Essays in Public Economics

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Abstract

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Studying how firms and individuals respond to tax policy changes is key to assess their trade-off between equity and efficiency. Among individuals, taxpayers at the top of the income distribution have received special attention in the Public Economics literature. Progressive tax systems disproportionately rely on high income individuals to raise revenues, making them susceptible to strategies adopted by these taxpayers to reduce their tax liability. In the first two chapters of this dissertation, I provide new empirical evidence on the characteristics of high income individuals that can inform the design of tax policies. Chapter 1, focusing on the UK, shows that migrants have become more prevalent among high income individuals, thus altering the composition of individuals in the top 1 percent. Chapter 2, focusing on Italy, provides evidence of long term persistence in economic status among present-day descendants of noble dynasties. These chapters shed light on the characteristics of high income taxpayers and their path to the top of the distribution in these two countries. Understanding the composition of individuals at the top of the income distribution is key for analyzing their response to tax policies and for informing the trade-off between equity and efficiency.

Firms too are a central part of the tax system of developed countries. They remit payment of the vast majority of government revenues, either fulfilling their own tax liabilities or on behalf of third parties. As a result, governments implement enforcement strategies to reduce evasion while minimizing their costs. In Chapter 3, I analyze one of these gov-

ernment interventions aimed at curbing tax evasion of Value Added Tax (VAT) in Italy and I provide evidence on a new margin of response adopted by businesses. As the government shifted the responsibility to remit VAT from the seller to the buyer for a subset of transactions in the economy, it altered the distribution of costs between the two sides of the transaction. I show that smaller firms face the largest increase in costs and, thus, exhibit higher exit rates, leading to higher market concentration.

Chapter 1, which is joint work with Arun Advani, Felix Koenig, and Andy Summers, studies the contribution of migrants to the rise in UK top incomes. Using administrative data on the universe of UK taxpayers we show that migrants are over-represented at the top of the income distribution, with migrants twice as prevalent in the top 0.1 percent as anywhere in the bottom 97 percent. These high incomes are predominantly from labor, rather than capital, and migrants are concentrated in only a handful of industries, predominantly finance. Finally, we calculate the contribution of migrants and natives to the observed growth in the UK top 1 percent income share over the past 20 years. We find that almost all (92 percent) of the observed growth can be attributed to migration.

Chapter 2 documents that present-day descendants of aristocratic dynasties enjoy high economic status in Italy, several decades or centuries after their ancestors received a title. Over this period of time, Italy experienced wars, annexations, political reforms, and a structural transformation of the economy. Yet, the income distribution of noble taxpayers living in Milan in 2005 is shifted to the right relative to the one of all other taxpayers. On average, noble descendants obtain €41,125 (or 1.77 times) more, controlling for observables. Moreover, aristocrats are three times more likely to be involved in firms, either as shareholders or company officials.

Chapter 3 analyzes how firms and markets adapt to a reform of the collection of Value Added Tax (VAT), combining a new administrative dataset on firm-to-firm links from Italy and a quasi-experimental research design. The reform shifted the responsibility to remit

payments of VAT from sellers to “trusted" buyers, such as government entities and large firms. I present three main findings. First, firm-to-firm links subject to the new rules are more likely to become inactive after the introduction of the new rules. Second, I find that the reform was costly for the average firm. Firms more exposed to the reform experienced lower sales and higher exit rates, relative to the counterfactual. Third, I document that the burden of the reform was not evenly distributed across firms. Small firms were hit hardest, while large firms did not appear to be negatively affected. As a result, I show that markets more exposed to the reform became more concentrated.

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Dedication

To my father.

Chapter 1: Importing Inequality: Immigration and the Top 1 percent

The dynamics of top incomes are important for our understanding of entrepreneurship and innovation, growth, aggregate demand and savings, and the effects of taxation.[1] Identifying the sources of growth in top incomes is necessary to interpret the underlying mechanisms, and determine what policy responses are appropriate, if any. Recent work has studied the source of these incomes and the characteristics of those who receive them (Bell and Van Reenen, 2014; Piketty, Saez and Zucman, 2018; Smith et al., 2019*a*; Advani and Summers, 2020). However, prior work was unable to distinguish between natives and migrants—a distinction we will show is essential for understanding changes in the top 1% income share in the UK. In particular, we find that migration accounts for the vast majority of the growth in UK top 1% income share in the past 20 years.

We make use of confidential, anonymised data on the universe of taxpayers in the UK, from 1997 to 2018, to study the role that immigration plays at the top of the income distribution. We exploit the process by which National Insurance Numbers (NINOs) – the UK's Social Security Numbers – are assigned to identify migrants arriving since the Second World War, and in more recent years cross-check this with administrative microdata on migrant workers. We use this to examine the rise in top income migrants, their sources of income and their contribution to measured growth in the top income share.

[1] See for example Gabaix et al. (2016); Jones and Kim (2018); Aghion et al. (2019); Bell et al. (2019); Lansing and Markiewicz (2018); Jones (2019); Auclert and Rognlie (2017, 2018); Straub (2019); Roine, Vlachos and Waldenström (2009); Aoki and Nirei (2017); Rubolino and Waldenström (2020).

In surveying the literature on the importance of high-skilled migration for innovation, entrepreneurship and growth, Kerr et al. (2017) highlight that 'a key objective that research should address over the next decade [is] to trace out how high-skilled migration impacts inequality within and across countries.' Saez and Veall (2005) suggest that rising top incomes in Canada are driven by changes in US top taxes and a consequent threat of emigration from Canada to the US; Atkinson and Leigh (2008) show a similar effect in New Zealand. These studies point to a potential impact of migration on inequality in the origin country. But little is known about how high-skilled migration affects inequality in the receiving country. Our work provides the first exploration of this relationship. We present three main results.

First, migrants are very prevalent at the top of the UK income distribution. Although much of the political and public discussion around migration focuses on low-skilled migrants, we show the share of migrants in the top 1% (0.01%) is 1.4× (2.2×) the share in the bottom 10%. This share has grown rapidly over the past two decades, rising by 50% for the share of migrants in the top 1%, and more than doubling for those in the top 0.01%.

The economic literature has advanced numerous explanations for rising top income shares, including tax policy (Roine, Vlachos and Waldenström, 2009; Alvaredo et al., 2013; Piketty and Saez, 2013), the degree of labour and product market regulation (Piketty and Saez, 2006; Bivens and Mishel, 2013; Saez, 2019), technological change (Autor, Katz and Kearney, 2006, 2008; Koenig, 2019), and performance pay for CEOs (Gabaix and Landier, 2008; Lemieux, MacLeod and Parent, 2009). These explanations share a common feature: they explore the effects of a changing economy on a *fixed* population. Thus far they omit the striking global growth of high-skilled migration, which 'rose by nearly 130% from 1990 to 2010' (Kerr et al., 2016). Migration and migration policy are therefore likely to be a crucial part of understanding changes to top income shares, not only in the UK but globally.

Second, we show that – as in the US (Smith et al., 2019*a*) – growth in UK top incomes has been driven by rising income from human capital. The UK has been the destination of choice for many high profile migrants, including high wealth individuals such as Lakshmi Mittal and Roman Abramovich. It is natural to wonder whether the incomes of top migrants are driven by investment rather than labour income. We find the share of earned income going to top migrants has doubled over the past twenty years, while there has been no change in the share of investment income they receive.

The rise of the financal sector in the UK has been a key contributor to the increase in the share of top incomes coming from labour (Bell and Van Reenen, 2014), and this is true for migrants as well: 47% of top income to migrants comes from finance. Similar to 'tech' in the US – which also has a large migrant share – these jobs are concentrated in particular locations, suggesting agglomeration externalities (Devereux, Griffith and Simpson, 2007; Brülhart, Jametti and Schmidheiny, 2012; Kerr et al., 2017). These location-specific productivity effects potentially serve not only as a magnet to top earning immigrants but may also dampen the returns to tax-induced emigration (Kleven et al., 2019).

In contrast to the US (Kerr et al., 2017), most migrants to the UK do not arrive as students or even immediately after university. Rather they are predominantly middle-aged individuals who migrate straight into a high-paying job, echoing findings by Azoulay et al. (2020) on the (middle) age of entrepreneurs. Despite this, they are significantly younger than top income natives: the median migrant joining the top 1% is 42 years old, compared with 47 for the median native. They are also highly paid relative to natives in the same industry. This suggests migrants are positively selected on earnings ability. Once in the top 1%, they are also no less likely to stay there than natives, up to two decades later.

Finally, we show that 92% of the rise in the top 1% share over the past two decades is contributed by migrants: the UK appears to be *importing inequality*. This comes from an accounting decomposition, in the manner of growth accounting; it is not intended to quan-

tify a causal estimate of the impact of migrants. Nevertheless it is an important stylised fact that quantitative models of top income shares, described earlier, need to account for: much of the growth in income concentration comes not from a reallocation of resources within a fixed population, but from a change in the underlying population. Our migration-adjusted top income shares narrow the gap in inequality between the UK and continental Europe to around 2 percentage points (pp), roughly half of the existing difference.

This result also provides a new lens on the debate concerning international comparisons of top share inequality. Top income shares have risen substantially in English-speaking countries (US, UK, Australia, Canada) over the past decades, while the rise has been more modest in continental Europe and in Japan (Atkinson, Piketty and Saez, 2011). Over the same period, English-speaking countries have attracted a large influx of high-skilled migrants. Kerr et al. (2016) report that the US, UK, Australia, and Canada alone received nearly 70% of high-skilled foreigners who migrated to OECD countries in 2010. Migration is therefore an important channel in explaining cross-country differences. Where tax and regulatory policy drive differences in top shares, this is not only because of changes *within* individual economies. Instead these differences also lead to a reallocation of human capital across countries, moving high earners and hence affecting national measures of top share inequality in both sending and receiving countries.

The remainder of the paper is organised as follows. Section 1.1 describes our data sources, including our novel approach to identifying migrants in the administrative data. Section 1.2 examines the prevalence and rise of top income migrants in the UK. Section 1.3 documents migrants' sources of incomes, and their characteristics. Section 1.4 decomposes top share growth in the UK over the past two decades, to quantify the proportion attributable to migrants. Section 1.5 concludes.

1.1 Data and Measurement

We use administrative tax data from the UK tax authority (HMRC) to measure top incomes and identify migrants and natives resident in the UK. We observe the universe of personal tax returns filed for tax years 1997 to 2018.[2] The tax unit is an individual.

Around one third of all UK taxpayers are required to file a tax return; this includes anyone with taxable income that has not already been subject to withholding tax, plus all individuals with total income above a nominal filing threshold, regardless of their income source.[3] We supplement our tax return data using data from HMRC's 'Pay-As-You-Earn' (PAYE) system. This system covers all income tax payers who did not file a tax return (as well as many who did file a return).[4] By combining the data from tax returns and PAYE records, we obtain full coverage of the universe of UK taxpayers.

To calculate top income shares based on the total adult population (given that not all adults are taxpayers), we apply external control totals for population and income. We use the same data sources and approach outlined in Alvaredo (2017), as currently used for the UK fiscal income series of the World Inequality Database (WID). We depart slightly from the current WID UK methodology in that we define 'adult' as an individual aged 18+ (instead of 15+ as used in WID). This is for consistency with our definition of a migrant, as we describe in Section 1.1.2.

[2]The UK tax year runs from April to April. In line with HMRC practice, we cite the latter year, so the tax year 2017-18 is given as 2018.

[3]Since 2005, the filing threshold has been fixed at £100,000; for the earlier period 1997-2004, the filing threshold tracked the top income tax threshold (between £29,265 to £35,115).

[4]For years 2015-2018 we use the universe of PAYE tax records; for 2000-2014 we use a 10 per cent random sample and apply weights to estimate the full PAYE population. For 1997-1999 PAYE data is unavailable; however in these years the threshold for filing a tax return was much lower than the top 1 per cent threshold and our results using tax return data alone closely match HMRC estimates for the entire taxpayer population within this income range.

1.1.1 Measuring Incomes

We measure pre-tax *fiscal* income, meaning all income that is assessable for income tax, prior to the deduction of income tax and National Insurance Contributions (NICs) levied at the personal level. We classify income into two main categories. 'Earned income' includes income from employment, self-employment and partnership activities, as well as pension income in retirement. 'Investment income' includes interest from savings, dividends, rents from property and all other taxable income from investments.[5] Our definition of income, and sub-division into earned and investment income, exactly replicates the definitions used in HMRC's Survey of Personal Incomes (SPI), which is the standard data source for top income statistics in the UK (Atkinson, 2007, 2014; Alvaredo, 2017).

Our definition of fiscal income excludes realised capital gains because these are not assessable for income tax. This is standard in the current UK inequality literature (Atkinson, 2007, 2014; Alvaredo et al., 2018; Burkhauser et al., 2018), and Piketty and Saez (2003) in the US. Recent work investigates the impact of capital gains on UK top shares and documents that some gains reflect repackaged income (Advani and Summers, 2020). However, here we follow the established approach to UK income measurement in order to focus our analysis on the role of migration, rather than making simultaneous innovations to the income definition.

In line with the literature, our income measure focuses on taxable income, so misses tax avoidance and evasion. One particular feature of the UK tax code effectively exempts foreign investment incomes from taxes if the taxpayer has a foreign 'domicile' i.e. the taxpayer declares their permanent home is abroad. 'Non-dom' status and offshore tax op-

[5] Although the categories of earned and investment income broadly map the economic distinction between labour and capital income, this distinction is blurred for some individuals. In the UK, like the US, there is a significant tax incentive for active owner-managers to repackage their labour income in form of dividends (Miller, Pope and Smith, 2019; Smith et al., 2019*a*). In this respect, our measure of earned income is likely to underestimate the labour share of total income in economic terms.

timisation are both likely to be more common among internationally-mobile individuals. Our income measure thus is a conservative estimate of the true position of migrants at the top of the income distribution. However, our income definition is the standard one used for top income statistics and thus allows us to accurately quantify the contribution of migrants to these headline figures.

1.1.2 Measuring Migrants

We define a 'migrant' as an individual who migrated to the UK after the age of 18. Identifying the migrant status of top earners is challenging in most countries because although administrative tax data provide excellent coverage of top incomes, they contain limited demographic information about taxpayers because these characteristics are typically not relevant for tax purposes. For example, the standard form used to file annual personal income tax in the US (IRS form 1040) is used by American citizens and foreigners ('resident aliens') alike and does not require disclosure of citizenship or migration status.

To build our migrant indicator, we exploit the structure of National Insurance Numbers (NINOs), which are issued to UK residents for social security purposes and are also used by HMRC as the primary unique taxpayer identifier. NINOs all have the following structure:

$$\underbrace{AB}_{\substack{\text{sequential}\\ \text{prefix}}} - 123456 - C$$

The two-letter 'NINO prefix' corresponds with a date range when the NINO was originally assigned. Once a NINO has been assigned to an individual, it is never reused. We use archival records to build a novel crosswalk from NINO prefixes to assignment dates covering the entire history of the National Insurance system since NINOs were introduced

in 1947.[6] This allows us to identify, for anyone born after 1930 (age 67 in the first year of our sample), the year when their NINO was assigned.[7]

Children who live in the UK are automatically assigned a NINO at age 16. The exact process of assignment has changed over time but has always been at this age.[8] A migrant who arrives in the UK after age 16 is required to apply for a NINO through the adult registration process. A NINO is required by law for any individual liable to pay National Insurance Contributions, which includes anyone working in the UK with earned income from any source; it is also required to claim benefits. A NINO is also required to file a tax return, other than in exceptional circumstances.

We determine an individual's migrant status by comparing the year when their NINO was assigned with their year of birth. We define a migrant as someone who was assigned their NINO after the age of 18. Since this leaves a clear gap between our age threshold and the age at which automatic assignment to natives occurs (age 16), it also guards against the risk of false positives for migrant status. It also means we can identify all adult migrants to the UK, without any bias from later naturalisation.

We cross-check our results on the number of migrants in several different ways. First, for individuals who arrived to the UK after 2001, we compare our results with data collected at the time of application for a NINO, available internally within HMRC. All adult registrants for a NINO must attend an in-person interview with a government employee and provide personal details. If the applicant does not have British nationality at the time of registration, this is recorded. This data source closely matches our results and gives us

[6] Bernstein et al. (2018) use a similar approach in the US to link patent records to migrants identified by Social Security Numbers.

[7] For individuals born before 1931 whose NINO was assigned in 1947 when the National Insurance system was introduced, we are unable to determine migrant status based on the NINO prefix, so these individuals are excluded from our analysis.

[8] From 1947 to 1975, it was compulsory for all UK residents to apply for a NINO by age 16 regardless of intention to work; archival records show that this requirement was strictly enforced. Since 1975, NINOs have been assigned automatically to children at age 16, based either on school registers or entitlement to (universal) child benefits.

confidence that we are correctly identifying migrants.

Second, the share of foreigners among all individuals in our dataset is close to the population-wide estimates produced by the UK Office of National Statistics (ONS). In 2017, we find that around 15.2% of all taxpayers are migrants. The ONS calculates that around 14.4% of individuals living in the UK are foreign-born, or 18.6% if considering only individuals aged 16-64 (Office for National Statistics, 2019).

Third, comparing the share of migrants across the income distribution in our data to those available in the Quarterly Labour Force Survey (QLFS) – a representative sample of the UK population from the ONS – we closely match the trends seen there (Figure A.1). Using our data we can explore further the top of the distribution, since the QLFS is censored around the 97th percentile; study the longitudinal dimension of individual's incomes; and observe the relationship between income and time since arrival in the UK.

1.1.3 Measuring Industry

To analyse the sectors in which top earning migrants work, we assign individuals to an industry based on the Standard Industrial Classification (SIC) 2007 version. For employees, PAYE (payroll) data provides the employer's SIC code. Individuals with self-employment or partnership income report their business description on the tax return, and HMRC convert these descriptions to a SIC code.

For individuals with only one source of earned income, we assign the industry associated with that source. For individuals with multiple different sources (or multiple employers), we take the SIC code associated with the single largest earned income source. We do not assign any industry to individuals with investment or pension income as their single largest source, except in the case of owner-managers of closely-held companies. We classify an individual as an owner-manager where they received dividends as their single

largest income source and reported being a director of a closely-held company, which is defined in UK tax law as a firm with five or fewer directors and/or shareholders. In this case we assign the industry of their firm.

1.2 Prevalance and rise of top migrants

1.2.1 Prevalance of migrants across the income distribution

Migrants make up 24% of individuals in the top 1% of the income distribution in 2017 (Figure **??**). This compares to just 15% across the UK population as a whole. As we show below, this pattern of concentration at the very top is observed across all years of the data.

In the popular imagination it is low-income migration that looms largest, and Figure **??** shows the migrant shares are declining gently across most of the income distribution. They reach a low between the 75th and 80th percentiles, then rise slowly up to the 90th percentile and more rapidly thereafter. The top three percentiles by share of migration are the 99th, 98th and 97th; but even among these the 99th stands out sharply at 4pp above the 98th.

This rise was previously not observable in UK data. The Quarterly Labour Force Survey data, shown in Figure A.1 and used by Dustmann, Frattini and Preston (2013) and Dustmann, Schönberg and Stuhler (2016), are censored from around the 97th percentile. This is too low to pick out the extreme rise at the top.

Within the top percentile, migrants predominantly locate at the very top, making up 29% of the top 0.1%, and 36% of the top 0.01% (Figure 1.2). This makes them twice as prevalent in the top 0.01% as anywhere in the bottom 97%. These results are a lower bound since, as described in Section 1.1, we do not observe foreign investment incomes for individuals with 'non-dom' status—almost all of whom will be migrants.[9]

[9]This untaxed foreign investment income is also missing from the fiscal income definitions typically used when measuring income top shares (Atkinson, 2002, 2007).

It is already known that the UK is an important destination for high-skilled migration (Kerr et al., 2016). What is striking is that these flows are so quantitively large, and the migrants so positively selected, that migrants make up a quarter of the top 1%, and a third of the top 0.01%. In one sense it should perhaps not be surprising: 37% of FTSE 100 chief executives, and 57% of the Sunday Times Rich List (top 100 defined on wealth not income) are foreign-born. The highest echelons of income and wealth are therefore clearly very international. Our results show that international mobility and global talent flows run far deeper, beyond the top hundreds of people down to the top hundreds of thousands of people.

1.2.2 Rise in migrants at the top

Over the past twenty years, migrants have become increasingly prevalent at the top of the income distribution in the UK. Figure 1.3a shows the rise in the proportion of migrants among individuals in various top shares. There are 52% more migrants in the top 1% in 2018 than in 1997, and more than twice as many in the top 0.01%. While this period encompasses economic expansions and recessions, it exhibits a steady increase in migrants at the top of the income distribution in the UK.

At the same time the ratio of average incomes between natives and migrants has remained roughly constant (Figure 1.3b), rising by 7% for the top 1%, and falling slightly – by 3% – for the top 0.01%. This suggests that the relative distribution of skills between natives and migrants who have come to the UK over this period has remained constant. The constant relative income of migrants during a period of sharply increasing labour supply also points towards increased demand for global talent in the UK economy. As we will show below this trend is closely linked to the continued growth of the City of London as a global financial centre.

Figure 1.4 shows the combined effect of these two trends on the share of all income at the top that goes to migrants. Driven largely by the rise in the number of top migrants, the share of top 1% (0.01%) income going to migrants rose from 16% (18%) in 1997 to 27% (36%) in 2018.

