. This analysis helps shed light on the effects of varying tax incentives throughout a firm's life cycle, a common global policy[1]. The limited empirical research on this aspect of place-based tax incentives could be due to the lack of theoretical guidance provided by this paper.

This paper contributes to the large literature on place-based policies[2]. The closest paper is Atalay et al. (2023), who examine a place-based industrial policy in Turkey. Beyond estimating the welfare effects of place-based tax incentives for firms in a world with changing migration barriers, this study provides both theoretical and empirical contributions. It mod-

[1]For references, see respectively Hasan et al. (2021) for India, the Regional Assistance Zones (ZAFR) "Tax incentives" (n.d.) for France, and "A Comprehensive Summary of Region-wise Tax Incentives in China" (n.d.) for China

[2]The growth in studies exploring the effects of place-based policies for firms has been consistent since Neumark and Simpson (2015)'s review. Significant contributions include Busso et al. (2013) and Kline and Moretti (2014) in the United States, and studies from developing countries including Lu et al. (2019), Chaurey (2017) and Hasan et al. (2021) using backward districts in India

els entrepreneurs' dynamic decisions and introduces wage jobs as an alternative occupational choice. This approach illuminates interactions between workers and firms. Furthermore, it combines the model and policy variations to provide novel estimation strategies to identify structural parameters influencing the impact of place-based policies.

This paper extends the migration literature by estimating the general equilibrium effects of a major policy change in migration costs. It builds upon Lagakos et al. (2023), who assess the welfare effects of migration subsidies for rural-urban migration, by developing a multi-region model tailored to Vietnam's geographical and local characteristics. Additionally, this study extends the work of Caliendo et al. (2021), who estimate the welfare effects of changes in trade and migration costs resulting from the EU expansion, by incorporating how firms respond to changes in migration costs for workers.

This study estimates migration costs related to the Ho Khau policy, akin to China's Hukou system, contributing to the literature on Hukou reform alongside recent studies like Wang et al. (2021) and Kinnan et al. (2018). Limited access to public services for internal migrants is not unique to Vietnam and China; Imbert and Papp (2020) find similar challenges in India. Furthermore, Tombe and Zhu (2019) investigate the general equilibrium effects of trade and migration cost reductions in China, some of which are linked to the Hukou policy.

Next, I provide the context of Vietnam and details of the policies in section 2. In section 3, I present the data sources and key facts. The model is introduced in section 4, with details on how to bring the model to data for estimation in section 5. The policy evaluation and counterfactual results can be found in section 6.

2 Vietnam's Place-based Policy and Ho Khau Reform

Vietnam offers a rare opportunity to explore the impact of location-based policies and migration restrictions. This section discusses a set of three policies: tax incentives for businesses in disadvantaged districts, central government redistribution mechanisms, and reforms to the household registration (Ho Khau) system, which restricts internal migration.

2.1 2003 Enterprise Income Tax Law

The 2003 revisions to the Enterprise Income Tax Law by the National Assembly, as illustrated in Figure A1, constitute a place-based tax policy that can directly influence where firms are located in Vietnam. The previous version of the law, effective from 1997 to 2003, imposed a 32% profit tax on all establishments, regardless of their location, age, or cohort. Any changes to this profit rate are highly significant, given that enterprise income taxes accounted for almost 40% of Vietnamese government tax revenue in 2000, surpassing all other taxes, such as value-added tax (22%) and personal income taxes (2%) (Shukla et al., 2011).

This study focuses on three major revisions to the law in 2003. First, the government lowered the tax rate for all establishments to 28%. Household businesses, defined as family-run entities employing fewer than ten people and operating at a single location without an official seal, are exempt from formal registration for tax IDs and therefore from this enterprise profit tax[3]. If a business does not fit this description, it must register as an enterprise[4].

Second, in accordance with Decree 164/2003/ND-CP, the government categorized districts for tax incentives, classifying them into three groups: those facing special socio-economic difficulties (referred to as Challenged - C), those with socio-economic difficulties (Burdened - B), and those without economic difficulties (Advantaged - A). While the precise criteria for these categories remain undisclosed, Figure 1 shows how the pre-reform poverty distributions across districts vary by tax policy labels. The 1999 poverty data comes from Minot et al. (2003), based on the 1999 population census and multiple poverty indicators. Poverty incidence clearly rises from A to C, but not perfectly. Moreover, Table A1 offers additional statistics derived from the establishment data detailed in section 3. It reveals that B and C districts have lower population densities, more ethnic minorities, lower urbanization rates, and lower wages than A districts.

The tax incentives provided to B and C districts vary over the life cycle of the firms. As demonstrated in Figure 2a, establishments that begin in or relocate to C or B districts receive lower tax rates starting from the first year they make profits in those areas. For instance, if a business enters an A district in 2005, it is indefinitely taxed at a 28% rate. Conversely, a counterpart in a B district pays no profit tax for the first two years, then 10% from three to eight years old, 20% from eight to ten years old, and 28% thereafter.

Third, in 2004, the government expanded the preferential tax rates to Special Economic Zones (SEZs)[5]. Manufacturing entrants post-2004 receive tax schedules akin to C districts, whereas service entrants get B district rates. I compiled a list of all SEZs up to 2021, encompassing industrial parks and high-tech zones. Later analysis only considers SEZs established before 2004 to avoid the potential endogenous response of setting up SEZs after the 2004 tax incentives. Notably, most SEZs are in A districts: of the 85 communes (the third administrative level after district and province) with an SEZ prior to 2004, only 8 are in C districts and 17 in B districts.

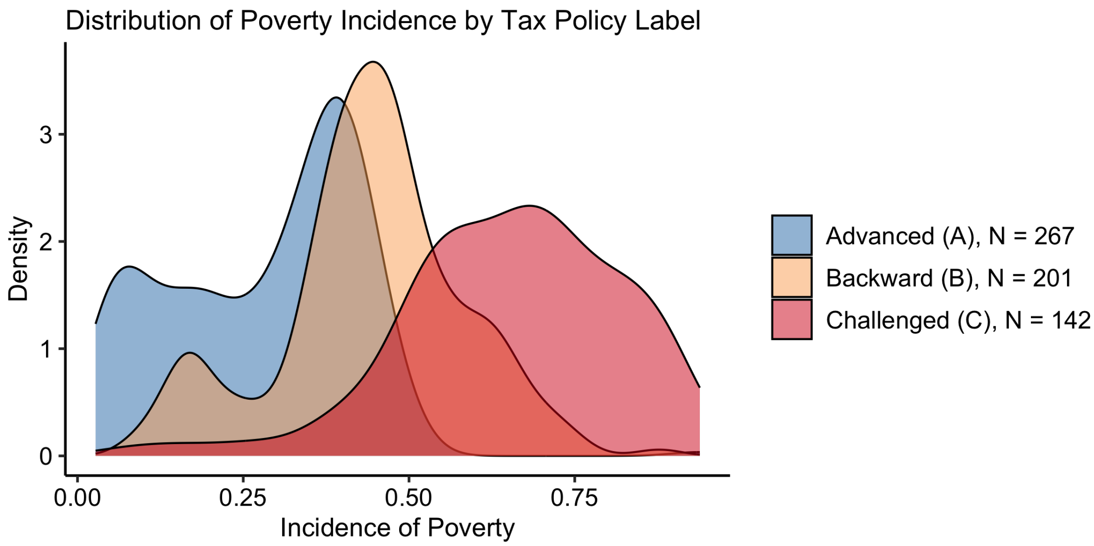
Although this place-based policy aims to uplift underdeveloped districts, concerns arise

[3] See Article 36 in Decree 88/2006/ND-CP

[4] Although formalization incurs costs like registration fees, hiring accountants, and adhering to reporting standards, it offers benefits such as access to broader markets, capital, and governmental support.

[5] Decree 88/2004/TT-BTC

Figure 1: Distribution of Poverty Incidence by Tax Policy Label in 1999



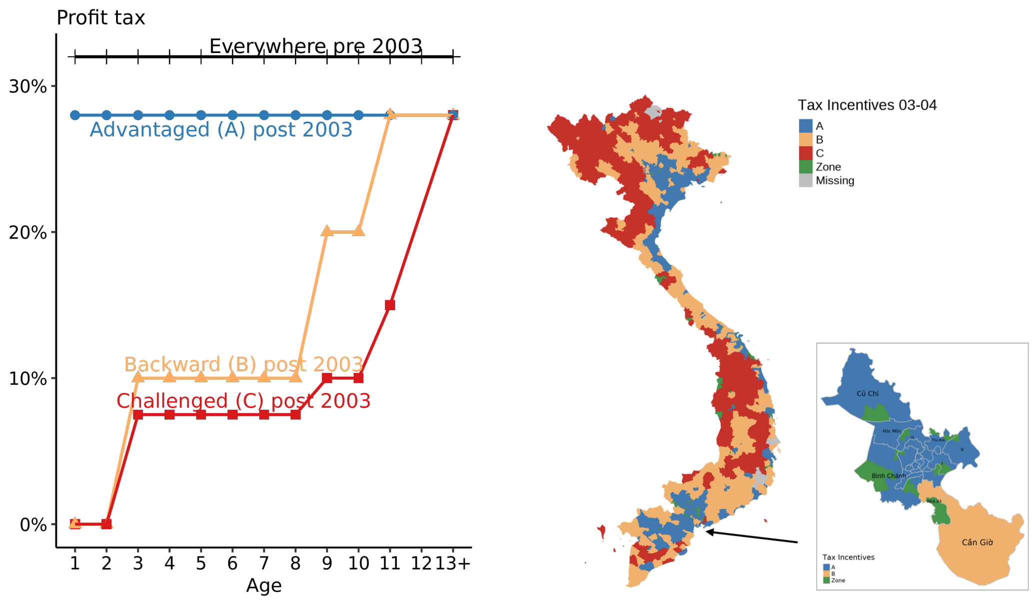
Sources: Minot et al. (2003) *Notes*: The labels A, B, and C denote Advanced, Backward, and Challenged districts, respectively, as per Decree 164/2003/ND-CP. Poverty incidence refers to the percentage of poor households in a district in 1999.

about firms exploiting these incentives by shutting down and restarting in tax-favored areas. However, the practicality of such maneuvers is restricted due to the high costs of business closure stemming from regulations strategically designed to thwart tax evasion and prevent capital flight out of the country. Moreover, merely changing the business name but keeping the same ownership fails to qualify for the tax advantages[6] Finally, Figure A5 shows that exit rates across cohorts did not spike in 2003.

The policy's effect on multi-entity firms might be complex. As per Table A2, in 2000, 99% of Vietnamese firms had just one establishment. While the number of multi-establishment firms might have risen over time, those operating across several districts in a province are taxed at the provincial level (Le et al., 2020). District tax authorities handle single-establishment businesses or household enterprises. Formal enterprises in various locations pay profit taxes at their headquarters unless they operate in tax-advantaged areas, where separate filings for each location are required[7].

[6]See Section III Article 1 of Decree 128/2003/TT-BTC and Item 6.1.2 of Decree 88/2004/TT-BTC.
[7]See Section III Article 1 of Decree 128/2003/TT-BTC and Article 11 of Decree 126/2020/ND-CP.

Figure 2: Profit tax on establishments varies across time, districts, and firm ages



(a) Tax schedule before and after 2003

(b) Map of district labels

Sources: Decree 164/2003/ND-CP amd Decree 88/2004/TT-BTC. *Notes*: Manufacturing entrants in SEZs post-2004 receive tax schedules akin to C districts in Panel (a), whereas service entrants get B district rates. Panel (b) shows the map of Vietnam at the commune level in 2010. The zoomed-in map is Ho Chi Minh City.

2.2 Revenue Redistribution Policy

In addition to cutting taxes in poorer districts B and C to attract firms, the central government is regularly engaged in a fiscal redistribution policy where they take more revenue from richer areas and allocate a higher share of their revenue to poorer regions. Figure A1 plots the retention shares of provincial revenues and the contribution from the central government across the periods 2003, 2006, and 2015, based on official records of the Ministry of Finance.

Since I do not have access to redistribution of lower level than provinces, I aggregate the A, B, and C labels from the tax policy to the province level which use 1999 population shares in B and C and try to keep the similar shares of A, B, C across provinces as in across districts. Figure A7 displays the map of these provinces with A, B, and C labels next to the map of the official labels at the districts levels.

The central government lets the most disadvantaged provinces keep all of the revenue while giving them back three times the revenue that they raise. At the same time, they take about half of local revenues from advantaged areas and redistributes only about 10%

of their income back. Since the focus of this paper is not on decisions of central government on redistribution or how it is best to combine it with other instruments like place-based and migration policies, I will take this revenue redistribution policy as given and allow it to either evolve exactly as I see in the data or experiment with varying levels of redistribution in the counterfactual analysis.

2.3 2005 Ho Khau Reform

In 2005, the government in Vietnam began easing the Ho Khau requirement, a regulation similar to China's Hukou system[8], which governs household registration and internal migration between provinces. Prior to this change, households moving to a different province faced challenges in obtaining permanent residency. To qualify for permanent residency, migrants had to meet several criteria, including obtaining a relocation certificate from their original province and demonstrating land or property ownership, which ironically required having a Ho Khau permanent status in the destination province (Liu and Meng (2019)).

The distinction between temporary and permanent status was primarily based on access to amenities in the destination province, with temporary migrants often struggling to access public services, healthcare, credit, and education for their children (World Bank Group and Vietnam Academy of Social Sciences, 2016).

In 2005, Decree 108/2005/ND-CP simplified the process by eliminating various prerequisites and introduced a path to permanent residency solely based on proof of residence. For instance, the law no longer linked home ownership to permanent residence and removed the requirement for a moving certificate from the migrant's origin.

As a result, migrants can apply for permanent residency if they can demonstrate legal residence in their destination province, including possessing land or property certificates, a certificate from local authorities confirming the legal status of their residence, or a lease agreement. However, for the five centrally administered cities (Hanoi, Hai Phong, Da Nang, Ho Chi Minh City, and Can Tho)[9], temporary migrants must also show evidence of continuous residence for at least one year[10], although in practice people must reside longer than a year due to the lengthy bureaucratic process and various difficulties in acquiring such proof.

In summary, the Ho Khau policy reform has decreased migration costs for migrants everywhere, but the decrease is less pronounced for the five centrally administered provinces.

[8] The Ho Khau policy is less strict than the Hukhou policy because, unlike the Hukhou, it does not restrict individuals to the birth sector.

[9] Ha Tay was merged into Ha Noi in 2008 and thus is considered part of Ha Noi in this study

[10] While Decree 108/2005/ND-CP requires a continuous stay of at least three years, the Residence Law of 2006 81/2006/QH11 reduces the requirement to at least one year.

For brevity, I call these central provinces A^* and the rest of Vietnam as R (for Rest). While changes in tariffs or taxes are given in numeric terms, the exact reduction in migration costs due to this policy is unknown. To perform welfare analysis, I will estimate this change using a model based on the features of this policy shift later on.

3 Data and Facts

The following data sources and three empirical facts provide insights into the economic trends in Vietnam from 2000 to 2019 and serve as the foundation for the coming model.

3.1 Data Sources

Establishment-level Data. The establishment-level data covers the period 2000 to 2015 and stems from annual enterprise surveys conducted by the General Statistics Office (GSO). This survey is mandatory for all registered firms. Starting in 2004, single-location household businesses employing fewer than ten workers are exempt from registration, allowing them to operate as "informal" entities without the need for survey reporting or paying taxes as discussed in subsection 2.1. Nevertheless, many of these enterprises opt to register voluntarily, as evidenced by the firm size distribution in Figure A2.

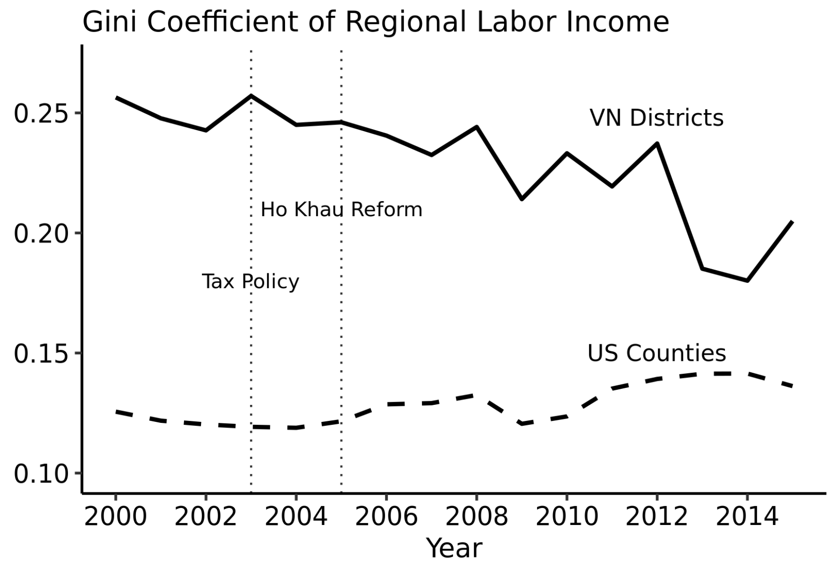
I follow McCaig et al. (2022) to create consistent firm identifiers, 4-digit ISIC industry codes, and locations. I also take advantage of employment and wage bill information. Additional details concerning these variables can be found in Appendix A.

Household Data. In addition to examining firm behavior from establishment surveys, I also analyze the choices made by households using the Population and Housing Censuses. Specifically, I use the 3% samples from the 1999, 2009, and 2019 censuses to assess the effects of policies on household location choices. I restrict the samples to the working-age population, aged 15 to 65.

In this study, a migrant is defined as someone who reports the current province as different from their province of residence five years ago, consistent with the GSO definition. However, this definition may underestimate actual migration since it does not consider seasonal migration or migrants who have returned to their origin within the past five years. Nonetheless, it is likely to be a good indicator of permanent migration.

Internal Trade Data. I use inter-provincial trade data for the year 2000 from JICA (2000). Using the 1999 IPUMS map, I calculated truck distances between provinces with

Figure 3: Evolution of Spatial Inequality Between Vietnam and USA, 2000-2015



Source: Vietnamese annual establishment surveys and US BEA (2000-2015).

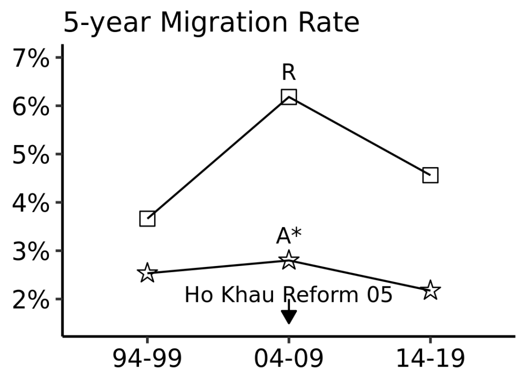
ArcGIS network analysis tools. This data will help me analyze the link between trade and distance, further detailed in subsection 5.3.

3.2 Descriptive Facts

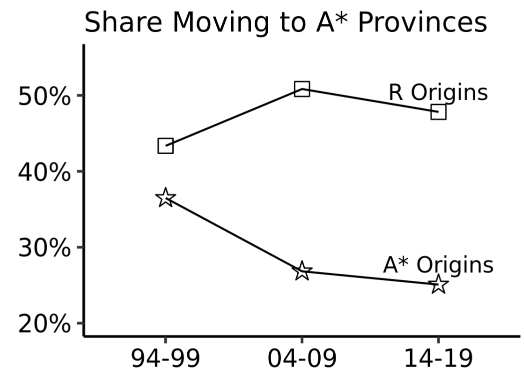
Spatial inequality in Vietnam, measured by labor income, reduced between 2000 and 2015. I analyzed the trend in spatial inequality across Vietnamese districts and compared it to US counties using the Gini coefficient, as depicted in Figure 3. I derived this metric by compiling wage and employment data from Vietnamese establishment surveys and used labor income data for US counties from the Bureau of Economic Analysis.

Figure 3 highlights two main points. First, Vietnam's spatial inequality is consistently higher than that of the US during this timeframe. This pronounced inequality was likely to contribute to the policies outlined in section 2 in Vietnam. Additionally, Vietnam experienced a notable reduction in spatial inequality between 2000 and 2015.

Significant changes in migration post-reforms, varied by origin and destination. The period following the tax and Ho Khau policy reforms, from 2004 to 2009, witnessed a substantial rise in migration relative to the period between 1994 and 1999. Figure 4a presents the out-migrant share across periods, aggregated by Ho Khau labels. R households, who



(a) Out-migrant Share



(b) Destination share

Source: Population and Housing Census, 1999, 2009, and 2019. *Notes*: A^* refers to the centrally administered cities, and R the rest of Vietnam. Panel (a) reports the share of out-migrants between year t and $t+5$ among people in all provinces of type R or A^* in year t. Panel (b) reports the share of migrants who choose A^* destinations among the out-migrants from R or A^* origins.

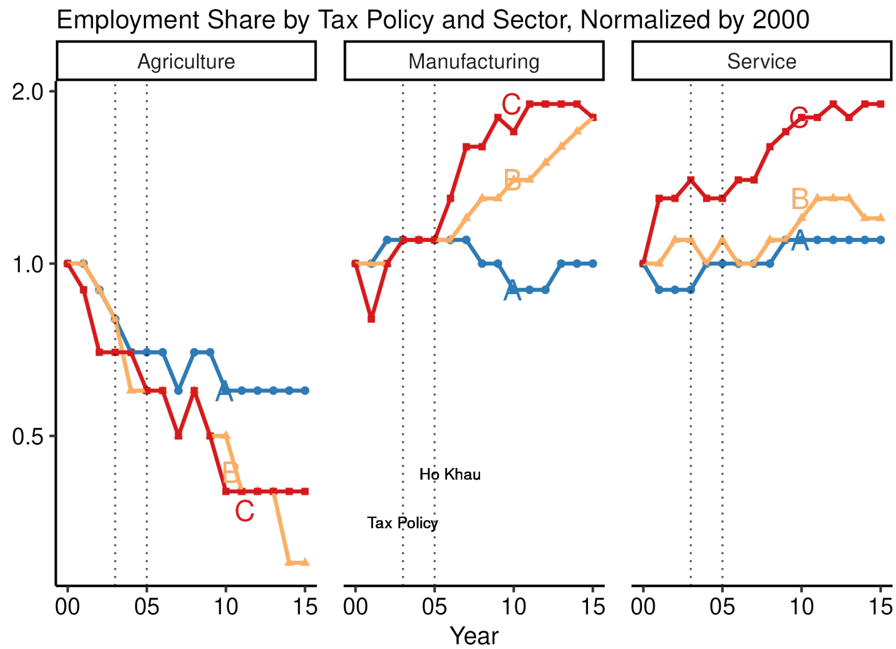
constituted around 80% of the Vietnamese total population in 1999, tend to migrate much more often than A^* ones. Furthermore, migration's appeal has increased from 1999 to 2009, irrespective of whether individuals originate in R or A^* areas. Notably, the out-migration share from R origins nearly doubled during the 2004-2009 period compared to 1994-1999.

When examining destination preferences of out-migrants, I find that individuals from R provinces increasingly favor A^* destinations, while the reverse holds true for those originating from A^*. This pattern is evident in Figure 4b, displaying the share of out-migrants choosing A^* destinations based on their origin types. After the Ho Khau reform, more migrants from R regions chose A^*, while those from A^* leaned towards R areas. Although the Ho Khau policy did not differentiate migrants based on origin, the migration pattern suggests that the stricter requirements for A^* Ho Khau post-reform could both lessen in-migration from R to A^* and had an even more significant effect on those from A^*.