Many explanations for the dynamics of top shares implicitly assume the individuals that make up that top share are fixed (Gabaix and Landier, 2008; Autor, Katz and Kearney, 2008; Lemieux, MacLeod and Parent, 2009). We see that in fact this is not the case: the rising migrant share comes not from rising relative incomes but from a rising number of migrants joining the top.

1.3 What are migrants doing?

1.3.1 The importance of earnings

Migrants make up an increasing share of top *earnings*, but their share of investment income is unchanged. Figure 1.5 shows, separately for earnings and investment income, the cumulative growth in the share of this income going to migrants. Migrants' share of all top 1% earnings has roughly doubled since 1997. In contrast there has been no change in the share of overall investment income: interest, dividends, and rents from properties.[10]

This pattern also holds, but is more extreme further up the income distribution. The share of earnings going to migrants in the top 0.1% (0.01%) has nearly tripled (quadrupled) since 1997 (Figure A.2). Hence even at the very top, migrants are active participants in the labour force, highlighting the increasing importance of labour income at the top. In

[10]Note, as discussed in Section 1.1.2, that we find a lower bound on the investment income of migrants. Some migrants will have 'non-dom' status, so will not be taxed on, or have to report, their foreign investment income. This foreign investment income is not observable nor is it included in standard fiscal income measures, so we are consistent with previous work, but it potentially undercounts additional investment income migrants may have. The number of non-doms has risen by only around 10% over the past decade (Table A.1), so income levels per non-dom migrant would have to have grown extremely rapidly to overturn the relative pattern between earnings and investment income.

both cases investment income shares for migrants have remained flat.

The rising importance of labour income is true for natives as well. In 1997 migrants in the top 1% received 84% of their income from earnings, compared with 80% for natives. By 2017 it was 92% to 87%. In the top 0.01%, migrants (natives) have moved from 68% (54%) of income from earnings to 90% (83%). These results are notwithstanding the repackaging of some labour income into investment income (Smith et al., 2019*a*; Miller, Pope and Smith, 2019).

The picture for migrants contrasts sharply with the common image of top migrants as high wealth individuals living off the returns to wealth. While such cases clearly exist, quantitatively earnings are more important, and increasingly so at the very top.

1.3.2 The importance of finance

Having seen that top migrants rely on earnings, it is natural to ask where these come from. Table 1.1a shows – among migrants who report some income from employment, self-employment or partnerships, or who are owner-managers – the ten industries which engage the largest share of migrants who are in the top 1%.

The importance of finance is immediately clear. More than one in six top migrants work for a bank. Taking into account support to financial services, fund managers, and other smaller areas of financial activity, finance employs more than a quarter of all migrants in the top 1%. Healthcare is the second most important area: one in ten top migrants is employed in a hospital, medical practice or some other human health activity.

The concentration in finance is disproportionate. Finance is clearly an important industry in the UK, and many people working in finance have high incomes (Bell and Van Reenen, 2014). But finance is highly dependent on migrants: they make up 40% of top individuals who are employed in banks, and between 35% and 45% of top individuals in credit

bureaus, securities dealing, financial management, fund management and support to financial services (Table 1.1b).

The concentration of finance in the UK, specifically London, is crucial for understanding how responsive migrants might be to economic policy. While they have no choice but to respond to migration policies such as visa restrictions – which would clearly have implications for the financial sector – their response to taxes will depend on their outside options. Given the large agglomeration externalities present in finance, it is likely that many migrants to the UK will be less responsive to top taxes than migrants seen in other contexts (Kleven et al., 2019).

1.3.3 Local training or international poaching?

Many migrants receive incomes that put them in the top 1% immediately on arrival to the UK. One in six migrants who join the top 1% in 2017 arrived in the UK in either 2016 or 2017 (Figure 1.6).[11] A third arrived in the past five years.[12]

Many top migrants are thus 'born' at the top, not made in the UK. This contrasts with the US, where the more important route to the top for migrants is via local training at a US university and then working their way up (Kerr et al., 2017). This may partly be explained by the US' historically more restrictive visa system, which made universities an important route into the US.

This again highlights the importance of going beyond national borders in thinking about the dynamics of top incomes, to account for international poaching of top earners. Not only is there substantial entry to the top, so that the top 1% are not a fixed group,

[11] We do not know when in the tax year a migrant arrives. We therefore combine the last two arrival years, since some migrants may immediately have an annualised income that puts them in the top 1%, but we only observe part of it in the year they arrive.

[12] Of those who were already at the top before 2017, 18% arrived in the previous five years, and 35% in the past decade.

but a large portion of that entry is from individuals who were not previously *anywhere* in the UK income distribution.

1.3.4 Migrants are positively selected

Migrants reach the top at younger ages than natives, but still in middle age. The median age for a native who newly joined the 1% in 2017 was 47, and the distribution is roughly symmetric around that (Figure 1.7). For a migrant joining the 1% the median was 42, with the distribution skewed to the right. The same distinctive pattern is visible among individuals who were in the top 1% in 2016 and in 2017 (Figure A.6) and in the pooled distribution (Figure A.7).

We have already seen that migrants are increasingly represented at higher income shares, so that a migrant in the 1% on average has an 8% higher income than a native in the top 1%. Looking at age provides another way to see that migrants are positively selected. Not only are they disproportionately represented at the top of the income distribution but relative to natives at the top they are much younger.

Using a DiNardo, Fortin and Lemieux (1996*a*) decomposition, we see that migrants earn more not because they work in high paying industries, but because they are positively selected within the industry. Migrants are only slightly more likely to work in extremely high paying industries, so that industry differences explain roughly 20% of the immigrant-native wage differences at the top. The majority of income differences are driven by top income migrants earning much more than comparable natives, again highlighting that they are positively selected.

Existing studies looking at the selection of immigrants use educational qualifications to determine skills (Grogger and Hanson, 2011; Peri, 2016). However, depending where these qualifications were earned, it is not always straightforward to compare these qualifi-

cations with those of natives. Moreover, educational qualifications at the top of the income distribution are often the same and reveal little about selection. We see that on direct economic measures – income, and age given income – top migrants do better than natives.

These results also highlight that a typical top migrant is not someone leaving university in the UK and immediately getting a high-paying job in a bank. Rather they are predominantly early middle-aged individuals who migrate straight into a high-paying job, echoing findings by Azoulay et al. (2020) on the (middle) age of entrepreneurs.

1.4 Contribution of migrants to the growth in top shares

1.4.1 Constructing contribution to top

To understand the contribution of migrants to inequality, we decompose the rise in the top 1% share into the contributions of migrants and natives. This is not a causal analysis of the 'impact' of migrants, but a decomposition in the vein of growth accounting (Solow, 1957; Barro, 1999).

We calculate the contribution of migrants and natives to the growth rate in the top share from year t to year $t + N$ as:

$$\frac{S_{t+N} - S_t}{S_t} = \frac{S^m_{t+N} - S^m_t}{S_t} - \frac{S^n_{t+N} - S^n_t}{S_t}$$

where S_t is share of fiscal income going to individuals in the top percentile in year t, while S^m_t and S^n_t are the shares going to migrants and natives, respectively, in the same percentile.

1.4.2 Migrants contribute almost all of the growth in the 1%

Migrants account for a substantial fraction of the increase in top income shares in the UK. Between 1997 and 2018 incomes at the top of the distribution grew substantially faster than average incomes: the top 1% share rose 15.8% from 12.4% to 14.3%. The top 0.1% (0.01%) share rose faster, growing 35.3% (49.5%) over the period.

Using the above growth accounting framework, we find that migrants account for 92% of the growth in top 1% share from 1997 to 2018 (Figure 1.8). Out of the 15.8% increase in the top 1% share, migrants accounted for 14.5pp (92%), while natives contributed 1.3pp. Further up the distribution, migrants accounted for more than 70% of the increase in the top 0.1% and 0.01% shares. In this sense it appears that the UK is *importing inequality*.

Most of this growth comes from migrants being positively selected. Using a decomposition in the manner of DiNardo, Fortin and Lemieux (1996*a*) and Firpo, Fortin and Lemieux (2011), we examine the effect of retaining migrants, but imposing that they come from the same distribution as natives. We find that when migrants are not positively selected relative to the UK distribution, the top 1% share falls to 11.2 in 1997 and 11.9 in 2018, and growth in this share falls from 1.9pp to 0.6pp. The *positive selection* of top income migration therefore contributes two thirds of the rise in UK top 1% share over this period.

Even without reallocating these migrants into their home country income distributions, removing them from the UK reduces the top share to a level much closer to other European countries: top 1% shares for France, Italy, and Sweden hover between 8-10%.[13]

[13]One might ideally like to also 'add back' UK natives who have outmigrated. Data on these individuals are not available after migration. However, they are unlikely to substantially change the results we see here, for two reasons. First, we see that once they join the 1% natives (and migrants) rarely leave the income distribution entirely until close to retirement age, so outmigration among those with high income is low. The number of individuals who leave for study is also very low (7,000 on average over the period, varying between 5,000 and 8,000 (Office for National Statistics, 2020), around 0.01% of the population), so the departure of potential future high earners does not substantially alter the picture. Second, net overall out-

Alvaredo et al. (2013) note the different paths of top income inequality taken by English-speaking countries and other European countries. They suggest tax and labour market developments are key explanatory factors, focusing on the impact on the existing population. We highlight that international sorting is an important channel by which these factors operate (Dustmann and Preston, 2019), driving some of the international difference in top shares. The English-speaking countries Alvaredo et al. (2013) report as seeing the largest rises in inequality are the same ones Kerr et al. (2016) single out as top destinations for high-skilled migrants.

UK top share inequality over the past two decades can be divided into two distinct periods (Figure 1.9). All the increase in top income concentration took place over the first decade, up to a peak in 2007. Top shares have remained broadly flat around 14% since then, although with significant volatility. This volatility was driven by policy: a pre-announced rise in the top rate of income tax led to 'dividend forestalling', where top income individuals who were owner-managers of companies brought forward dividend payments before the tax rate increase, and later delayed dividends ahead of a pre-announced rate cut (Miller, Pope and Smith, 2019).

Over the same period, top migrant incomes have grown steadily, while top native incomes have been much more volatile. The lack of volatility partly reflects the importance of labour income for migrants: this means they did not have the opportunity to engage in the forestalling behaviour undertaken by (some) natives.

The overall top income series has broadly taken its trend from migrant incomes, and its volatility from natives. Right before the financial crisis, migrants accounted for less than half of the increase in the top 1 share from 1997. In the ten years since 2007, the

migration rates among natives have been low and stable, with around 0.1% of individuals across the entire population leaving in a given year (Office for National Statistics, 2020), so the composition of outmigrants would have had to change dramatically to change the trends we see–it is not enough for potential high earners to be disproportionately likely to migrate, but they must have become increasingly disproportionately likely to do so.

contribution of migrants continued to increase and doubled to 92%. A similar pattern is observed further up the income distribution (see Figure **??**). The rise in migrants has thus continued even while income concentration remained roughly constant.

1.5 Discussion

The evolution of top income shares are of interest to researchers, policymakers and the public at large. Most explanations for changes to these top incomes implicitly assume a fixed population whose incomes are rising, and the public discussion is conducted in the same way. In contrast, we show that the share of migrants at the top of the income distribution is large and rising. Almost all of the rise in the top 1% share over the past two decades can be attributed to migrants. Their incomes are largely from employment, focused in the finance industry.

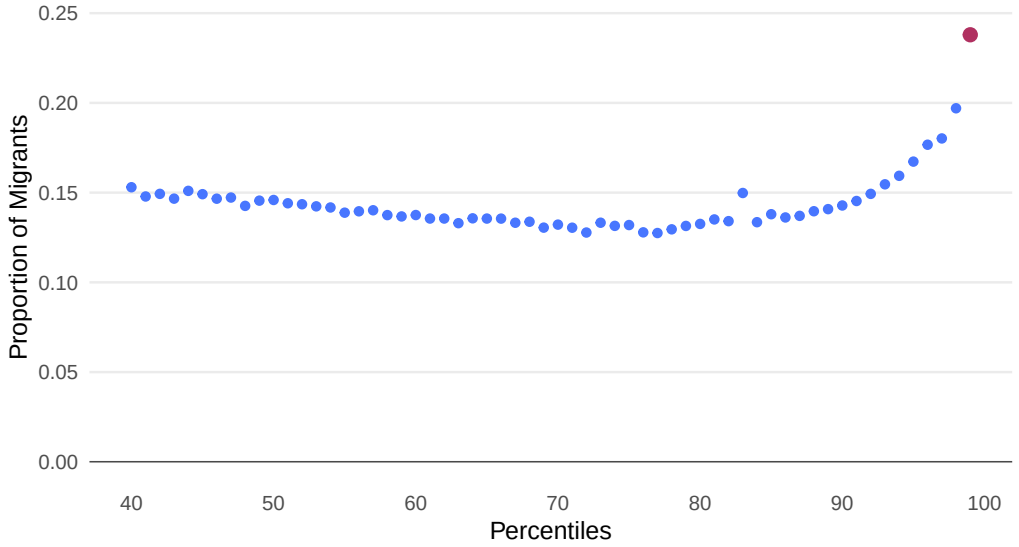
These trends in migration highlight the importance of the international allocation of talent. Particular industries, including finance and technology, are known to have strong agglomeration externalities. It is perhaps no surprise that migrants should sort internationally to where they can receive the highest returns. These migrants are also positively selected: they are younger than natives with the same incomes, and are increasingly concentrated at higher fractiles of income. Understanding what these migrants are doing, and what their alternatives are, is key to understanding how responsive they are likely to be to policy, including top tax rates.

Some industries have an extremely high concentration of migrants: they make up more than half of top earners in some parts of finance. Recent nativist policies in the US and UK, which heavily restrict visa availability, are largely premised on the idea that natives can and will fill those jobs. But the high concentrations by industry mean that, even if this were ultimately possible, transition costs from removing existing migrants are extremely

high. Political decisions about the future of the UK visa system are therefore critical in determining what happens to top incomes, and to the industries which rely on top migrants.

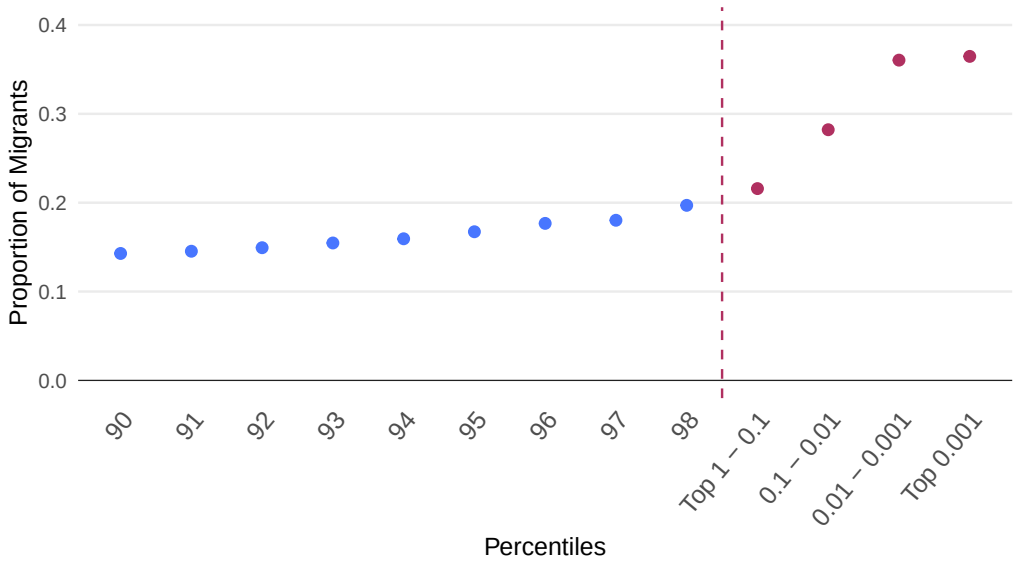
1.6 Figures and Tables

Figure 1.1: Migrants are over-represented at the top of the income distribution



Notes: The charts show the proportion of migrants among individuals located in each fractile of the (fiscal) income distribution in 2017. The figure plots the proportion for all percentiles of the income distribution above the 40th. The unit of analysis is an individual taxpayer. Percentiles of the fiscal income distribution are defined according to publicly available data from HMRC Survey of Personal Income. Income is defined as the sum of "total earned income" (TEI) and "total investment income" (TII). TEI comprises income from employment, trading income from self-employment activities, partnership income, and pensions. TII comprises income from savings and investments including interest, dividend payments, rent from properties.

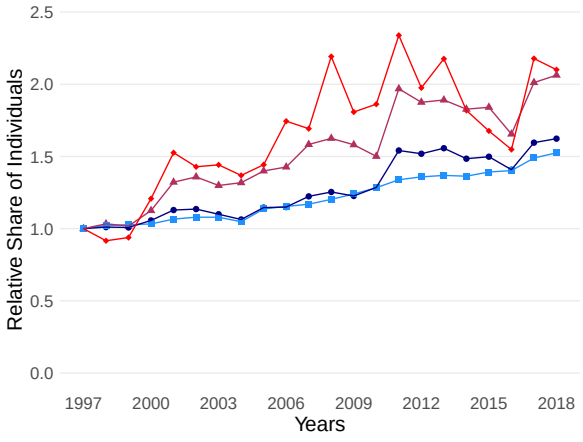
Figure 1.2: Proportion of migrants within the top decile



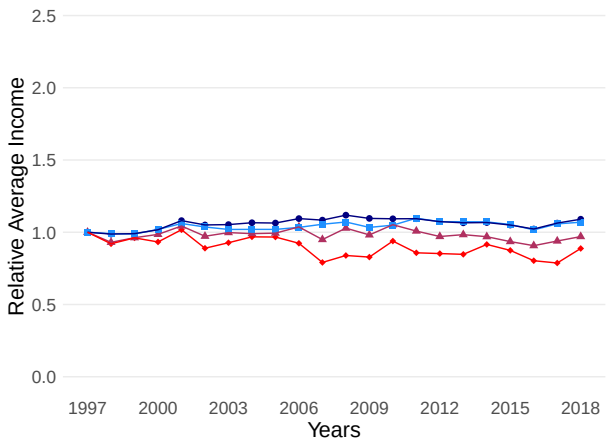
Notes: The charts show the proportion of migrants among individuals located in each fractile of the (fiscal) income distribution in 2017. The figure shows the proportion for percentiles from 90th-98th, for the top 1% of individuals excluding the top 0.1%, for the top 0.1% excluding the top 0.01%, for the top 0.01% excluding the top 0.001%, and for the top 0.001%. The unit of analysis is an individual taxpayer. Percentiles of the fiscal income distribution are defined according to publicly available data from HMRC Survey of Personal Income. Income is defined as the sum of "total earned income" (TEI) and "total investment income" (TII). TEI comprises income from employment, trading income from self-employment activities, partnership income, and pensions. TII comprises income from savings and investments including interest, dividend payments, rent from properties.

Figure 1.3: Migrants have become more prevalent at the top since 1997

(a) Share of top individuals who are migrants (1997=1)

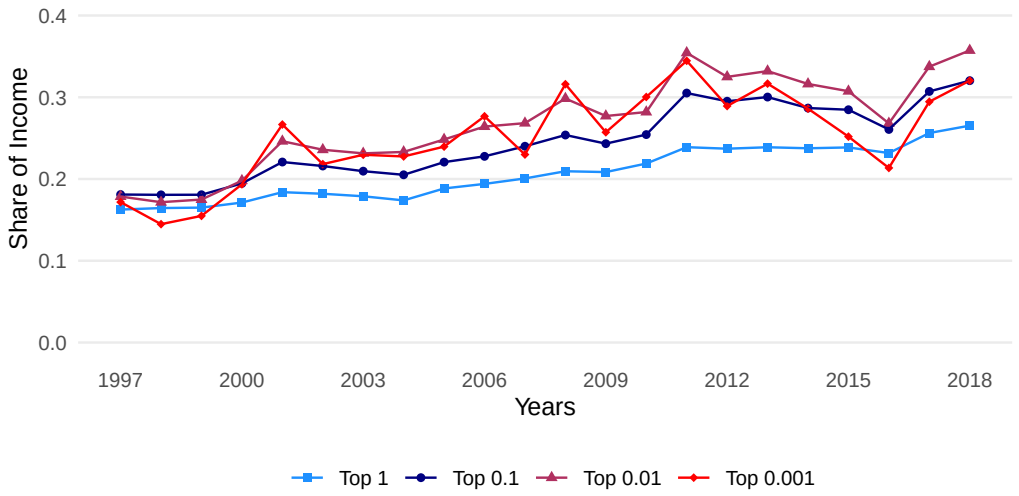


(b) Average migrant income relative to average native income (1997 = 1)



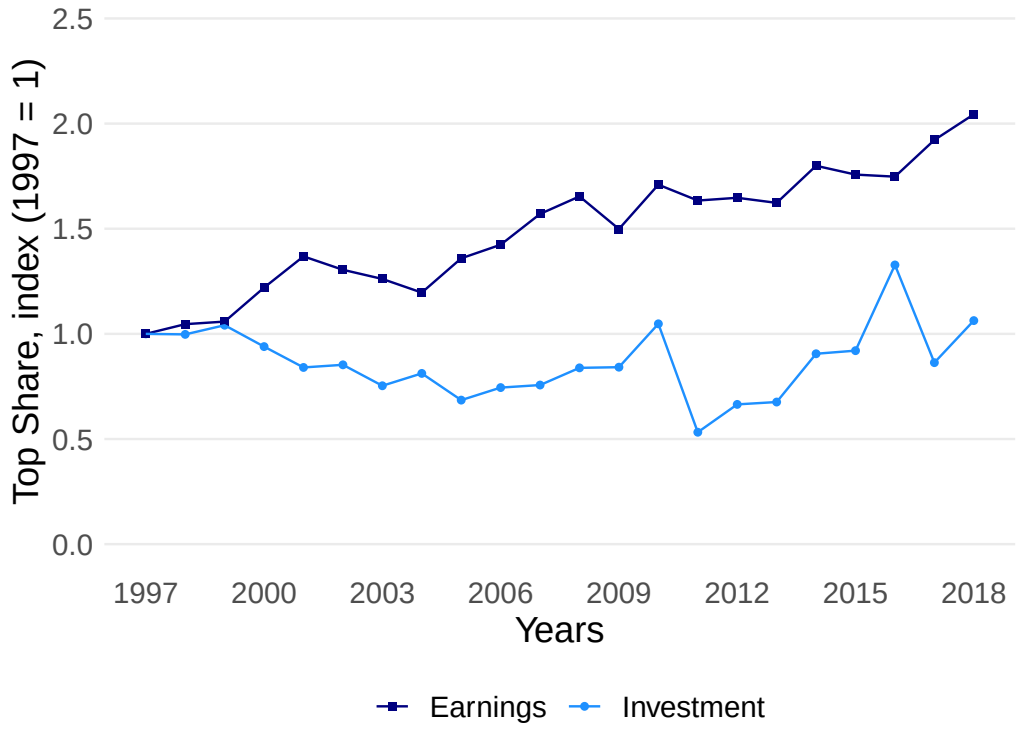
Notes These graphs display cumulative growth rates for the following time series: Panel (a) shows the cumulative growth in the ratio of the number of migrants and the total number of individuals in each fractile, normalized to 1 in 1997; Panel (b) shows the cumulative growth in the ratio of average income for migrants and natives in each fractile, normalized to 1 in 1997. The unit of analysis is an individual. Income is defined as the sum of earned income and investment income. A migrant is identified as a taxpayer who received their National Insurance Number (NINO) at the age of 18 or older. All top shares are defined relative to the total number of individuals aged 18 or older in the population living in the UK.

Figure 1.4: Share of income in top fractiles that goes to migrants



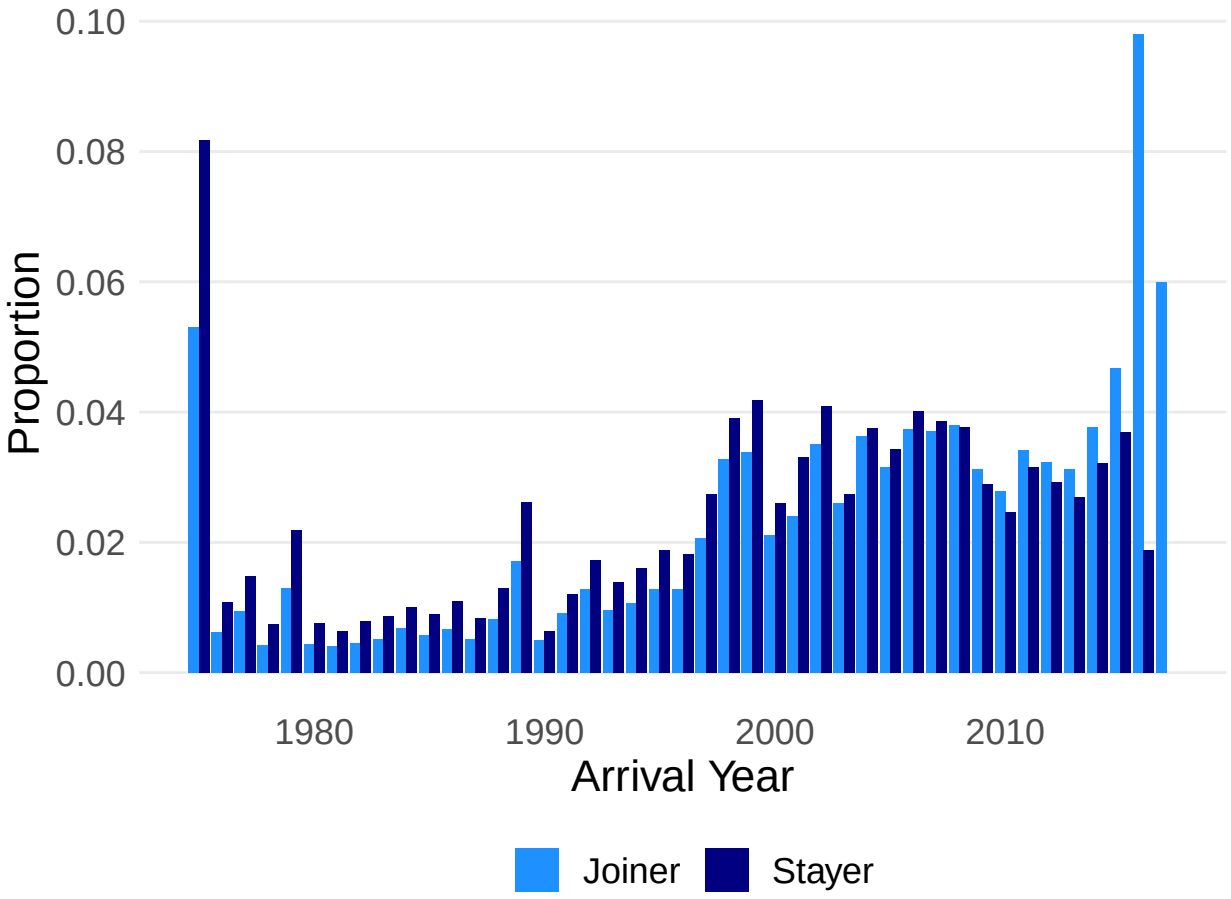
Notes: This graph shows the cumulative growth rates of the share of top income going to migrants in each fractile. The unit of analysis is an individual. Income is defined as the sum of earned income and investment income. A migrant is identified as a taxpayer who received their National Insurance Number (NINO) at the age of 18 or older. All top shares are defined relative to the total number of individuals aged 18 or older in the population living in the UK.

Figure 1.5: Fraction of earnings and investment income in top 1% going to migrants



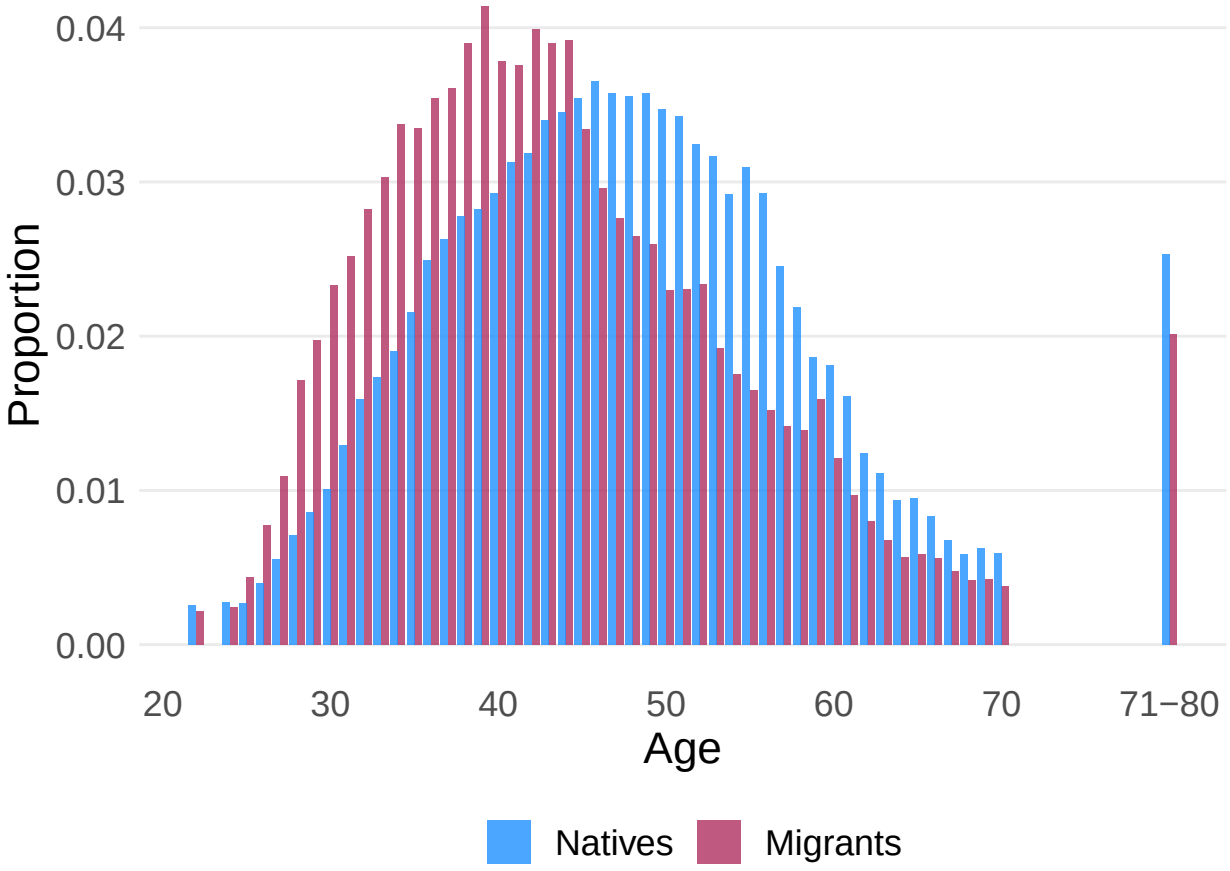
Notes This figure shows the cumulative growth rate from 1997 to 2018 of the following time series: the series labeled "earnings" represents the cumulative increase in migrants' earnings share of top 1% income, the series labeled "investment" represents the cumulative increase in migrants' investment income share of top 1% income. Each time series is normalized to 1 in 1997. The unit of analysis is an individual. A migrant is identified as a taxpayer who received their National Insurance Number (NINO) at the age of 18 or older. All top shares are defined relative to the total number of individuals aged 18 or older in the population living in the UK.

Figure 1.6: Distribution of year of arrival for migrants who reach the top 1% in 2017



Notes This figure shows the distribution of year of arrival for migrants in the top 1% in 2017. The series labeled "Joiner" represents the distribution of individuals who reached the top 1% in 2017 but were not in the top 1% in 2016, while the series labeled "Stayer" represents the distribution of individuals who were in the top 1% in both 2016 and in 2017. Individuals arriving before 1975 are pooled into the left-most bars. The unit of analysis is an individual. A migrant is identified as a taxpayer who received their National Insurance Number (NINO) at the age of 18 or older. All top shares are defined relative to the total number of individuals aged 18 or older in the population living in the UK.

Figure 1.7: Age distribution of individuals who reach the top 1% in 2017



Notes This figure shows the age distribution for individuals that reached the top 1% in 2017 but were not in the top 1% in 2016, showing the distribution for migrants and natives separately. Each bar represents one year of age, except for years of age between 20-24 that are grouped into two-year bins and for ages between 71-80 that are grouped into a single bin labeled "71 – 80" in the figure, for reasons of disclosure. The unit of analysis is an individual. A migrant is identified as a taxpayer who received their National Insurance Number (NINO) at the age of 18 or older. All top shares are defined relative to the total number of individuals aged 18 or older in the population living in the UK.

Table 1.1: Industries with highest proportions and concentrations of migrants

(a) What industries do top 1% migrants work in?

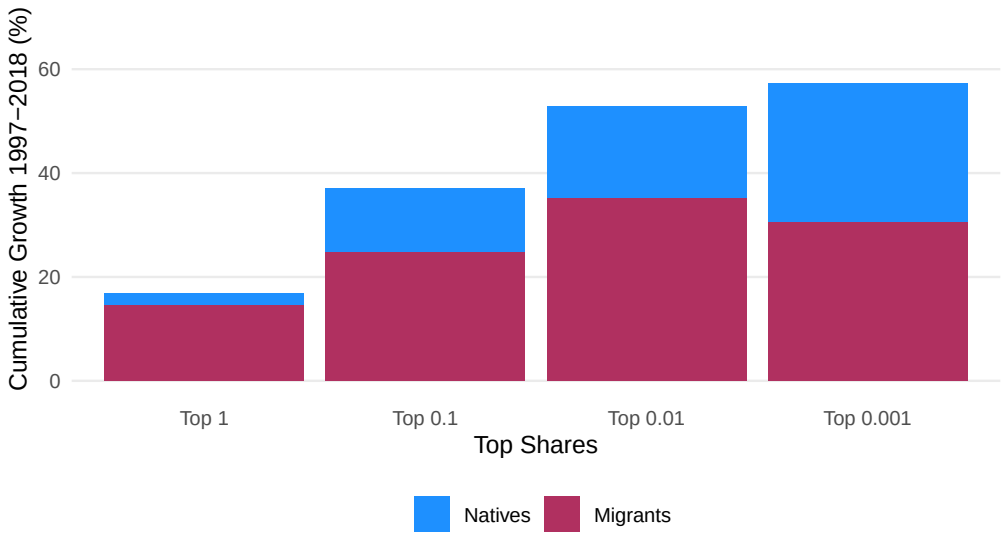
	Industry (SIC)	Share of Top 1% Migrants	Average Income (£)	Industry Dependency Ratio: Share	Industry Dependency Ratio: Rank
1	Banks (64191)	17.0	383,301	39.7	5
2	Hospitals (86101)	6.4	160,412	37.1	8
3	Management consulting (70229)	4.2	326,813	27.4	31
4	Support to financial services (66190)	4.1	515,550	34.7	10
5	Fund managers (66300)	3.6	431,620	36.1	9
6	Information technology (62020)	2.4	207,960	21.1	59
7	Head offices (70100)	2.2	422,862	27.1	32
8	Medical practice (86210)	2.1	194,188	29.2	27
9	Business administration (82990)	1.9	314,761	25.8	34
10	Software development (62012)	1.3	208,332	20.9	64

(b) How reliant are specific industries on migrants among top 1% workers?

	Industry (SIC)	Industry Dependency Ratio	Average Income (£)	Share of Top 1% Migrants: Share	Share of Top 1% Migrants: Rank
1	Web portals (63120)	51.0	259,669	1.0	18
2	Credit bureaus (82912)	47.4	321,500	0.1	84
3	Securities dealers (64991)	44.9	498,245	1.1	16
4	Financial management (70221)	43.9	373,728	1.1	14
5	Banks (64191)	39.7	383,301	17.0	1
6	News agencies (63910)	39.0	217,338	0.4	35
7	Human Resource management (78300)	38.7	273,508	0.2	68
8	Hospitals (86101)	37.1	160,412	6.4	2
9	Fund managers (66300)	36.1	431,620	3.6	5
10	Support to financial services (66190)	34.7	515,550	4.1	4

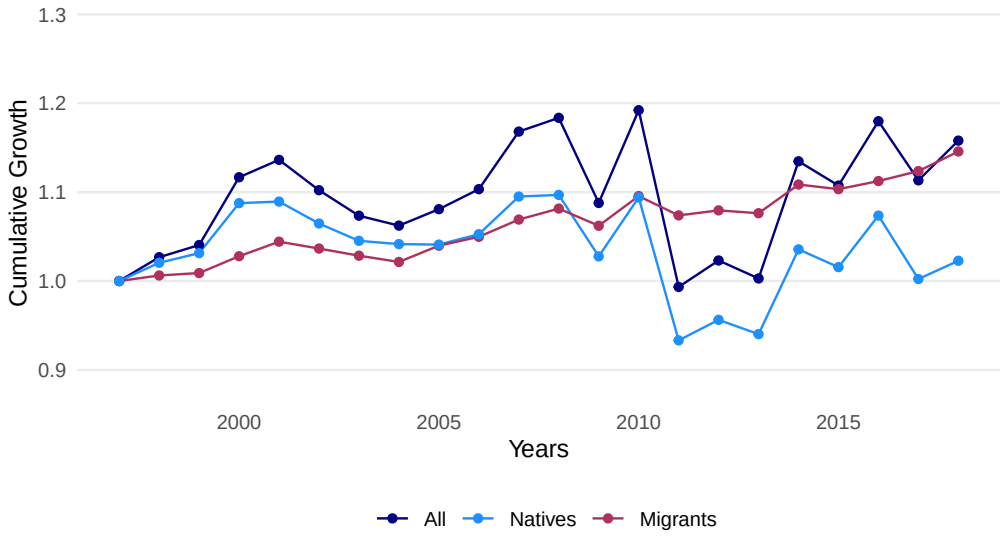
[Notes] This table presents statistics on migrants within 5-digit industries. "Share of top 1% migrants" is the fraction of all migrants in the top 1% who are in this industry. "Average Income" is the mean total income of top 1% migrants employed in this industry. "Industry Dependency Ratio: share" is the fraction of all top 1% workers in this industry who are migrants. "Industry Dependency Ratio: rank" is the ranking of the industry from highest to lowest fraction of all top 1% workers who are migrants. In Panel (a) the rows are sorted by the "share of top 1% migrants". In Panel (b) the rows are sorted by the "industry dependency ratio".

Figure 1.8: Migrants account for a large fraction of growth in top shares



Notes The figure shows the decomposition of the total cumulative growth rate between migrants and natives, as described in Section 1.4.1. The unit of analysis is an individual. Income is defined as the sum of earnings and investment income. A migrant is identified as a taxpayer who received their National Insurance Number (NINO) at the age of 18 or older. All top shares are defined relative to the total number of individuals aged 18 or older in the population living in the UK.

Figure 1.9: Decomposition of cumulative total growth of top 1% share over time



Notes The figure shows the decomposition of the cumulative growth rate in the top 1% share from 1997 up to each subsequent year. The unit of analysis is an individual. Income is defined as the sum of earnings and investment income. A migrant is identified as a taxpayer who received their National Insurance Number (NINO) at the age of 18 or older. All top shares are defined relative to the total number of individuals aged 18 or older in the population living in the UK.

Chapter 2: Shirtsleeves to Shirtsleeves? Income Persistence, Family Firms, and Aristochratic Dynasties

2.1 Introduction

Understanding the sources of inequality is a widely debated topic among economists, politicians, and society at large. Family background is one the factors that has received special attention in the economic literature because it allows to "distinguish between equality of opportunity and equality of outcomes" (Stokey, 1998). If children have the same chance of attaining economic success regardless of the family they were born into, everyone enjoys equality of opportunity. The distribution of income might still be unequal because of other factors (such as, effort and luck), but the society is perceived as fair. If instead family characteristics play a role in determining economic status later in life, then unequal outcomes are less desirable.

Recent studies find that the family influences future generations' income to a varying degree, depending on the setting and the time horizon considered. The vast majority of papers focuses on persistence across two adjacent generations within the same family (Chetty et al., 2014; Acciari, Polo and Violante, 2019). In developed countries, estimates of mobility, even those at low end of the range, imply a relatively quick reversal of fortunes after few generations.[1] A handful of studies, instead, take a longer run perspective. They find a higher degree of income and wealth transmission across generations that are several

[1]Some studies provide evidence that income transmission in the short run is much higher at the top of the income distribution (Björklund, Roine and Waldenström, 2012).

decades or centuries apart (Barone and Mocetti, Forthcoming; Clark, 2014). In fact, long run estimates shows a much higher degree of transmission than the one implied by studies focused on adjacent generations.

This paper finds that present-day descendants of aristocratic dynasties enjoy high economic status in Italy, several decades or centuries after their ancestors received a title. To do so, I combine information on descendants of all noble families, administrative data on taxable income, and the public registry of shareholders and company officials. To find present-day descendants of noble families, I use detailed information on family trees of noble dynasties that have been continuously updated since 1910 to the present day. To measure economic status, I use administrative data on taxable income for the universe of taxpayers living in Milan in 2005 and the public registry of shareholders and company officials for all corporations, limited liability companies, and limited partnerships registered in Italy. The administrative data sources allow to quantify the economic advantage that present-day descendants of noble dynasties enjoy relative to the rest of the population.

I present three findings. First, I show that descendants of noble dynasties obtained a significant income premium relative to the average taxpayer living in Milan in 2005. The income premium is visible throughout the distribution and, in particular, in the upper half of the distribution. Second, to analyze a factor that contribute to this advantage, I examine the prevalence of noble descendants among shareholders and company officials. I find that noble descendants are three times more likely to be a shareholder or a company official in any firm registered in Italy from 2009 to 2018. While noble and commoner taxpayers in the top decile of the income distribution own firms at roughly the same rate, noble taxpayers in the bottom 9 deciles of the distribution are clearly distinct from the rest. In addition, I find that firms with a noble shareholder exhibit a worse return on asset and on equity, relative to comparable firms. Finally, I measure income transmission among father-son pairs in the sample and find a moderate degree of income persistence, in line

with the literature that focuses on two adjacent generations.

The analysis proceeds in the three steps. I first quantify the advantage enjoyed by present-day descendants of noble dynasties. They obtained €41,000 more in 2005 than the average taxpayer living in the city of Milan. This income premium is statistically significant at any common level and it is economically sizable as it amounts to 1.77 times the mean income in the sample (€23,165). Moreover, the entire income distribution of noble descendants is shifted to the right, with the gap increasing with income. Using a linear quantile regression model, I estimate that the gap between the two distributions is around €44,000 at the median yet it increases to €101,000 at the 90th percentile of the distribution. To illustrate that differences in observables are not main drivers of these results, I show that age and the composition of income explain a small fraction of the overall difference in average earnings. Similarly, a counterfactual distribution of all taxpayers remain close to the observed distribution with the gap between nobles and the other taxpayers remaining distinctly visible.