In sum, migration costs differ based on migrants' origin and destination, and the Ho Khau policy can influence these costs. I integrate this aspect into the dynamic model in section 4. In section 5, I demonstrate how the Ho Khau policy's effects on migration costs can be deduced from migration flow variations, informed by the model's structure.

Post-reform increase in manufacturing firm entry and employment. By merging the firm's location with the district label from the 2003 tax policy, I examine Vietnam's overall changes across industries and regions. Figure 5 displays the evolution of employment share by district tax labels and the three main sectors: Agriculture, Manufacturing, and

Figure 5: Employment share by tax policy status and sector, 2000-2015



Source: Annual establishment surveys (2000-2015). *Notes*: I aggregate firm-level employment to the district statuses of the place-based profit tax 2003 and broad sectors. Each data point represents the ratio of employment share in a specific type of district-sector combination for a given year compared to its level in 2000.

Services. For each sector-district type, employment shares are normalized based on their respective 2000 levels. The figure first illustrates the substantial structural transformation in Vietnam, as observed in prior studies (McCaig and Pavcnik, 2013). The shares of employment in the manufacturing and service sectors experience rapid growth, while agriculture share falls.

Equally significant as the aggregate structural change are the employment dynamics across district categories within sectors. Prior to 2003, Advantaged (A) districts held about 90% of employment in manufacturing and services and around 50% in agriculture. Yet, from 2005 onward, B and C districts saw faster growth in manufacturing employment share than A districts. This change is particularly significant considering the parallel employment trends across these areas before 2005. This pattern remains evident even when adding the Zone category as a fourth location in Figure A3. These figures highlight the potential impact of policy reforms on the regional economic landscape.

During this period, the entry and exit margins play a crucial role in shaping the economy and are likely the driving force behind the substantial growth in non-agricultural employment observed in Figure 5, particularly in poorer districts. Table A3 presents data on entrants and exiters in 2000 and 2015. In 2015, firms that were newly established (not present in 2000) accounted for 98% of all firms, contributing to 85% of employment and 83% of revenue. On the other hand, exiters, referring to firms present in 2000 but no longer in operation by 2015, tended to be smaller in size, comprising only 47% of employment and 49% of revenue in 2000. These figures highlight the significant degree of establishment turnover in the economy and underscore the importance of new establishments in driving employment growth.

At the local level, entry is not limited to completely new firms. Firms can also enter a location by relocating from another place between $t-1$ and t, or "in-migrants". Additionally, firms can re-enter after a period of inactivity or for other reasons that make them unobserved. Among re-entrants, there are "re-entrant incumbents" that return to the same location and "re-entrant migrants" that relocate from elsewhere. Nonetheless, most entrants to a district are completely new, as shown in Figure A4. The average annual entry rate is 27%, consistent with the rate reported by McCaig and Pavcnik (2021). Relocation across districts for incumbents is 6%, while the re-entrant in-migrant rate is less than 1%[11].

The establishment-level data used in this study omits the informal sector, encompassing small household businesses, and lacks information on whether an entrant was informal before. However, this limitation's impact on firm entry measurement should be minimal, given the infrequent formalization of private domestic firms. As highlighted by McCaig et al. (2022) and McCaig and Pavcnik (2021), the majority of private firms start as formal, and only about 2% of informal firms transition to formality within two years. Additionally, although the informal sector makes up a large part of employment, Cling et al., 2011 estimates it contributes just 20% to GDP. In short, the establishment-level data effectively capture the majority of Vietnamese firm dynamics.

3.3 Difference-in-Difference Analysis

In this subsection, I use a Difference-in-Differences (DiD) design to document how district labels under the Enterprise Income Tax Law correlate with firm location decisions and employment. As the policy offers incentives for firms entering C and B districts, along with Zone communes, I expect that these regions will experience higher rates of new entry and increased employment compared to A districts. As suggested by Figure 5, the answer may differ across sectors.

The unit of analysis is the district-zone level, as illustrated in Figure 2b. The map displays

[11] The fraction of firms that re-enter after one exit period is extremely rare, at 0.1% among all firms that exit on average across exit cohorts.

each polygon as a commune, an administrative tier below the district level. Commune colors denote socioeconomic status (C, B, A, or Zone). A commune is classified as a Zone if it hosted at least one economic zone before 2004. For instance, consider Cu Chi, a district in Ho Chi Minh City. While classified as A under the 2003 tax law, one of its communes is labeled as Zone, colored Green at the upper right corner. This distinction divides Cu Chi into two units for subsequent analysis: Cu Chi with Zone and Cu Chi without Zone. The following analyses aggregate establishment data into a balanced panel at the district-zone-sector level, encompassing approximately 700 district zones and 60 two-digit ISIC sectors.

The time and spatial variation of the policies suggest the following event-study specification:

$$Y_{ist} = \sum_{j \in \{-3,\ldots,0,\ldots,12\}} \boldsymbol{\beta}_j^P \cdot \mathbf{Treat}_i \cdot \mathbf{1}_{t-j} + \underbrace{\alpha_i}_{\text{Region FE}} + \underbrace{\theta_s \cdot \delta_t}_{\text{Sector-Region FE}} + \varepsilon_{ist}, \tag{1}$$

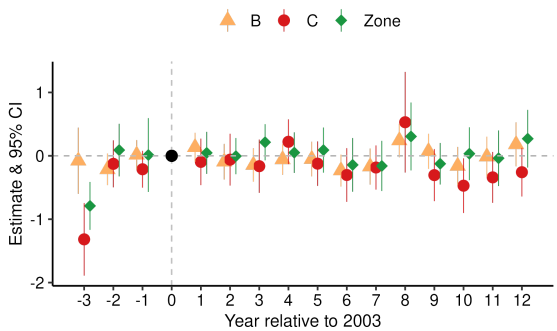
where Y_{ist} is an outcome variable, which measures the share of entrants located in district-zone i among all entrants in sector s at year t, or the total labor employed by all firms in district-zone-sector is in year t. The variable $\mathbf{Treat}_i$ takes four different values (A, B, C, and $Zone$) with A being the control group, while indicator $\mathbf{1}_{t-j}$ equals one for year t. Commune i is classified as a Zone if it has an economic zone prior to 2004. Thus, the vector of coefficients of interest, $\boldsymbol{\beta}_j^P$, include $\beta_t^B, \beta_t^C, \beta_t^{\text{Zone}}$ which I hypothesize to be positive for both outcomes after 2003.

The estimated coefficients for years prior to 2003 are used to provide suggestive evidence of the parallel trend assumptions for the identification of these coefficients. In order to address potential unobserved correlations within locations, standard errors are clustered at the district-zone level. To account for numerous zeros in the outcome variables, I estimate Equation 1 using Pseudo Poisson Maximum Likelihood (PPML).

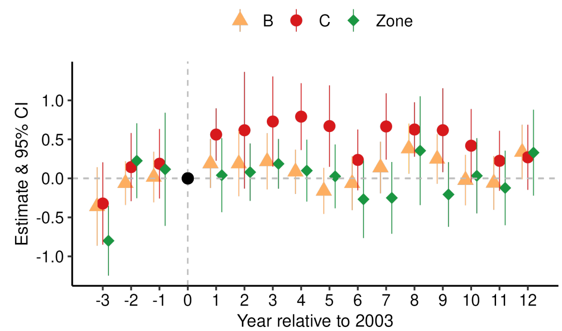
The introduction of tax incentives in B and C districts, as shown in Figure 6a and Figure 6c, did not yield increases in entry or employment when running regression Equation 1 on all establishments. This outcome can potentially be explained by heterogeneous effects across sectors. Manufacturing, comprising many tradable sectors, is more likely to respond to tax incentives in geographically disadvantaged districts due to its dependence on broader market demand rather than local consumption. However, given the relatively small share of manufacturing firms (approximately 24%), their response may not significantly impact the overall trends.

Consequently, when separately estimating Equation 1 within the major sectors, I find an increase in both entry rates and employment within manufacturing. Tax incentives lead to an approximate 65% rise in the entrant share in C districts compared to A districts. Furthermore, these effects exhibit a degree of persistence over time, as depicted in Figure 6b. These

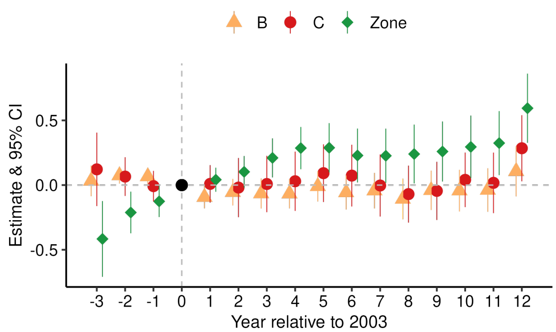
Figure 6: Event-study estimates of entry and employment



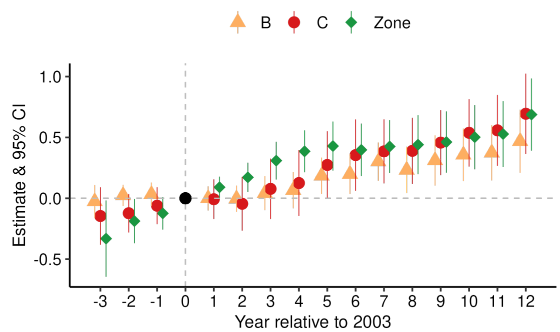
(a) Entry - All



(b) Entry - Manufacturing



(c) Employment - All



(d) Employment - Manufacturing

Source: Annual establishment surveys (2000-2015). *Notes*: The panel of figures displays various outcomes, including entry share and employment, organized in rows. The columns represent different data subsets: all sectors and manufacturing only. Each figure showcases PPML estimates of Equation 1, with all regressions incorporating fixed effects for district-zone and sector-year.

findings align with results in India, where place-based tax incentives led to an increase in manufacturing entry in backward districts (Chaurey, 2017; Hasan et al., 2021). Additionally, the rise in firm entry potentially translates to increased employment within manufacturing firms in B and C districts, as illustrated in Figure 6d.

The Zone results suggest that tax incentives may not be the main driver of firm entry into SEZs. However, lower tax rates can allow firms to persist longer in these areas as I will explore after presenting how age-specific taxes affect the likelihood of continuing operating versus exit in the model.

In summary, this DiD analysis reveals that tax policy has the potential to stimulate structural transformation in less affluent districts. Table A4 presents the results of pooled regressions based on Equation 1, where I aggregate the data into pre- and post-periods and analyze them separately for major sectors. Following the implementation of tax incentives, both entry and employment in the manufacturing sector in B and C districts increase compared to A districts. Conversely, the agriculture sector witnesses a decline. There is a modest increase in the service sector, although not statistically significant, possibly due to a higher likelihood of informal operations with smaller-scale businesses in the service sector.

Interpreting these DiD results as effects of tax incentives, Ho Khau reform, or both, requires careful consideration for two reasons. First, I exclude the Ho Khau reform from this analysis due to the lack of a clean control group. In particular, several A districts, acting as the control group in regression Equation 1 for the tax policy, become the A^* treatment group in the Ho Khau reform. Furthermore, it is difficult to isolate the effects of each and both policies because of the close timing of both policies. Furthermore, even with a clean control group, the DiD analysis is partial equilibrium in nature, as the impact of these policies on the control group is ignored. Large-scale policies can yield intricate general equilibrium effects through prices. Overcoming these challenges to quantify the welfare effects of the policies of interest requires a model.

4 A Dynamic Spatial General Equilibrium Model

I develop a dynamic spatial general equilibrium model to achieve three main objectives. First, due to the national scope of both policies, the model allows me to assess their welfare effects, incorporating general equilibrium responses. Second, its structure provides a stronger connection between data and policies than the previous DiD analysis, tapping into a broader range of policy variations with firm age for estimation. Lastly, the model serves not only for policy evaluations but also for exploring counterfactual policies involving different taxation levels and migration barriers.

This model extends the work of Caliendo and Parro (2020) by introducing heterogeneity among entrepreneurs, based on firm age, and introducing occupational choice. The first extension incorporates tax schedules that vary across space, time, and firm age to align with the tax policy outlined in subsection 2.1. The second allows place-based policies to impact the national and regional levels of entrepreneurship, potentially affecting the distributional welfare gains.

4.1 Environment

The economy evolves in discrete time, indexed by $t \geq 0$, and consists of N locations indexed by $i, n \in \{1, \ldots, N\}$, and J sectors indexed by $j, k \in \{1, \ldots, J\}$. Each location contains four types of infinitely-lived households: workers and entrepreneurs of types I, II, and III. The three entrepreneur types correspond to the age of the firm.

Each household in location i derives utility from consuming per capita public services and a local basket of goods $c_{i,t}$ with the following preferences:

$$\mathbb{E}_t \left[\sum_{t'=t}^{\infty} \beta^{t'-t} \log \left(c_{i,t'} \right) \right],$$

where β is the discount factor and $c_{i,t} = \prod_j (c_{i,t}^j)^{\alpha^j}$. Specifically, each household's preferences exhibit nested constant elasticity of substitution (CES) structure, with a Cobb-Douglas outermost nest allocating consumption share γ to public services, a Cobb-Douglas second nest with share α^j to sector-j goods, and a CES innermost nest with an elasticity of substitution σ applied to a continuum of varieties produced by entrepreneurs across the country.

The local price index, denoted as $P_{i,t}$, is computed through the second Cobb-Douglas nest and is given by

$$P_{i,t} = \prod_{j=1}^{J} \left(\frac{P_{i,t}^j}{\alpha^j} \right)^{\alpha^j}, \quad 0 < \alpha^j < 1 \text{ and } \sum_j \alpha^j = 1, \tag{2}$$

where $P_{i,t}^j$ represents the location-sector price index. Plus, given CES preference in the innermost nest, the location-sector price index can be expressed as

$$P_{i,t}^j = \left(\sum_{n=1}^{N} E_{n,t}^j (p_{ni,t}^j)^{1-\sigma} \right)^{1/(1-\sigma)}, \tag{3}$$

where $E_{n,t}^j$ is the measure of varieties produced in location n and sector j and $p_{ni,t}^j$ represents the price set by entrepreneurs in location n and shipping to i at time t. The location-sector price index emphasizes the first interaction between locations, involving the spatial frictions in the movement of goods.

4.2 Workers

Each location has a continuum of workers of measure $L_{i,t}$, who supply labor inelastically. They are perfectly mobile across sectors. At the start of period t, a worker in location i

earns a wage $w_{i,t}$, spends all of it consuming varieties, enjoys amenity $\mathcal{A}_{i,t}$ and per capita public services $\frac{G_{i,t}}{L_{i,t}}$ where $G_{i,t}$ denotes public services and $L_{i,t}$ the local mass of workers. Then, the worker draws idiosyncratic shocks across locations, represented by $\boldsymbol{\epsilon}_t = \{\epsilon_{n,t}\}_{n=1}^{N}$, and decides the next location based on the expected value of being in location n, denoted by $U_{n,t+1} \equiv \mathbb{E}_{\epsilon}\left[u_{n,t+1}\right]$, and migration costs $m_{in,t}$.

The worker's lifetime utility for working in location i is given by

$$u_{i,t} = \log\left(c_{i,t}\right) + \max_{n=1,\dots,N}\left\{\beta U_{n,t+1} - m_{in,t} + \nu\epsilon_{n,t}\right\} \tag{4}$$

where

$$c_{i,t} = \mathcal{A}_{i,t}\left(\frac{G_{i,t}}{L_{i,t}}\right)^{\gamma}\left(\frac{w_{i,t}}{P_{i,t}}\right)^{1-\gamma}$$

and the idiosyncratic shocks $\boldsymbol{\epsilon}_t$ are i.i.d over time with a Type-I Extreme Value distribution. The parameter $\nu > 0$ dictates the shock dispersion across locations. A larger ν implies higher worker heterogeneity and lower responses to policy changes. The consumption structure follows from Fajgelbaum et al. (2018) where workers consume a share γ of rivalrous public services. I consider this congestion effect as the main driver of the Ho Khau policy that aims to reduce congestion in the consumption of public services such as hospitals and schools.

Following Caliendo et al. (2021), the migration cost $m_{in,t}$ from origin i to destination n comprises two parts: a time-invariant component and a Ho Khau-related policy cost, denoted by $mpol_{in,t}$, for migrants living in n but born in province i. The migration cost $m_{in,t}$ can be expressed as

$$m_{in,t} = m_{in} + mpol_{in,t}, \tag{5}$$

where m_{in} represents time-invariant factors for the origin-destination pair (i, n), such as distance. I assume that $m_{ii,t} = 0$ and $m_{in,t} > 0$ for $n \neq i$.

To determine migration flows, I rely on the distributional assumption to first derive the option value of being in location i in Equation 4[12]

$$\Xi_{i,t} \equiv \mathbb{E}\left[\max_{\{n\}} \beta U_{n,t+1} - m_{in,t} + \nu\epsilon_{n,t}\right] = \nu \log\left[\sum_{n=1}^{N} \exp\left(\beta U_{n,t+1} - m_{in,t}\right)^{1/\nu}\right], \tag{6}$$

resulting in the expected lifetime utility of working in i at date t

$$U_{i,t} = \log\left(c_{i,t}\right) + \Xi_{i,t}, \tag{7}$$

[12] Appendix B provides the details of all model derivations.

and the share of workers who migrate from i to be in n between time t and $t+1$

$$\mu_{in,t} = \frac{\exp\left(\beta U_{n,t+1} - m_{in,t}\right)^{1/\nu}}{\sum_{n'=1}^{N} \exp\left(\beta U_{n',t+1} - m_{in',t}\right)^{1/\nu}}. \tag{8}$$

4.3 Entrepreneurs

Entrepreneurs, unlike workers, operate in a sector due to sector-specific technologies. Their productivity is independently drawn every period. The firm has different stages represented by $s \in \{\text{O, I, II, III}\}$ that determines their local profit tax rate, denoted by $\tau_{i,t}^{s}$. Like workers, they do not save and spend all net profits on goods. Furthermore, they face monopolistic competition.

4.3.1 Static Decisions

An operating entrepreneur in location i and sector j decides how much to produce and at what price to charge in each period t. The entrepreneur's output, $y_{i,t}^{j}$, depends on location-sector productivity ($A_{i,t}^{j}$) and labor ($L_{i,t}^{j}$). The production function features constant returns to scale

$$y_{i,t}^{j} = A_{i,t}^{j} L_{i,t}.$$

In addition to input costs, firms in sector j and location i incur iceberg trade costs d_{in}^{j} in destination n. Thus, entrepreneurs set their optimal prices by including a constant markup to the combined input cost, which is the local wage $w_{i,t}$, and the trade cost:

$$p_{in,t}^{j} = \frac{\sigma}{\sigma - 1} \frac{d_{in}^{j} w_{i,t}}{A_{i,t}^{j}}. \tag{9}$$

Entrepreneurs sell their varieties across all locations, generating pre-tax profits $\pi_{i,t}^{j}$, given by

$$\pi_{i,t}^{j} = \left(\frac{\sigma - 1}{\sigma}\right)^{\sigma} \left(\frac{A_{i,t}^{j}}{w_{i,t}}\right)^{\sigma - 1} \sum_{n=1}^{N} (d_{in}^{j})^{1-\sigma} X_{n,t}^{j} (P_{n,t}^{j})^{\sigma - 1} \tag{10}$$

where $X_{n,t}^{j}$ represents the expenditure on sector j in location n. If varieties are substitutes (i.e., $\sigma > 1$), profits rise with lower effective input costs ($w_{i,t}/A_{i,t}^{j}$), lower trade costs, and higher demand.

4.3.2 Dynamic Decisions

Stage I, II, and III entrepreneurs decide to continue operations or exit in the next period to become a worker. While an entrepreneur in practice might pursue various outside options like managing a different firm, I limit their outside option to being a worker based on observations that (a) exiting firms seldom return, (b) firms rarely change locations, and (c) transitioning to a worker role aligns with an idea in Lucas (1978) where economic development may see small entrepreneurs join larger firms as workers.

Let $v_{i,t}^{js}$ represent the value of an s-entrepreneur in location-sector ij at time t, with the expected value of operating an s firm in ij given by $V_{i,t+1}^{js} \equiv \mathbb{E}_t[v_{i,t+1}^{js}]$.

Stage III entrepreneurs. Each period, a mass of III entrepreneurs $E_{i,t}^{j\text{III}}$ use their post-tax profits for local consumption. They choose to remain in the same location-sector or exit to work as employees, factoring in idiosyncratic productivity shocks. The value for an III entrepreneur in location-sector ij at time t is given by

$$v_{i,t}^{j\text{III}} = \log c_{i,t}^{j\text{III}} + \max\left\{\beta V_{i,t+1}^{j\text{III}} + \chi\epsilon_{stay,t}, \beta U_{i,t+1} + \chi\epsilon_{exit,t}\right\}. \tag{11}$$

where

$$c_{i,t}^{j\text{III}} = \left(\frac{G_{i,t}}{L_{i,t}}\right)^{\gamma}\left((1-\tau_{i,t}^{\text{III}})\frac{\pi_{i,t}^{j}}{P_{i,t}}\right)^{1-\gamma}$$

As entrepreneurs consume locally, their growing numbers can lead to reduced local prices. This reduction in prices, in turn, provides a greater incentive for more entrepreneurs to establish their businesses in the same location, thereby creating an agglomeration effect.

I assume that the idiosyncratic productivity shocks ϵ are drawn from a Type-I extreme value distribution with variance χ. Thus, the expected value for an III entrepreneur at time t in location-sector ij is given by

$$V_{i,t}^{j\text{III}} = \log c_{i,t}^{j\text{III}} + \chi\log\left[\exp\left(V_{i,t+1}^{j\text{III}}\right)^{\beta/\chi} + \exp\left(U_{i,t+1}\right)^{\beta/\chi}\right], \tag{12}$$

where the value function of being worker is given in Equation 7. The fraction of III entrepreneurs who choose to stay in location-sector ij between time t and $t+1$ is given by

$$\varsigma_{i,t}^{j\text{III}} = \frac{\exp\left(V_{i,t+1}^{j\text{III}}\right)^{\beta/\chi}}{\exp\left(V_{i,t+1}^{j\text{III}}\right)^{\beta/\chi} + \exp\left(U_{i,t+1}\right)^{\beta/\chi}}. \tag{13}$$

The evolution of the mass of III entrepreneurs is given by

$$E_{i,t+1}^{j\mathrm{III}} = \varsigma_{i,t}^{j\mathrm{III}} E_{i,t}^{j\mathrm{III}} + \varsigma_{i,t}^{j\mathrm{II}} E_{i,t}^{j\mathrm{II}}, \tag{14}$$

where $E_{i,t}^{j\mathrm{II}}$ represents a mass of II entrepreneurs in location-sector ij at time t and $\varsigma_{i,t}^{js}$ the share of type s entrepreneurs that decide to stay in location-sector ij between t and $t+1$.

Stage I and II entrepreneurs. I group the two types of entrepreneurs together due to their similar value functions. The value of being an s-entrepreneur in location-sector ij at time t includes the real after-tax profits and the option value, represented as:

$$v_{i,t}^{js} = \log\left(c_{i,t}^{js}\right) + \max\left\{\beta V_{i,t+1}^{js+1} + \chi\epsilon_{stay,t}, \beta U_{i,t+1} + \chi\epsilon_{exit,t}\right\}, s \in \{\mathrm{I}, \mathrm{II}\}$$

where $V_{i,t+1}^{js+1}$ indicates the future value of an s-entrepreneur. For instance, it corresponds to the value of an II-entrepreneur if s is I. The distinction between III and both I and II entrepreneurs is that III entrepreneurs do not consider the future value of another type.