These first set of descriptive results shows that noble descendants command a sizeable income premium that increases at the top of the distribution. While striking, these results do not support a causal interpretation of the link between family background and economic success later in life. It is possible that these individuals would fare as well if they were born in a different family or that their family would create the same environment conducive to economic success even without a noble title. Yet, as Figure 2.2 shows, the chances of observing a larger average in a random sample of equal size are around 5 percent. Moreover, Italy is an interesting context for studying income transmission within dynasties because these titles do not give rise to any legal privilege or economic benefits since World War II. In addition, Italy experienced significant political, institutional, and economic transformations over the previous century that would normally be associated to changes among elites and a re-ranking of individuals across the income distribution.

Second, I investigate one of the factors that contribute to the income premium of noble descendants: control over businesses. I document that noble descendants are more likely to be a shareholder or a company official than the rest of the population.[2] I find that almost a fifth of noble individuals are either a shareholder or an official, a proportion that is more than three times higher than the base rate among all other taxpayers. Focusing on ownership alone, 12.7 percent of noble individuals own shares in a business, while only 4.1 percent of commoner taxpayers do. Among company roles, member of the board of directors is the most common among nobles. While noble and commoner taxpayers in the top decile of the income distribution own firms at roughly the same rate, noble taxpayers in the bottom 9 deciles of the distribution are clearly distinct from the rest of the population. These results show that noble descendants are more likely to be involved in companies, therefore exerting control over their operations and their profits.

Turning the analysis to firms, this paper shows that firms with at least one noble shareholder are more predominantly active in real estate. In addition, they report higher assets and equity on their balance sheet relative to a comparable set of firms. But they do not obtain higher turnover nor do they post higher profits. As a result, firms with a noble shareholder exhibit a lower return on asset and on equity. The difference in total assets is mainly driven by fixed tangible assets.

Finally, I find moderate intergenerational transmission among father-son pairs. The rank-rank slope is 0.21 for all pairs of noble fathers and sons, which is in line with the recent estimates that focus on adjacent generations. For example, Acciari, Polo and Violante (2019) find a rank-rank slope of 0.25 for the entire Italian population and of 0.18 for the province of Milan. The degree of income transmission between adjacent generations of noble dynasties do not appear to be higher than in the broader population. Yet,

[2]Most of company officials in the dataset are C-level managers, members of the board of directors including the chair, and other executives. A small fraction of roles are reported less frequently and include auditors, legal counsels, and court appointed liquidators.

descendants of these dynasties enjoy a significantly higher economic status relative to the broader population, even though they are far apart from the ancestor that first received the title. This difference echoes the discrepancy between estimates that focus on two adjacent generations and those that take a long run perspective.

The rest of the chapter proceeds as follows. Section 2.2 links the paper to the existing literature. Section 2.3 presents the data sources, discusses the potential biases that could affect the results, and provides some background information on the evolution of noble titles in Italy. Section 2.4 quantifies the income premium enjoyed by present-day noble descendants. Section 2.5 discusses the role of family firms and Section 2.6 computes intergenerational mobility among noble dynasties. Finally, Section 2.7 concludes.

2.2 Related Literature

This paper speaks to three main strands of literature. First, it is related to vast literature on income transmission among generations within the same family. While most of the literature focuses on transmission between two adjacent generations (see Solon (1999) and Black and Devereux (2011) for a survey), this paper complements a handful of studies that take a long term perspective. For example, Ager, Boustan and Eriksson (2019) show that grandsons of former slaveholders in the US South surpassed their counterparts in 1940, despite the end of the Civil War eliminated the slave wealth of their ancestors. In Italy, Barone and Mocetti (Forthcoming) use pseudo family links to document that individuals at the top of the housing wealth distribution in the 15th century in Florence are more likely to be at the top of the present-day income distribution. Across a range of developed countries, Clark (2014) measures persistence of economic status among individuals that share rare last names. This paper uses actual descendants from dynasties that first reached elite status decades or centuries ago. Therefore, it provides evidence of persistence across

several generations within the same family.

Second, this paper adds to the broad cross-section of literatures on the role of dynasties in politics and the economy (Dal Bó, Dal Bó and Snyder, 2009; Durante, Labartino and Perotti, 2011). Sylos-Labini (2004) shows the importance of family connections in the search for jobs.

Finally, I find that the present day economic success of some noble families goes through closely held businesses. This complements the recent literature that provides new evidence on firm ownership at the top of the income distribution (Smith et al., 2019*b*; Fagereng et al., 2020). These papers show that closely held businesses generate a large share of total top income and represent a sizable fraction of assets of individuals at the top of the wealth distribution. I show that firm ownership is one of the channels through which noble taxpayers differ from the rest of the distribution. Moreover, this paper contributes to the corporate finance literature that connects performance of family firms and the appointment of family members as managers (Bennedsen et al., 2007).

2.3 Background and Data

In this section, I describe the context and the data sources used to quantify the persistence in economic status of descendants of noble dynasties. I also discuss the potential limitations of the archival and administative datasets used in the paper.

2.3.1 Nobility in Italy

Noble titles codify elite status reached by one individual and they allow for the hereditary transmission of privileges that accompany them. Bestowing noble titles is a common practice adopted by several governments throughout history and across geographies. The motivations that call for a title range from benign and virtous (such as, an act of generosity

or heroism in combat) to shrewd and transactional (some titles were granted in exchange for money, political support, etc.).

In Italy, noble titles were passed on to younger generation of the same families over centuries[3]. From the Middle Ages to World War II, those ruling Italian regions continued to bestow new titles. These titles and their privileges survived regime changes, wars, annexation, etc. Moreover, these titles were formally recognized by the Italian government upon re-unification in 1861. In the 19th and 20th century, the titles did not grant additional privileges but they came with property rights over land.

The Italian constitution established that noble titles ceased to have any legal effect from 1948[4]. The new constitution was written during the transition from monarchy to republic as provided for by popular referendum in 1946. Lawmakers decided to eliminate privileges and rights stemming from noble titles, but they did not encroach property rights over land and real estate that were lawfully acquired[5]. While titles were no longer allowed, territorial designations (*predicati*) were allowed to be included in an individual's last name[6]. As a result, these designations were passed on from the father to his children, following the general rules on last names as in the rest of the population.

Family Trees of Noble Dynasties and Potential Selection

In order to identify present-day descendants of Italian noble families, I use data from "*Libro d'oro della nobiltà italiana*." This book contains information on all noble dynasties and it has been updated every two to five years since 1910 by *Collegio Araldico*, a private association aimed at promoting the history and record keeping of noble dynasties. The

[3]See see Genta Ternavasion (1992) for a legal analysis of Italian noble and other hereditary titles.

[4]This is provided for in *Disposizioni Finali e Transitorie XIV* and Article 3 of the Italian Constitution.

[5]The new republican government did not introduce special taxes targeted at their assets.

[6]For example, the nobleman *Mario Cordero Marchese di Montezemolo* legally became *Mario Cordero di Montezemolo*, where he dropped the title *Marchese* (Marquis) but he kept the local designation *di Montezemolo* as part of his last name.

first edition of the book was based on the official list prepared by the Italian government[7]. Since the unification of Italy, the government compiled a list of families who obtained titles under previous jurisdictions and it included families that were granted new titles under the unified government.

Libro d'oro provides biographical information for each member of a dynasty: first and last name, date of birth and, in some cases, educational attainment, job and place of residence at the time of publication. It also reports all children descending from a male member of the dynasty. I use this information to create father-son and siblings pairs to quantify income transmission among adjacent generations. Figure B.1 shows a sample page of *Libro d'oro* where information about noble descendants is provided as text. I manually look for noble individuals among taxpayers living in the city of Milan and I hand code information on family trees where available[8].

Potential Selection. While aiming to be comprehensive, *Libro d'oro* could suffer from potential selection that could bias the results presented in the paper. Selective inclusion in the sample could occur at the dynasty level and at the individual level.

The first source of potential selection comes from the coverage of dynasties in the book. The book aims to keep track of all noble dynasties in Italy as its first edition uses the official registry maintained by the government as a starting point. Yet, subsequent editions of the book –including the one I use for this paper– might not provide the same coverage as the first edition because some dynasties failed to provide information to Collegio Araldico or the authors of the book did not find enough information about the heirs. In addition, selection occurs naturally as dynasties who are not able to reproduce themselves are less

[7]The official list prepared by the Italian government was also named *Libro d'oro*.

[8]For the current version of this Chapter, I have hand coded data for dynasties whose first letter of the last name is from A to L included. As next steps, I plan to use Layout Parser to digitize information for all dynasties (Shen et al., 2021).

likely to be included in the book[9]. If dynasties who experience a decline in economic status are less likely to be included in the sample, then the results of the paper will suffer from bias.

The second potential source of bias comes at the individual level. For each family, *Libro d'oro* reports descendants from male members only. While this does not directly alter the gender balance of the sample of nobles[10], it might affect the result of the paper depending on the allocation of resources among siblings within a dynasty. For example, parents might invest more in the development of human capital of male offspring or they might decide for an unequal distribution of assets among their children. If male members of a dynasty obtain better economic outcomes that can in turn give an advantage to their offspring, the results of the paper could overstate the true income premium enjoyed by all descendants of noble dynasties, including offspring of female members. Finally, similarly to the survivorship bias at the dynasty level, the likelihood of appearing in the book might also be systematically related to the individual's economic status. Family members who experience a decline in their income or assets might be less keen on being included in the book, although the book itself does not include information on the economic status of each individual.

2.3.2 Economic Outcomes

I measure the economic status of noble descendants using two data sources. The first dataset contains is a cross-section of income tax returns for all taxpayers living in the city of Milan in 2005. The second one is the registry of shareholders and managers for all limited liabilities companies active in Italy, updated to 2019. In this section, I describe the data

[9]The book reports some of the dynasties without heirs.

[10]In fact, male descendants are slightly over-represented as they account for 55 percent of the sample of noble individuals.

sources and explain how I construct the sample for the main analysis of the paper.

Income tax returns

To understand the economic success of descendants of noble dynasties, I use the universe of tax returns filed by residents of the city of Milan in Italy for the year 2005. The Italian tax authority published this data, including names and date of birth of individuals, on 30 April 2008 on its institutional website[11]. While tax returns of Italian taxpayers are considered to be public information, they are usually made available upon request subject to regulations.[12] As a result, the Italian Privacy Authority took issue with the online publication and ordered the removal of tax returns from the tax authority's website. However, "the Authority also clarified that whoever had obtained the data through the Ministry's website had done so legally." (Guell et al., 2018).

The dataset contains the universe of taxpayers living in Milan which amounts to 888,720 individuals. However, the law provides for some exceptions. First, individuals with annual income below thresholds that range from €3,000 to €7,500 are not required to file. Second, dependants, such as children or other family members, are also exempted as long as they report less than €2,800 in annual income.

I define income as fiscal income, which includes income from employment, businesses and sole proprietorships, rents from properties, royalties, and other small sources. Interests and dividends are not reported on tax returns if they are subject to exact withholding. The definition includes capital gains which are reported on the tax form upon realization. For individuals that obtain business income, the dataset reports business income

[11]Decision by the director of the Italian Tax Authority taken on 5 March 2008available at https://www.agenziaentrate.gov.it/portale/web/guest/archivio/normativa-prassi-archivio-documentazione/provvedimenti/altri-provvedimenti-non-soggetti/provvedimenti-2008/marzo-2008. Accessed on 2021-04-25.

[12]To be more precise, Italian residents may ask to see no more than ten tax returns each year. Inspecting tax returns in bulk is not allowed.

separately from other sources and the 5-digit industry code.

The dataset contains some information that allows me to infer the most important source of income for each individual. To do this, I use a categorical variable that reports the section of the tax form with the largest amount of income. Another categorical variable specify which tax form an individual used for filing. Individuals may choose among three types of returns. First, individuals who obtain labor income only are subject to exact withholding and their employer file the return (*CUD*) on their behalf. Second, individuals that earned income from employment, rents from property, and few types of business income file a simplified form (*Modello 730*). Finally, the last form (*Unico Persone Fisiche*) is used by individuals with incomes that do not fall in the previous categories. This form is divided in section corresponding to broad categories of income, such as rents, business income, capital gains, etc.

Table 3.1 reports descriptive statistics for all taxpayers in Milan and for taxpayers residing in Italy.[13] The average income for individual taxpayers in Milan was €23,165 which is 68 percent higher than the Italian average. A significant proportion of taxpayers (16.2 percent) reports zero income. Turning to the income composition, the main source of income is employment for 82.9 percent of individuals, whereas a combined 10.0 percent report self-employment or business as their main source of income (Table 2.3).

Registry of Shareholders and Managers

In addition to individual income, I quantify the prevalence of noble descendants as shareholders and managers of business. For this purpose, I use the *Amadeus* dataset provided by Bureau Van Djik. This dataset contains financial statement information for firms and their main shareholders, managers, and directors. The data is collected by Cerved Group from mandatory information reports that all registered firms have to file annually

[13]The statistics for the whole country come from Guell et al. (2018).

with the local Public Registry (*Registro delle Imprese*).

2.3.3 Matching Noble Descendants and Income Data

To quantify the economic advantage enjoyed by descendants of noble dynasties, I match heirs found in *Libro d'oro* with individuals in the personal income tax returns. The matching occurs in two steps. First, I subset individuals based on their last names. I find xxx individuals who have one of the noble last names. Most of these individuals are not descendants of noble families, but they just happen to have the same last name. The second step in the matching process involve identifying all descendants of noble families. I match individuals by first and last name and by date of birth.

2.4 Quantifying the Advantage

In this section, I quantify the advantage of descendants of noble families relative to the rest of the population and I investigate the composition of their income. In addition, I explore the correlation of income between father-son pairs and among siblings.

I quantify the advantage of present-day descendants of noble families using the following specification:

$$y_i = d_i\mu + X_i\beta + \varepsilon_i \tag{2.1}$$

where y_{if} is annual income of individual i, D_i is a dummy variable that is equal to one for individuals that are descendants of a noble family, X_i contains individual characteristics, such as age and gender. The coefficient μ captures the economic advantage that noble descendants enjoy with respect to the rest of the population.

Table 2.4 shows estimates from equation 2.1. Each column provides results for a dif-

ferent specification. Column (1) shows the unadjusted difference, while columns (2)-(4) includes additional individual controls.

The main finding is that noble individuals reported between €41,123 and 49,710 more in annual income than the average taxpayer in Milan in 2005. The unadjusted difference shows the largest gap between noble descendants and the average taxpayers. The difference is barely unchanged when I control for age (column 2) or for the presence of self-employment income (column 3), but it declines to €41,123 in the specification that controls for the composition of income sources by including dummies for each type of tax form used (column 4). In all specifications, the income gap between noble descendants and the average tax payer is statistically different from zero at any common level of significance.

These differences are quantitatively large. Relative to the average of €23,165 for the city of Milan, average taxable income of noble descendants is 1.77 to 2.14 times higher. Given that the distribution of income is heavily skewed to the right, I also test for the log difference in taxable income (Cunningham, 2021). The income premium amounts to 105 log points, with robust standard errors of 6.4. In relative terms, the gap between the average taxpayers and noble descendants is equal to the difference between the 25th and the 88th percentiles of the income distribution of taxpayers living in Milan in 2005.

The income premium enjoyed by noble individuals is not driven by few outliers, it is a visible shift of the entire distribution. Figure 2.1 compares the distribution for each group, clearly showing that the one for noble descendants is to the right. This is confirmed by a test on the difference in conditional quantiles of the distribution. To perform this test, I adopt the following linear quantile model:

$$Q_{y_i|X_i}(\tau, X_i) = d_i\mu_t + X_i\beta_\tau \tag{2.2}$$

where $Q_{y_i|X_i}(.)$ is the quantile τ of the (conditional) distribution of $y_i|X_i$. The vector of covariates is the same as in the main OLS specification (equation 2.1). Standard errors are computed using the "wild" bootstrap method (Feng, He and Hu, 2011) with 100 repetitions.

Table 2.5 presents the differences in conditional quantiles for the 5th, 10th, 25th, 50th, 75th, 90th, 95th, and 99th percentiles. The shift of the income distribution of noble descendants to the right is sizeable and rising with income. The difference in the two distributions is €6,470 at the 25th percentile, a shift that is more than 2.5 times the value of the unconditional quantile for the distribution of the rest of the population. This difference is statistically significant at the 5 percent level. The premium at the median is €22,033, which is around half the average premium estimated by OLS. In the upper half of the distribution, the shift to the right keeps increasing in absolute terms, reaching more than €100,000 at the 90th percentile and surpassing €200,000 at the 99th percentile.

2.4.1 The Composition of Noble Descendants

The composition of noble individuals cannot explain the observed income gap between noble descendants and the average taxpayer. While noble individuals are different on observables relative to the rest of the population, in this section I show that observed variables are only able to explain a small fraction of the income premium enjoyed by the noble descendants. Most of the gaps in income between the noble and the average taxpayer remains unexplained by observables.

First, I explicitly address one of most important correlates of income: age. Given the strong income-age profile documented in the literature, one might wonder whether the income premium enjoyed by noble descendants can be a different age distribution. However, all specifications presented in the previous section explicitly control for the individ-

ual's age. Indeed, Table 2.4 shows that the average income premium barely changes after controlling for age. To complement these findings, Figure 2.3 displays the median (panel a) and the mean (panel b) for each group in 5 year bins. Starting from the 35-40 age bin, noble individuals exhibit a clear premium relative to the rest of the population. The premium remains high throughout the age profile, even though the mean premium declines to some extent towards the end of life. These results show that the different age composition of noble individuals cannot explain the income premium.

To quantify the fraction of the income premium attributable to observed variables, I decompose the difference in an unexplained and explained components following Oaxaca (1973), Blinder (1973), and Fortin, Lemieux and Firpo (2011):

$$\Delta y = (\bar{X}_n - \bar{X}_c)\hat{\beta}_c - (\hat{\beta}_c - \hat{\beta}_n)\bar{X}_c \tag{2.3}$$

where and $\hat{\beta}_g$ is the estimated coefficient from equation $y_g = X_g\beta_g + v_g$ for each group $g \in \{n, c\}$ and $\bar{X}_g$ is the average of observables. The first term on the right hand side of equation (2.3) is the composition effect, while the second term represents the unexplained (or "wage structure") effect.

Table 2.6 reports the result of the decomposition. The overall income premium is €49,710. The decomposition yields that the part that is explained by the gap is €8,980 (or 18 percent), yet the vast majority (82 percent) of the average gap remains unexplained by the observables. Standard errors are reported in parenthesis and are bootstrapped.

While the Oaxaca-Blinder decomposition allows me to isolate the contribution of observables on the average difference, I now investigate their effect on the entire distribution. To do so, I reweight the probability density function of income for common taxpayers following DiNardo, Fortin and Lemieux (1996*b*). Estimates for the actual and the counterfactual distributions of income are obtained from:

$$\hat{f}_{Y_c} = \frac{1}{hN_c} \sum_{i \in C} K\left(\frac{y_i - y}{h}\right) \tag{2.4}$$

$$\hat{g}_{Y_c} = \frac{1}{hN_c} \sum_{i \in C} \hat{\Psi}(X_i) \cdot K\left(\frac{y_i - y}{h}\right) \tag{2.5}$$

where $K(.)$ is the Gaussian kernel function and $\hat{\Psi}(X_i)$ are the reweighting factors. Defining $Pr(D_c = 1|X_i)$ as the probability of being a noble descendants conditional on X_i and $Pr(D_c = 1)$ the corresponding unconditional version, I estimate these probability via a probit model and obtain an estimate for the reweighting factor as follow:

$$\hat{\Psi}(X_i) = \frac{\hat{Pr}(D_B = 1|X_i)/\hat{Pr}(D_B = 1)}{\hat{Pr}(D_B = 0|X_i)/\hat{Pr}(D_B = 0)} \tag{2.6}$$

Figure 2.4 shows that observables are able to explain a small part of the right shift in the income distribution of noble descendants. The figure plots kernel density estimates for each group and an estimate of the counterfactual distribution of income for common taxpayers had they the same observables as noble descendants. The actual and counterfactual distribution for common taxpayers lie very close to each other, while the distribution for noble descendants remain visibly shifted to the right. While the set of observables available in this paper is limited, it nonetheless includes some of the key correlates of income, such as age and the sources of income. Yet, these variables are able to explain a small part of the difference in economic fortunes between noble and common taxpayers.

The source of the income premium enjoyed by noble taxpayers can be explained by a range of unobserved factors. This paper does not provide causal evidence that being born in a noble family determines the future economic success of an individual, but it shows that the two are positively correlated. In other words, I cannot rule out the possibility that noble descendants would have been as successful (or more) were they born in a random

family. However, my results still point towards a strong association between family background and economic success later in life. I turn the analysis to the association between members of the same family to provide additional evidence that the family background is an important factor in lifting nobles' incomes.

2.5 The Role of Family Firms

Recent evidence from the US shows that more than half of all individuals in the top 1 percent of the income distribution are business owners (Smith et al., 2019*b*). Moreover, the most common firm owned by high income individuals are "single establishment firms in professional services [...] or health services." To better understand the sources of the advantage of noble descendants, I analyze the characteristics of private firms owned by noble shareholders and discuss their role in shaping the advantage enjoyed by noble descendants documented in previous sections. To do this, I match personal income tax records to the shareholder registry for of firms registered in Italy.