Like III-entrepreneurs, the productivity shocks have a Type-I extreme value distribution with variance χ. The expected value for an s-entrepreneur at time t in location-sector ij is

$$V_{i,t}^{js} = \log c_{i,t}^{js} + \chi \log\left[\exp\left(V_{i,t+1}^{js+1}\right)^{\beta/\chi} + \exp\left(U_{i,t+1}\right)^{\beta/\chi}\right], \tag{15}$$

and the fraction of s entrepreneurs staying in location-sector ij between time t and $t+1$ is given by

$$\varsigma_{i,t}^{js} = \frac{\exp\left(V_{i,t+1}^{js+1}\right)^{\beta/\chi}}{\exp\left(V_{i,t+1}^{js+1}\right)^{\beta/\chi} + \exp\left(U_{i,t+1}\right)^{\beta/\chi}}. \tag{16}$$

Finally, the evolution of II-entrepreneurs is given by

$$E_{i,t+1}^{j\mathrm{II}} = \varsigma_{i,t}^{j\mathrm{I}} E_{i,t}^{j\mathrm{I}} \tag{17}$$

$$E_{i,t+1}^{j\mathrm{I}} = \psi_{i,t}^{j} E_{t}^{j\mathrm{O}} \tag{18}$$

where $\psi_{i,t}^{j}$ is the share of O-entrepreneur in sector j selecting location i between t and $t+1$, and $E_{\mathrm{O},t}^{j}$ represents the mass of O-entrepreneurs in sector j.

Stage O entrepreneurs. Each O entrepreneur is endowed with productivity ϕ. The value of being an O entrepreneur with productivity ϕ at time t in sector j is given by

$$v_t^{j\mathrm{O}}(\phi) = \max_{n=1,\ldots,N}\left\{\beta V_{n,t+1}^{j\mathrm{I}} - f_{in,t}^{j}(\phi) + \chi\epsilon_{n,t}\right\},$$

where $\epsilon^j_{n,t}$ represents idiosyncratic productivity shocks that follow the Type-I Extreme Value distribution. The entry cost, $f^j_{n,t}(\phi)$, summarizes the efforts required by entrepreneurs to begin operating in a location-sector and is given by

$$f^j_{n,t}(\phi) = \log(f^j_n) - \log(\phi),$$

which on the entrepreneur's own productivity ϕ and the location-sector-specific f^j_n fixed cost. A higher productivity ϕ implies a lower entry cost for the entrepreneur across all locations.

The expected value of an O entrepreneur with productivity ϕ, denoted by $V^j_{\mathrm{O},t}(\phi)$, is given by

$$V^{j\mathrm{O}}_t(\phi) = \log(\phi) + \chi \log \left[\sum_{n=1}^{N} \exp\left(\beta V^{j\mathrm{I}}_{n,t+1} - f^j_{n,t}\right)^{1/\chi} \right], \tag{19}$$

and the fraction of O entrepreneurs in sector j that enter location i between t and $t+1$ is given by

$$\psi^j_{i,t} = \frac{\exp\left(\beta V^{j\mathrm{I}}_{i,t+1} - f^j_{i,t}\right)^{1/\chi}}{\sum_{n=1}^{N} \exp\left(\beta V^{j\mathrm{I}}_{n,t+1} - f^j_{n,t}\right)^{1/\chi}}, \tag{20}$$

which is independent of the entrepreneur's productivity ϕ. The measure of O entrepreneurs in sector j at time t, $E^{j\mathrm{O}}_t$, is determined by occupation choice.

4.4 Occupational Choice

Before each period ends and prior to workers deciding on migration, a fraction, ι, of workers in each location draw their productivity, ϕ, from a distribution with CDF F. These workers can either continue as workers or become entrepreneurs. If they remain workers, their productivity is irrelevant, and their expected value corresponds to the future value of being a worker, as indicated in (6). If they choose entrepreneurship, they first select an industry and then use their productivity according to (19).

An entrepreneur with productivity ϕ chooses the sector that gives them the highest lifetime utility

$$v^j_t(\phi) = \max_{j=1,\ldots,J} \left\{ \beta V^{j\mathrm{O}}_{t+1}(\phi) + \eta \epsilon^j_t \right\}$$

where ϵ^j_t is the idiosyncratic productivity shock that follows a Type I EV distribution with variance η. The distributional assumption again yields the expected value, $V_t(\phi)$, and the share of O entrepreneurs selecting sector j, Ψ_t^j,

$$V_t(\phi) \equiv \mathbb{E}[v_t^j(\phi)] = \eta \log \left[\sum_{j=1}^{J} \exp\left(V_{t+1}^{j\mathrm{O}}(\phi) \right)^{\frac{\beta}{\eta}} \right], \tag{21}$$

$$\Psi_t^j = \frac{\exp\left(V_{t+1}^{j\mathrm{O}} \right)^{\beta/\eta}}{\sum_{k=1}^{J} \exp\left(V_{t+1}^{k\mathrm{O}} \right)^{\beta/\eta}}. \tag{22}$$

The share of O entrepreneurs selecting sector j is independent of productivity ϕ.

For workers re-evaluating their occupation, the indifference one pins down the productivity cutoff, $\underline{\phi}_{i,t}$, which is determined by

$$V_t(\underline{\phi}_{i,t}) = \Xi_{i,t}. \tag{23}$$

Hence, the measure of O entrepreneurs in location-sector ij, denoted by $E_{i,t}^{j\mathrm{O}}$, is given by

$$E_{i,t}^{j\mathrm{O}} = \Psi_t^j \left(1 - F(\underline{\phi}_{i,t}) \right) \iota L_{i,t}.$$

Aggregating these values across all regions provides the total mass of O entrepreneurs in sector j, $E_t^{j\mathrm{O}} = \sum_{i=1}^{N} E_{i,t}^{j\mathrm{O}}$.

Finally, the evolution of workers in location i depends on those choosing to stay, incoming migrants, and those who leave entrepreneurship:

$$L_{i,t+1} = \sum_{n=1}^{N} \mu_{ni,t} \left(1 - (1 - F(\underline{\phi}_{n,t}))\iota \right) L_{n,t} + \sum_{j=1}^{J} \sum_{s \in \{\mathrm{I,II,III}\}} \left(1 - \varsigma_{i,t}^{js} \right) E_{i,t}^{js}. \tag{24}$$

4.5 Local government

Each local government spends its revenue $G_{i,t}$ on local goods to finance public service with the same share α^j on each sector as other agents. The local government's expenditure is given by

$$P_{i,t} G_{i,t} = \Omega_{i,t} \Lambda_t + \omega_{i,t} \sum_{j=1}^{J} \sum_{s=\mathrm{I}}^{\mathrm{III}} E_{i,t}^{js} \tau_{i,t}^{s} \pi_{i,t}^{j} \tag{25}$$

where $\omega_{i,t}$ is the fraction that the local government gets to keep from their total revenue and $\Omega_{i,t}$ the share from the central government budget that distributes to the location i, and Λ_t is the central government revenue

$$\Lambda_t = \sum_{i} (1 - \omega_{i,t}) \sum_{j=1}^{J} \sum_{s=\mathrm{I}}^{\mathrm{III}} E_{i,t}^{js} \tau_{i,t}^{s} \pi_{i,t}^{j}$$

4.6 Equilibrium

In each sector j, the bilateral trade share of goods bought by location n and produced by i is given by

$$\lambda_{in,t}^{j} = E_{i,t}^{j} \frac{p_{in,t}^{j} y_{in,t}^{j}}{X_{n,t}^{j}} = E_{i,t}^{j} \left(\frac{p_{in,t}^{j}}{P_{n,t}^{j}} \right)^{1-\sigma} = \frac{E_{i,t}^{j} (d_{in}^{j} w_{i,t})^{1-\sigma} (A_{i,t}^{j})^{\sigma-1}}{\sum_{n'=1}^{N} E_{n',t}^{j} (d_{n'n}^{j} w_{i,t})^{1-\sigma} (A_{n',t}^{j})^{\sigma-1}}, \tag{26}$$

where the last equation follows from (9).

The total income of location i, denoted by $\Pi_{i,t}$, is the sum of three components: workers' income, tax revenue, and total after-tax profits of producing entrepreneurs. However, the last two components are the total pre-tax profits of the entrepreneurs. Thus, income can be expressed as

$$\Pi_{i,t} = P_{i,t} G_{i,t} + \sum_{j=1}^{J} \left(w_{i,t} L_{i,t}^{j} + \pi_{i,t}^{j} \sum_{s=\mathrm{I}}^{\mathrm{III}} E_{i,t}^{js} (1 - \tau_{i,t}^{s}) \right) \tag{27}$$

Since each agent spends the same share, α^j, on goods from sector j, the total expenditure on goods in sector j in location i is given by

$$X_{i,t} = \alpha^j \Pi_{i,t}. \tag{28}$$

The labor market clearing condition is given by

$$w_{i,t} L_{i,t}^{j} = \frac{\sigma - 1}{\sigma} \sum_{n=1}^{N} \lambda_{in,t}^{j} X_{n,t}^{j}. \tag{29}$$

I can now define the equilibrium of the model given the economy's exogenous fundamentals, policies, and state variables. Let the set of exogenous fundamentals be $\mathcal{F}_t \equiv \{d_{in}^{j}, \mathcal{A}_{i,t}, A_{i,t}^{j}, m_{in}\}_{i,n,j}$ which includes trade costs, amenities, TFPs, entry costs, and non-policy migration cost, and the set of policies be $\mathcal{P}_t \equiv \{\tau_{i,t}^{s}, mpol_{in,t}\}_{i,n,s}$ which comprises profit tax and Ho Khau policy. The state variables consist of the distribution of workers and entrepreneurs $\mathcal{S}_t \equiv \{L_{i,t}, E_{i,t}^{j\mathrm{I}}, E_{i,t}^{j\mathrm{II}}, E_{i,t}^{j\mathrm{III}}\}_{i,j,s}$.

Definition 1. Each period t, given the set of state variables, policies, and exogenous fundamentals $\{\mathcal{S}_t, \mathcal{P}_t, \mathcal{F}_t\}$, the *static equilibrium* is a set of factor prices $\{w_{i,t}\}_i$ that solves the equilibrium conditions (2), (3), (9), (10), (26), (27), (29).

I use the variables with only time subscripts to denote matrices in the next definition. For instance, L_t is a $N \times 1$ matrix that represents the distribution of labor across N locations in period t.

Definition 2. Given an initial set of allocations of $\mathcal{S}_0$, a set of sequences of fundamentals and policies $\{\mathcal{F}_t, \mathcal{P}_t\}_{t=0}^{\infty}$, a *sequential competitive equilibrium* consists of sequences of allocations, values, and prices $\left\{L_t, \mu_t, , E_t, \varsigma_t, \psi_t, \underline{\phi}_t, \Psi_t, V_t, U_t, w_t, P_t\right\}_{t=0}^{\infty}$ that solve each household's dynamic problem (7), (11), (15), (19), equilibrium conditions (8), (24), (16), (18), (20), (23), (25), and the static equilibrium at each period t.

4.7 Solving the Model with Policy Changes

To analyze the impact of policy changes from $\mathcal{P}_t$ to a counterfactual $\mathcal{P}'_t$, I need data on exogenous fundamentals and policy levels before and after the changes based on equilibrium definitions. To simplify this task, I extend the "hat algebra" approach from dynamic models in Eaton et al. (2016) and Caliendo et al. (2019). This method not only eliminates the need to estimate a large set of unknowns but also ensures a precise matching between the model and observed data, accommodating economies in transitional phases—particularly useful for rapidly growing economies like Vietnam.

The first step involves constructing the actual economy with observed data, reflecting equilibrium outcomes that incorporate both the evolution of fundamentals and policy changes. As the data only spans up to 2019, I assume that fundamentals and policies remain constant from the last data period and solve the model to reach a steady state. This sequential equilibrium, combined with available data, constitutes the "actual economy," reflecting the presence of policy reforms.

To get the sequential equilibrium from the last data period, I extend Proposition 2 in Caliendo et al. (2019) to this model, which accounts for heterogeneous entrepreneurs and occupational choice. I use their dot notation to indicate relative time changes for each variable y, denoted by $\dot{y}_{t+1} \equiv y_{t+1}/y_t$. Appendix C provides the proof of the next proposition.

Proposition 1. *Given allocation $(\mathcal{S}_t, \mu_{t-1}, \varsigma_{t-1}, \psi_{t-1}, \Psi_{t-1}, \underline{\phi}_{t-1}, \lambda_t)$ and constant sequences of policies and fundamentals following t, the sequential equilibrium in relative time change can be solved without knowing the levels of fundamentals and policies.*

Once I have the actual economy after applying Proposition 1, I then solve for a counterfactual economy using the hat notation for each variable x, $\widehat{x} = \frac{x'}{x}$ where x' is the value of variable x in the counterfactual economy. This notation is similar to the hat algebra in Eaton et al. (2016) rather than the dynamic hat algebra in Caliendo et al. (2019). The following proposition, with its proof in Appendix D, outlines the main advantage of this approach in solving counterfactual economies:

Proposition 2 (Hat Algebra)**.** *Given an economy, $\{\mathcal{S}_t, \mu_{t-1}, \varsigma_{t-1}, \psi_{t-1}, \Psi_{t-1}, \underline{\phi}_{t-1}, \lambda_t\}_{t=0}^{\infty}$ and* *a sequence of policy changes relative to the actual economy* $\{\widehat{\mathcal{P}}_t\}_{t=1}^{\infty}$*, the counterfactual sequential equilibrium* $\{\mathcal{S}'_t, \mu'_{t-1}, \varsigma'_{t-1}, \psi'_{t-1}, \Psi'_{t-1}, \underline{\phi}'_{t-1}, \lambda'_t\}_{t=1}^{\infty}$ *can be determined without requiring information on the level of the fundamentals.*

Proposition 2 enables the creation of a counterfactual economy that mirrors the actual economy except for the absence of policy changes. I assume that households do not anticipate the counterfactual policy at time $t = 0$ but instead learn about the entirely new policy sequence starting from period $t = 1$. Consequently, this approach allows me to address the counterfactual question: How would the economy change if the only alteration were in policy while all other factors (such as changes in fundamentals and other policies) continued to evolve as observed in the data?

Finally, I can calculate the welfare changes for households in location i, denoted as $\widehat{W}_i$, using consumption equivalent variation. The welfare change in hat notation, which is derived in Appendix B, is given by

$$\widehat{W}_i = (1-\beta)\sum_{t=0}^{\infty}\beta^t \log\left(\frac{(\widehat{G}_{i,t}/\widehat{L}_{i,t})^{\gamma}(\widehat{w}_{i,t}/\widehat{P}_{i,t})^{1-\gamma}}{\widehat{\mu}_{ii,t}^{\nu}}\right). \tag{30}$$

To use Proposition 2 for computing the welfare effects described in (30), I need data on allocations, flows, parameter estimates, and measurements of the policy changes. While profit taxes are already provided in numeric terms, measuring the changes in migration costs associated with the Ho Khau policy in utils demands additional effort.

5 Estimation

To take the model to the data, I further parameterize and estimate the parameters of the model. I begin by externally setting several parameters. First, I set the discount factor β to 0.9 and assign the elasticity of substitution σ value of 6, a common estimate in the trade literature. By combining these parameter values with the market clearing condition (29) and wage bill data, I can deduce the values of $\{\alpha^j\}_j$. Furthermore, I set the fraction of workers that get to choose their occupation to 1% or $\iota = 0.01$.

I follow Hsieh et al. (2019) and parameterize the productivity distribution in subsection 4.4 as a Fréchet distribution with CDF, $F(\phi) = \exp\left(-\phi^{-\vartheta}\right)$ where I use their ϑ estimate of 2. The migration elasticity ν is set at 3. I calibrate the share of public service consumption to $\gamma = 0.06$ following Fajgelbaum et al. (2018). Lastly, I assume the sectoral elasticity for entrepreneurs η is equal to the spatial firm entry elasticity χ, which will be estimated in this section. Future research will delve into estimating or providing robustness checks for these three parameters $\vartheta, \nu,$ and η.

This section focuses on estimating three crucial pieces of information. First, I exploit changes in tax policy across time, space, and firm age as a quasi-random experiment to identify the inverse of the spatial firm entry elasticity χ in subsection 5.1, employing a difference-in-difference-in-difference design. Next, in subsection 5.2, I estimate the changes in migration costs associated with the Ho Khau policy, leveraging heterogeneous responses among migrants' origins, along with variations in time and destination. Finally, I tackle the scarcity of data on internal trade shares (λ_t), a key element for conducting counterfactual analyses as outlined in Proposition 2, in subsection 5.3.

5.1 Identifying the Spatial Firm Entry Elasticity

In addition to spatial and temporal variations, the tax policy reform also introduces variations across firm age. The model developed in section 4 yields reduced-form equations that leverage the full spectrum of firm variations to identify the spatial firm entry elasticity (χ). This approach not only identifies the parameter of interest but also serves as a qualitative test of the model's predictions.

Specifically, I investigate the impact of place-based profit tax changes on both entry and the dynamics of staying and exiting for I, II, and III firms. By taking the log of the entry equation (20) for sector j relative to paid employment, the model implies how the share of workers choosing sector j relative to paid employment responds to tax cuts aimed at early-stage I firms. The resulting expression is given by

$$\log \psi_{i,t}^{j} = \frac{\beta}{\chi} V_{i,t+1}^{jI} - \frac{1}{\chi} f_{i,t}^{j} - \log \sum_{n=1}^{N} \exp\left(\beta V_{n,t+1}^{jI} - f_{i,t}^{j}\right)^{1/\chi}.$$

I observe that the term $\log \sum_{n=1}^{N} \exp\left(\beta V_{n,t+1}^{jI} - f_{i,t}^{j}\right)^{1/\chi}$ can be captured by sector-age-time fixed effects, denoted as $\boldsymbol{\Theta}_t^{jI}$. Substituting (15) into $V_{i,t+1}^{jI}$, I get

$$\log \psi_{i,t}^{j} = \frac{\beta}{\chi} \log c_{i,t}^{j\mathrm{I}} + \beta \log \left(\exp\left(V_{i,t+2}^{j\mathrm{II}}\right)^{\frac{\beta}{\chi}} + \exp\left(U_{i,t+1}\right)^{\frac{\beta}{\chi}} \right) - \frac{1}{\chi} f_{i,t}^{j} + \boldsymbol{\Theta}_t^{jI} \tag{31}$$

To isolate the impact of profit tax changes, $\tau_{i,t+1}^{I}$ on firm entry, I need to examine the forward-looking nature of the entrepreneur's decision-making process, particularly the value of a II firm, $V_{i,t+2}^{jII}$. I can derive sufficient statistics for this option value by expressing the future values of staying in ij as a function of the fraction of early-stage I firms that remain, based on equation (16):

$$\underbrace{1-\varsigma^{jI}_{i,t+1}}_{\text{Exit rate}} = \frac{\exp\left(U_{i,t+1}\right)^{\frac{\beta}{\chi}}}{\exp(V^{jII}_{i,t+2})^{\frac{\beta}{\chi}} + \exp\left(U_{i,t+1}\right)^{\frac{\beta}{\chi}}}.$$

Rearranging terms and taking the log on both sides, I get

$$\log\left(\exp\left(V^{jII}_{i,t+2}\right)^{\frac{\beta}{\chi}} + \exp\left(U_{i,t+1}\right)^{\frac{\beta}{\chi}}\right) = \frac{\beta}{\chi}U_{i,t+1} - \log(1-\varsigma^{jI}_{i,t+1}),$$

which indicates that the share of early-stage I firms that exit location-sector ij, $1-\varsigma^{jI}_{i,t+1}$, encapsulates some of the future value of operating an II firm in ij. Substituting this expression into equation (31) results in

$$\log\left(\psi^{j}_{i,t}(1-\varsigma^{jI}_{i,t+1})^{\beta}\right) = \frac{\beta}{\chi}\log c^{j\mathrm{I}}_{i,t} + \frac{\beta^2}{\chi}U_{i,t+1} - \frac{1}{\chi}f^{j}_{i,t} + \mathbf{\Theta}^{jI}_{t} \tag{32}$$

which relates the local entry share and future exit share of I entrepreneurs to the firms' instantaneous values, taxes, and the future value of being a worker.

A reduction in the tax rate for early-stage I firms in location i increases the current period's entry rate $\log\psi^{j}_{i,t}$ by making the location more attractive. However, it also leads to an increased exit rate for firms in the subsequent period due to the heightened competition for inputs from the surge in the number of firms.

Running the regression derived from equation (32) presents a key challenge related to potential correlations between changes in taxes on I entrepreneurs ($\tau^{I}_{i,t+1}$) and other local factors, such as local revenues ($\pi^{j}_{i,t+1}$) and the future value of being in i (e.g., being a worker there, $U_{i,t+1}$). This correlation likely leads to a violation of the parallel assumption required for identification when relying on two sources of variation—across time and space—rendering a DiD with time and space ineffective for identifying β/χ.

Nonetheless, I use tax variations across age groups to eliminate the impact of real profits and the future value of being a worker. Based on equation (16), I take the ratio between the fraction of early-stage I firms that remain and those that exit to get

$$\frac{\varsigma^{jI}_{i,t}}{1-\varsigma^{jI}_{i,t}} = \exp\left(V^{jII}_{i,t+1} - U_{i,t+1}\right)^{\frac{\beta}{\chi}}.$$

Taking the natural logarithm on both sides and substituting the value of an II entrepreneur (15) yields

$$\log \frac{\varsigma_{i,t}^{j\mathrm{I}}}{1-\varsigma_{i,t}^{j\mathrm{I}}} = \frac{\beta}{\chi}\log c_{i,t}^{j\mathrm{II}} - \frac{\beta}{\chi}U_{i,t+1} + \beta \log\left[\exp\left(V_{i,t+1}^{j\mathrm{III}}\right)^{\beta/\chi} + \exp\left(U_{i,t+1}\right)^{\beta/\chi}\right].$$

Following similar steps as earlier, I get

$$\log \frac{\varsigma_{i,t}^{j\mathrm{I}}}{1-\varsigma_{i,t}^{j\mathrm{I}}}\left(\frac{1-\varsigma_{i,t+1}^{j\mathrm{II}}}{\varsigma_{i,t+1}^{j\mathrm{II}}}\right)^{\beta} = \frac{\beta}{\chi}\log\left((1-\tau_{i,t+1}^{j\mathrm{II}})\frac{\pi_{i,t+1}^{j}}{P_{i,t+1}}\right) - (1-\beta)\frac{\beta}{\chi}U_{i,t+1}.$$

An increase in the profit tax for II firms has a twofold effect: it makes early-stage I firms more likely to stay than exit, as indicated by the relative tendency to stay ($\frac{\varsigma_{i,t}^{jI}}{1-\varsigma_{i,t}^{jI}}$), while also increasing the likelihood of exit in the next period for II firms due to heightened market competition, captured in $\left(\frac{1-\varsigma_{i,t+1}^{jII}}{\varsigma_{i,t+1}^{jII}}\right)^{\beta}$.