2.5.1 Characteristics of Noble Owned Firms

Table 2.11 shows that noble descendants are more likely to be shareholders and managers of firms, relative to the rest of the population. They are 3 times more likely to be shareholders compared to a base rate of 4.1 percent among the general population. A similar difference appears for positions of company officials, such as C-level managers, administrator, and member of the board of directors. Among all the roles of company officials, 9.1 percent of noble individuals are members of the board of directors of a company, which 7.5 percentage points higher than the base rate in the sample. These statistics show that noble descendants are more likely to exert control over business assets, not only as owners, but also as managers and directors.

Turning the analysis to firms owned by noble descendants, Figure 2.6 summarizes the main difference in observables between firms with at least one noble shareholder relative to all the other firms in the sample. Firms owned by noble descendants are predominantly active in real estate. In addition, they exhibit higher assets and shareholders' equity relative to the median firm in the sample. But, they are not different in terms of turnover or median number of employees. As a result, usual metrics of returns on the investment, such as return on assets or return on equity, are lower.

2.6 Intergenerational Mobility within Noble Dynasties

Noble individuals enjoyed a sizable income premium in 2015 on average, but did members of some dynasties do particularly well? To explore the role of family background on the success of their descendants, I leverage the information on family trees contained in *Libro d'oro* to link adjacent generations and siblings belonging to the same family. In this section, I show a strong association of incomes both within and across generations of the same dynasty.

2.6.1 Measures of Relative Mobility

To measure the relation between income of two members of the same family, I use the following specification

$$\log y_i = \alpha + \beta \log y_i^r + X_i\gamma + e_i \tag{2.7}$$

where $\log y_i$ is the log taxable income for individual i, while the superscript r in $\log y_i^r$ denotes a relative. When the two individuals come from different generations of the same family, the parameter β is defined as the intergenerational income elasticity (IGE) and it is

one of the canonical measures of relative mobility (Solon, 1999; Black and Devereux, 2011). Estimating the IGE on a cross-section presents important challenges. First of all, observing father and sons pairs at the same time implies that these individuals are at different points in their careers and life cycles. The most recent studies in the literature use datasets that span several decades to observe adjacent generations at the same point in their life cycles. In this paper, however, we are constrained to use a single cross-section, which will reduce the measured association across different generations. Second, a single observation in time does not allow to smooth out transient idiosyncratic shocks that affect individual income profiles. While these fluctuations happen throughout the income distribution, they are particularly pronounced at the top, where most of the nobles in my sample are located[14].

To address some of these issues, I estimate the rank-rank slope from

$$R_i(c_i) = \delta + \gamma R_i^r(c_r) + e_i \tag{2.8}$$

where $R_i(c_i)$ is the percentile rank of individual i among all taxpayers belonging to the same birth cohort c_i, while the superscript r in $R_i(c_i)$ denotes a relative of individual i. The coefficient γ is the rank-rank slope. As in Chetty et al. (2014) where they compute the rank of children and parents using separate distributions[15], I rank parents and children within their own birth cohorts to obviate some of concerns discussed above.

2.6.2 Results

Table 2.7 reports the rank-rank slopes estimated via OLS on the sample of son and father pairs. Using all pairs, I find that an increase of 1 percentage point (pp) in the per-

[14]For a more detailed analysis of pitfalls of the techniques currently adopted to estimated the IGE using panel data, please see Black and Devereux (2011).

[15]Chetty et al. (2014) compute the rank-rank slope $\rho_{PR} = Corr(P_i, R_i)$ by regressing the child's rank R_i on his parents' rank P_i, with R_i is defined as "child i's percentile rank in the income distribution of children" and P_i as "parent i's percentile rank in the income distribution of parents."

centile rank of noble fathers is associated with an increase of 0.210pp in the child's mean rank, as shown in row 1 of Table 2.7. This estimate is marginally significant at the 5 percent level. When I focus on the subsample of children aged 20-40 and on those aged 40-60 separately, the slopes increase to 0.237 and 0.284 respectively. However, as the sample size declines, these coefficients individually are not statistically different from zero.

The rank-rank slope for noble families in Milan is higher relative to recent comparable estimates, suggesting a higher degree of income persistence across generations within noble families[16]. Acciari, Polo and Violante (2019) calculate a rank-rank slope of 0.182 for the entire population living in the province of Milan, 13 percent lower than the slope for noble individuals[17]. The estimate for noble families lies within the range of estimates computed for countries. Chetty et al. (2014) compute a rank-rank slope of 0.341 for the US and they provide estimates of 0.180 for Denmark and of 0.174 for Canada[18]. Acciari, Polo and Violante (2019) report a rank-rank slope of 0.25 for Italy as a whole. They also highlight the substantial geographic heterogeneity across Italian provinces, with a clear North-South gradient. Using a broad set of measures, they conclude that "the level of upward mobility in Northern Italy exceeds that of Scandinavia." With the cards stacked against us, finding a relatively high degree of persistence within noble families in an area where the general population is upwardly mobile might suggest even stronger transmission within noble dynasties in other parts of the country. To be more concrete, the rank-rank slope of 0.180 places the province of Milan 50th out of 110th provinces, yet the value estimated off of noble families comes in at the 85th place.

Turning to the IGE, Table 2.8 presents the estimates from equation 2.7 where I control

[16] All these studies

[17] While pertaining to different years, the data sources for this paper and Acciari, Polo and Violante (2019) are the same. The dataset used in this paper contains the universe of tax returns for the municipality of Milan, which is one of the municipalities included in the province of Milan.

[18] Chetty et al. (2014) estimates rank-rank slopes for Denmark using data from **?** and for Canada using data from Corak and Heisz (1999).

for the age (and its square) of the father and the son. The point estimate is 0.066, imprecisely estimated. As a measure of relative mobility, IGE suffers from many drawbacks even in settings where researchers can observe adjacent generations at the same point in their life cycle. In this paper, with a single cross-section, estimates of IGE suffer from attenuation bias because I observe fathers and sons at different points in their careers or when the older generation is retired while the younger is near the apex of their careers. Similarly to the rank-rank specification, I divide the sample based on the age of the child. In both subsample, the point estimate of IGE increases substantially to 0.110 for children aged 20-40 and to 0.440 for children aged 40-60.

2.7 Conclusions

In this chapter, I document a high degree of persistence in economic status among present-day descendants of Italian noble dynasties. These individuals belong to generations that came several decades or centuries after their ancestors received the title. Despite the long time gap, in 2005 noble descendants obtain around €41,000 more than (or 1.77 times) the average taxpayer living in Milan. Moreover, I find that part of their higher economic status involve control over closely held businesses. Noble descendants are three times more likely to be owners or company officials. Therefore these results show that present-day descendants of noble dynasties form a positively selected group and they suggest that income transmission can be high and persistent in families that achieved elite status in the past.

This chapter contributes to the literature on intergenerational mobility by providing new evidence on income transmission over the long run. Most of the papers in this literature focus on transmission between two adjacent generations. They present estimates of the rank-rank slope that are consistent with full reversal of fortunes within few gener-

ations, even in countries with relatively low mobility. Yet, a handful of papers show that income transmission can be high within families in the long run. The results presented in this chapter reflect this contrast. Among noble families, the rank-rank slope between fathers and sons is moderate and in line with recent estimates for the entire Italian population. At the same time, noble descendants enjoy higher economic status in the present days. This chapter adds to the evidence that the income process across generations within elite families has long memory and therefore it is not very well captured by standard measures of mobility. In other words, short run measures of intergenerational mobility are not a sufficient statistics, at least for capturing transmission within elite families.

Finally, this chapter provides some suggestive evidence about the channels that allow such a high degree of transmission among noble families. Some papers have highlighted the role of social networks (Ager, Boustan and Eriksson, 2019) in helping descendants preserve a high economic status. This paper provides some preliminary evidence that control over family businesses plays a role in preservation of status.

2.8 Tables

Table 2.1: Descriptive Statistics

	Milan	Italy
Mean	23,165	15,737
Standard dev.	105,651	42,993
Min	0	0
Max	44,963,206	101,255,692
Observations	888,720	38,514,292

Notes: This table reports descriptive statistics for taxable income obtained in 2005. The unit of analysis is an individual taxpayer aged 16-100 years old. The column labeled “Milan" uses the sample of taxpayers residing in the city of Milan, while the column labeled “Italy" uses the sample of all Italian taxpayers and comes from Guell et al. (2018).

Table 2.2: Descriptive Statistics

	Commoner	Noble
Demographics		
Age	52.67	51.78
Male		0.55
Income		
No taxable income	0.16	0.12
Taxable income (excl. 0s)	27,615	82,893
Self-empl. income > 0	0.08	0.16
Self-empl. income (excl. 0s)	37,092	94,029
Observations	888,192	528

Notes: This table reports descriptive statistics for commoner and noble taxpayers separately. The unit of analysis is an individual taxpayer aged 16-100 years old. The upper panel reports key demographics of taxpayers. The gender composition of the sample is currently available for noble taxpayers. The lower panel reports statics about income variables. The row labeled "No taxable income" computes the proportion of taxpayers with zero taxable income. The row labeled "Taxable income (excl. 0s)" provides the average taxable income computed among those with strictly positive income. The row labeled "Self-empl. income > 0" reports the proportion of taxpayers with income from self-employment and from professional services (such as, lawyers, doctors, engineers, architects, etc.). The row labeled "Self-empl. income (excl. 0s)" computes the average self-employment income calculated among those with strictly positive self-employment income. The final rows reports the total number of taxpayers in each group.

Table 2.3: Main Source of Income

Main source of income	Commoner	Noble
Capital/Business	0.076	0.125
Employment	0.829	0.561
Other	0.010	0.019
Rent	0.049	0.193
Self-employed	0.036	0.102
Observations	888,192	528

Notes: This table shows the proportion of taxpayers by main source of income. Proportions are calculated as group-wise proportions for noble and commoner taxpayers separately. Sources of income are classified in five categories based on two variables that record the tax form used and the section of the tax form with the highest reported amount of income. “Capital/Business" refers to income from partnerships, corporations, and limited liability companies. It does not include dividends distributed by listed companies. “Rent" includes income from real estate, including imputed rent for owner-occupied real estate. “Self-employment" includes income from self-employment activities and professional services (such as, lawyers, architects, engineers, etc...). “Employment" contains income from labor, finally “Other" include the remaining sources of income not already categorized.

Table 2.4: Quantifying the advantage of noble descendants

	(1)	(2)	(3)	(4)
Noble	49,710	48,509	47,132	41,125
	(4,599)	(4,589)	(4,583)	(4,571)
I(CUD)				-13,009
				(276)
I(Unico)				9,173
				(300)
I(Self-Employment)			19,478	8,575
			(412)	(459)
Age		2,303	2,136	1,531
		(37)	(37)	(38)
Age Squared		-21	-19	-14
		(0)	(0)	(0)
R Squared	0.000	0.005	0.007	0.013
Number of observations	888,720	888,720	888,720	888,720

Notes: This table reports the estimates of coefficients from regression specification 2.1 where the dependent variable is taxable income in euros. The unit of analysis is an individual taxpayer. "Noble" is a dummy variable equal to 1 for noble descendants. "I(CUD)" and "I(Unico)" are dummy variables for each tax form used to file taxes. The excluded group is the tax form *Modello 730*. "I(Self-Employed)" is a dummy equal to 1 for individuals with positive self-employment income. Standard errors are robust to heteroskedasticity.

Table 2.5: Differences in Quantiles

Quantile, τ	Unconditional Quantile, $Q_y(\tau)$	Difference in Conditional Quantile, $\Delta Q_{y\|x}(\tau, x)$	Std. err.
5	0	0	(377)
10	0	0	(371)
25	2,547	6,470	(1,493)
50	12,564	22,033	(2,844)
75	25,806	44,026	(3,875)
90	48,297	101,010	(13,254)
95	72,700	144,736	(18,902)
99	176,789	230,811	(50,353)
Observations	100,528		

Notes: This table shows selected percentiles of the income distribution for a sample of taxpayers living in Milan in 2005. For computational reasons, the table is based on a random sample of 100,000 taxpayers (or 11.52 percent of the universe) and all 528 noble taxpayers. The unit of analysis is an individual taxpayer. The second column represents the unconditional percentile of the income distribution. The third column represent the difference in the conditional quantile of the income distributions of noble descendants and commoner taxpayers. It is calculated from a linear quantile model, as specified in equation 2.2, where the dependent variable is taxable income and the regressors include a dummy variable equal to 1 for noble descendants, the individual's age and its square, indicator variables for tax forms and for positive self-employment income. Standard errors are computed using the "wild" bootstrap method using 100 repetition.

Table 2.6: Oaxaca-Blinder Decomposition of Annual Income

	LHS: Income
overall	
Commoner	23,135
	(112)
Noble	72,846
	(6,704)
Difference	-49,710
	(6,705)
Explained	-8,584
	(474)
Unexplained	-41,126
	(6,651)
Observations	888,720

Notes: This table reports the results of the two-fold Oaxaca-Blinder decomposition, as specified in equation 2.3. The unit of analysis is an individual taxpayer. The dependent variable is taxable income and the regressors are the regressors include a dummy variable equal to 1 for noble descendants, the individual's age and its square, indicator variables for tax forms and for positive self-employment income. "Commoner" and "Noble" refer to the simple average taxable among each group of taxpayers. "Explained" and "Unexplained" report the results of the two-fold Oaxaca-Blinder decomposition of "Difference". Standard errors are robust to heteroskedasticity.

Table 2.7: Intergenerational rank-rank slope

Sample	Rank-rank slope	Standard error	Observations
Full sample	0.210	(0.115)	61
Age of child			
16-40	0.252	(0.135)	40
41-60	0.127	(0.199)	21

Notes: This table shows the estimated rank-rank slope as specified in equation 2.8. The sample includes all noble father-son pairs. The unit of analysis is an individual taxpayer. The rank is defined as the percentile rank of each individual computed using the full distribution of taxpayers with the same year of birth. The bottom section of the table presents the estimation results obtained from splitting the sample in two groups according to the age of the child. Standard errors are robust to heteroskedasticity.

Table 2.8: Intergenerational income elasticity

Sample	IGE	Standard error	Observations
Full sample	0.066	(0.104)	51
Age of child			
16-40	0.123	(0.082)	33
41-60	0.438	(0.498)	18

Notes: This table shows the estimated intergenerational income elasticity (IGE) as specified in equation 2.7. The sample includes all noble father-son pairs where both individuals have strictly positive income. The unit of analysis is an individual taxpayer. The dependent variable is the log of taxable income of the child and the regressors include the log of taxable income of the father, the age (and its squared) of both child and father. The bottom section of the table presents the estimation results obtained from splitting the sample in two groups according to the age of the child. Standard errors are robust to heteroskedasticity.

Table 2.9: Rank-rank slope among brothers

Sample	Rank-rank slope	Standard error	Observations
Full sample	0.113	(0.254)	41
Age of younger brother			
16-49	-0.158	(0.155)	25
50-100	0.952	(0.402)	16

Notes: This table shows the estimated rank-rank slope as specified in equation 2.8. The sample includes all pairs of noble brothers. The unit of analysis is an individual taxpayer. The rank is defined as the percentile rank of each individual computed using the full distribution of taxpayers with the same year of birth. The bottom section of the table presents the estimation results obtained from splitting the sample in two groups according to the age of the younger brother. Standard errors are robust to heteroskedasticity.

Table 2.10: Intragenerational income elasticity

Sample	β	Standard error	Observations
Full sample	0.179	(0.163)	37
Age of younger brother			
16-49	0.116	(0.193)	23
50-100	0.270	(0.381)	14

Notes: This table shows the estimated intergenerational income elasticity (IGE) as specified in equation 2.7. The sample includes all pairs of noble brothers where both individuals have strictly positive income. The unit of analysis is an individual taxpayer. The dependent variable is the log of taxable income of the younger brother and the regressors include the log of taxable income of the older brother, the age (and its squared) of both brothers. The bottom section of the table presents the estimation results obtained from splitting the sample in two groups according to the age of the younger brother. Standard errors are robust to heteroskedasticity.

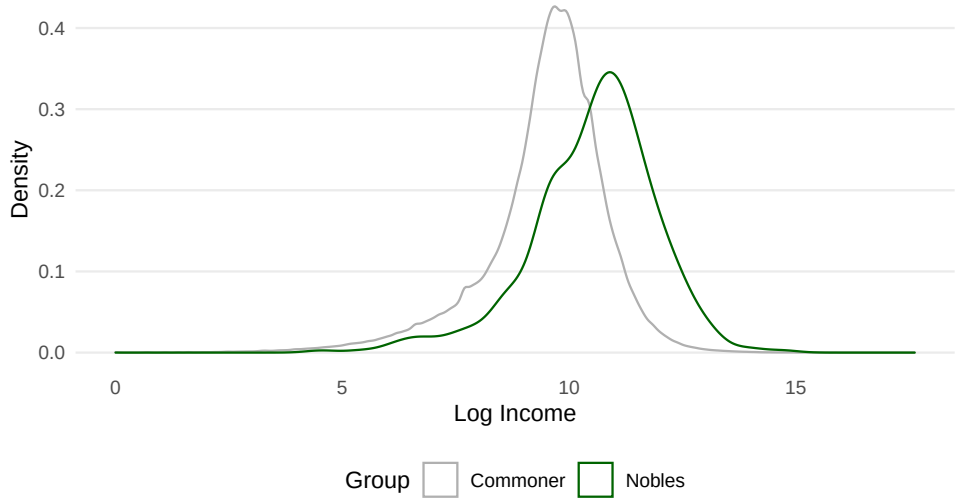
Table 2.11: Company Officials

	Commoner	Noble	T-stat
Proportion of taxpayers who are			
Shareholder	0.041	0.127	5.92
Company Official	0.038	0.129	6.22
Either	0.057	0.199	8.19
Proportion with at least one role as			
Manager	0.018	0.045	2.99
Board Member	0.018	0.093	5.89
Director	0.008	0.038	3.60
Other	0.006	0.011	1.11
Observations	888,220	528	

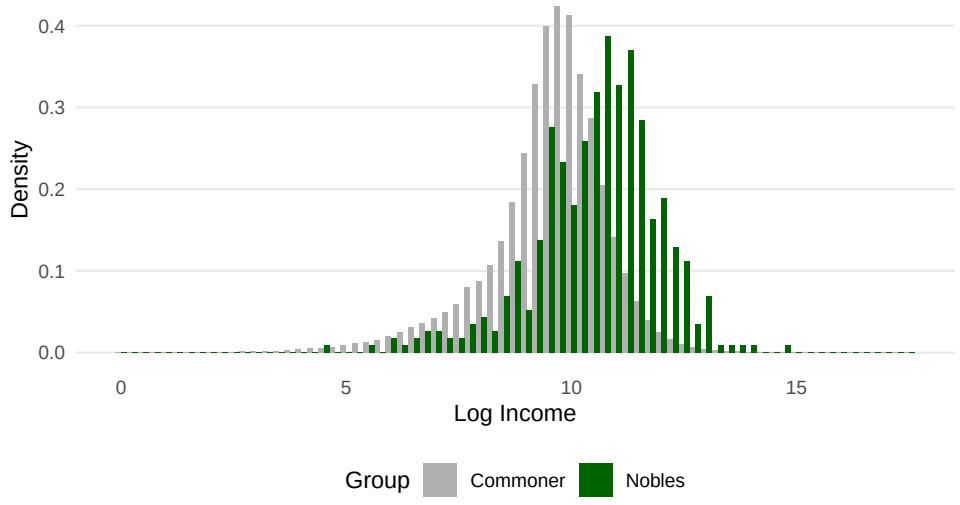
Notes: This table shows the proportion of taxpayers who are shareholders or company officials for noble and commoner taxpayers separately. In the upper panel, “Shareholder" indicates anyone who owns shares in a corporation or in a limited liability company, or who is a partner in a partnership. “Company Official" includes anyone who is a director, manager, or board members of a company. In the lower panel, “Manager" identifies C-level managers or sole administrator, “Board Member" refers to members of the board of directors, including the chair and the deputy chair. “Director" refers to other executive officials, while “Other" includes the remaining roles, such as other managers, auditors, legal counsels, court-appointed liquidators, etc. The column “T-stat" reports the t-stat for testing the null hypothesis of equal proportions across the two groups, obtained from a regression where the dependent variable is a dummy equal to 1 for each company role and the regressor is an indicator variable that is equal to 1 for noble descendants. Standard errors are robust to heteroskedasticity.