By subtracting each side of this equation from the corresponding side of (32), I obtain

$$\log \frac{\psi_{i,t}^{j}(1-\varsigma_{i,t+1}^{j\mathrm{I}})^{\beta}}{\frac{\varsigma_{i,t}^{j\mathrm{I}}}{1-\varsigma_{i,t}^{j\mathrm{I}}}\left(\frac{1-\varsigma_{i,t+1}^{j\mathrm{II}}}{\varsigma_{i,t+1}^{j\mathrm{II}}}\right)^{\beta}} = \frac{\beta}{\chi}\log\frac{(1-\tau_{i,t+1}^{\mathrm{I}})}{(1-\tau_{i,t+1}^{\mathrm{II}})} + \mathbf{\Sigma}_{i,t}^{j} + \mathbf{\Theta}_{t}^{jI} \tag{33}$$

where f_t^{ij} can be encapsulated by location-sector-time fixed effects $\mathbf{\Sigma}_{i,t}^{j}$, while taxes vary at the age-location-time level.

In Appendix B.2, I extend the model to accommodate continuous stages, where $s \in \{1,\ldots,S\}$ represents firms' stages or ages. This extension avoids the need to categorize entrepreneurs into I, II, or III in the data. As a result, the estimation equation features a triple difference-in-difference (DiDiD) design and is expressed as

$$\log \frac{\psi_{i,t}^{j}(1-\varsigma_{i,t+1}^{j1})^{\beta}}{\frac{\varsigma_{i,t}^{j,s-1}}{1-\varsigma_{i,t}^{j,s-1}}(1-\varsigma_{i,t+1}^{js})^{\beta}} = \gamma_F \log\frac{1-\tau_{i,t+1}^{1}}{1-\tau_{i,t+1}^{s}} + \mathbf{\Sigma}_{i,t}^{j} + \mathbf{\Theta}_{t}^{j,\widetilde{S}} + \varphi_{i}^{\widetilde{S}} + \varepsilon_{i,t}^{js}. \tag{34}$$

In this equation, the dependent variable, which I call the Local Age-Specific Turnover Rate (LAST), consists of four components. The first, $\psi_{i,t}^{j}$, is the share of entrants in location i between periods t and $t+1$ among all entrants in sector j. Next, the share of 1-year-old establishments exiting location-sector ij between period $t+1$ and $t+2$ is represented by $(1-\varsigma_{i,t+1}^{j1})$. Third, $\frac{\varsigma_{i,t}^{i,a-1}}{1-\varsigma_{i,t}^{ja-1}}$ signifies the ratio of the share of $s-1$-year-old establishments that remain in location-sector ij between t and $t+1$ to the share of those that exit over the same period. Fourth, $(1-\varsigma_{i,t+1}^{js})$ is the share of s-year-old establishments that exit between $t+1$ and $t+2$ from location-sector ij.

Table 1: Triple difference-in-differences estimate of the firm entry elasticity

Dependent Variable:	Local Age-Specific Turnover Rate
	(1)
Log(Net Tax Rate Ratio)	0.82**
	(0.36)
Observations	45,823
#District-AgeGroup	1,366

Source: Annual establishment surveys (2000-2015).
Notes: Unit of observation is district-zone, 2-digit sector, age group, and year. This regression (34) includes district-sector-time, sector-age group-time, and district-age group fixed effects and is estimated by PPML. ***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$. Standard errors clustered at the district-zone and age group level are reported in parenthesis.

The identification assumption behind γ_F is that tax changes across time, locations, and age cohorts are not correlated with the error term. To violate this assumption, an unobserved variable, such as a technology or changes in tax enforcement, would need to disproportionately favor younger establishments over older ones and concurrently shift along the district tax labels, age groups, and the year of the tax policy.

Table 1 presents the estimate for γ_F of 0.82, which is statistically significant at the 5 percent level. With $\beta = 0.9$, I obtain $\chi = 1.01$.

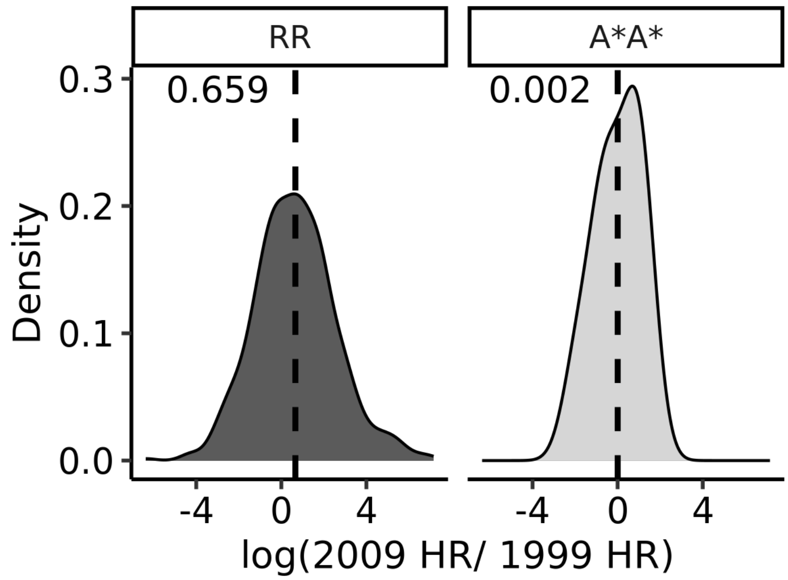
5.2 Identifying Changes in Ho Khau-related Migration Cost

As the Ho Khau policy underwent changes over time and across locations, this subsection aims to estimate these temporal and spatial variations. I define the time difference in Ho Khau policy for any pair of locations i and n as

$$\Delta_{in} = mpol_{in,post} - mpol_{in,pre},$$

where I recall $mpol_{in,t}$ is a component of the migration cost in (5). After the Ho Khau reform in 2005, Ho Khau cost should drop everywhere, i.e. $\Delta_{in} < 0$ for all combinations of i and n

Figure 7: Distributions of Log(Head Ries Ratio)



Source: Population and Housing Census 1999 and 2009. *Notes*: Each distribution reports the log ratios of the Head Ries indexes computed for each type of origin-destination for 1999 and 2009. The dashed lines and the numbers correspond to the means of the distributions.

such that $i \neq n$.

Not only did the Ho Khau cost decrease after 2005, but it also varied across locations. Thus, I focus on two estimands: the average change over time due to Ho Khau $\Delta_T \equiv \mathbb{E}[\Delta_{in}]$ and the magnitude of spatial variation $\Delta_L \equiv \mathbb{E}[\Delta_{,A^*} - \Delta_{,R}]$. The latter should be positive as the drop in Ho Khau cost in R compared to A^*.

To identify these changes, I use migration data and leverage the relationship between migration flows and migration costs presented in (8). By applying this equation and taking the log of the ratio between migration shares from location i to n and the shares of those who stay in i, I get

$$\log \frac{\mu_{in,t}}{\mu_{ii,t}} = -\frac{1}{\nu} m_{in,t} + \frac{\beta}{\nu} \left(U_{n,t+1} - U_{i,t+1} \right). \tag{35}$$

This equation implies that any change in migration cost $m_{in,t}$ can impact the future value of being in location n through the second term on the right-hand side, which captures the GE effects. Hence, a simple DiD design with a dummy variable for A^* and the post-policy period is inadequate to account for such changes in option values.

To address this issue, I construct the Head-Ries index (Head and Ries, 2001), which is defined as

$$y_{in,t} \equiv \log\left(\frac{\mu_{in,t}}{\mu_{ii,t}}\frac{\mu_{ni,t}}{\mu_{nn,t}}\right) = -\frac{1}{\nu}(m_{in,t} + m_{ni,t})$$

where I refer the LHS, $y_{in,t}$, as the Head Ries (HR) Index. Since the HR is symmetric for pairs i, n, and n, i, I only consider locations where $i < n$ to avoid duplicating observations. Taking the time difference of $y_{in,t}$ yields

$$y_{in,post} - y_{in,pre} = -\frac{1}{\nu}\left(\Delta_{in} + \Delta_{ni}\right).$$

In Figure 7, I plot the LHS of this equation–the logarithm of the ratio between the HR in 2009 and the HR in 1999–two types of flows: R-R (RR) and A^*-A^* (UU). The mean of each distribution is denoted next to the dashed line.

To estimate the temporal changes in Ho Khau cost, Δ_T, I rely on the mean of HR changes for RR flows, as shown in the left panel of Figure 7. On average, changes in Ho Khau cost for RR migration should be symmetric. Thus, the logarithm of the ratio of HRs for RR flows corresponds to $\frac{-2}{\nu}\Delta_T$. The main identifying assumption is that other time-varying changes are relatively minor compared to the changes in the Ho Khau policy, on average.

Furthermore, since $\nu > 0$, both means displayed in Figure 7 indicate declines in migration costs over time for both flow types, aligning with the policy-driven reduction in Ho Khau costs over time. More significantly, the decline in RR is substantially larger than in UU, consistent with the spatial variation of the policy, where the reduction in requirements for A^* destinations is less pronounced than in R ones.

Therefore, I use the difference in means between these two distributions to estimate spatial variation, Δ_L, after the Ho Khau reform. Alternatively, another approach involves specifying and estimating a DiDiD regression, where the outcome variable is the HR, and the main independent variable is an interaction of dummies for A^* origin, A^* destination, and Post 2005. Appendix E provides detailed discussions and insights into this analysis. While the difference in means here yields an estimate of approximately 0.65, the result of the DiDiD estimate is 0.55 (SE: 0.27). Both approaches provide statistically indistinguishable estimates, bolstering the credibility of the spatial variation estimate.

In conclusion, the estimated temporal and spatial variations in Ho Khau policies are both scaled by the migration elasticity parameter, ν. With a known value of ν, I can calculate the changes in migration costs resulting from the Ho Khau reform, denoted as $\widehat{mpol}_{in,t}$, which is equal to $\exp(mpol'_{in,t} - mpol_{in,t})$.

5.3 Internal Trade Flows

To calculate trade shares, I use Equation (26), which depends on estimating trade costs d^j_{in} and TFPs $A^j_{i,t}$. These trade costs are modeled based on distance, following the approach by Monte et al. (2018), where $d^j_{in} = (\text{distance}_{in})^{\kappa^j}$ and κ^j represents sector-specific elasticity of trade costs with respect to distance. Then, taking the log of (26) yields the following cross-sectional relationship:

$$\log(\lambda^j_{in}) = (1-\sigma)\kappa^j \log(\text{distance}_{in}) + \text{Origin FE } + \text{Destination FE } + \varepsilon^j_{in}.$$

I digitized inter-provincial trade data for the year 2000 from JICA (2000). I determine truck distances between province pairs using the 1999 IPUMS map and apply ArcGIS network analysis tools. With the trade data and truck distance in hand, I estimate $(1-\sigma)\kappa^j$ using PPML. Figure A8 displays these estimates, all of which closely resemble the value of -1.29 reported by Monte et al. (2018) for the US.

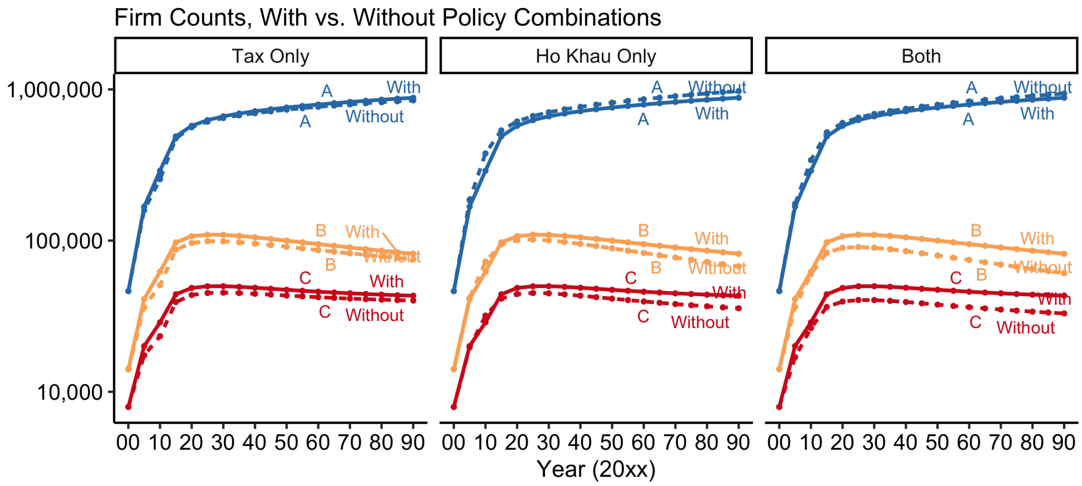
6 Policy Evaluation and Counterfactuals

In this section, I combine the estimated policy changes in migration costs and profit taxes to assess their impact on firms, employment, and welfare within the context of place-based tax incentives and the Ho Khau reform in Vietnam. To clarify and understand the model's mechanisms, I also conduct various counterfactual policy analyses, allowing me to explore the consequences of different place-based tax schedules and their interactions with mobility barriers.

Measurement. The first step is to harmonize the establishment and household data. Given that household migration flows are recorded on a five-year cycle, each period in the model is five years. Furthermore, the first period with migration data spans from 1994 to 1999, which does not precisely synchronize with the firm-side data. To address this discrepancy, I opt to measure the entry and exit flows of establishments between 2000 and 2003 as the first period in the model. Subsequently, I maintain consistency by retaining the period from 2004 to 2009 for both data sources. For the final data period available, I rely on firm flows from 2009 to 2014, complemented by migration flows from 2014 to 2019 using the census data. In short, I have three data periods: one preceding, one during, and one following policy changes.

I aggregate employment data from the establishment surveys to measure the stock of

Figure 8: Firm Effects



Notes: This figure displays the count of establishments categorized under tax policy labels A, B, and C for economies with and without the implemented policies.

labor L_t and use wage bills to measure wages. Furthermore, since I do not have migration flows across districts and only at the province levels, I need to redefine the A, B and C labels to the province level. I aggregate based on the province population shares in 1999 that reside in A, B, and C. Figure A7 shows the map of provinces by their tax status after this process.

6.1 Firm, Employment and Real Wage effects

Figure 8 illustrates how the number of establishments changes across 60 provinces, aggregated into tax categories A, B, and C. Solid lines represent the actual economy with policy implementation, while dashed lines depict a counterfactual scenario without policy changes. The gap between these lines for each location type reflects the impact of the corresponding policy combination mentioned in the panel title.

In the “Tax Only” panel, focusing on place-based tax incentives, I observe an increase in the overall number of firms since lower tax rates make entrepreneurship more attractive than paid employment. Furthermore, the number of firms in B and C increases more than in A with a short-run increase of about 20% in B and C and an increase of 10% in A.

The Ho Khau reform significantly reduces migration costs and increases the attractiveness of being a worker everywhere. Consequently, the improved outside option of being a worker initially reduces the overall number of entrepreneurs in the economy. This trade-off between migration and entrepreneurship aligns with recent findings from Mobarak et al. (2023), who report that Bangladeshi households with successful lottery winners allowing them to work in Malaysia are less likely to start nonfarm businesses compared to households with lottery losers.

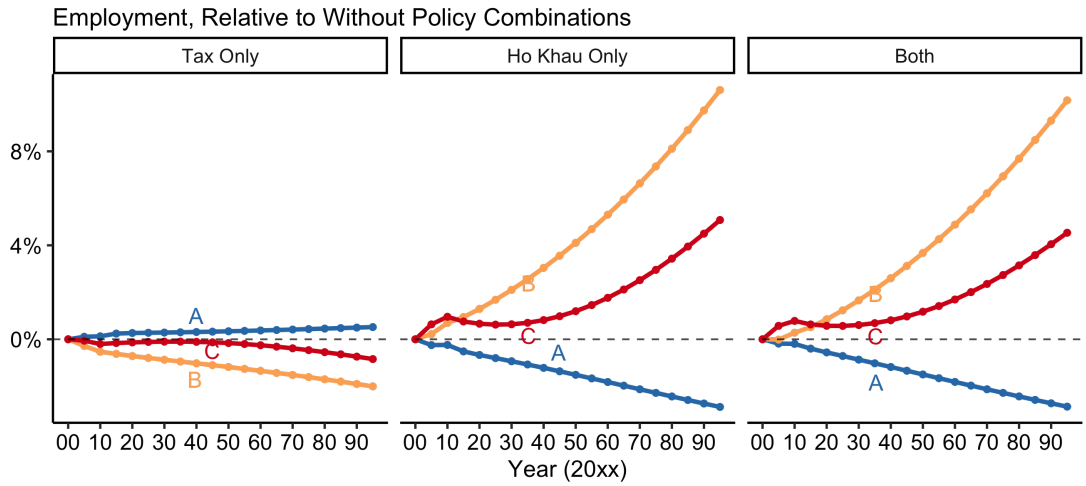
Furthermore, this decline in entrepreneurship disproportionately affects the wealthier region, A, which houses a significant portion of entrepreneurs, especially those in the early-stage stage I. As a result, the real wages in regions B and C experience smaller reductions compared to region A initially as demonstrated in Figure 10. This effect, coupled with the higher barriers to entry in region A^* after the Ho Khau reform relative to the rest of Vietnam, encourages more migration to regions B and C. The increased population in these areas puts downward pressure on wages, which in turn facilitates the accumulation of more firms in regions B and C over time. This endogenous response of firms to lower wage places involves various counteracting forces. First, lower wages can reduce the purchasing power of local demand. Second, lower wages also diminish the value of being a worker as an outside option to entrepreneurship. Despite these counteracting factors, firms continue to enter less affluent regions after the Ho Khau reform.

The place-based tax incentives and the relaxation of Ho Khau barriers work in contrasting ways. Thus, the firm-level impacts seen under the combined "Both" policies are a middle ground between the individual effects of each, with a tilt towards the Ho Khau policy. The significant lowering of mobility barriers leads to fewer firms overall. Yet, firm growth in regions B and C is more marked since both policies drive firms similarly. The place-based approach spurs firm entry, drawing more workers to these regions. With eased mobility constraints and subsequent higher real wages, migration to these less affluent areas grows. This population boost eases wage demands, fostering even more firm entries in regions B and C.

When only place-based incentives were implemented, employment in A grew relative to B and C. Figure 9 shows the employment change percentage between the actual economy and a counterfactual one without certain policies. The tax incentives increase firm entry in B and C, which raises labor demand. Yet, significant tax rate cuts diminish public services, even with existing central government redistribution to offset local revenue losses. Consequently, public services decline universally, but more noticeably in B and C. Since workers value these services, they gravitate towards A.

The employment response to the Ho Khau policy is more complex. The Ho Khau reform significantly reduces migration costs. As seen in 8, the more substantial reduction in the total number of firms in A compared to B and C raises the real wages in B and C compared to A. Furthermore, since the reduction in migration costs in A^* is less than in R more people opt

Figure 9: Employment Effects of Different Policies



Notes: This figure illustrates the percentage change in employment compared to an economy without the implemented policies. Employment data across provinces is aggregated to tax policy labels.

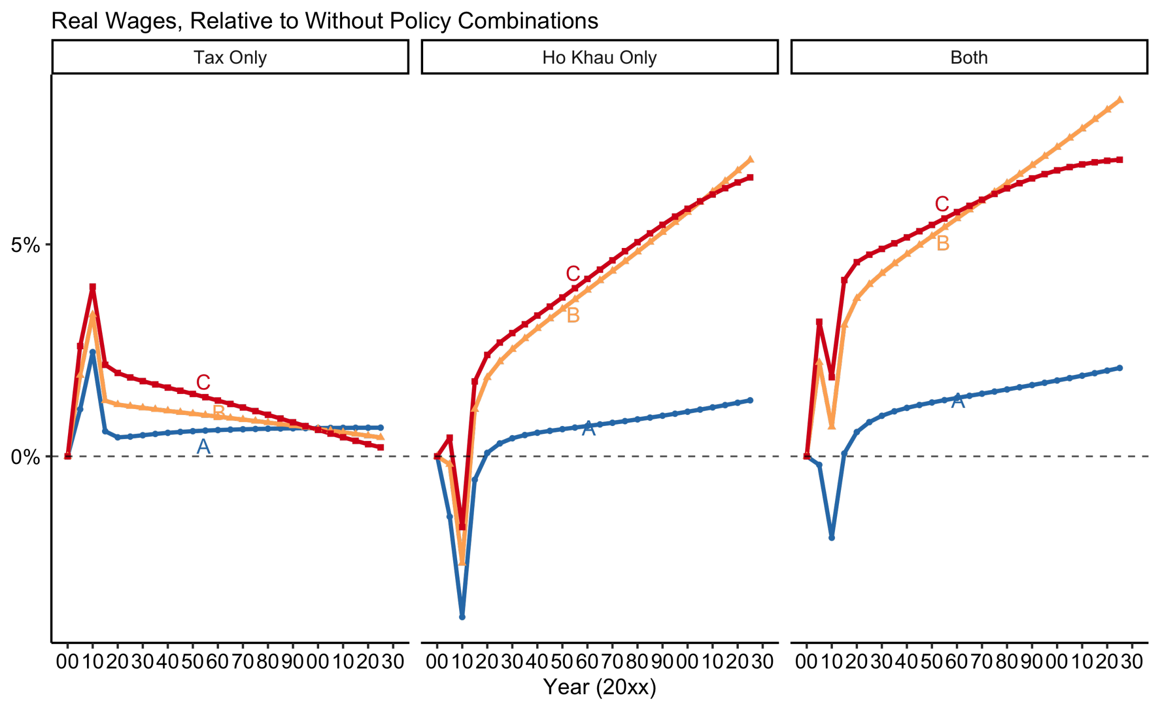
to move to B and C. The increased population exerts downward pressure on wages. Since wages are a key input in production, firms are also drawn to these areas. Consequently, employment experiences growth in regions B and C. When both policies are implemented simultaneously, their combined impact continues to expand employment in B and C relative to A.

Before delving into the welfare analysis, I examine the impact of policies on real wages to gain a better understanding of the firm and employment outcomes. Figure 10 illustrates the percentage change in real wages compared to different counterfactual scenarios without policies. Each point aggregates real wages across provinces according to tax policy labels, weighted by 1999 provincial population shares.

In the "Tax Only" panel, I observe a 4% increase in real wages in B and C relative to a 2% increase in A in the short run. As workers gravitate towards A, firms follow them into A reducing labor demand in the poorer areas. The short-run effect of the Ho Khau only is a decrease in real wages because of fewer firms in the economy, leading to higher local price indexes and consequently lower real wages. This effect is particularly pronounced in region A. However, in the long run, as workers gain mobility and choose their locations based on productivity, real wages in the economy begin to rise again. As more firms enter B and C, their real wages rise by 4% in the long run.

The interaction between workers and firms is further highlighted in Panel "Both" of Figure 10 when combining the place-based tax incentive with the Ho Khau reform. Initially,

Figure 10: Real Wage Effects

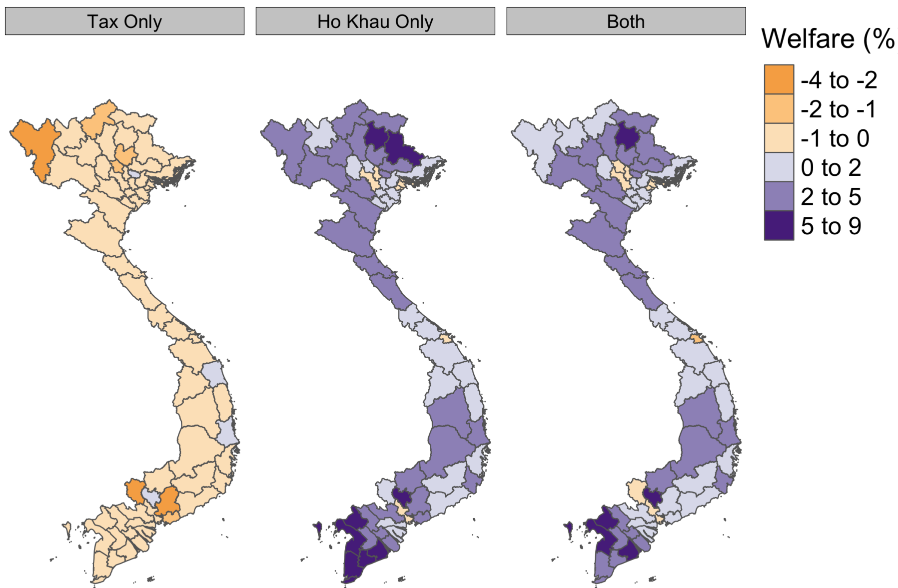


Notes: This figure illustrates the percentage change in real wages relative to an economy without the implemented policies. Each point aggregates real wages across provinces according to tax policy labels, weighted by their initial population shares.

this combination boosts real wages for B and C and counteracts some of the loss in A due to the Ho Khau policy. However, with increased worker mobility, the real wages in A catch up more quickly when having both policies compared to the Tax Only scenario. As people migrate from A to poorer regions to take advantage of rising real wages, the gains from the place-based policy targeting poorer areas are reduced.

Atalay et al. (2023) emphasizes this migration mechanism, showing that the endogenous response of migration plays a significant role in the small impact of place-based policies on reducing inequality. Once incorporating the endogenous response of firms, I find that, as real wages increase fast in A due to out-migration from A to improving B and C, real wages in poorer areas B and C can continue to grow due to firm adjustments. As more people move to these poorer regions, wages decrease, prompting firms to enter areas with lower input costs. This dynamic allows these regions to sustain real wage growth.

Figure 11: Maps of the Welfare Effects of Policies



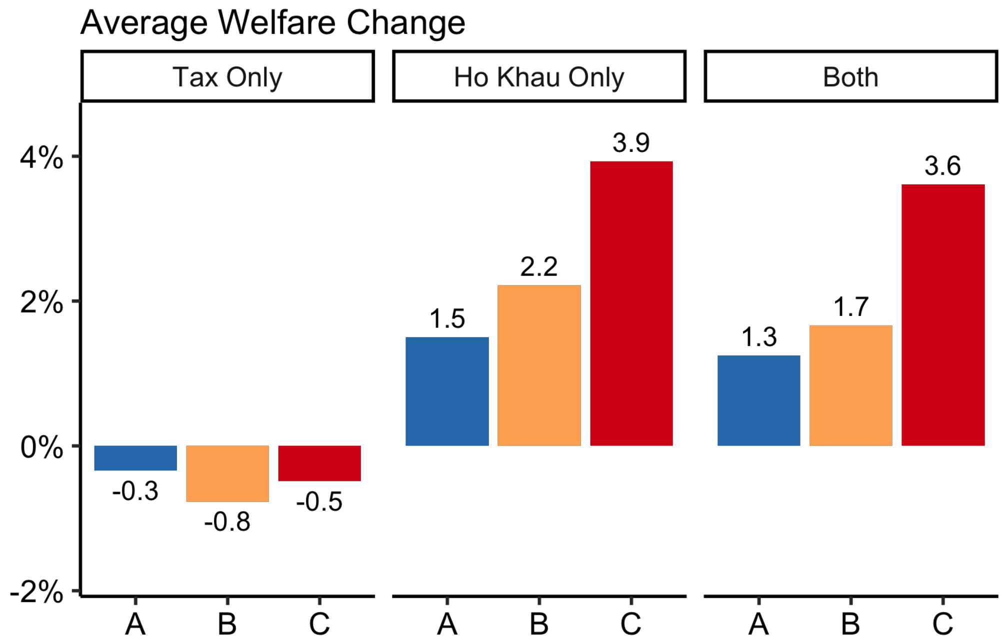
Source: IPUMS 1999 map of Vietnam. *Notes*: Each map shows the welfare effects of different policy combinations on provinces across Vietnam. Welfare is measured in compensating variation given in (30).

6.2 Welfare Effects

With a grasp of how policies impact allocations and prices, I examine the distributional welfare effects. The welfare effects for a specific province according to (30) represent the change in welfare, measured in terms of consumption equivalence, for a representative worker residing in that province before the introduction of policies. Thus, the welfare effects take into account both individuals who leave the province and those who choose to stay.

Figure 11 depicts the distributional welfare effects resulting from various policy combinations. When the tax policy is implemented on its own, it generally reduces welfare in most provinces, with only a few exceptions, due to the loss of public services in the poorer areas and the reduction in number of firms in advantaged places. The Ho Khau policy, when implemented independently, leads to a substantial overall welfare increase across the country, particularly benefiting regions like Binh Duong, located just outside the largest city Ho Chi Minh City, which experiences a significant influx of migrants. However, the loss of entrepreneurship has a negative impact, with the large cities, Ho Chi Minh City and Ha Noi, suffering the most. When both policies are combined, the effects of the Ho Khau policy generally outweigh the losses from the place-based policy.

Figure 12: Distributional Welfare Effects by Tax Status



Notes: Each panel shows the welfare effects of different policy combinations at the aggregate and across different tax labels. Welfare is measured in compensating variation given in (30) and aggregated based on initial population shares.

To gain a broader view of the overall impact, I aggregate the welfare effects across provinces, using initial population weights and categorizing them into tax policy groups labeled as $A, B,$, and C. The results, as depicted in Figure 12, reveal that the greatest beneficiaries among the three categories of both policies most are the poorest ones in group C with a 3.6 percent increase in welfare. This gain compares to a 1.7 percent increase for B and a 1.3 percent increase for A.

The Ho Khau policy stands out by significantly boosting overall welfare. This outcome can be attributed to its substantial relaxation of a key mobility restriction, addressing a significant misallocation of people across regions. The loss in public services from the tax policy reduces welfare in all locations and even more in poorer places. In other words, without a careful redistribution policy to counter the loss in public services from tax cuts, place-based policy can reduce welfare and increase spatial inequality.

7 Conclusion

This paper aims to quantify the impact of large-scale place-based policies and migration barriers on spatial inequality. While place-based subsidies can stimulate business activity in disadvantaged areas, boosting employment and potential wage growth, these gains can be offset by reduced local public services due to lower taxes. Furthermore, relaxed migration barriers may seem to counteract the benefits of place-based subsidies. Still, the combined effect can create a feedback loop, where firms are lured to regions with slowed wage growth due to population shifts. Through quantitative analysis, this paper reveals how place-based policies can increase spatial inequality, while reducing migration costs, especially to poorer regions, can substantially decrease it.

I combine micro-level data and large-scale policy changes with a dynamic spatial general equilibrium model that captures many mechanisms that can influence the spatial distribution of economic activities. The results shed light on the endogenous responses of workers and entrepreneurs as well as their occupation decisions to policy incentives. The paper overcomes challenges with identification by combining the model's structure and the rich policy variations for both place-based and reform to Ho Khau barriers.

Expanding on this research, upcoming studies can delve deeper into additional factors that affect the outcomes of place-based and migration policies. These factors include changes in housing costs and input-output linkages. As nations worldwide work to diminish spatial inequalities, it becomes essential to navigate the intricate interactions between various policies. This study provides essential tools to guide future efforts to craft more tailored and effective policy solutions.

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A Appendix

Table A1: Summary Statistics by Tax Policy Labels

Characteristic	**Overall**, N = 610	**A**, N = 267	**B**, N = 201	**C**, N = 142
Incidence of Poverty	0.42 (0.21)	0.28 (0.14)	0.44 (0.14)	0.65 (0.16)
Pop. per Acre	6.47 (23.18)	13.65 (33.72)	1.21 (1.09)	0.43 (0.82)
Ethnic Minority (%)	0.23 (0.33)	0.03 (0.09)	0.21 (0.26)	0.65 (0.32)
Urban Share (%)	0.22 (0.29)	0.33 (0.37)	0.15 (0.18)	0.10 (0.09)
Average Wage (Million VND)	7.99 (3.88)	9.07 (4.25)	7.66 (3.49)	6.43 (2.99)
Agriculture Share (%)	0.72 (0.25)	0.58 (0.30)	0.79 (0.15)	0.87 (0.09)
Manufacturing Share (%)	0.07 (0.09)	0.12 (0.11)	0.05 (0.04)	0.02 (0.02)

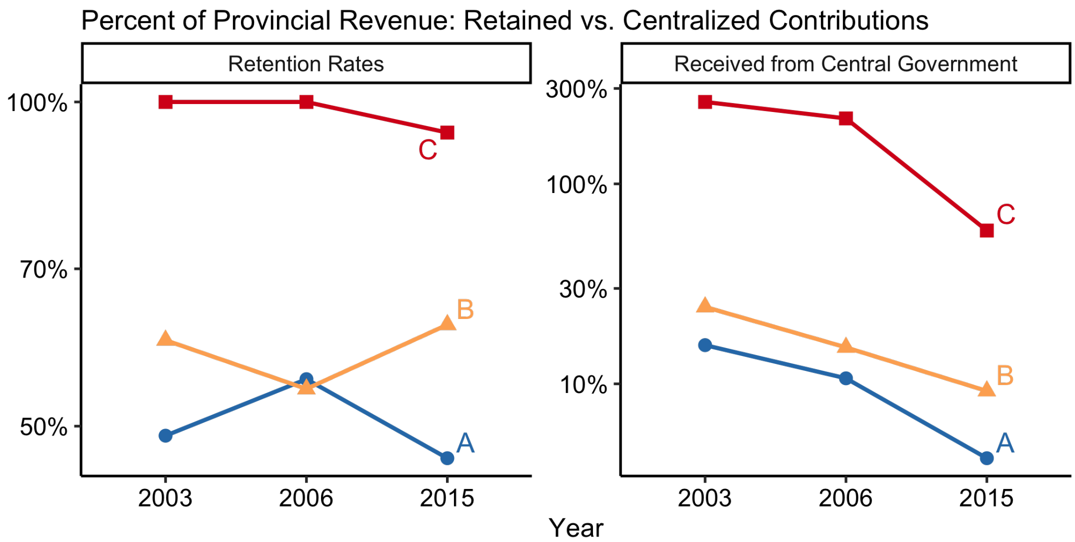
Sources: Minot et al. (2003) for rows 1-4. Annual Establishment Surveys (2000-2002) for row 5. Population Census 1999 for the last rows.
Notes: Mean (SD). The A, B, and C district labels correspond to Advanced, Backward, and Challenged districts according to Decree 164/2003/ND-CP. Average wage is the average across 2000-2002.

Table A2: Shares of multi-plant firms in 2000

Shares of Multi-plant	Firms	Sales	Employment
All	0.011	0.078	0.077
SOE	0.068	0.136	0.119
Private	0.002	0.006	0.018
Foreign	0.006	0.006	0.013

*

Figure A1: Revenue Redistribution Policy



Sources: Ministry of Finance, Decisions 757/2003/QD-BTC, and 3137/QD-BTC *Notes*: The A, B, and C labels are at the provincial levels, constructed using the 1999 population share in B and C districts within each province. See Figure A7 for a map of these provincial labels.

B Model appendix

B.1 Migration shares

To derive results in Section 4.2, I follow Appendix 1, section 11.2, in Aguirregabiria (2021). First, I derive the distribution of the maximum utility. Denote by $\bar{\delta}_{in,t}$ for the value of working in n for an individual being in location i at time t, i.e.,

$$\bar{\delta}_{in,t} \equiv \beta U_{n,t+1} - m_{in,t}.$$

Let $\bar{\delta_{i,t}}^*$ be the random variable that represents the maximum utility from choosing a location, that is, $\bar{\delta_{i,t}}^* \equiv \max_{n\in\mathcal{R}} \left\{ \bar{\delta}_{in,t} + \epsilon_{n,t} \right\}$.

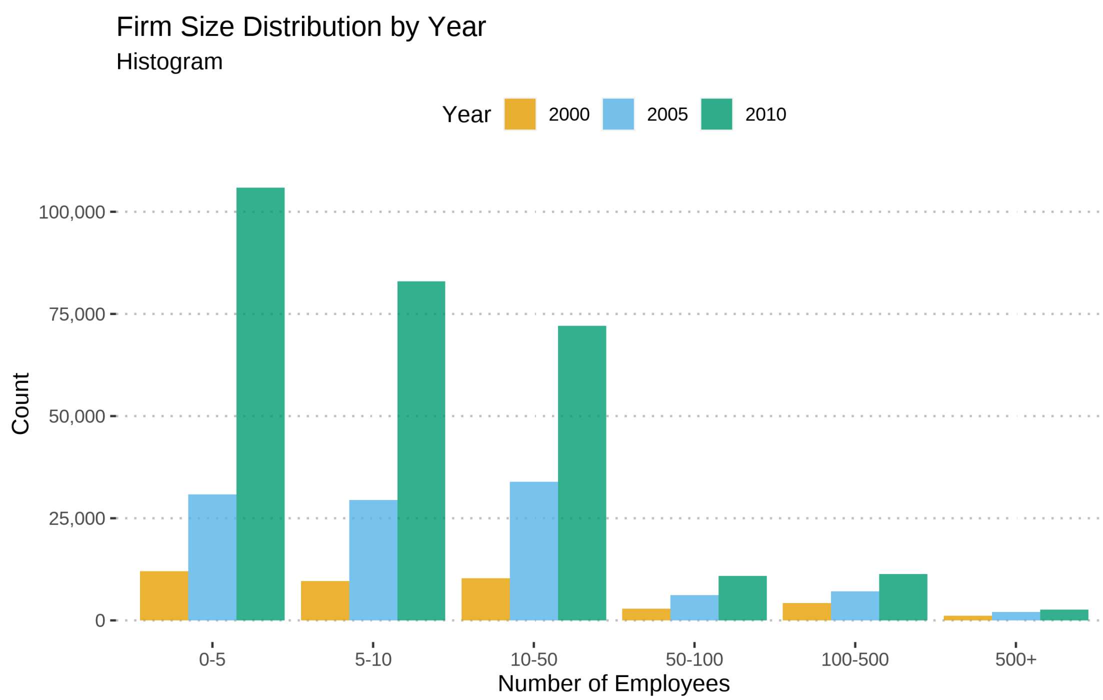


Figure A2: Firm Size Distribution 2000, 2005, and 2010

I want to derive the distribution of the maximum utility $\bar{\delta_{i,t}}^*$, denoted by $\bar{H}_i(\bar{\delta})$.

$$\begin{aligned}\bar{H}_i(\bar{\delta}) \equiv \Pr\left(\bar{\delta_{i,t}}^* \leq \bar{\delta}\right) &= \prod_n \Pr\left(\epsilon_{n,t} \leq \bar{\delta} - \bar{\delta}_{in,t}\right) \\ &= \prod_n \exp\left\{-\exp\left(-\frac{\bar{\delta} - \bar{\delta}_{in,t}}{\nu} - \bar{\gamma}\right)\right\} \\ &= \exp\left\{-\exp\left(-\frac{\bar{\delta}}{\nu} - \bar{\gamma}\right)\mathcal{U}_t\right\},\end{aligned}$$

where $\bar{\gamma}$ is the Euler–Mascheroni constant.

$$\mathcal{U}_t \equiv \sum_{n=1}^{N} \exp\left(\frac{\bar{\delta}_{in,t}}{\nu}\right).$$

Thus, the density function of $\bar{\delta_{i,t}}^*$ is given by

$$\bar{h}_i(\bar{\delta}) = \bar{H_i}'(\bar{\delta}) = \exp\left\{-\exp\left(-\frac{\bar{\delta}}{\nu} - \bar{\gamma}\right)\mathcal{U}_t\right\}\frac{\mathcal{U}_t}{\nu}\exp\left(-\frac{\bar{\delta}}{\nu} - \bar{\gamma}\right)$$

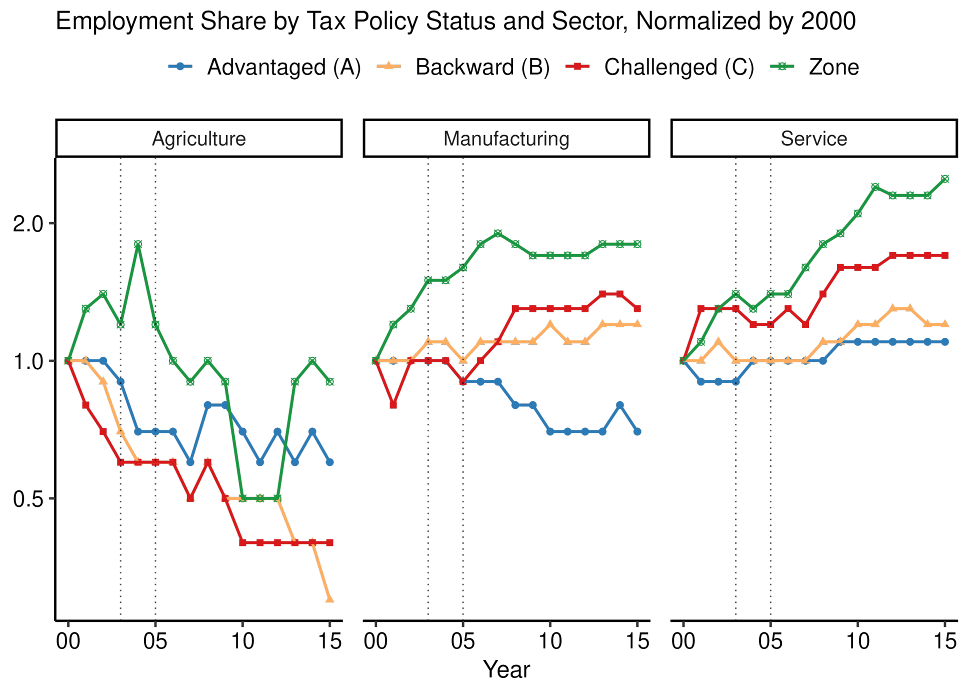


Figure A3: Employment by tax policy status including Zone

The expected maximum value is therefore given by

$$
\begin{aligned}
\Xi_{i,t} &= \int_{-\infty}^{+\infty} \bar{\delta}_{i,t}^{*} h\left(\bar{\delta}_{i,t}^{*}\right) d\bar{\delta}_{i,t}^{*} \\
&= \int_{-\infty}^{+\infty} \bar{\delta}_{i,t}^{*} \exp\left\{-\exp\left(-\frac{\bar{\delta}_{i,t}^{*}}{\nu} - \bar{\gamma}\right)\mathcal{U}_t\right\}\frac{\mathcal{U}_t}{\nu}\exp\left(-\frac{\bar{\delta}_{i,t}^{*}}{\nu} - \bar{\gamma}\right) d\bar{\delta}_t^{i*}.
\end{aligned}
$$

Applying the following change in variable: $\bar{z} = \exp\left(-\frac{\bar{\delta}_{i,t}^{*}}{\nu} - \bar{\gamma}\right)$, such that $\bar{\delta}_{i,t}^{*} = -\nu\left(\log(\bar{z}) + \bar{\gamma}\right)$, and $d\bar{\delta}_{i,t}^{*} = -\nu(d\bar{z}/\bar{z})$. Then,

$$
\begin{aligned}
\Xi_{i,t} &= \int_{+\infty}^{0} -\nu(\log(\bar{z}) + \bar{\gamma})\exp\{-\bar{z}\mathcal{U}_t\}\frac{\mathcal{U}_t}{\nu}\bar{z}\left(-\nu\frac{d\bar{z}}{\bar{z}}\right) \\
&= -\nu\mathcal{U}_t \int_{0}^{+\infty} \log(\bar{z})\exp\{-\bar{z}\mathcal{U}_t\}d\bar{z} - \nu\bar{\gamma}\mathcal{U}_t \int_{0}^{+\infty} \exp\{-\bar{z}\mathcal{U}_t\}d\bar{z}
\end{aligned}
$$

And using Laplace transformation where $\int_0^{+\infty} \log(\bar{z})\exp\{-\bar{z}\mathcal{U}_t\}d\bar{z} = -\frac{\log(\mathcal{U}_t)+\bar{\gamma}}{\mathcal{U}_t}$

$$
\begin{aligned}
\Xi_{i,t} &= \nu\mathcal{U}_t\left(\frac{\log(\mathcal{U}_t) + \bar{\gamma}}{\mathcal{U}_t}\right) - \nu\bar{\gamma} \\
&= \nu\log(\mathcal{U}_t),
\end{aligned}
$$

Shares of	Firms	Employment	Revenue
All			
Entrants	0.98	0.85	0.83
Exiters	0.74	0.47	0.49
A			
Entrants	0.96	0.88	0.90
Exiters	0.76	0.49	0.56
B			
Entrants	0.98	0.88	0.97
Exiters	0.82	0.62	0.74
C			
Entrants	0.98	0.85	0.84
Exiters	0.74	0.48	0.50

[*] *Notes:* This table summarizes establishment turnover between 2000 and 2015 in Vietnam. An entrant is defined as an establishment in year t but not in year $t-1$, while an exiter is present in year $t-1$ but not in year t. For example, the first-row-second-column cell indicates that 98% of establishments present in 2015 did not exist in 2000. The first-row-second-column cell shows that these entrants accounted for 85% of total employment in 2015. The second-row-second column cell reports that 74% of establishments in 2000 were no longer operating in 2015. This group of exiters accounted for 47% of employment in 2000.

Table A3: Entry and exit of firms in 2000 and 2015

which is similar to (6).

The choice probability $\mu_{in,t}$ follows from Williams-Daly-Zachary (WDZ) theorem by differentiating $\Xi_{i,t}$ w.r.t $\bar{\delta}_{n,t}$, that is,

$$\mu_{in,t} = \nu \frac{1}{\mathcal{U}_t} \frac{\partial \mathcal{U}_t}{\partial \bar{\delta}_{n,t}} = \frac{\exp\left(\beta U_{n,t+1} - m_{in,t}\right)^{1/\nu}}{\sum_{c=1}^{N} \exp\left(\beta U_{c,t+1} - m_{in,t}\right)^{1/\nu}},$$

which is (8).