2.9 Figures

Figure 2.1: Distribution of Income by Group



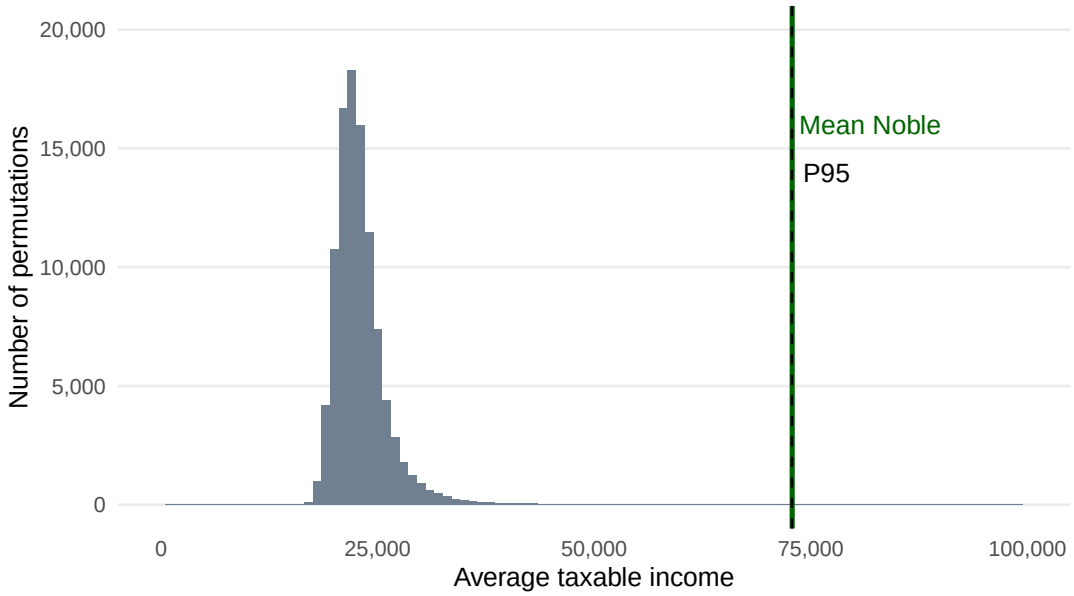
(a) Kernel density estimates



(b) Histograms

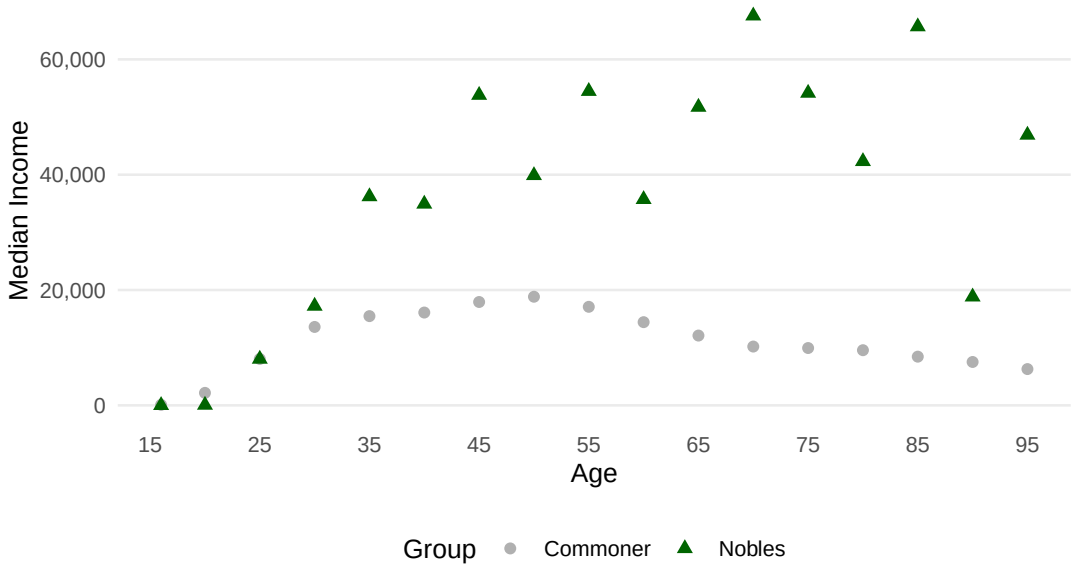
Notes: These figures show the distribution of the log of taxable income for commoner and noble individuals separately. The sample includes all taxpayers with strictly positive taxable income. The sample size is 744,119 (of which 464 are noble descendants). Panel (a) shows an estimated probability density function using a Gaussian kernel. Panel (b) shows histograms where the width of each bin is equal to 25 log points.

Figure 2.2: Permutations

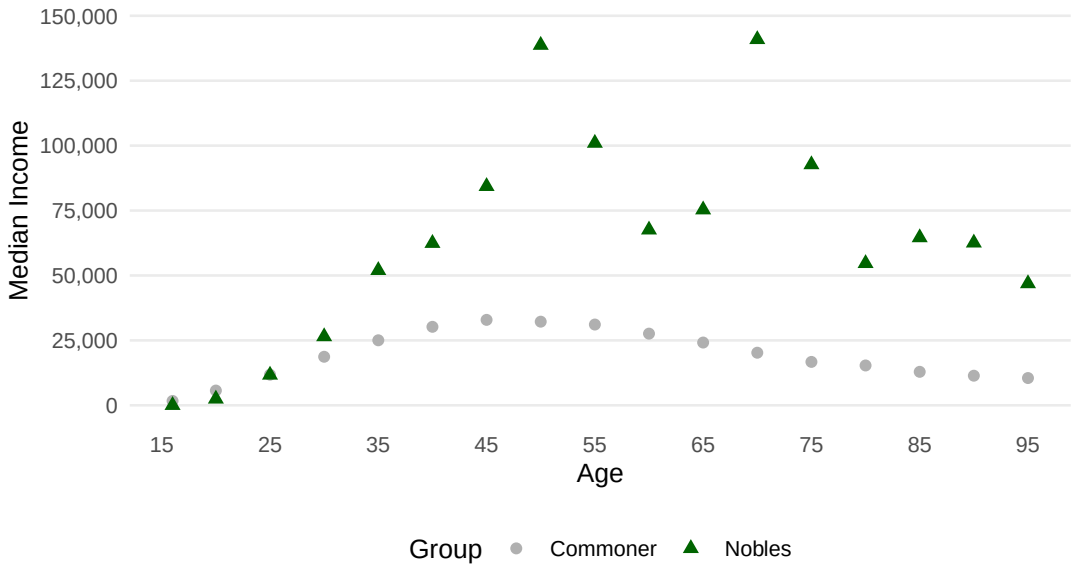


Notes: This figure shows the histogram of average taxable income computed in random samples repeatedly extracted without replacement from the universe of taxpayers. Each random sample is the same size as the number of noble taxpayers, that is 528. The number of samples extracted is 100,000. The unit of analysis is an individual taxpayer. The solid green vertical line labeled "Average Nobles" is equal to the actual average taxable income among noble taxpayers. The dashed black vertical line labeled "P95" represents the 95th percentile of the distribution of average taxable income obtained from the randomly extracted samples.

Figure 2.3: Age Income Profile by Group



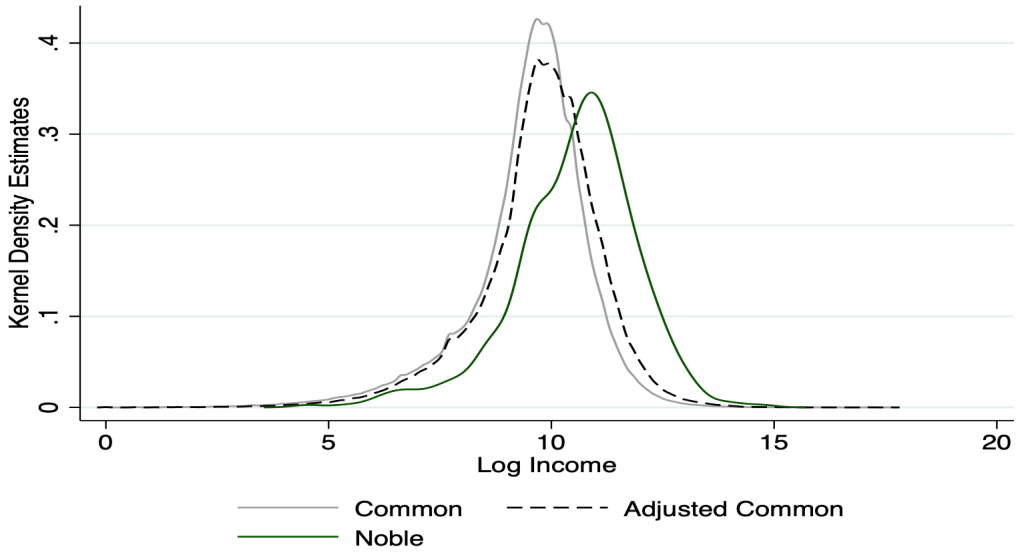
(a) Median Income by Age Group



(b) Mean Income by Age Group

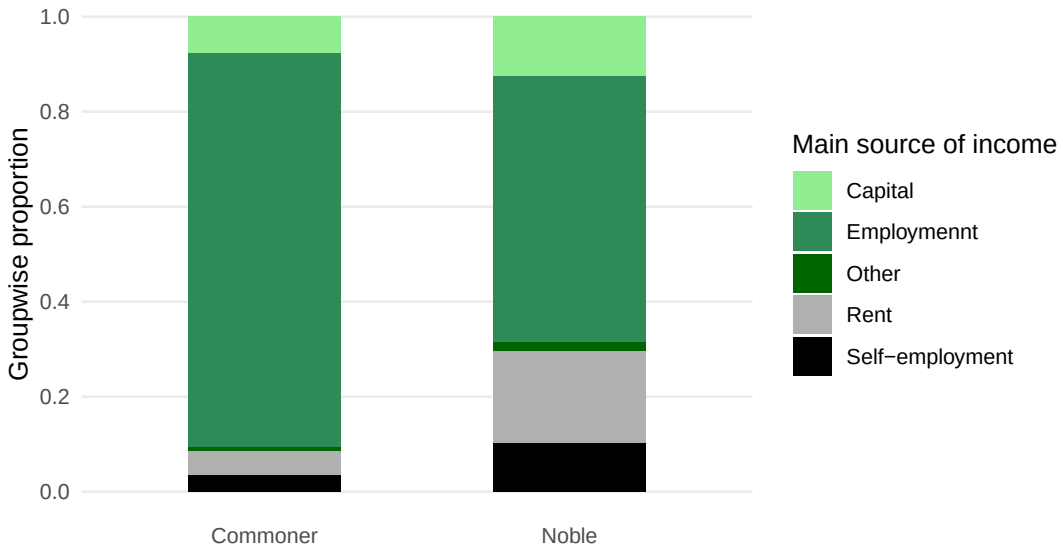
Notes: These figures show the income-age profile for commoner and noble taxpayers separately. The sample includes all taxpayers. The sample size is 888,720. The sample is divided in 5-year age bins. Panel (a) reports the median taxable income for commoner and noble taxpayers in each age bin, while panel (b) reports the mean taxable income.

Figure 2.4: Density Re-weighting



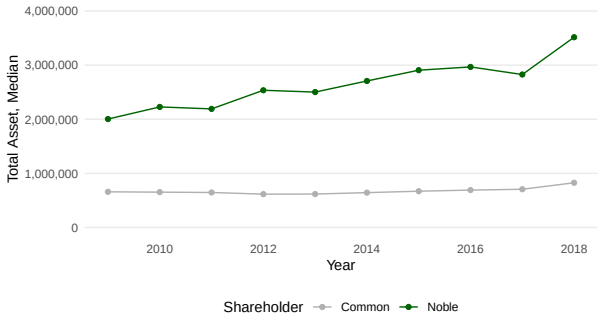
Notes: This figure shows the results of the decomposition of the difference in the distribution of taxable income between commoner and noble taxpayers. The dashed line labeled "Adjusted Common" refers to the counterfactual distribution of commoner taxpayers if they had the same observables as noble taxpayers. The counterfactual distribution is based on reweighting the unadjusted distribution of commoner taxpayers using the method proposed by DiNardo, Fortin and Lemieux (1996*b*) based on the propensity score. The propensity score is obtained from a logit model of the noble dummy (equal to 1 for noble descendants) on age and its squared, dummies for the tax forms, and a dummy for positive self-employment income. The solid lines are estimates of the probability density functions of the distribution of taxable income obtained using a Gaussian kernel. The grey line pertains to commoner taxpayers, while the green line to noble taxpayers. The sample includes all taxpayers with strictly positive taxable income. The sample size is 744,119 (of which 464 are noble descendants).The sample includes all taxpayers with strictly positive taxable income. The sample size is 744,119 (of which 464 are noble descendants).

Figure 2.5: Main Source of Income

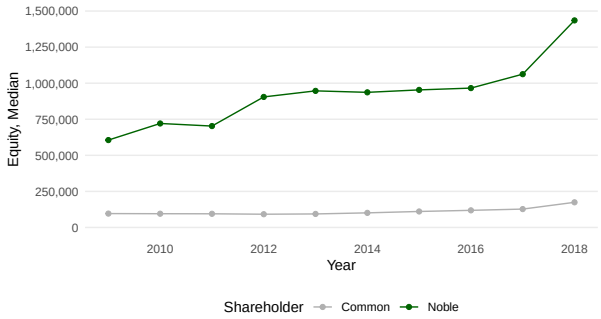


Notes: This figure shows the proportion of taxpayers by main source of income. Proportions are calculated as group-wise proportions for noble and commoner taxpayers separately. Sources of income are classified in five categories based on two variables that record the tax form used and the section of the tax form with the highest reported amount of income. “Capital" refers to income from partnerships, corporations, and limited liability companies. It does not include dividends distributed by listed companies. “Rent" includes income from real estate, including imputed rent for owner-occupied real estate. “Self-employment" includes income from self-employment activities and professional services (such as, lawyers, architects, engineers, etc...). “Employment" is equal to income from labor, finally “Other" include the remaining sources of income not already categorized.

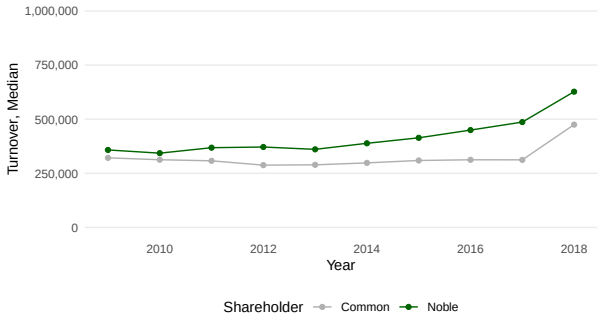
Figure 2.6: Characteristics of Firms by Shareholders' Type



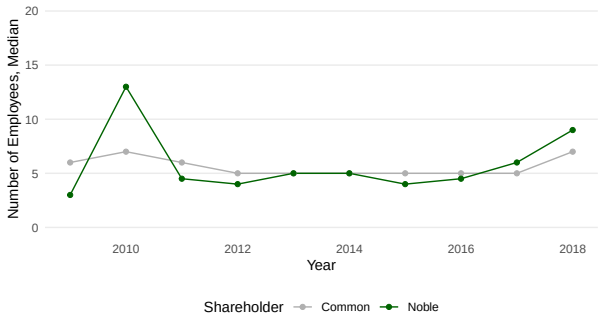
(a) Median total assets



(b) Median equity



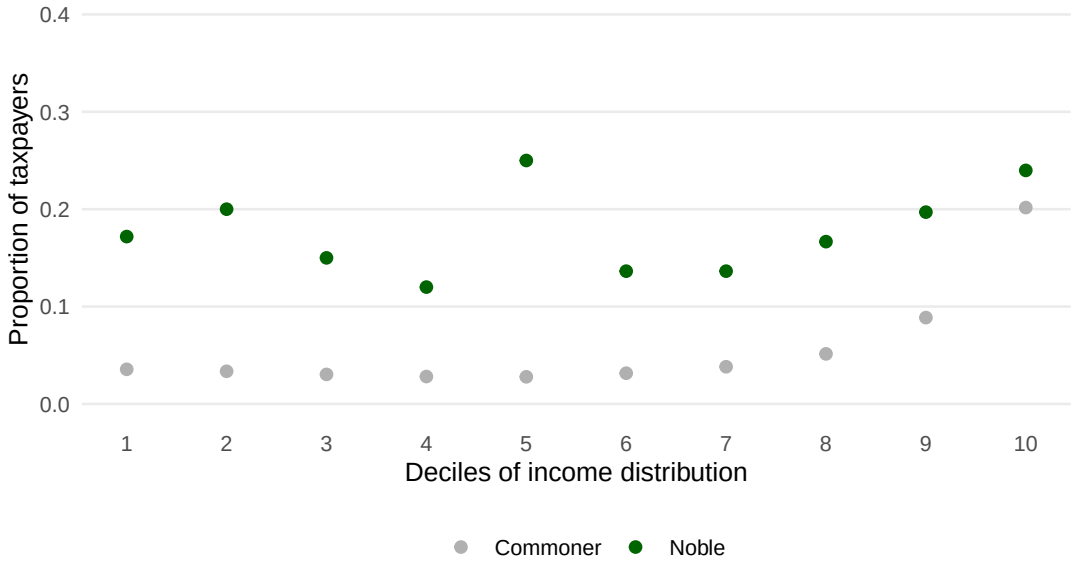
(c) Median turnover



(d) Median number of employees

Notes: These figures show the median of total asset (panel a), shareholders' equity (panel b), turnover (panel c), and number of employees (panel d) in year each from 2009 to 2018. The unit of analysis is a firm. The sample includes all firms registered in Italy over those years. The green line labeled "Noble" refers to all the firms that have at least one noble shareholder listed among their shareholders, while the gray line labeled "Grey" refers to all remaining firms.

Figure 2.7: Managers and Shareholders by Income Decile



Notes: This figure shows the proportion of individuals that are either shareholders or company officials in each decile of the income distribution for commoner and noble taxpayers separately. The unit of analysis is an individual taxpayer. Deciles of the income distribution are determined using the universe of tax filers living in Milan in 2005. A shareholder is defined as any taxpayer who holds share in a corporation, limited liability company, or limited partnership and is registered in the public registry of shareholders. A company official is defined as any taxpayer who holds an official role within a company, such as C-level managers, members of the board of directors, other executives, etc. The size of the sample is 888,720 individuals.

Chapter 3: Who Writes the Check to the Government Does Matter: Evidence from Firm-to-Firm Links

3.1 Introduction

How do firms and markets respond to reforms to tax collection? Does it matter whether it is the buyer or the seller who "writes the check to the government?" It is widely accepted that the amount of taxes affects the operations of businesses.[1] Tax collection, instead, is often considered to be inconsequential in the academic literature. Indeed, several public finance textbooks and advance surveys suggest that firms should ignore tax collection (Gruber, 2015; Kotlikoff and Summers, 1987).

In fact, policy makers often alter the side of the market that is responsible to collect and remit taxes to the government. Firms might need to adapt their operations to comply with these rules for several reasons. First, tax collection changes cash-flows between the two sides of the market. When the seller holds the responsibility to remit taxes, she receives the net price plus taxes at the time of the transaction. When the buyer remits taxes to the government, the seller receives the net price only. Second, tax collection affects the opportunities to evade. The side of the market that is supposed to remit taxes may fail to do so and evade the tax liability.

In this paper, I quantify the response of firms and markets to a reform to the collection

[1] See for example: Suárez Serrato and Zidar (2016); Fuest, Peichl and Siegloch (2018); Yagan (2015); Zwick and Mahon (2017); Chen et al. (2019); Auerbach (2002); Chetty and Saez (2005); Tørsløv, Wier and Zucman (2020).

of Value Added Tax (VAT). To do this, I use a new administrative dataset on firm-to-firm links from Italy and a quasi-experimental research design. The reform shifted the responsibility to remit payments of VAT from sellers to "trusted" buyers, such as government entities and large firms. I present three main findings. First, firm-to-firm links subject to the new rules are more likely to become inactive after the introduction of the new rules. Second, I find that the reform was costly for the average firm. Firms more exposed to the reform experienced lower sales and higher exit rates, relative to the counterfactual. Third, I document that the burden of the reform is not evenly distributed across firms. Small firms are hit hardest, while large firms do not appear to be negatively affected. As a result, I show that markets more exposed to the reform became more concentrated.

To establish a causal link between collection of VAT and firm behavior, I leverage a reform implemented in Italy. In 2015, the government shifted the responsibility to remit payments of VAT from the seller to the buyer for all transactions between firms and a subset of government entities. These rules were later extended to a broader set of entities in mid-2017. For each firm, I build a measure of exposure to the reform based on the share of pre-reform sales that would be subject to the new rules. In a difference-in-difference framework, I then compare firms that are relatively more exposed to the reform to firms that are less exposed to the reform.

To further clarify the logic of the exercise, consider two furniture manufacturers that sell office supplies to government and corporate clients. One of them predominantly sells its product to public entities, while the other to corporate clients. They follow the same set of rules to compute their VAT liability. However, the reform affects them differently because they serve separate sets of clients. The manufacturer doing business with government entities obtains lower cash-flows from its clients at the time of the transaction because it no longer receives VAT from its clients. The other manufacturer, instead, continues to collect VAT from its clients. The reform to the collection of VAT alters the availability of

liquid funds, which are a key source of financing for many small and medium sized enterprises.

The research design of the paper is based on the assumption that suppliers more exposed to the reform would have behaved similarly to less exposed suppliers. Several factors suggest that this is indeed the case. First, the two groups of firms are similar on a number of observables at baseline. Second, they are on parallel trends before the introduction of the reform.[2] Finally, among government entities, the distinction between affected and non-affected ones appear somewhat arbitrary. The general principle underlying the classification is that "economic" government entities fall within the scope of the reform, whereas "non-economic" ones do not, but there is a substantial number of exceptions to this general principle.[3]

To analyze the response of firms and markets to VAT collection, I exploit a new administrative dataset on firm-to-firm links from the Italian tax authority ("Agenzia delle Entrate"). This dataset captures the entire size distribution of firms, from small firms with few hundred thousand euros in annual revenues to large businesses. The possibility to span the entire distribution, including very small firms, allows me to perform detailed heterogeneity analysis. The dataset contains a random sample of sellers from three of the largest regions in Italy (Lombardy, Lazio, and Campania) for the years 2014-2016, covering around 40% of national value added.

Moving to the empirical analysis of the paper, I find that the reform reduced the proportion of firms that regularly remit VAT to the tax authority by almost 20 percentage points. This result can be interpreted as the first stage of the reform. On the intensive mar-

[2] I am able to provide evidence in support of the parallel trend assumption for variables measured at the infra annual frequency.