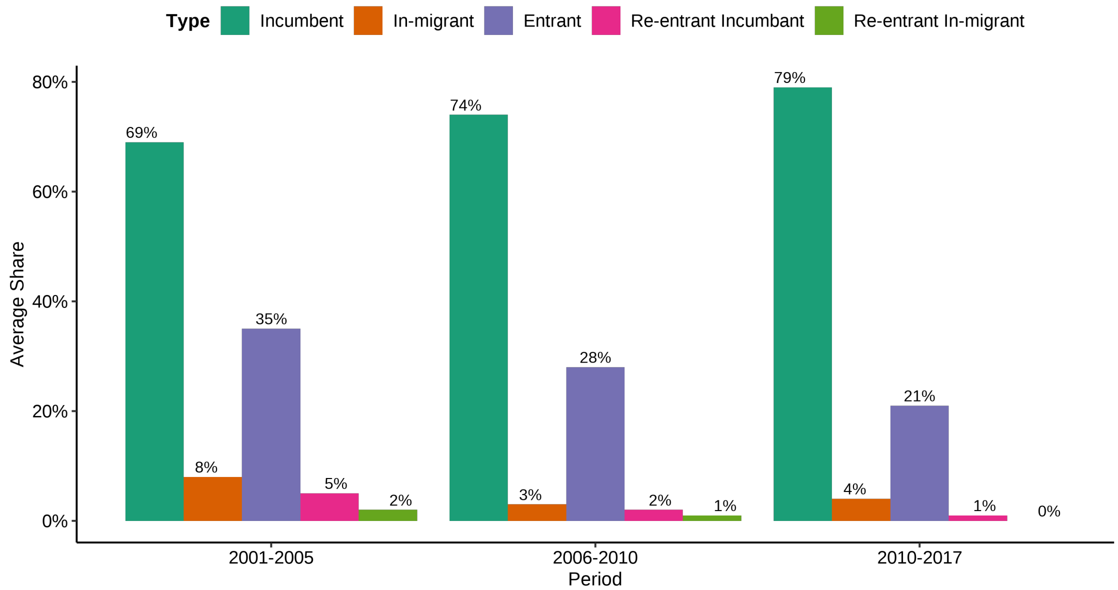


Figure A4: Mean shares of different types of entry

B.2 Firms with continuous stages

This subsection extends the entrepreneur discrete stages to a continuous one where I denote each stage as $s \in \{1, \ldots, S\}$. The value functions of $s-$entrepreneurs are given by

$$V_{i,t}^{js} = \log\left((1-\tau_{i,t}^{s})\frac{\pi_{i,t}^{j}}{P_{i,t}}\right) + \chi \log\left[\exp(V_{i,t+1}^{js+1})^{\frac{\beta}{\chi}} + \exp(U_{i,t+1})^{\frac{\beta}{\chi}}\right] \tag{B.1}$$

$$\varsigma_{i,t}^{js} = \frac{\exp\left(V_{i,t+1}^{js+1}\right)^{\frac{\beta}{\chi}}}{\exp\left(V_{i,t+1}^{js+1}\right)^{\frac{\beta}{\chi}} + \exp(U_{i,t+1})^{\frac{\beta}{\chi}}} \tag{B.2}$$

Recall that $\psi_{i,t}^{j}$ denotes the fraction of informal entrepreneurs that choose to locate in i among all informal entrepreneurs in sector j between t and $t+1$

$$\psi_{i,t}^{j} = \frac{\exp\left(\beta V_{i,t+1}^{j1} - f_{i,t}^{j}\right)^{1/\chi}}{\sum_{n=1}^{N}\exp\left(\beta V_{n,t+1}^{j1} - f_{n,t}^{j}\right)^{1/\chi}} \tag{B.3}$$

From here, I follow the same steps as in Section 5.1 by first taking log of the entry equation $\psi_{i,t}^{j}$

$$\log\psi_{i,t}^{j} = -\frac{1}{\chi}f_{i,t}^{j} + \frac{\beta}{\chi}V_{i,t+1}^{j1} - \log\sum_{n=1}^{N}\exp\left(V_{n,t+1}^{j1} - f_{n,t}^{j}\right)^{1/\chi}.$$

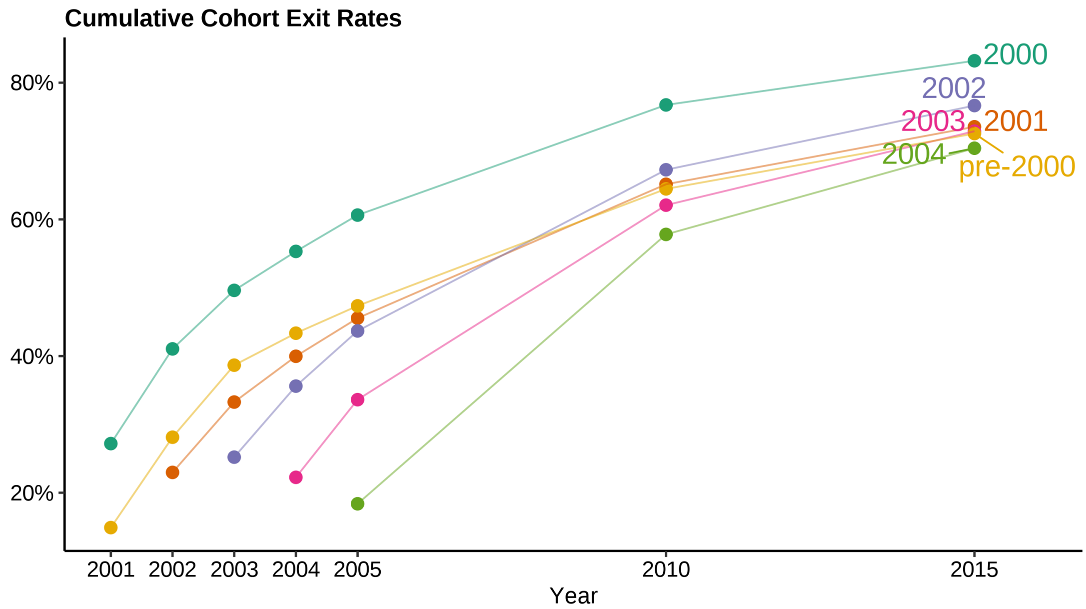


Figure A5: Exit rates by cohorts over time

Next, I substitute the expected value of 1-year-old firms $V_{i,t+1}^{j1}$ to get

$$\log \psi_{i,t}^{j} = \frac{\beta}{\chi} \log \left((1-\tau_{i,t+1}^{1}) \frac{\pi_{i,t+1}^{j}}{P_{i,t+1}} \right) + \beta \log \left[\exp \left(V_{i,t+2}^{j2} \right)^{\frac{\beta}{\chi}} + \exp(U_{i,t+2})^{\frac{\beta}{\chi}} \right] - \frac{1}{\chi} f_{i,t}^{j} + \Theta_{t}^{j1}. \tag{B.4}$$

Rearranging terms and taking the log of (B.2) yield

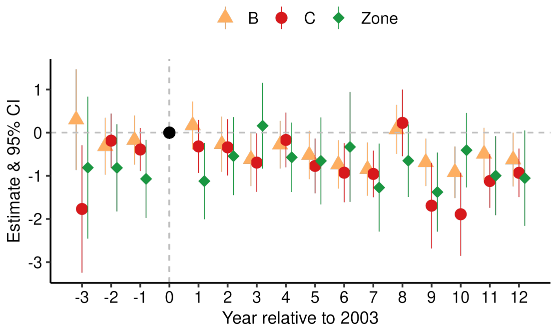
$$\log \left(\exp \left(V_{i,t+2}^{j2} \right)^{\frac{\beta}{\chi}} + \exp(U_{i,t+2})^{\frac{\beta}{\chi}} \right) = \frac{\beta}{\chi} U_{i,t+1} - \log(1 - \varsigma_{i,t+1}^{j1}) \tag{B.5}$$

Substituting this expression into (B.4) yields

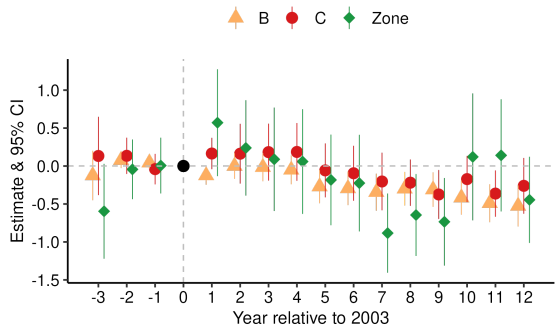
$$\log \left(\psi_{i,t}^{j} (1 - \varsigma_{i,t+1}^{j1})^{\beta} \right) = \frac{\beta}{\chi} \log \left((1-\tau_{i,t+1}^{1}) \frac{\pi_{i,t+1}^{j}}{P_{i,t+1}} \right) - \frac{1}{\chi} f_{i,t}^{j} + \frac{\beta^{2}}{\chi} U_{i,t+1} + \Theta_{t}^{j1}. \tag{B.6}$$

To further exploit the variation across age groups, consider the ratio between the fraction of s-year-old firms that stay and the fraction of them that exit for stage $s > 1$ based on (B.2)

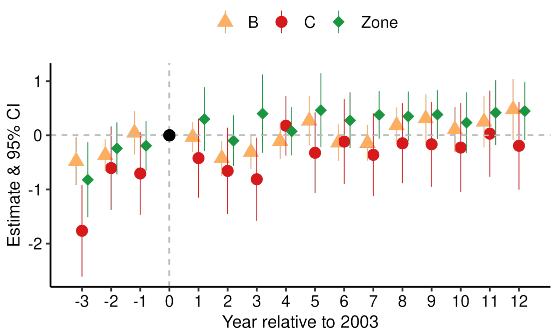
$$\frac{\varsigma_{i,t}^{js-1}}{1 - \varsigma_{i,t}^{js-1}} = \exp \left(V_{i,t+1}^{js} - U_{i,t+1} \right)^{\frac{\beta}{\chi}}.$$



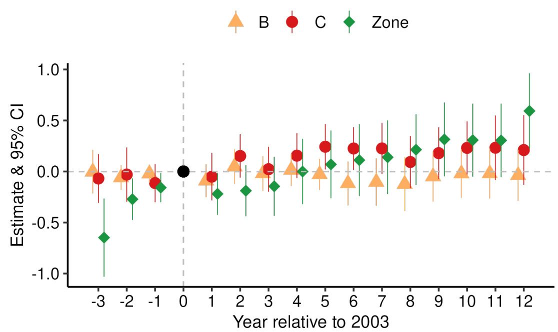
(a) Agriculture - Entry



(b) Agriculture - Labor



(c) Service - Entry



(d) Service - Labor

Figure A6: Effects of tax policy on entry share and labor in other sectors

Taking log both sides and substituting the value (B.1) yields

$$\log \frac{\varsigma_{i,t}^{js-1}}{1-\varsigma_{i,t}^{js-1}} = \frac{\beta}{\chi}\log\left((1-\tau_{i,t+1}^{s})\frac{\pi_{i,t+1}^{j}}{P_{i,t+1}}\right) + \beta\log\left(\exp(V_{i,t+2}^{js+1})^{\beta/\chi} + \exp(U_{i,t+2})^{\frac{\beta}{\chi}}\right) - \frac{\beta}{\chi}U_{i,t+1}.$$

Applying (B.5) yields

$$\log \frac{\varsigma_{i,t}^{js-1}}{1-\varsigma_{i,t}^{js-1}}(1-\varsigma_{i,t+1}^{js})^{\beta} = \frac{\beta}{\chi}\log\left((1-\tau_{i,t+1}^{s})\frac{\pi_{i,t+1}^{j}}{P_{i,t+1}}\right) - \frac{\beta}{\chi}U_{i,t+1} + \frac{\beta^2}{\chi}U_{i,t+1}.$$

If an old firm's profit tax increases, the young firms are more likely to stay than exit, which is captured by the relative tendency to stay. Still, the young ones are also likely to exit in the next period also increases due to an increase in market competition for marginal firms.

Finally, by subtracting each side of this equation from the corresponding side of the entry

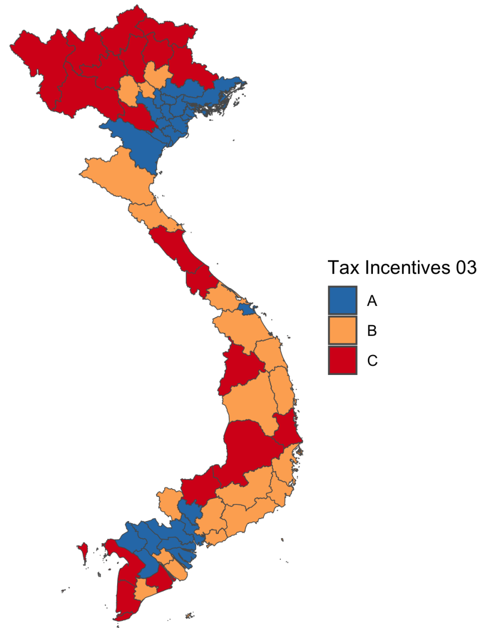


Figure A7: Map of Tax Policy Labels at Province level

Notes: The map shows provinces in Vietnam belonging to different tax categories. These labels are based on 1999 population shares in C districts within each province from Decree 164/2003/ND-CP

equation (B.6), I obtain

$$\log \frac{\psi_{i,t}^{j}(1-\varsigma_{i,t+1}^{j1})^{\beta}}{\frac{\varsigma_{i,t}^{js-1}}{1-\varsigma_{i,t}^{js-1}}(1-\varsigma_{i,t+1}^{js})^{\beta}} = \frac{\beta}{\chi}\log\frac{(1-\tau_{i,t+1}^{1})}{(1-\tau_{i,t+1}^{s})} - \frac{1}{\chi}f_{i,t}^{j} + \frac{\beta}{\chi}U_{i,t+1} + \Theta_{t}^{j1} \tag{B.7}$$

which is (34).

B.3 Welfare

Consider the share of stayers from (8)

$$\mu_{ii,t} = \frac{e^{(\beta U_{i,t+1}-m_{ii,t})/\nu}}{\sum_{c=1}^{N} e^{(\beta U_{c,t+1}-m_{ic,t})/\nu}}$$

Taking log yields

$$\log(\mu_{ii,t}) = \frac{\beta}{\nu}U_{i,t+1} - \log\sum_{c=1}^{N} e^{(\beta U_{c,t+1}-m_{ic,t})/\nu}$$

Table A4: DiD Estimates of tax policy by sector

Sector	Agriculture		Manufacturing		Service	
	Entry	Labor	Entry	Labor	Entry	Labor
	(1)	(2)	(3)	(4)	(5)	(6)
B x Post	-0.45**	-0.28***	0.23**	0.23**	0.24**	-0.03
	(0.20)	(0.09)	(0.11)	(0.09)	(0.12)	(0.09)
C x Post	-0.32	-0.16	0.54***	0.43***	0.37*	0.23**
	(0.20)	(0.11)	(0.15)	(0.13)	(0.19)	(0.10)
Zone x Post	-0.04	0.00	0.10	0.56***	0.59***	0.42**
	(0.25)	(0.28)	(0.18)	(0.13)	(0.18)	(0.18)
# DistrictZone	724	724	759	759	760	760
# ISIC2-Year	114	114	412	412	365	365
Observations	32,788	32,788	135,974	135,974	131,335	131,335
Control mean	0.38%	190	0.47%	420	0.48%	195

Source: Annual establishment surveys (2000-2015).
Notes: Unit of observation is district-zone-sector-year. Each row reports a coefficient in Equation 1 collapsed to a two-way fixed effects DiD model. All regressions include district-zone and sector-year fixed effects and are estimated by PPML. Standard errors are clustered at the district-zone level and reported in parenthesis.
***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$.

Thus

$$\Xi_{i,t} = \beta U_{i,t+1} - \nu \log(\mu_{ii,t})$$
$$\log(\psi^0_{i,t}) = \frac{1}{\chi}\Xi_{i,t} -$$

Plugging this equation into the value function (7) yields

$$U_{n,t} = \log\left(c_{n,t}\right) + \Xi_{i,t} - \chi \log(\psi^0_{n,t}) = \log\left(c_{n,t}\right) + \beta U_{i,t+1} - \nu \log(\mu_{ii,t}) - \chi \log(\psi^0_{n,t})$$

Iterating this equation forward yields

$$U_{n,t} = \sum_{h=t}^{\infty} \beta^{h-t} \log\left(\mathcal{A}_{n,h} \frac{w_{n,h}}{P_{n,h}}\right) - \nu \sum_{h=t}^{\infty} \beta^{h-t} \log(\mu_{nn,h})$$

I can write the expected lifetime utility as

$$U_{n,t} = \sum_{h=t}^{\infty} \beta^{h-t} \log \frac{\mathcal{A}_{n,h} \frac{w_{n,h}}{P_{n,h}}}{(\mu_{nn,h})^{\nu}}$$

Let the scalar Ω_n be the compensating variation in consumption for location n at time $t = 0$

$$U'_{n,t} = U_{n,t} + \sum_{h=0}^{\infty} \beta^h \log(\Omega_n)$$

Thus, I obtain the welfare change between the counterfactual economy and the actual economy (30).

Plugging this equation into the value function (7) yields

$$U_{n,t} = \log \left(\mathcal{A}_{n,t} \left(\frac{G_{n,t}}{L_{n,t}} \right)^{\gamma^i} \left(\frac{w_{n,t}}{P_{n,t}} \right)^{1-\gamma^i} \right) + \beta U_{n,t+1} - \nu \log(\mu_{nn,t})$$

Iterating this equation forward yields

$$U_{n,t} = \sum_{h=t}^{\infty} \beta^{h-t} \log \left(\mathcal{A}_{n,h} \left(\frac{G_{n,h}}{L_{n,h}} \right)^{\gamma^i} \left(\frac{w_{n,h}}{P_{n,h}} \right)^{1-\gamma^i} \right) - \nu \sum_{h=t}^{\infty} \beta^{h-t} \log(\mu_{nn,h})$$

I can write the expected lifetime utility as

$$U_{n,t} = \sum_{h=t}^{\infty} \beta^{h-t} \log \frac{\mathcal{A}_{n,h} \left(\frac{G_{n,h}}{L_{n,h}} \right)^{\gamma^i} \left(\frac{w_{n,h}}{P_{n,h}} \right)^{1-\gamma^i}}{(\mu_{nn,h})^{\nu}}$$

Let the scalar Ω_n be the compensating variation in consumption for location n at time $t = 0$

$$U'_{n,t} = U_{n,t} + \sum_{h=0}^{\infty} \beta^h \log(\Omega_n)$$

Thus, I obtain the welfare change between the counterfactual economy and the actual economy

$$\widehat{W}_i = (1-\beta) \sum_{t=1}^{\infty} \beta^t \log \frac{\left(\frac{\widehat{G}_{n,h}}{\widehat{L}_{n,h}} \right)^{\gamma^i} \left(\frac{\widehat{w}_{n,h}}{\widehat{P}_{n,h}} \right)^{1-\gamma^i}}{(\widehat{\mu}_{nn,h})^{\nu}}$$

C Dot Algebra

I collect all equilibrium equations and rewrite them in exponential notations. In particular, let $\widetilde{v}^{js}_{i,t} = \exp(V^{js}_{i,t})$, $\widetilde{f}^{j}_{i,t} = \exp(f^{j}_{i,t})$, $\widetilde{u}_{i,t} = \exp(U_{i,t})$, and $\widetilde{m}_{in,t} = \exp(m_{in,t})$. The following system of equations characterizes the baseline economy where $\dot{x}_{t+1} \equiv \frac{x_{t+1}}{x_t}$.

$$\dot{v}^{j\mathrm{III}}_{i,t} = \dot{\mathcal{T}}^{\mathrm{III}}_{i,t} \left(\frac{\dot{\pi}^{j}_{i,t}}{\dot{P}_{i,t}}\right) \left[\varsigma^{j\mathrm{III}}_{i,t-1} \left(\dot{v}^{j\mathrm{III}}_{i,t+1}\right)^{\frac{\beta}{\chi}} + (1-\varsigma^{j\mathrm{III}}_{i,t-1}) \left(\dot{u}_{i,t+1}\right)^{\frac{\beta}{\chi}}\right]^{\chi} \tag{C.1}$$

$$\dot{v}^{j\mathrm{II}}_{i,t} = \dot{\mathcal{T}}^{\mathrm{II}}_{i,t} \left(\frac{\dot{\pi}^{j}_{i,t}}{\dot{P}_{i,t}}\right) \left[\varsigma^{j\mathrm{II}}_{i,t-1} \left(\dot{v}^{j\mathrm{III}}_{i,t+1}\right)^{\frac{\beta}{\chi}} + (1-\varsigma^{j\mathrm{II}}_{i,t-1}) \left(\dot{u}_{i,t+1}\right)^{\frac{\beta}{\chi}}\right]^{\chi} \tag{C.2}$$

$$\dot{v}^{j\mathrm{I}}_{i,t} = \dot{\mathcal{T}}^{\mathrm{I}}_{i,t} \left(\frac{\dot{\pi}^{j}_{i,t}}{\dot{P}_{i,t}}\right) \left[\varsigma^{j\mathrm{I}}_{i,t-1} \left(\dot{v}^{j\mathrm{II}}_{i,t+1}\right)^{\frac{\beta}{\chi}} + (1-\varsigma^{j\mathrm{I}}_{i,t-1}) \left(\dot{u}_{i,t+1}\right)^{\frac{\beta}{\chi}}\right]^{\chi} \tag{C.3}$$

$$\dot{v}^{jO}_{i,t} = \left[\sum_{n=1}^{N} \psi^{j}_{n,t-1} \left(\dot{v}^{j\mathrm{I}}_{n,t+1}\right)^{\frac{\beta}{\chi}}\right]^{\chi} \tag{C.4}$$

$$\dot{u}_{i,t} = \frac{\dot{w}_{i,t}}{\dot{P}_{i,t}} \left(\sum_{n=1}^{N} \mu_{in,t-1} (\dot{u}_{n,t+1})^{\frac{\beta}{\nu}}\right)^{\nu} \tag{C.5}$$

$$\varsigma^{j\mathrm{III}}_{i,t} = \frac{\varsigma^{j\mathrm{III}}_{i,t-1} \left(\dot{v}^{j\mathrm{III}}_{i,t+1}\right)^{\frac{\beta}{\chi}}}{\varsigma^{j\mathrm{III}}_{i,t-1} \left(\dot{v}^{j\mathrm{III}}_{i,t+1}\right)^{\frac{\beta}{\chi}} + (1-\varsigma^{j\mathrm{III}}_{i,t-1}) \left(\dot{u}_{i,t+1}\right)^{\frac{\beta}{\chi}}} \tag{C.6}$$

$$\varsigma^{j\mathrm{II}}_{i,t} = \frac{\varsigma^{j\mathrm{II}}_{i,t-1} \left(\dot{v}^{j\mathrm{III}}_{i,t+1}\right)^{\frac{\beta}{\chi}}}{\varsigma^{j\mathrm{III}}_{i,t-1} \left(\dot{v}^{j\mathrm{III}}_{i,t+1}\right)^{\frac{\beta}{\chi}} + (1-\varsigma^{j\mathrm{II}}_{i,t-1}) \left(\dot{u}_{i,t+1}\right)^{\frac{\beta}{\chi}}} \tag{C.7}$$

$$\varsigma^{j\mathrm{I}}_{i,t} = \frac{\varsigma^{j\mathrm{I}}_{i,t-1} \left(\dot{v}^{j\mathrm{II}}_{i,t+1}\right)^{\frac{\beta}{\chi}}}{\varsigma^{j\mathrm{I}}_{i,t-1} \left(\dot{v}^{j\mathrm{II}}_{i,t+1}\right)^{\frac{\beta}{\chi}} + (1-\varsigma^{j\mathrm{I}}_{i,t-1}) \left(\dot{u}_{i,t+1}\right)^{\frac{\beta}{\chi}}} \tag{C.8}$$

$$\psi^{j}_{i,t} = \frac{\psi^{j}_{i,t-1} \left(\dot{v}^{j\mathrm{I}}_{i,t+1}\right)^{\frac{\beta}{\chi}}}{\sum_{n=1}^{N} \psi^{j}_{n,t-1} \left(\dot{v}^{j\mathrm{I}}_{n,t+1}\right)^{\frac{\beta}{\chi}}} \tag{C.9}$$

$$\dot{\Psi}^{j}_{t} = \frac{\Psi^{j}_{t-1} \left(\dot{v}^{jO}_{t+1}\right)^{\beta/\eta}}{\sum_{k} \Psi^{k}_{t-1} \left(\dot{v}^{jO}_{t+1}\right)^{\beta/\eta}} \tag{C.10}$$

$$\mu_{in,t} = \frac{\mu_{in,t-1} \left(\dot{u}_{n,t+1}\right)^{\frac{\beta}{\nu}}}{\sum_{c=1}^{N} \mu_{ic,t-1} (\dot{u}_{c,t+1})^{\frac{\beta}{\nu}}} \tag{C.11}$$