[3] It seems rather odd that all agencies supervising sea ports are exempted, while those supervising rivers are not. Departments of the national executive (including the Ministry of Economy and Finance) are subject to the reform, but the tax authority and the central bank are not. All public universities must apply the new rules, yet government agencies administering scholarships for university students are exempted.

gin, sellers reduce the average monthly payment of VAT by 30 percent. This represents a sizeable decline in the amount of cash-flows that each transaction generates, especially for firms that used to remit periodic payments to the tax authority and found themselves in a credit position vis-à-vis the tax authority.

To illustrate the response of firms and markets to VAT collection, I organize the results in three main sets. First, I show that the reform was costly for the average firm. Firm-to-firm links subject to the new rules are 2.5 percentage point more likely to become inactive. This altered the composition of buyers for sellers more exposed to the reform. They became less likely to continue trading with an affected client. Moreover, the reform caused a decline in reported sales by 2.2 percent and increased the exit probability by 1.1 percentage points on average. These results suggest that the reform to tax collection is far from irrelevant and imposes significant costs to firms.

Second, I document that the burden of the reform was not evenly distributed across firms. Small firms were hit hardest while large businesses appear to be unaffected, relative to the counterfactual. The reform lowered immediate cash-flows to the seller and reduced its opportunities to evade. Smaller firms are both more likely to evade and to be have limited access to external funds. Consistent with this, small firms exhibit higher exit rates relative to large firms. Large businesses have more flexibility to undo the negative impact of the reform.

Third, moving the analysis at the aggregate level, I show that tax collection impacts the structure of markets. In particular, tax collection of VAT increased market concentration in markets more exposed to the reform. A 10 percentage point higher exposure led to an increase of 40 points in the Herfindahl-Hirschman Index. This result suggests that the reform caused a reallocation of economic activity from small to large firms, therefore increasing market concentration. It provides further evidence that tax collection is far from neutral and it does have economic consequences.

This paper speaks to several strands of the literature. First, it relates to a growing literature in public finance that quantifies the behavioral response of firms to tax administration and, in particular, to the point of collection of a tax. Public finance textbooks (Gruber, 2015) and more advanced surveys (Kotlikoff and Summers, 1987) make the case for the irrelevance of statutory incidence, at least in a partial equilibrium setting. Yet, recent papers challenge this view and provide empirical evidence that the point of collection of a tax has real economic effects. For example, assigning statutory incidence to the side of the market least likely to evade has been proven successful in improving compliance (Kopczuk et al., 2016; Brockmeyer and Hernandez, 2019). In a qualitative discussion, Slemrod (2008) suggests that holding the responsibility to remit is beneficial to the firm because it increases cash-flows. A related branch of literature has identified rationales why individual taxpayers are not neutral to different regimes of tax collection, such as incomplete adjustment to withholding rules (Jones, 2012), underreaction to non-salient taxes (Chetty, Looney and Kroft, 2009) and asymmetric pass-through of payroll taxes depending on whether the statutory incidence falls on the employer or on the employee (Saez, Matsaganis and Tsakloglou, 2012).

In addition, this paper adds to the literature that exploits the availability of domestic firm-to-firm links to investigate how businesses are affected by their trading partners.[4] Being the first to use firm-to-firm links from Italy, this paper provides evidence on how tax collection affects patterns of trade between firms. Within this burgeoning strand of the literature, a handful of papers analyze how the tax system affects firm-to-firm relations. For example, Pomeranz (2015) shows that the positive effects of audits propagate along the supply chain in Chile thanks to the credit-invoice system of VAT, whereas Gadenne, Nandi and Rathelot (2019) show that firms are more likely to trade with business with the

[4]Examples include papers using data from Belgium (Dhyne, Kikkawa and Magerman, 2019; Tintelnot et al., 2018), Japan (Bernard et al., 2019; Furusawa et al., 2018), the US (Barrot and Sauvagnat, 2016), Chile (Huneeus, 2018) and Turkey (Demir et al., 2019).

same VAT registration status.

Finally, as the inversion of statutory incidence of VAT reduces cash-flows to seller, this paper adds to the empirical corporate finance literature that studies the role of cash-flows in firms' business decisions. A large empirical literature has shown that cash-flows affect investment (Fazzari, Hubbard and Petersen, 1988; **?**; Lamont, 1997; Rauh, 2006; Meyer and Kuh, 1957), and employment (Benmelech, Bergman and Seru, 2011; Chodorow-Reich, 2014; Barrot and Nanda, 2020). Using surveys of firms in Vietnam, McMillan and Woodruff (1999) show that firms are more likely to conduct business with firms that have more generous trade credit policies.

The rest of the paper proceeds as follows. Section 3.2 provides background on VAT and the policy reform studied in the paper. Section 3.3 describes the data, while Section 3.4 lays out the empirical strategy of the paper. Section 3.5 shows the first stage of the reform and its effect on the amount of VAT remitted by firms exposed to the reform. Section 3.6 documents the effects of VAT collection on business links and Section 3.7 on firms. Section 3.8 describes the heterogeneity in the treatment effect and Section 3.9 shows the effects of the reform at the aggregate level. Section 3.10 concludes.

3.2 Background on VAT Collection

To analyze the response of firms to the collection of VAT, I exploit a reform that shifted the responsibility to remit VAT from the seller to the buyer for all transactions between firms and a subset of government entities. This section provides details on the administration of VAT and on the rules around public procurement in Italy.

3.2.1 Periodic Payments of VAT

Italy introduced a broad-based VAT on sales of goods and services in the early 1970s, at around the same time as other Western European countries. Today, VAT represents one of the main sources of government revenues, accounting for 14.8% of total tax receipts in 2017 (OECD, 2019*b*). The seller of taxable goods and services is responsible to remit VAT to the tax authority. For each firm, the tax base is the difference between taxable sales and taxable purchases recorded over a calendar year.

Firms are required to make payments of their VAT liability throughout the year. The frequency of payments depend on the size of the firm. Larger firms make payments every month, while smaller firms every quarter[5]. At the end of every calendar year, firms file an annual VAT return where they reconcile any discrepancy between payments made throughout the year and the actual tax liability. Firms in a debit position are required to remit payment of any amount outstanding, while firms in a credit position may carry forward the credit or ask for a cash refund.

VAT liabilities and credits experience an asymmetric treatment from the tax authority. Firms that report a tax liability are required to make payments to the tax authority within 45 days after the end of the filing period. On the other hand, businesses that report a credit could either ask for a cash refund or carry forward the tax credit[6]. More than 90% of firms chooses the second option. This is mainly due to the fact that asking for a cash refund involves additional costs, stemming from additional checks that the tax authority performs on firms' books and the time-delay with which the tax authority fulfills requests for cash refunds.

[5]The sales threshold for making monthly VAT payments is €400,000 for services firms, whereas it is €700,000 for all other firms. The frequency of payments in year t depends on annual sales reported in year $t-1$.

[6]A third option would be to sell the credit to a third party, but this option is used very rarely.

Compliance Gaps in VAT

While VAT is generally considered to be easy to enforce because the credit-invoice system creates a long paper trails on transactions between firms (Pomeranz, 2015), the economic literature has began to analyze some issues with the administration of VAT. For example, VAT compliance is significantly lower at the retail stage because the credit-invoice system breaks down when the buyer is a final consumer (Naritomi, 2019). Another issue with VAT compliance that received recent scrutiny are so-called invoice mills, that is firms whose sole purpose is to produce invoices used as deductions by other businesses (Waseem, 2020).

Italy has a large VAT compliance gap relative to other developed countries (European Commission, 2020; Ministero dell'Economia e delle Finanze, 2019; D'Agosto and Santoro, 2019)[7]. As a result, the Italian government has introduced a number of programs to increase VAT compliance among firms and customers. The reform studied in this paper has been introduced against this background.

3.2.2 Quasi-experimental variation in statutory incidence

In 2015, the government shifted the responsibility to remit VAT from the seller to the buyer for all transactions between a firm and some government entities in 2015. Before the reform, the seller used to receive the tax-inclusive price from the buyer. After the reform, the seller obtains the tax-exclusive price, while the buyer remits the VAT to the tax authority. This reform did not alter the tax liability of the reform.

Even though these new rules required approval by the Italian parliament and unanimous consent by the European Union[8], they were approved on a relatively fast timeline.

[7]European Commission (2020) estimates the VAT compliance gap to reach 23.8% in Italy in 2017.

[8]While the main VAT rates are freely set by each EU country, all other aspects related to the implementation of VAT (including its collection) must by approved by the EU.

The reform was first presented by the government as one the many interventions that are bundled together in the annual budget process in mid-October 2014. After obtaining the final approval by the Italian parliament in late December, the new rules entered into force on January 1st, 2015. While the green light from the EU came in later on July 14th, 2015, the executive and the tax authority repeatedly issued binding guidelines on implementation and enforcement of the law[9]. Moreover, government entities affected by the reform issued notices to their suppliers that they would comply with the new rules and start withholding payment of VAT.

The government broadened the set of transactions affected by the reform in mid-2017. This extension of the reform was not anticipated at the time of the first roll out of the policy in 2015. Yet, it created a set of clients that were not affected in the first phase of the reform that would later be affected by the same rules. These clients are (i) government entities that were exempted in the first phase, (ii) firms owned or controlled by the central and local government, (iii) firms traded on the Milan stock exchange and included in the FTSE MIB index.

This staggered implementation of the reform allows me to distinguish between clients that had to apply the new rules on VAT collection in 2015 and those that were exempted at first and had to apply the new rules on tax collection in mid 2017. The empirical strategy of this paper relies on this staggered implementation of the reform to create a treatment and control group.

3.2.3 Similar Reforms in Other Countries

Several countries adopted policies similar to the one studied in this paper. The US came quite close to implementing an almost identical reform that would have introduced

[9]The Ministry for Economic Affairs and Finance issued binding guidelines on 1/23/2015 and the tax authority followed on 2/9/2015.

a withholding provision on payments to government contractors. This section situates the reform implemented in Italy in the broader effort of governments around the world to curb tax evasion.

Several countries have shifted the responsibility to remit VAT from the seller to the buyer for a subset of transactions in the economy. This type of reforms is commonly known as *"reverse charge."* Developing and developed countries have adopted it over the past decades. For example, the UK has implemented a reverse charge for all domestic business transactions involving mobile phones, computer chips, and wholesale gas and electricity[10]. Similarly to the reform implemented in Italy, the reverse charge assigns the responsibility to remit VAT to the buyer. However, the UK reform usually includes provisions that impose joint and several liability on the seller if the buyer fails to ultimately remit VAT to the tax authority. The reform in Italy does not impose any liability on the seller for the buyer's failure to remit payments of VAT.

In developing countries, governments have introduced a number of withholding provisions on VAT that also result in deviation from the general rule. In Peru, for example, the buyer is required to withhold a fraction of the value of the transaction and deposit it on a separate bank account. The seller can access those funds to settle tax liabilities within the first three months of the transaction.

The US came close to enacting a reform similar to the one passed in Italy. In 2006, the US approved a 3 percent withholding on all payments from federal, state and local governments. The amount withheld would be then be credited towards the firm's income tax liability. Firms would be able to reconcile withheld taxes with their tax liability on their annual returns. The law was scheduled to enter into force in 2009, but Congress delayed its implementation twice before repealing it in 2013. The reforms were both justified on

[10]The UK tax authority provides a detailed and practical guidance on the domestic reverse charge implemented in the UK is available at https://www.gov.uk/guidance/the-vat-domestic-reverse-charge-procedure-notice-735.

the grounds of limiting tax evasion by government contractors.

While these reforms are introduced to limit tax evasions, businesses often complain about their costs. In particular, the impact of tax collection of cash-flows is one of the top concerns raised by firms. Indeed, this was one of the main reasons why the US Congress finally repealed the reform before it became effective. In Italy, business associations were vocal in their opposition to the reform and the trade group supporting construction companies is now suing the Italian government to obtain relief from the costs associated with the reform.

3.2.4 Government Procurement

Government procurement spans a large set of industries and its weight in the Italian economy is sizeable: it accounts for 10.4% of GDP in 2017 (OECD, 2019*a*). In addition to the executive branch, the perimeter of government includes the majority of universities, schools, and hospitals. This is higher than the US, but in line with other European countries. Therefore, the reform to the collection of VAT affected a rather diverse set of industries and firms.

Transactions between firms and government entities receive more scrutiny relative to other business transactions. All public offices in Italy are subject to binding transparency requirements set by the European Union. As the size of the transaction increases, the publicity requirements increase as well. For goods and services that are expected to cost more than €40,000, government entities are required to use an action to select the winning firm. Whereas, contracts below the threshold of €40,000, government offices can procure goods or services without the need of a public tender. Despite all the rules on transparency, public procurement is not immune from instances of corruption or collusion among bidders (Conley and Decarolis, 2016; Tulli, 2019).

3.3 Data

This section describes the main datasets used to measure the response of firms and markets to a reform to VAT collection.

3.3.1 Firm-to-Firm Links and VAT Returns

The main dataset contains information on firm-to-firm links for a random sample of sellers, for the years 2014-2016. This information comes from mandatory information reports that firms must file annually with the tax authority. Firms in this dataset are then linked to their annual VAT returns via unique identifiers. In this section, I describe the data sources and the process to select the samples.

For the purpose of this analysis, the tax authority created a stratified random sample of 100,000 firms. The stratification is based (i) on the geographic location of firms and (ii) on the pre-reform relationships of firms. Firms in my sample are located in three large Italian regions (Campania, Lazio, and Lombardia), accounting for slightly less than 40% of total value added in Italy. While this sample is not nationally representative, it captures the wide geographic heterogeneity within Italy since Lombardia is in the North, Lazio in the Center, and Campania in the South.

From this sample, I exclude firms with zero or negative sales. I also eliminate firms below the minimum VAT registration threshold, to limit the issues stemming from selective registration below the threshold. The exemption threshold for VAT registration in Italy ranges between €15,000 and 40,000 of annual sales, depending on the firm's industry. This leaves me with 63,267 firms in the *full sample*. For the main analysis on firm outcomes, I further restrict the sample to firms that have pre-reform relations with either affected clients or non-affected clients. This is the *analysis sample* and it includes 14,987

firms.

In addition to firm-to-firm links, this paper uses annual VAT returns for the universe firms registered in the same three regions. The dataset contains line-by-line items from annual VAT returns for all firms. Businesses are required to provide detailed information on sales, purchases, value added and to compute any VAT liability outstanding at the end of the fiscal year. In case firms are due a refund, they also file an annual return to settle their credit position. Some firms are not required to file an annual VAT return and therefore they do not appear in the dataset. These include (i) firms that exclusively perform domestic VAT-exempt transactions, (ii) firms that adopt a simplified regime to calculate their tax liabilities[11], (iii) agricultural firms.

Table 3.1 provides summary statistics for the main variables in the sample. The median firms reports sales of €307 thousand at baseline, with the 10th and the 90th percentiles at €57 thousand and €3.5 million respectively. The distribution is skewed to the right as the mean is at 1.5 million thousand. Turning to tax variables, the median value added is €113 thousand, while the median tax base is even higher at €268 thousand. All costs measures do not include labor costs, as these expenses are not deductible for VAT purposes. Following standard practice with firm-level data, all variables are winsorized at the 99^{th} percentile to limit the influence of outliers. In the main specifications, all variables enter in logs, while value added and tax base are scaled by baseline sales.

3.3.2 Financial Accounts

I use financial accounts of all registered firms in Italy to compare the distribution of firms across industries and provinces in the VAT dataset. This data is obtained from the

[11] In 2014, there were three simplified regimes. In 2015, the government added a fourth one, which became the only simplified regime in force starting from 2016. All of these regimes are open to small firms with annual sales below some regime-specific threshold. However, they all prescribe additional eligibility requirements that further restrict the pool of eligible firms (More details on this in the Appendix).

Amadeus dataset from Bureau van Dijk. It includes the universe of limited liability entities, excluding most of sole proprietorship and unincorporated partnerships.

3.4 Empirical Strategy

To quantify the response of firms to the reform of VAT collection, I adopt a difference-in-difference framework. I compare firms with pre-reform relationships with affected clients and firms with pre-reform relationships with non-affected clients. Moreover, to reflect the intensity of these relationships, I measure the share of pre-reform business sales going to affected clients.

3.4.1 Measuring Reform Exposure at the Firm Level

I define the measure of intensity of the reform as the share of pre-reform sales to affected clients. In the economy, there are firms that develop highly specialized relationships with a handful of clients, while others do not specialize and have thousands of clients. As the reform targeted a subset of transactions in the economy, businesses vary in the degree of exposure to the new rules depending on their pre-reform relationships. Conditional on serving at least one affected client in 2014, firms differ in the share of business sales going to affected clients. To capture this ex-ante heterogeneity, the measure of exposure is the share of business sales going to affected clients.

Formally, let B_f be the set of buyers of goods and services produced by firm f. Then, consider the partition of B_f between clients that are affected by the new rules, denoted as B_f^A, and those that are not B_f^N. The latter group of clients continue to send the net price and VAT to its sellers after the reform, whereas the former withholds payment of VAT to its sellers. Let's denote the annual value of the link between firm f and buyer i as y_{if}. Then, the total value of business sales for firm f is $y_f = \sum_{i \in B_f} y_{if}$. With this notation, I

define the exposure to the reform of VAT collection as the ratio of sales to affected clients to total sales:

$$\text{Exposure}_f = \frac{\sum_{i \in B_f^A} y_{if}}{y_f}$$

This measure of exposure is bounded between 0 and 1 by definition. The higher its value, the more exposed the firm is to the reform.

Figure 3.1 reports the distribution of this variable for all firms, conditional on having at least one pre-reform relationship with affected clients. The figure shows that firms are quite heterogeneous in their exposure to government entities as they span the entire interval between 0 and 1. Moreover, the distribution appear to be bi-modal with a significant mass of firms that are completely specialized and others that generate only a small share of business sales from government entities. Finally, to report summary statistics, the mean of $Exposure$ is 0.116 with a standard deviation of 0.243.

3.4.2 Measuring Reform Exposure at the Market Level

To assess whether the adjustment affected the structure of markets, I compare markets more exposed to the reform to markets less exposed. Mirroring the empirical strategy adopted at the firm level, I measure the exposure to the reform at the market level as the share of business sales going to government entities, that is:

$$\text{Market exposure}_m = \frac{\sum_f y_f}{Y_m}$$

where m identifies a market and f firms within each market. Y_m represents total sales in market m. To ease notation, this variable does not have time subscript as it pertains to pre-reform information. Markets exhibit a high degree of heterogeneity in terms of the

prevalence of government procurement.

3.5 First Stage: Effect on VAT Payments

This section shows that assigning the responsibility to remit VAT to the buyer significantly reduced periodic payments of VAT by the seller. Heuristically, this can be interpreted as the first stage of the reform. Moreover, this section shows evidence that treated and control firms were on parallel trends before the reform, lending credence to the empirical design of the paper. Finally, I discuss the economic significance and magnitude of the shock for the median firm in the analysis sample.

3.5.1 Extensive Margin Results on VAT Remittance

The first outcome to consider is whether the reform reduced the proportion of firms that periodically remit VAT to the tax authority. Firms are required to compute their VAT position every quarter or every month for large firms. If any VAT is due, they must remit payment within the tax deadline. If they report a VAT credit, firms may decide to carry forward the credit or ask for a cash refund. In either case, they need to report the VAT balance in each period.

To quantify the effect of the reform on VAT remittance, I estimate the following event-study specification:

$$y_{ft} = \sum_{s \neq 0} \alpha_s \cdot Exposure_f + \sum_{s \neq 0} \beta_s \cdot Exposure_f \cdot \mathbb{1}\{Quarter_s = t\} + x'_{ft}\gamma + \delta_t + \varepsilon_{ft} \qquad (3.1)$$

where $Exposure_f$ captures the exposure to the reform defined in Section 3.4.1, $\mathbb{1}\{Quarter_s = t\}$ is a dummy equal to one when the quarter equals t, $x'_{ft}\gamma$ include industry by filing

period and province by filing period fixed effects to flexibly control for time trends common to all firms within each industry and province. In the extensive margin model, the dependent variable is an indicator variable equal to 1 for firm f when it remits any positive amount of VAT in period t. Standard errors are clustered at the firm level.

Figure 3.3 plots the estimate $\hat{\beta}_s$ from the above specification obtained via OLS. These coefficients represent the reduced-form effect of the reform on the probability to remit any VAT payment in a given filing period. I report results separately for monthly and quarterly filers in order to deal with differences in the frequency of periodic VAT deadlines across these two groups of firms.

The results show a sharp and persistent drop in the probability of remitting any VAT among firms with pre-reform relationships with affected clients. To quantify the effect, Figure 3.3 shows that 10 percentage point higher exposure to the reform leads to a 2 percentage point decline in the probability of remitting any VAT, by the end of the second quarter following the reform. Moreover, the size of the effect remains stable afterwards. Finally, the probability of reporting a VAT credit increased by a similar amount.

Estimates are robust across specifications and are reported in Tables C.3. Columns (1) and (4) include fixed effects by industry-year and province-year, while Columns (2) and (5) have fixed effects by industry-filing period and province-filing period. Finally, results are broadly unchanged when defining VAT payments and credits on a a gross rather than net basis. These results are in Column (3) and Column (6).

In terms of internal validity of the research design, these figures provide a visual inspection of the parallel trend assumption. The underlying identifying assumption of the research design is that firms less exposed to the reform offer a valid counterfactual for those firms that are more exposed. The periodic VAT balance reported on annual VAT returns of firms provides a high-frequency view of firms' operations before the introduction of the reform.