Evolution

$$(\dot{\underline{\phi}}_{i,t})^{\beta} = \left(\sum_n \mu_{in,t-1}(\dot{u}_{n,t+1})^{\frac{\beta}{\nu}}\right)^{\nu} \left(\sum_j \Psi^j_{t-1}\left(\sum_n \psi^j_{n,t}(\dot{v}^{j\mathrm{I}}_{n,t+2})^{\frac{\beta}{\chi}}\right)^{\frac{\beta}{\eta}\chi}\right)^{-\eta} \tag{C.12}$$

$$L_{i,t+1} = \sum_{n=1}^{N} \mu_{ni,t}(1-(1-\exp(-\underline{\phi}_{i,t}^{-\vartheta}))\iota)L_{n,t} + \sum_{j=1}^{J}\sum_{s\in\{\mathrm{I,II,III}\}}\left(1-\varsigma^{js}_{i,t}\right)E^{js}_{i,t} \tag{C.13}$$

$$E^{j\mathrm{III}}_{i,t+1} = \varsigma^{j\mathrm{III}}_{i,t}E^{j\mathrm{III}}_{i,t} + \varsigma^{j\mathrm{II}}_{i,t}E^{j\mathrm{II}}_{i,t} \tag{C.14}$$

$$E^{j\mathrm{II}}_{i,t+1} = \varsigma^{j\mathrm{II}}_{i,t}E^{j\mathrm{I}}_{i,t} \tag{C.15}$$

$$E^{j\mathrm{I}}_{i,t+1} = \psi^j_{i,t}E^j_t \tag{C.16}$$

$$E^j_t = \sum_n \Psi^j_t\left(1-\exp(-\underline{\phi}_{i,t}^{-\vartheta})\right)\iota L_{i,t} \tag{C.17}$$

Temporary equilibrium

$$\dot{P}^j_{i,t+1} = \left(\sum_n \lambda^j_{ni,t}\dot{E}^j_{n,t+1}\left(\dot{p}^j_{ni,t+1}\right)^{1-\sigma}\right)^{1/(1-\sigma)} \tag{C.18}$$

$$\dot{K}_{i,t+1} = \beta(q_{i,t}/P_{i,t} + (1-\delta_i)); \tag{C.19}$$

$$\dot{P}_{i,t+1} = \prod_{j=1}^{J}(\dot{P}^j_{i,t+1})^{\alpha^j} \tag{C.20}$$

$$\dot{p}^j_{in,t+1} = \dot{x}^j_{i,t+1} = (\dot{w}_{i,t+1})^{\xi^j}(\dot{q}_{i,t+1})^{1-\xi^j} \tag{C.21}$$

$$\dot{\lambda}^j_{in,t+1} = \dot{E}^j_{i,t+1}\left(\frac{\dot{p}^j_{in,t+1}}{\dot{P}^j_{n,t+1}}\right)^{1-\sigma} \tag{C.22}$$

$$\pi^j_{i,t+1} = \frac{1}{\sigma}\sum_{n=1}^{N}(\dot{x}^j_{i,t+1})^{1-\sigma}(\dot{P}^j_{n,t+1})^{\sigma-1}\frac{\lambda^j_{in,t}}{E^j_{i,t}}\alpha^j\Pi_{n,t+1} \tag{C.23}$$

$$\Pi_{i,t+1} = \sum_{j=1}^{J}\dot{w}_{i,t+1}w_{i,t}\dot{L}^j_{i,t+1}L^j_{i,t} + \dot{q}_{i,t+1}\dot{K}^j_{i,t+1}q_{i,t}K^j_{i,t} + \dot{E}^j_{i,t+1}E^j_{i,t}\dot{\pi}^j_{i,t+1}\pi^j_{i,t} \tag{C.24}$$

$$\dot{w}_{i,t+1}\dot{L}^j_{i,t+1}w_{i,t}L^j_t = \xi^j\frac{\sigma-1}{\sigma}\sum_{n=1}^{N}\dot{\lambda}^j_{in,t+1}\lambda^j_{in,t}\dot{X}^j_{n,t+1}X^j_{n,t} \tag{C.25}$$

Worker's value in dot algebra: Let's start with the value of the household in changes (C.5). Recalling the value of a household that works in location i from (7), and taking the ratio $\dot{u}_{i,t+1} \equiv \frac{\widetilde{u}_{i,t+1}}{\widetilde{u}_{i,t}}$ yields

$$\dot{u}_{i,t+1} = \frac{\dot{w}_{i,t+1}}{\dot{P}_{i,t+1}}\left[\frac{\sum_{n=1}^{N}(\widetilde{u}_{n,t+2})^{\frac{\beta}{\nu}}(\widetilde{m}_{in,t+1})^{\frac{-1}{\nu}}}{\sum_{n=1}^{N}(\widetilde{u}_{n,t+1})^{\frac{\beta}{\nu}}(\widetilde{m}_{in,t})^{\frac{-1}{\nu}}}\right]^{\nu}$$

The second fraction on the right-hand side can be written as

$$\frac{\sum_n (\widetilde{u}_{n,t+2})^{\frac{\beta}{\nu}} (\widetilde{m}_{in,t+1})^{\frac{-1}{\nu}}}{\sum_n (\widetilde{u}_{n,t+1})^{\frac{\beta}{\nu}} (\widetilde{m}_{in,t})^{\frac{-1}{\nu}}} = \sum_n \frac{(\widetilde{u}_{n,t+2})^{\frac{\beta}{\nu}} (\widetilde{m}_{in,t+1})^{\frac{-1}{\nu}}}{\sum_c (\widetilde{u}_{c,t+1})^{\frac{\beta}{\nu}} (\widetilde{m}_{ic,t})^{\frac{-1}{\rho\nu}}} \frac{(\widetilde{u}_{n,t+1})^{\frac{\beta}{\nu}} (\widetilde{m}_{in,t})^{\frac{-1}{\nu}}}{(\widetilde{u}_{n,t+1})^{\frac{\beta}{\nu}} (\widetilde{m}_{in,t})^{\frac{-1}{\nu}}}$$
$$= \sum_n \mu_{in,t} \left(\dot{u}_{n,t+2}\right)^{\frac{\beta}{\nu}}$$

where the last line assumes no future changes in migration costs. Thus, we have derived (C.5).

Next, recalling the share of workers that move between i and n (8)

$$\mu_{in,t} = \frac{(\widetilde{u}_{n,t+1})^{\frac{\beta}{\nu}} (\widetilde{m}_{in,t})^{\frac{-1}{\nu}}}{\sum_{c=1}^{N} (\widetilde{u}_{c,t+1})^{\frac{\beta}{\nu}} (\widetilde{m}_{ic,t})^{\frac{-1}{\nu}}}$$

Multiplying both the numerator and denominator by $(\widetilde{u}_{n,t})^{\frac{\beta}{\nu}} (\widetilde{m}_{in,t-1})^{\frac{-1}{\nu}} \sum_{c=1}^{N} (\widetilde{u}_{c,t})^{\frac{\beta}{\nu}} (\widetilde{m}_{ic,t-1})^{\frac{-1}{\nu}}$ yields

$$\mu_{in,t} = \frac{(\widetilde{u}_{n,t+1})^{\frac{\beta}{\nu}} (\widetilde{m}_{in,t})^{\frac{-1}{\nu}}}{\sum_{c=1}^{N} \frac{(\widetilde{u}_{c,t+1})^{\frac{\beta}{\nu}} (\widetilde{m}_{ic,t})^{\frac{-1}{\nu}}}{\sum_{c=1}^{N} (\widetilde{u}_{c,t})^{\frac{\beta}{\nu}} (\widetilde{m}_{ic,t-1})^{\frac{-1}{\nu}}}} \frac{(\widetilde{u}_{n,t})^{\frac{\beta}{\nu}} (\widetilde{m}_{in,t-1})^{\frac{-1}{\nu}}}{(\widetilde{u}_{n,t})^{\frac{\beta}{\nu}} (\widetilde{m}_{in,t-1})^{\frac{-1}{\nu}}} \frac{1}{\sum_{c=1}^{N} (\widetilde{u}_{c,t})^{\frac{\beta}{\nu}} (\widetilde{m}_{ic,t-1})^{\frac{-1}{\nu}}}$$

Thus,

$$\mu_{in,t} = \frac{\mu_{in,t-1} (\dot{u}_{n,t+1})^{\frac{\beta}{\nu}}}{\sum_{c=1}^{N} \mu_{ic,t-1} \left(\dot{u}_{c,t+1}\right)^{\frac{\beta}{\nu}}},$$

which is (C.11).

Firm's Location Choice The value of being an old entrepreneur (11) in time changes is given by

$$\dot{v}^{j\mathrm{III}}_{i,t+1} = \dot{T}^{\mathrm{III}}_{i,t+1} \frac{\dot{\pi}^{j}_{i,t+1}}{\dot{P}_{i,t+1}} \left(\frac{(\widetilde{v}^{j\mathrm{III}}_{i,t+1})^{\frac{\beta}{\chi}} + (\widetilde{u}_{i,t+1})^{\frac{\beta}{\chi}}}{(\widetilde{v}^{j\mathrm{III}}_{i,t})^{\frac{\beta}{\chi}} + (\widetilde{u}_{i,t})^{\frac{\beta}{\chi}}} \right)^{\chi}.$$

where $\mathcal{T}^{a}_{i,t}$ denotes the net profit rate $(1 - \tau^{a}_{i,t})$. Equivalently,

$$\dot{v}^{j\mathrm{III}}_{i,t+1} = \dot{T}^{\mathrm{III}}_{i,t+1} \frac{\dot{\pi}^{j}_{i,t+1}}{\dot{P}_{i,t+1}} \left(\varsigma^{j\mathrm{III}}_{i,t} \left(\dot{v}^{j\mathrm{III}}_{i,t+1}\right)^{\frac{\beta}{\chi}} + (1 - \varsigma^{j\mathrm{III}}_{i,t}) \left(\dot{u}_{i,t+1}\right)^{\frac{\beta}{\chi}} \right)^{\chi}.$$

Similarly, the value of a firm s-years old (15), where $s \in \{\mathrm{I}, \mathrm{II}, \mathrm{III}\}$, in time difference is given by (C.2) and (C.3)

Since talent is fixed over time, the value of an informal entrepreneur (19) in time differences is constant across talent type ϕ and is given by

$$\dot{v}^{jO}_{t+1} = \left[\frac{\sum_n (\widetilde{f}^j_{n,t+1})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{n,t+2}\right)^{\frac{\beta}{\chi}}}{\sum_n (\widetilde{f}^j_{n,t})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{n,t+1}\right)^{\frac{\beta}{\chi}}}\right]^{\chi} = \left[\frac{\sum_n (\widetilde{f}^j_{n,t+1})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{n,t+2}\right)^{\frac{\beta}{\chi}} \frac{(\widetilde{f}^j_{n,t})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{n,t+1}\right)^{\frac{\beta}{\chi}}}{(\widetilde{f}^j_{n,t})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{n,t+1}\right)^{\frac{\beta}{\chi}}}}{\sum_n (\widetilde{f}^j_{n,t})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{n,t+1}\right)^{\frac{\beta}{\chi}}}\right]^{\chi}$$

$$= \left[\frac{\sum_n \left(\dot{v}^{j\mathrm{I}}_{n,t+2}\right)^{\frac{\beta}{\chi}} (\widetilde{f}^j_{n,t})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{n,t+1}\right)^{\frac{\beta}{\chi}}}{\sum_n (\widetilde{f}^j_{n,t})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{n,t+1}\right)^{\frac{\beta}{\chi}}}\right]^{\chi} = \left[\sum_n \psi^j_{n,t} \left(\dot{v}^{j\mathrm{I}}_{n,t+2}\right)^{\frac{\beta}{\chi}}\right]^{\chi}$$

where the last equation follows from (20), thus, I get (C.4).

Recall the fraction of I entrepreneurs that stays in ij (16)

$$\varsigma^{j\mathrm{I}}_{i,t+1} = \frac{\left(\widetilde{v}^{js+1}_{i,t+2}\right)^{\frac{\beta}{\chi}}}{\left(\widetilde{v}^{js+1}_{i,t+2}\right)^{\frac{\beta}{\chi}} + \widetilde{u}^{\frac{\beta}{\chi}}_{i,t+2}} = \frac{\left(\widetilde{v}^{js+1}_{i,t+2}\right)^{\frac{\beta}{\chi}} \frac{\left(\widetilde{v}^{js+1}_{i,t+1}\right)^{\frac{\beta}{\chi}}}{\left(\widetilde{v}^{js+1}_{i,t+1}\right)^{\frac{\beta}{\chi}}}}{\left(\widetilde{v}^{js+1}_{i,t+2}\right)^{\frac{\beta}{\chi}} \frac{\left(\widetilde{v}^{js+1}_{i,t+1}\right)^{\frac{\beta}{\chi}}}{\left(\widetilde{v}^{js+1}_{i,t+1}\right)^{\frac{\beta}{\chi}}} + \widetilde{u}^{\frac{\beta}{\chi}}_{i,t+2}} = \frac{\left(\dot{v}^{js+1}_{i,t+2}\right)^{\frac{\beta}{\chi}} \left(\widetilde{v}^{js+1}_{i,t+1}\right)^{\frac{\beta}{\chi}}}{\left(\dot{v}^{js+1}_{i,t+2}\right)^{\frac{\beta}{\chi}} \left(\widetilde{v}^{js+1}_{i,t+1}\right)^{\frac{\beta}{\chi}} + \widetilde{u}^{\frac{\beta}{\chi}}_{i,t+2}}$$

Dividing the numerator and denominator by $(\widetilde{v}^{js+1}_{i,t+1})^{\frac{\beta}{\chi}} + \widetilde{u}^{\frac{\beta}{\chi}}_{i,t+2}$ yields

$$\varsigma^{ij}_{a,t+1} = \frac{\varsigma^{ij}_{a,t} \left(\dot{v}^{js+1}_{i,t+2}\right)^{\frac{\beta}{\chi}}}{\varsigma^{ij}_{a,t} \left(\dot{v}^{js+1}_{i,t+2}\right)^{\frac{\beta}{\chi}} + (1 - \varsigma^{ij}_{a,t})\widetilde{u}^{\frac{\beta}{\chi}}_{i,t+2}},$$

which is (C.8).

Similarly, the fraction of informal entrepreneurs that enter i (20) is given by

$$\psi^j_{i,t+1} = \frac{(\widetilde{f}^j_{i,t+1})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{i,t+2}\right)^{\frac{\beta}{\chi}}}{\sum_n (\widetilde{f}^j_{n,t+1})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{n,t+2}\right)^{\frac{\beta}{\chi}}} = \frac{(\widetilde{f}^j_{i,t+1})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{i,t+2}\right)^{\frac{\beta}{\chi}} \frac{(\widetilde{f}^j_{i,t})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{i,t+1}\right)^{\frac{\beta}{\chi}}}{(\widetilde{f}^j_{i,t})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{i,t+1}\right)^{\frac{\beta}{\chi}}}}{\sum_n (\widetilde{f}^j_{n,t+1})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{n,t+2}\right)^{\frac{\beta}{\chi}} \frac{(\widetilde{f}^j_{n,t})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{n,t+1}\right)^{\frac{\beta}{\chi}}}{(\widetilde{f}^j_{n,t})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{n,t+1}\right)^{\frac{\beta}{\chi}}}}$$

$$= \frac{\left(\dot{v}^{j\mathrm{I}}_{i,t+2}\right)^{\frac{\beta}{\chi}} (\widetilde{f}^j_{i,t})^{\frac{-1}{\chi}} \left(\widetilde{v}^{j\mathrm{I}}_{i,t+1}\right)^{\frac{\beta}{\chi}}}{\sum_n \left(\dot{v}^{j\mathrm{I}}_{n,t+2}\right)^{\frac{\beta}{\chi}} (\widetilde{f}^j_{n,t})^{\frac{-1}{\chi}} (\widetilde{v}^{j\mathrm{I}}_{n,t+1})^{\frac{\beta}{\chi}}}$$

Thus,

$$\psi^j_{i,t+1} = \frac{\psi^j_{i,t} \left(\dot{v}^{j\mathrm{I}}_{i,t+2}\right)^{\frac{\beta}{\chi}}}{\sum_{n=1}^N \psi^j_{n,t} \left(\dot{v}^{j\mathrm{I}}_{n,t+2}\right)^{\frac{\beta}{\chi}}},$$

which is (C.9).

The sectoral choice of households that choose to be entrepreneurs (22)

$$\dot{\Psi}_t^j = \frac{\Psi_{t-1}^j \left(\dot{v}_{t+1}^{jO}\right)^{\beta/\eta}}{\sum_k \Psi_{t-1}^k \left(\dot{v}_{t+1}^{jO}\right)^{\beta/\eta}}.$$

Occupation choice in changes The talent cut-off from (23) can be written as

$$\begin{aligned}\beta \log(\underline{\phi}_{i,t}) = \nu \log \left[\sum_{n\in\mathcal{R}} \exp\left(\beta U_{n,t+1} - m_{in,t}\right)^{1/\nu}\right] \\ - \eta \log\left[\sum_{j=1}^{J}\left[\sum_{n=1}^{N} \exp\left(\beta V_{n,t+2}^{j\mathrm{I}} - f_{n,t+1}^{j}\right)^{1/\chi}\right]^{\frac{\beta}{\eta}\chi}\right].\end{aligned}$$

Taking the dot ratio

$$(\dot{\underline{\phi}}_{i,t})^{\beta} = \left(\frac{\sum_n \widetilde{u}_{n,t+1}^{\frac{\beta}{\nu}} \widetilde{m}_{in,t}^{\frac{-1}{\nu}}}{\sum_n \widetilde{u}_{n,t}^{\frac{\beta}{\nu}} \widetilde{m}_{in,t-1}^{\frac{-1}{\nu}}}\right)^{\nu} \left(\frac{\sum_j \left(\sum_n \left(\widetilde{v}_{n,t+2}^{j\mathrm{I}}\right)^{\frac{\beta}{\chi}} \left(\widetilde{f}_{n,t+1}^{j}\right)^{\frac{-1}{\chi}}\right)^{\frac{\beta}{\eta}\chi}}{\sum_j \left(\sum_n \left(\widetilde{v}_{n,t+1}^{j\mathrm{I}}\right)^{\frac{\beta}{\chi}} \left(\widetilde{f}_{n,t}^{j}\right)^{\frac{-1}{\chi}}\right)^{\frac{\beta}{\eta}\chi}}\right)^{-\eta}$$

Consider

$$\begin{aligned}\sum_j \frac{\left(\sum_n \left(\widetilde{v}_{n,t+2}^{j\mathrm{I}}\right)^{\frac{\beta}{\chi}} \left(\widetilde{f}_{n,t+1}^{j}\right)^{\frac{-1}{\chi}}\right)^{\frac{\beta}{\eta}\chi}}{\sum_k \left(\sum_n \left(\widetilde{v}_{n,t+1}^{kY}\right)^{\frac{\beta}{\chi}} \left(\widetilde{f}_{n,t}^{k}\right)^{\frac{-1}{\chi}}\right)^{\frac{\beta}{\eta}\chi}} &= \sum_j \frac{\left(\sum_n \left(\widetilde{v}_{n,t+1}^{j\mathrm{I}}\right)^{\frac{\beta}{\chi}} \left(\widetilde{f}_{n,t}^{j}\right)^{\frac{-1}{\chi}}\right)^{\frac{\beta}{\eta}\chi}}{\sum_k \left(\sum_n \left(\widetilde{v}_{n,t+1}^{kY}\right)^{\frac{\beta}{\chi}} \left(\widetilde{f}_{n,t}^{k}\right)^{\frac{-1}{\chi}}\right)^{\frac{\beta}{\eta}\chi}} \frac{\left(\sum_n \left(\widetilde{v}_{n,t+2}^{j\mathrm{I}}\right)^{\frac{\beta}{\chi}} \left(\widetilde{f}_{n,t+1}^{j}\right)^{\frac{-1}{\chi}}\right)^{\frac{\beta}{\eta}\chi}}{\left(\sum_n \left(\widetilde{v}_{n,t+1}^{j\mathrm{I}}\right)^{\frac{\beta}{\chi}} \left(\widetilde{f}_{n,t}^{j}\right)^{\frac{-1}{\chi}}\right)^{\frac{\beta}{\eta}\chi}} \\ &= \sum_j \Psi_{t-1}^j \left(\sum_n \psi_{n,t}^j (\dot{v}_{n,t+2}^{j\mathrm{I}})^{\frac{\beta}{\chi}}\right)^{\frac{\beta}{\eta}\chi}\end{aligned}$$

Recall (22)

$$\Psi_t^j = \frac{(\widetilde{v}_{t+1}^{jO})^{\beta/\eta}}{\sum_k (\widetilde{v}_{t+1}^{kI})^{\beta/\eta}} = \frac{\left(\sum_n (\widetilde{v}_{n,t+2}^{j\mathrm{I}})^{\beta/\chi} (\widetilde{f}_{n,t+1}^{j})^{-1/\chi}\right)^{\chi\beta/\eta}}{\sum_k (\widetilde{v}_{t+1}^{kI})^{\beta/\eta}}$$

Thus, the cut-off in time changes is given by

$$(\dot{\underline{\phi}}_{i,t})^{\beta} = \left(\sum_n \mu_{in,t-1} (\dot{u}_{n,t+1})^{\frac{\beta}{\nu}}\right)^{\nu} \left(\sum_j \Psi_{t-1}^j \left(\sum_n \psi_{n,t}^j (\dot{v}_{n,t+2}^{j\mathrm{I}})^{\frac{\beta}{\chi}}\right)^{\frac{\beta}{\eta}\chi}\right)^{-\eta}$$

C.1 Temporary equilibrium equations in changes

The sectoral price index from (3) in changes is given by

$$\dot{P}^j_{i,t+1} = \frac{\left(\sum_n E^j_{n,t+1}(p^j_{ni,t+1})^{1-\sigma}\right)^{1/(1-\sigma)}}{P^j_{i,t}} = \frac{1}{P^j_{i,t}}\left(\sum_n \dot{E}^j_{n,t+1}E^j_{n,t}\left(\dot{p}^j_{ni,t+1}p^j_{ni,t}\right)^{1-\sigma}\right)^{1/(1-\sigma)}$$

Since $\lambda^j_{ni,t} = E^j_{n,t}(p^j_{ni,t}/P^j_{i,t})^{1-\sigma}$, I have

$$\dot{P}^j_{i,t+1} = \left(\sum_n \lambda^j_{ni,t}\dot{E}^j_{n,t+1}\left(\dot{p}^j_{ni,t+1}\right)^{1-\sigma}\right)^{1/(1-\sigma)}$$

I copy the pricing equation (9) for reference

$$p^j_{ni,t} = \frac{\sigma}{\sigma-1}\frac{d^j_{ni}x^j_{n,t}}{A^j_{n,t}} = \frac{\sigma}{\sigma-1}\frac{(\text{distance}_{ni})^{\kappa^j}B^j(w_{n,t})^{\xi}(q_{n,t})^{1-\xi^j}}{A^j_{n,t}}$$

where each component is either estimated in Section 5 or recovered from data.

Recall (**??**)

$$\dot{q}_{i,t+1} = \frac{\dot{w}_{i,t+1}}{\dot{K}_{i,t+1}}\frac{\sum_j \frac{1-\xi^j}{\xi^j}L^j_{i,t+1}}{\sum_j \frac{1-\xi^j}{\xi^j}L^j_{i,t}},$$

so I can solve for the new user's cost $q_{i,t+1}$. Thus, the price of intermediate goods (9) in changes is given by

$$\dot{p}^j_{in,t+1} = \dot{x}^j_{i,t+1} = (\dot{w}_{i,t+1})^{\xi^j}(\dot{q}_{i,t+1})^{1-\xi^j}$$

The last equality follows the assumption that TFP stays constant from time t and the cost of the input bundle (**??**) in changes.

The change in aggregate bilateral expenditure shares (26)

$$\dot{\lambda}^j_{in,t+1} = \dot{E}^j_{i,t+1}\left(\frac{\dot{p}^j_{in,t+1}}{\dot{P}^j_{n,t+1}}\right)^{1-\sigma}$$

The revenue function from selling to nj in changes is given by

$$\dot{\pi}^j_{in,t+1} = (\dot{x}^j_{i,t+1})^{1-\sigma}\dot{X}^j_{n,t+1}(\dot{P}^j_{n,t+1})^{\sigma-1}$$

The total profit (10) from selling everywhere in the next period becomes

$$\pi^j_{i,t+1} = \frac{1}{\sigma}\sum_{n=1}^{N}\pi^j_{in,t}\dot{\pi}^j_{in,t+1}$$

Using $\pi^j_{in,t} = \lambda^j_{in,t} \frac{X^j_{n,t}}{E^j_{i,t}} = \left(\frac{p^j_{in,t}}{P^j_{n,t}}\right)^{1-\sigma} X^j_{n,t}$ yields

$$\pi^j_{i,t+1} = \frac{1}{\sigma} \sum_{n=1}^{N} \dot{\pi}^j_{in,t+1} \frac{\lambda^j_{in,t}}{E^j_{i,t}} X^j_{n,t}$$

Total income (27) in changes is given by

$$\Pi_{i,t+1} = \sum_{j=1}^{J} \dot{w}_{i,t+1} w_{i,t} \dot{L}^j_{i,t+1} L^j_{i,t} + \dot{q}_{i,t+1} \dot{K}_{i,t+1} q^j_{i,t} K^j_{i,t} + \dot{E}^j_{i,t+1} E^j_{i,t+1} \pi^j_{i,t+1}$$

Substituting the expression of profits yields

$$\Pi_{i,t+1} = \sum_{j=1}^{J} \dot{w}_{i,t+1} w_{i,t} \dot{L}^j_{i,t+1} L^j_{i,t} + \dot{q}_{i,t+1} \dot{K}_{i,t+1} q^j_{i,t} K^j_{i,t} + \dot{E}^j_{i,t+1} E^j_{i,t+1} \frac{1}{\sigma} \sum_{n} \left(\frac{x^j_{i,t+1}}{P^j_{n,t+1}}\right)^{1-\sigma} \alpha^j \Pi_{i,t+1}$$

Thus, expenditure shares (28) in changes is given by

$$\dot{X}^j_{i,t+1} = \dot{\Pi}_{i,t+1}$$

The labor market clearing condition in changes (29)

$$\dot{w}_{i,t+1} \dot{L}^j_{i,t+1} w_{i,t} L^j_{i,t} = \xi^j \frac{\sigma - 1}{\sigma} \sum_{n=1}^{N} \dot{\lambda}^j_{in,t+1} \lambda^j_{in,t} \dot{X}^j_{n,t+1} X^j_{n,t}.$$

C.2 Algorithm for dot algebra

1. The program starts at $t = 3$ corresponding to 2015. Guess a set of paths of values for old entrepreneurs and workers

$$\mathbf{V}^0 \equiv \left\{ \dot{v}^{j\mathrm{III}}_{i,t+1}; \dot{u}_{i,t+1} \right\}_{t=4}^{T}$$

where the superscript 0 indicates a guess. All paths converge to 1 for a sufficiently large T.

2. Build the sequences of flows for $t = 3, \ldots, T$: The guess $\mathbf{V}^0$ yields real profits $\frac{\dot{\pi}^j_{i,t}}{\dot{P}_{i,t}}$ using (C.1) and flows $\varsigma^{j\mathrm{II}}_{i,t}$ using (C.7). Then, (C.2) gives $\dot{v}^{j\mathrm{II}}_{i,t}$ which gives $\varsigma^{j\mathrm{I}}_{i,t}$ based on (C.8). Thus, (C.3) gives $\dot{v}^{j\mathrm{I}}_{i,t}$ resulting in the entry shares $\psi^j_{i,t}$ based on (C.9).

3. Build the migration shares $\mu_{in,t}$ from (C.11), and the talent cutoffs $\dot{\underline{\phi}}^j_{i,t}$ using (C.12).

4. Compute the measures of workers $L_{i,t+1}$ using , the measure of III entrepreneurs $E^{j\text{III}}_{i,t+1}$ from (14) the measure of II and the measure of I entrepreneurs from (18).

5. Solve for temporary equilibrium for each $t \geq 4$

   (a) Guess wages $\dot{w}_{i,t+1}$

   (b) Compute $\dot{K}^j_{i,t+1}$ and using (C.19)

   (c) Compute $\dot{x}^j_{i,t}$ using (C.21)

   (d) Compute $\dot{P}^j_{i,t+1}$ using (C.18), $\dot{\lambda}^j_{i,t+1}$ using (C.22)

   (e) Compute $\Pi_{i,t+1}$ using (C.24).

   (f) Compute new pre-tax profits using (C.23).

   (g) Solve for new wages using market clearing condition (C.25).

   (h) Update wages until convergence.

6. Update $\mathbf{V}$ using (C.1) and (C.5) until convergence.

D Hat Algebra

I use the usual hat notation $\widehat{x} = \frac{x'}{x}$ where x' represents a variable in a counterfactual economy and x represents the same variable in the baseline economy. I can derive the following conditions similar to the algebra in 1.

Value functions

$$\widehat{v}^{jIII}_{i,t} = \frac{(1-{\tau'}^{III}_{i,t})}{(1-\tau^{rom3}_{i,t})}\frac{\widehat{\pi}^{j}_{i,t}}{\widehat{P}_{i,t}}\left[\varsigma^{jIII}_{i,t}\left(\widehat{v}^{jIII}_{i,t+1}\right)^{\frac{\beta}{\chi}} + (1-\varsigma^{jIII}_{i,t})\widehat{u}^{\frac{\beta}{\chi}}_{i,t+1}\right]^{\chi} \tag{D.1}$$

$$\widehat{v}^{jII}_{i,t} = \frac{(1-{\tau'}^{II}_{i,t})}{(1-\tau^{II}_{i,t})}\frac{\widehat{\pi}^{j}_{i,t}}{\widehat{P}_{i,t}}\left[\varsigma^{jII}_{i,t}\left(\widehat{v}^{jIII}_{i,t+1}\right)^{\frac{\beta}{\chi}} + (1-\varsigma^{jII}_{i,t})\widehat{u}^{\frac{\beta}{\chi}}_{i,t+1}\right]^{\chi} \tag{D.2}$$

$$\widehat{v}^{jI}_{i,t} = \frac{(1-{\tau'}_{i,t}I)}{(1-\tau_{i,t}I)}\frac{\widehat{\pi}^{j}_{i,t}}{\widehat{P}_{i,t}}\left[\varsigma^{jI}_{i,t}\left(\widehat{v}^{jII}_{i,t+1}\right)^{\frac{\beta}{\chi}} + (1-\varsigma^{jI}_{i,t})\widehat{u}^{\frac{\beta}{\chi}}_{i,t+1}\right]^{\chi} \tag{D.3}$$

$$\widehat{v}^{j\mathrm{O}}_{i,t} = \left[\sum_{n=1}^{N}\psi^{j}_{n,t}(\widehat{v}^{jI}_{n,t+1})^{\frac{\beta}{\chi}}\right]^{\chi} \tag{D.4}$$

$$\widehat{u}_{i,t} = \frac{\widehat{w}_{i,t}}{\widehat{P}_{i,t}}\left[\sum_{n=1}^{N}\mu_{in,t}\widehat{m}^{\frac{-1}{\nu}}_{in,t}\widehat{u}^{\frac{\beta}{\nu}}_{n,t+1}\right]^{\nu} \tag{D.5}$$

$$\widehat{\varsigma}^{jIII}_{i,t} = \frac{\left(\widehat{v}^{jIII}_{i,t+1}\right)^{\frac{\beta}{\chi}}}{\varsigma^{jIII}_{i,t}\left(\widehat{v}^{jIII}_{i,t+1}\right)^{\frac{\beta}{\chi}} + (1-\varsigma^{jIII}_{i,t})\widehat{u}^{\frac{\beta}{\chi}}_{i,t+1}} \tag{D.6}$$

$$\widehat{\varsigma}^{jII}_{i,t} = \frac{\left(\widehat{v}^{jIII}_{i,t+1}\right)^{\frac{\beta}{\chi}}}{\varsigma^{jII}_{i,t}\left(\widehat{v}^{jIII}_{i,t+1}\right)^{\frac{\beta}{\chi}} + (1-\varsigma^{jII}_{i,t})\widehat{u}^{\frac{\beta}{\chi}}_{i,t+1}} \tag{D.7}$$

$$\widehat{\varsigma}^{jI}_{i,t} = \frac{\left(\widehat{v}^{jII}_{i,t+1}\right)^{\frac{\beta}{\chi}}}{\varsigma^{jI}_{i,t}\left(\widehat{v}^{jII}_{i,t+1}\right)^{\frac{\beta}{\chi}} + (1-\varsigma^{jI}_{i,t})\widehat{u}^{\frac{\beta}{\chi}}_{i,t+1}} \tag{D.8}$$

$$\widehat{\psi}^{j}_{i,t} = \frac{\widehat{f}^{j}_{i,t+1}\left(\widehat{v}^{jI}_{i,t+1}\right)^{\frac{\beta}{\chi}}}{\sum_{n=1}^{N}\widehat{f}^{j}_{n,t+1}\left(\widehat{v}^{jI}_{n,t+1}\right)^{\frac{\beta}{\chi}}\psi^{j}_{n,t}} \tag{D.9}$$

$$\widehat{\Psi}^{j}_{t} = \frac{\left(\widehat{v}^{j\mathrm{O}}_{t+1}\right)^{\beta/\eta_S}}{\sum_k \Psi^{k}_{t}\left(\widehat{v}_{t+1}\right)^{\beta/\eta_S}} \tag{D.10}$$

$$\widehat{\mu}_{in,t} = \frac{\widehat{m}^{\frac{-1}{\nu}}_{in,t}(\widehat{u}_{n,t+1})^{\frac{\beta}{\nu}}}{\sum_{c=1}^{N}\mu_{ic,t}\widehat{m}^{\frac{-1}{\nu}}_{ic,t}\left(\widehat{u}_{c,t+1}\right)^{\frac{\beta}{\nu}}} \tag{D.11}$$

Law of motions

$$(\widehat{\underline{\phi}}_{i,t})^{\beta} = \left[\sum_{n=1}^{N} \widehat{m}_{in,t}^{\frac{-1}{\nu}} \mu_{in,t} (\widehat{u}_{n,t+1})^{\beta/\nu}\right]^{\nu} \left[\sum_{j=1}^{J} \Psi_t^j \left(\sum_{n} \psi_{n,t+1}^j \left(\widehat{v}_{n,t+2}^{jI}\right)^{\frac{\beta}{\chi}}\right)^{\frac{\beta}{\eta_S}\chi}\right]^{-\eta_S}$$

$$L'_{i,t+1} = \sum_{n=1}^{N} \widehat{\mu}_{ni,t} \mu_{ni,t} \left(1 - \left(1 - \exp\left(-\widehat{\underline{\phi}}_{i,t} \underline{\phi}_{i,t}\right)^{-\vartheta}\right) \iota\right) \widehat{L}_{n,t} L_{n,t} + \sum_{s \in \{I,II,III\}} \sum_{j=1}^{J} (1 - \widehat{\varsigma}_{i,t}^{js} \varsigma_{i,t}^{js}) \widehat{E}_{i,t}^{js} E_{i,t}^{js}$$

$$E'^{jIII}_{i,t+1} = \widehat{\varsigma}_{i,t}^{jIII} \varsigma_{i,t}^{jIII} \widehat{E}_{i,t}^{jIII} E_{i,t}^{jIII} + \widehat{\varsigma}_{i,t}^{jII} \varsigma_{i,t}^{jII} \widehat{E}_{i,t}^{jII} E_{i,t}^{jII}$$

$$E'^{jII}_{i,t+1} = \widehat{\varsigma}_{i,t}^{jI} \varsigma_{i,t}^{jI} \widehat{E}_{i,t}^{jI} E_{i,t}^{jI}$$

$$E'^{jI}_{i,t+1} = \widehat{\psi}_{i,t}^{j} \psi_{i,t}^{j} \sum_{n=1}^{N} \widehat{\Psi}_t^j \Psi_t^j \left(1 - \exp\left(-\widehat{\underline{\phi}}_{i,t} \underline{\phi}_{i,t}\right)^{-\vartheta}\right) \iota \widehat{L}_{i,t} L_{i,t}$$

$$K'_{i,t+1} = \beta \left(\frac{\sum_j \frac{1-\xi^j}{\xi^j} \widehat{w}_{i,t} \widehat{L}_{i,t}^j w_{i,t} L_{i,t}^j}{\widehat{K}_{i,t} K_{i,t} \widehat{P}_{i,t} P_{i,t}} + (1-\delta)\right) \widehat{K}_{i,t} K_{i,t}$$

Temporary equilibrium

$$\widehat{P}_{i,t}^j = \left(\sum_n \lambda_{ni,t}^j \widehat{E}_{n,t}^j (\widehat{p}_{ni,t}^j)^{1-\sigma}\right)^{1/(1-\sigma)} \tag{D.12}$$

$$\widehat{p}_{ni,t}^j = \widehat{x}_{n,t}^j = (\widehat{w}_{n,t})^{\xi^j} (\widehat{q}_{n,t})^{1-\xi^j} \tag{D.13}$$

$$\widehat{q}_{i,t} = \widehat{w}_{i,t} \frac{\widehat{L}_{i,t}}{\widehat{K}_{i,t}} \tag{D.14}$$

$$\widehat{\lambda}_{in,t}^j = \widehat{E}_{i,t}^j (\widehat{x}_{i,t}^j)^{1-\sigma} (\widehat{P}_{n,t}^j)^{\sigma-1} \tag{D.15}$$

$$\pi'^{j}_{i,t} = \frac{1}{\sigma} \sum_{n=1}^{N} \frac{\lambda_{in,t}^j}{E_{i,t}^j} \left(\frac{\widehat{p}_{in,t}^j}{\widehat{P}_{n,t}^j}\right)^{1-\sigma} \alpha^j I'_{n,t} \tag{D.16}$$

$$I'_{i,t} = \widehat{w}_{i,t} w_{i,t} \widehat{L}_{i,t} L_{i,t} + \widehat{q}_{i,t} q_{i,t} \widehat{K}_{i,t} K_{i,t} + \sum_{j=1}^{J} \widehat{E}_{i,t}^j E_{i,t}^j \widehat{\pi}_{i,t}^j \pi_{i,t}^j \tag{D.17}$$

$$\widehat{w}_{i,t} \widehat{L}_{i,t}^j w_{i,t} L_{i,t}^j = \xi^j \frac{\sigma - 1}{\sigma} \sum_{n=1}^{N} \lambda_{in,t}^j \widehat{\lambda}_{in,t}^j X'^{j}_{n,t} \tag{D.18}$$

E Estimation appendix

E.1 Identifying the spatial variation in HoKhau-related costs

This subsection first discusses the challenge of using a simple difference-in-difference strategy with a dummy for destination A^* and Post 2005 and how heterogeneous effects driven by different origins complicate the estimates. It then specifies different specifications that overcome this challenge to complement the simple approach described in subsection 5.2 that led to Figure 7.

The aim is to uncover the estimand $\Delta_L = \mathbb{E}[\Delta_{,A^*} - \Delta_{,R}]$, multiplied by $-1/\nu$, which represents the expected spatial variation in migration costs between A^* provinces and the rest of Vietnam R using the timing and spatial variation of the Ho Khau policy. Consider the following DiD design:

$$y_{ab,t} = \gamma \mathbf{1}(b \in A^*, t > 2005) + \xi_{ab} + \theta_t + \varepsilon_{ab,t}, \tag{E.1}$$

where $y_{ab,t}$ is the Head Ries index for locations a and b defined in subsection 5.2, the dummy $\mathbf{1}(b \in A^*, t > 2005)$ is equal to 1 if destination b is an A^* province and year t is larger than 2005. Based on (**??**), the DiD estimator is related to changes in Ho Khau costs in the following way

$$\widehat{\gamma} = -\frac{1}{\nu}\frac{1}{N}\sum_{i=1}^{N}\left(\Delta_{iA^*} - \Delta_{iR} + \Delta_{A^*i} - \Delta_{Ri}\right).$$

To identify the object of interest $\frac{1}{N}\sum_{i=1}^{N}\left(\Delta_{iA^*} - \Delta_{iR}\right)$, I need to assume that

$$\frac{1}{N}\sum_{i=1}^{N}\left(\Delta_{A^*i} - \Delta_{Ri}\right) = 0. \tag{E.2}$$

Column (1) of Table A5 reports the result of this regression. Both estimates $\widehat{\gamma}$ in 2009 and the long-run effect in 2019 are positive and imprecisely estimated. In other words, Δ_L is not identified. I argue next that heterogeneous effects lead to this imprecise estimate. Let's examine how realistic the identification assumption (E.2) is by considering two cases of i.

Case 1: $i \in A^*$. Assumption (E.2) implies no difference between the growth in migration costs between A^*-to-A^* and R-to-A^*. Since the Ho Khau policy applies similarly regardless of migrant's origins, this assumption should hold regardless of i is A^* or R.

However, the Ho Khau policy change is not the only change over this period that could alter migration costs. Hence, we need to consider whether other time-varying variables in practice can violate our assumption. I believe this assumption is likely to hold because other time-varying factors affecting migration costs, such as road networks, favor A^* destinations equally.

To isolate the case, I run the following regression

$$y_{ab,t} = \gamma \mathbf{1}(a \in A^*, b \in A^*) \times \mathbf{1}(t > 2005) + \xi_{ab} + \theta_t + \varepsilon_{ab,t} \tag{E.3}$$

Table A5: Estimation of spatial variation in Ho Khau cost

Dependent variable:	log(Head Ries Index)			
	-$A*$, -R	A^*A^*, A^*R	A^*A^*, RR	DiDiDiD
	(1)	(2)	(3)	(4)
γ_{2009}	0.14	-0.77***	-0.55**	
	(0.18)	(0.14)	(0.27)	
γ_{2019}	0.08	-0.83***	-0.55*	
	(0.23)	(0.15)	(0.28)	
$\mathbf{1}(i \in A^*, n \in A^*, t > 2005)$				-0.94**
				(0.37)
# Origin-Destination	1,573	329	1,274	1,530
Standard-Errors		Destination		Origin-Destination
Observations	3,519	744	2,841	2,261
R^2	0.92	0.97	0.89	0.97
Origin-Destination fixed effects	✓	✓	✓	✓
Year fixed effects (3)	✓	✓	✓	
Destination-Year fixed effects (116)				✓
Origin-Year fixed effects (116)				✓

Source: Household and Population Census 1999, 2009, 2019.
Notes: The table shows different regression specifications to identify the spatial variation in Ho Khau cost after the reform in 2005. The column name corresponds to the treatment and control flows. For instance, column (1) compares flows to R and A^* provinces, and column (2) uses flows between A^*-A^* as treatment and R-A^* as control. The Standard-Errors row shows the level of clustering of the standard errors.

where

$$\mathbf{1}(a \in A^*, b \in A^*) = \begin{cases} 1 \text{ if } a \in A^*, b \in A^* \\ 0 \text{ if } a \in A^*, b \in R \end{cases}$$

Column (2) of Table A5 reports estimates $\widehat{\gamma}$ for the short-run and long-run effects. Both estimates are negative and statistically significant which are consistent with the hypothesis that the Ho Khau reform reduces migration costs on average.

Case 2: $i \in R$ In this case, for condition (E.2) to hold, I need the growth in migration costs between A^*-to-R and R-to-R to be equal. This assumption is more problematic than the first case. If, in addition to the Ho Khau policy, other policies promote connectivity between A^*-to-R more than R-to-R (such as road networks that tend to connect A^*-R more than R-R), we could get

$$\Delta^{U,R} - \Delta^{R,R} < 0,$$

resulting in a positive estimate for $\widehat{\gamma}$.

Why do cases 1 and 2 not cancel each other when running the regression in equation (E.1)? The reason is that there are significantly more R than A^* areas in the sample (with only 5 A^* areas), so the Δ_{A^*i} terms for $i \in R$ will dominate the Δ_{Ri} terms for $i \in A^*$. As a result, when combining cases 1 and 2, case 2 dominates on average.

Thus, identification would require another level of variation at the origin, where I argue that A^* origins would respond stronger to the policy changes than R origins. The fact that the policy drops many requirements over this period should encourage migration from R to A^* as seen in Figure 4b. Despite a relatively larger cost after the policy change between R and A^*, this cost may not deter the incentives to move from R origins as much as A^* origins who already enjoy many amenities of the A^* areas. Thus, this intuition suggests a triple difference-in-difference design:

$$y_{in,t} = \gamma \mathbf{1}(i \in A^*, n \in A^*, t > 2005) + \alpha_{in} + \theta_{i,t} + \varphi_{n,t} + \varepsilon_{in,t}$$

where the dummy $\mathbf{1}(i \in A^*, n \in A^*, t > 2005)$ is equal to 1 if origin i is an A^*, destination n is an $A*$, and year t is after 2005, and $y_{in,t}$ is the HR index of in. I include the full set of fixed effects including the origin-destination $\alpha^{i,n}$, origin-year θ_t^i and destination-year φ_t^c fixed effects. Standard errors are clustered at the origin-destination levels. I only use the 1999 and 2009 censuses for this regression to avoid future changes in migration costs that are unrelated to the Ho Khau reform.

The identification assumption for γ follows from Olden and Møen (2022). That is, the differential in the HR index of A^* and A^* versus R and A^* trends similarly to the differential in the HR index of A^* to R and R to R group A and group B in the absence of the policy change. So if the road network is improved between A^* to R, then this assumption only requires that the road improvement between A^* to R does not change the gap A^*-R and A^*-A^* versus A^*-R and R-R.

Column (4) of Table A5 reports the result where $\widehat{\gamma} = -\frac{1}{\nu}\widehat{\Delta}_L = -0.94$ with standard error of 0.34. This estimate is similar to the simple comparison in means of the HR distributions in Figure 7. In fact, the comparison between two means is akin to running a regression of the type (E.3) and using the flows RR as the control instead of A^*R. Column (3) of Table A5 reports the result of such regression and shows that the difference in means is around -0.55 and statistically different.

In sum, according to Figure 7 and the current results, I estimate the migration cost change between a counterfactual world, prime notation, and the actual economy (with Ho Khau reform or a reduction in migration cost) as

$$mpol'_{in,t} - mpol_{in,t} = \Delta'_{in} - \Delta_{in} = 0 - (0.659 * \nu/(-2)), \forall i \neq n, n \notin A^*, t \geq 2005,$$

and

$$mpol'_{in,t} - mpol_{in,t} = \Delta'_{i,n} - \Delta_{i,n} = 0 - (0.002 * \nu/(-2)), \forall n \in A^*.$$

E.2 Distance elasticity

Figure A8: Estimates of distance elasticities $(1 - \sigma)\kappa^j$

Notes: Inter-provincial trade flows data come from JICA (2000). Standard errors are clustered at the origin-destination level.