Indeed, Figures 3.3 and 3.4 show that there is no evidence of diverging trends between firms with pre-reform relations with affected buyers and those without in the period before the reform. These results lend credence to the key identification assumption that underpins the research design of the paper. In the Appendix, I report results estimated for the sample of quarterly filers, which also support the identification assumption of this research design.

3.5.2 Intensive Margin Results

Figure 3.5 shows the effect of the reform to VAT collection on the value of periodic VAT payments in panel (a) and of periodic VAT credits in panel (b). Similarly to the extensive margin results, the sample contains all monthly filers in the analysis sample and the specification includes fixed effects by industry-filing period, province-filing period, and firm.

The results show that the reform induced a share and large decline in the amount of VAT remitted by firms. In particular, 10 percentage point higher exposure leads to a 20 percent decline in periodic VAT payments to the tax authority. For the remaining periods, the magnitude of the effect is broadly unchanged. As shown in Tables C.4 and C.5, results are robust to the inclusion of fixed effects by industry-year and province-year.

3.5.3 Magnitude of the Shock

At this point, it is worth assessing the size of the shock for the median firm in the analysis sample. One potential concern would be that the size of the reform is relatively small for most firms. In this section, I provide details on the magnitude to the reform to assuage this concern.

First, baseline monthly VAT payments amount to €17,000 which represent 24 percent

of estimated monthly sales[12], whereas VAT credits are 13 percent of monthly sales, on average. These statistics are calculated on the full sample, thus including firms that make no VAT payment or report zero VAT credit in some filing period. If instead we consider firms that regularly remit payments or report a credit, the ratio of VAT payments and credits to monthly sales increases[13].

Second, the share of sales subject to the inversion of statutory incidence is sizeable. Conditional on doing business with at least one affected client, the share of sales subject to the reform is 10 percent for the average firm. This increases to 19 percent if we exclude sales to final consumers and exports, which are not reported in the firm-to-firm dataset. Similarly, the share of VAT due on sales subject to the reform is 18 percent of total VAT.

3.6 Effects of VAT Collection on Business Links

This section presents the effects of VAT collection on firm-to-firm links. I find that the reform had an adverse effect on business links on the extensive margin. Firm-to-firm links subject to the new rules were 2.5 percentage point more likely to become inactive, relative to the counterfactual. On the intensive margin, the reform led to a 3.4 percent decline in the value of transactions. While the point estimate is not statistically different from zero, the 95 percent confidence interval excludes an increase larger than 0.3 percent. This suggests that the reform did not increase the reported value of links that remain active throughout the reform.

[12]VAT returns report sales at the annual frequency. To obtain an estimate for monthly sales, I divide the annual value by 12.

[13]Firms that regularly remit payments are defined as those that make a payment for at least 8 months in a year.

3.6.1 Specifications

To conduct the analysis at the link level, I adopt the following specification:

$$y_{lft} = \beta_0 + \sum_{s \neq 0} \beta_s \cdot T_l \cdot \mathbb{1}\{Year_t = s\} + x'_{lft}\gamma + \delta_t + \varepsilon_{lft} \tag{3.2}$$

where each observation is a firm-to-firm link l for firm f in year t. The dummy T_l indicates whether the link is subject to the new rules on tax collection. The dependent variable y_{lft} is either the probability that the link is active in year t or the net value of the link. A link is active if the annual value of transactions is above €1,000. The vector x_{lft} contains fixed effects for firm, industry by year, and province by year. In specifications without firm fixed effects, it also includes pre-determined controls for the number of links and total sales of each seller. The sample of firm-to-firm links include links that account for at least 0.1% of firm sales to other businesses. This sample restriction ensures that results are not driven by firms that are marginally important. Results estimated on the full sample of firm-to-firm links are reported in the Appendix. Standard errors are clustered at the seller level.

To understand whether the reform changed the types of clients that firms are trading with, I run the following specification at the firm-level:

$$y_{ft} = \beta_0 + \sum_{s \neq 0} \beta_s \cdot Exposure_f \cdot \mathbb{1}\{Year_t = s\} + x'_{ft}\gamma + \delta_t + \varepsilon_{ft} \tag{3.3}$$

where each observation is a firm i in year t. The dependent variable is an indicator that signals whether the firm continues to do business with an affected clients or starts a new link in year t. The vector x_{it} includes a full set of fixed effects. To measure the adjustment to the types of clients, I use the full sample of firms.

3.6.2 Extensive Margin Effects on Business Links

In this section, I document how the reform to VAT collection affected firm-to-firm links on the extensive margin. Firm-to-firm links that are subject to the new rules are 2.5 percentage point more likely to become inactive. Moreover, firms more exposed to the reform are 10 percentage point less likely to continue trading with affected clients, relative to the counterfactual.

Table 3.3 shows that firm-to-firm links subject to the new rules on VAT statutory incidence were more likely to become inactive after the reform, relative to links non-affected by the reform. I estimate the conditional probability of the link remaining active after the reform via OLS. In the specification with a full range of fixed effects, the survival probability of links to affected clients is 2.5 percentage points lower relative to other links (Column (4) in Table 3.3). This specification includes fixed effects for industry by year, province by year, and firm. Columns (1) to (3) reduce the set of fixed effects included in the specifications. The results are robust and they indicate a lower survival probability for links subject to the new rules on VAT remittance.

To understand which links became inactive, I explore the heterogeneity of the effects of the new rules on VAT statutory incidence next. Table 3.4 shows that links that make up a larger share of business sales exhibit the largest decline in survival probability, relative to the counterfactual. The table also shows that all links affected by the reform have a lower survival probability. The estimates are all significant at the 1 percent level and are precisely estimated. Reflecting the smaller sample size, standard errors for strategic links are wider. The large and negative effect for links that account for a large share of business sales mechanically implies a significant adjustment on the part of firms.

The magnitude of the effect is more uniform across the size distribution, with small and large links roughly equally likely to remain active after the reform. The relationship

between size of the link and the effect of the reform is non-monotonic with links in the mid-range of the distribution having the highest survival probability. That said, the coefficient of each quantile are not statistically different from each other.

I then check whether the negative effect on the survival of firm-to-firm links altered the composition of buyers of firms. Figure 3.6 shows that firms more exposed to the reform are 4 percentage points less likely to trade with affected clients. This effect manifest the year following the reform and it remains stable afterwards. Table 3.7 provides the coefficient estimates.

3.6.3 Intensive Margin Response on Existing Links

In this section, I compute the effect of the reform to VAT collection on the value of links that remain active throughout the sample. The results on the intensive margin detects any change in reporting behavior of sellers. Brockmeyer and Hernandez (2019) finds that a reform to tax collection of sales taxes increased the reported value of transactions. Moreover, the value of links reported by firms is one of the determinant of the amount of taxes effectively collected by the tax authority.

Table 3.6 shows that the value of firm-to-firm links declined by 3.4 percent, on average. While the point estimate is rather stable across specifications, the effect is not statistically different from zero at common levels of significance. Yet, the 95 percent confidence interval can exclude any increase in the value of firm-to-firm transactions larger than 0.3 percent. This result can therefore exclude any economically significant increase in the reported value of existing links.

3.7 Effects of VAT Collection on Firm Outcomes

In this section, I present the results on the effects of the reform to VAT collection on the operations of sellers. I showed earlier that the reform altered relationships that were in place between sellers and affected clients and shifted the composition of buyers away from affected clients. This response is consistent with higher costs of trading between sellers and affected clients. Yet, firms have ample margins to adapt. For example, they can substitute government clients with non-affected ones. Or they expand already existing relationships with non-affected clients. Therefore, it is worth investigating what happens to the outcomes of firms more exposed to the reform. I first look at the effects on sales and purchases and then to the exit rates of firms.

3.7.1 Sales and Purchases

The first set of firm-level outcomes I examine are sales and purchases. These variables provide a good measure of how the reform affected businesses.

Table 3.8 shows that firms more exposed to the reform reduced their reported business sales. Column (4) shows firms with 10 percentage point more pre-reform sales to affected clients experienced a decline in reported business sales by 2.2 percentage points. The effect is precisely estimated as the 95 percent confidence interval ranges from -1.1 to -3.3. While point estimates are noisy across specifications, the models with the most comprehensive sets of fixed effects point to a decline in business sales.

3.7.2 Firm Exit

The adjustment of business operations to the new rules on VAT collection is costly for the average firm. The results in the previous section show that firms did not manage to off-

set affected links that became inactive with new clients in the aftermath of the reform. As a result, some firms might hit the participation constraint and shut down. In this section, I compare exit rates for more and less exposed firms.

Table 3.9 shows that firms with pre-reform relationships with affected clients were more likely to become inactive after the reform to VAT collection. An active firm is defined as a business with at least €50,000 in annual revenues. While this definition would mis-classify some active businesses as inactive, it has the advantage of avoiding any interaction with the exemption thresholds for VAT registration. The qualitative results are robust to the choice of the threshold and I will report heterogeneity results for different firm sizes.

In the OLS specifications, the inversion of statutory incidence for VAT has a negative effect on firm survival. Column 1 reports the results from the specification without fixed effects or controls, while Column 4 includes industry and province fixed effects. The coefficients are precisely estimated and very similar across specifications. Column 4 shows that firms that were more exposed to affected clients before the reform were more likely to become inactive. More specifically, a 10 percentage point increase in the proportion of sales to affected clients lead to a decline in the probability of remaining active by 1.1 percentage points. The implied magnitude is not trivial. As reference, the unadjusted exit rates for firms without pre-reform relationships with affected clients is 14pp two years after the base year. This implies that the reform caused a 7.8 percent increase in the exit rate of firms exposed to affected clients.

Table 3.10 presents the results of the heterogeneity analysis. I divide firms into quintiles based on their pre-reform total sales. The Table shows that firms in the smallest quintile of the size distribution exhibited the largest increase in exit rates, with the effect decreasing in absolute terms as the size of the firm increases. That said, the effect of the reform on exit rates is negative for all quintiles of the size distribution. This pattern of heterogeneity

in the treatment effect is not surprising. Previous literature has shown that smaller firms are more likely to evade and are also more likely to hold little cash at their disposal.

3.8 Heterogeneous Response

In this section, I explore the heterogeneity in the response of firms. I do so by estimating the impact of VAT collection for different groups of firms based on pre-reform characteristics. I measure any treatment heterogeneity along two dimensions: firm size and geographical location. I run the following specification on firms in the analysis sample:

$$\begin{aligned} y_{ft} = \quad & \beta_0 + \textstyle\sum_{g \in G} \beta_{1,g} Exposure_f \cdot After_t \cdot \mathbb{1}\{Group = g\} + \\ & \beta_2 Exposure_f \cdot After_t + x'_{ft}\gamma + \delta_t + \eta_g + \varepsilon_{ft} \end{aligned} \tag{3.4}$$

where $Exposure_f$ captures the exposure to the reform defined in Section 3.4.1, $After_t$ is a dummy equal to 1 for years 2015 and 2016 and $\mathbb{1}\{Group = g\}$ is a dummy that uniquely assigns each firm to a group based on pre-determined size and location. Specifications include fixed effects for firms, industry by year, and province by year. Standard errors are clustered at the firm level.

Heterogeneity by Size. First, I find that there is significant treatment heterogeneity by firm size. I divide firms into four groups by pre-reform annual sales[14]. Figure 3.7 shows that smaller firms exhibit higher exit rates, compared to larger firms. For the group containing the smallest firms, the point estimate is negative and statistically different from zero. Interestingly, the point estimate turns positive for the two largest groups of firms by size. This suggests that the burden of the reform to VAT collection is unevenly distributed across the size distribution. In addition the higher exit rates for small firms and lower exit

[14]The four groups are determined by the intervals €50,000-250,000; €250,000-500,000; €500,000-1,000,000; and firms above €1,000,000 in annual sales.

rates for large firms point to a reallocation of economic activity among firms exposed to the reform towards larger firms. This has implications for the structure of markets that I explore in the next Section.

The pattern of heterogeneity of the effect is not as clear when examining the effect of the reform on business sales in a balanced panel of firms (Table 3.11). Point estimates are lowest for larger firms, but they are not statistically different across size groups.

3.9 Effects of VAT Collection on Markets

Does VAT collection influence supply chains and markets at the aggregate level? Did overall tax collection improve in markets more exposed to the reform? As the reform to VAT collection altered interactions between firms, it is worth investigating whether the reform altered the structure of markets.

In this section, I show that VAT collection and the ensuing adjustment at the firm level affected market structure and increased the overall tax base. In particular, I find that concentration in industries more exposed to the reform increased. As smaller firms exhibit a lower survival probability and lower sales, larger firms stood to gain and accounted for a larger share of market sales after the reform. To quantify these aggregate effects, I use the full sample of firms and I define markets by 2-digit industries and provinces. Mirroring the empirical strategy adopted at the firm level in the previous sections, I distinguish markets more exposed to VAT collection based on the share of pre-reform market sales that would be subject to the new reform.

3.9.1 Market level Specifications

To estimate the effects of VAT collection on markets, I distinguish markets more exposed to the reform from markets less exposed. This strategy mirrors the empirical strat-

egy adopted in previous sections to measure the effects of the reform at the firm level. The measure of exposure is the share of pre-reform sales that would be subject to the reform to VAT collection. In symbols:

$$\text{Market exposure} = \frac{\sum_f s_f}{sales}$$

Markets are defined as pairs of industry and location. In the full dataset, there are 80 two-digit industries and 21 industries which create 1,463 markets. Table 3.12 provides summary statistics for markets. They are heterogeneous in terms of size, number of active firms, and concentration. As this dataset comes from information reported on VAT returns, they exclude sales that are exempted from VAT and they do not include firms below the VAT registration threshold. More fundamentally, one might be concerned that the sampling process might lead to bias in the analysis at the market level[15]. To assuage this concerns, I cross-check the distribution of sales by industry in the full sample and in an external dataset. In particular, I use mandatory financial accounts provided that all limited liability entities must file with the company registry. Figure 3.9 shows that the proportion of sales by industry is relatively similar across datasets, supporting the use of the full sample for the market level analysis.

The empirical specification at the aggregate level is equivalent to the firm level specification

$$y_{mt} = \beta_0 + \beta_1 \text{Market Exposure}_m \times \text{After}_t + \varepsilon_{mt} \tag{3.5}$$

where $MarketExposure$ is defined above.

At the aggregate level, I will focus on two main sets of variables. First, I will examine how VAT collection has changed the interactions between firms. Given that taxable events

[15]The full sample is random sample of buyers of affected and non-affected clients, stratified by geography.

are transactions between firms along the supply chain, the administration and collection of VAT could alter the concentration of firms in a market and the types of transactions occurring between them. Second, I will focus on the effect of the reform on the VAT tax base. As the stated goal of the reform is to improve tax compliance, it is natural to examine whether the reform managed to increase the reported tax base.

3.9.2 Market Concentration

In Section 3.7.2, I showed that smaller firms exhibit the highest increase in exit rates. This highlights the uneven distribution of the burden of the reform of VAT collection. In this section, I show that this pattern translate into a higher concentration of markets. Therefore, larger firms stood to gain from the exit of smaller firms and they increased their market power. I use two measures of market concentration that are standard in the literature: the Herfindahl-Hirschman (HH) Index and the share of sales made by the top 3 firms in each market. The correlation between these two measures is high and results are qualitatively similar across the two measures.

Table 3.13 shows that the HH Index increased by 444 points in markets more exposed to the reform. The coefficient is stable to the inclusion of finer sets of fixed effects. Column (1) reports the results for the specification without fixed effect, Column (2) includes fixed effects for industry, Column (3) has fixed effects for provinces, while Column (4) includes fixed effects at the level of individual markets. As a robustness check, I measure the importance of large firms in each market by computing the share of sales made by the top 1, 2, or 3 firms in each markets over time. Table 3.14 suggests that VAT collection increased the share of sales by the largest firms in each market.

These results suggest that the adjustment that occurred among firms altered the structure of markets. Indeed, with larger appearing to benefit from the reform and smaller

firms being the ones hardest hit, economic activity shifted towards larger firms. It is ex-ante unclear whether this effect improves overall welfare or not. On the one hand, market concentration is usually associated with higher market prices. In the current context, higher prices for government procurement would have a negative effect on welfare. On the other hand, if firms that exit the market are firms that are evading or, even more extreme, if they were operating because they were evading, then the reform successfully increased the cost of operations of those businesses. In order to assess the overall benefits, I turn to the effect of the reform on the tax base.

3.9.3 Aggregate Tax Variables

To measure whether the reform achieved the stated goal of reducing tax evasion, I examine the effect on the aggregate tax base in markets more exposed to the reform. Keen and Slemrod (2017) propose to use the responsiveness of tax revenues collected as a sufficient statistics to evaluate interventions in tax administration. Tax revenues are proportional to the tax base, in this section I measure the change in the aggregate tax base in markets that are more exposed to the reform.

Table 3.15 shows that the aggregate tax went up in markets more exposed to the reform. The effect is positive in all specifications, yet it is imprecisely estimated and not statistically different from zero. Therefore, the overall effort of the reform to increase compliance remains limited, yet the costs to individual firms are substantial.

3.10 Conclusions

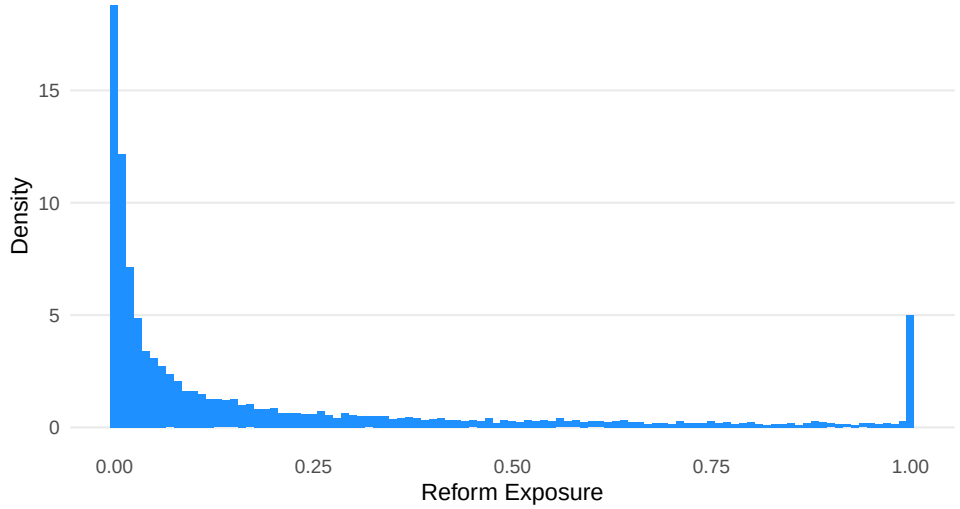
This paper shows that assigning the responsibility to remit taxes to the buyer or the seller has economic consequences. It affects the operations of businesses and the structure of markets. Combining a new administrative data set on firm-to-firm links and a quasi-

experimental research design, I find that links subject to the new rules are more likely to become inactive. Moreover, firms exposed to the reform exhibit lower sales and a higher exit probability. I document that the burden of the reform is not evenly distributed across firms. Smaller firms were hardest hit, while larger firms did not appear to be negatively affected. Finally, I find that this heterogeneity translates into an effect at the aggregate level. I show that markets more exposed to the reform became more concentrated, suggesting a reallocation of economic activity from small to large firms.

While the reform achieved its stated goal of increasing tax collection, it imposed costs on firms. Interventions in tax administration and collection have generally proven to be successful in raising revenues. Yet, the costs of these measures are usually poorly studied or ignored by policy makers. Several interventions in tax administration might alter the cash-flows to each side of the market. It is crucial that policy makers have in mind the distribution of the burden of the reform.

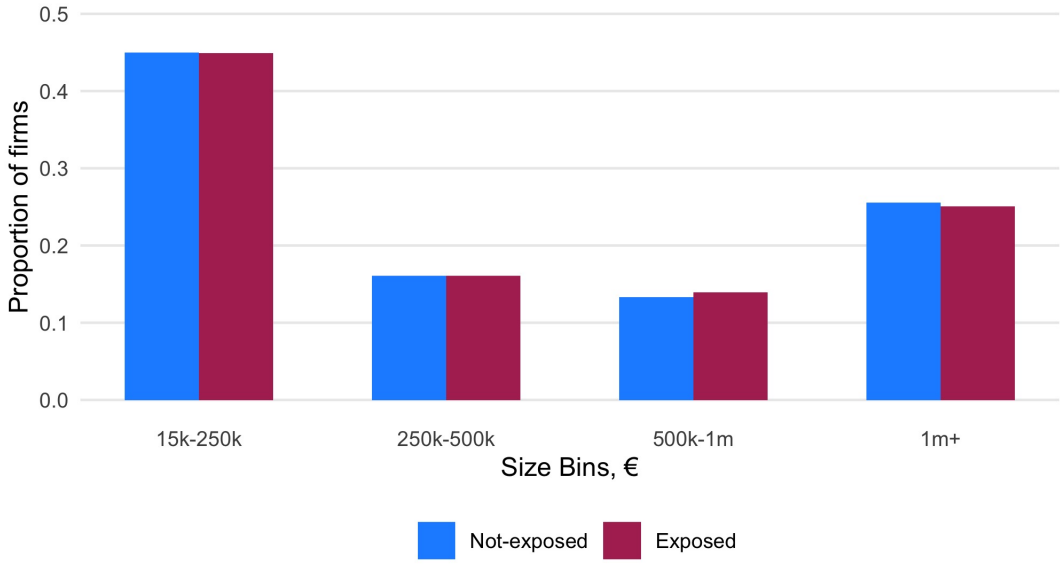
Figures

Figure 3.1: Treatment Exposure



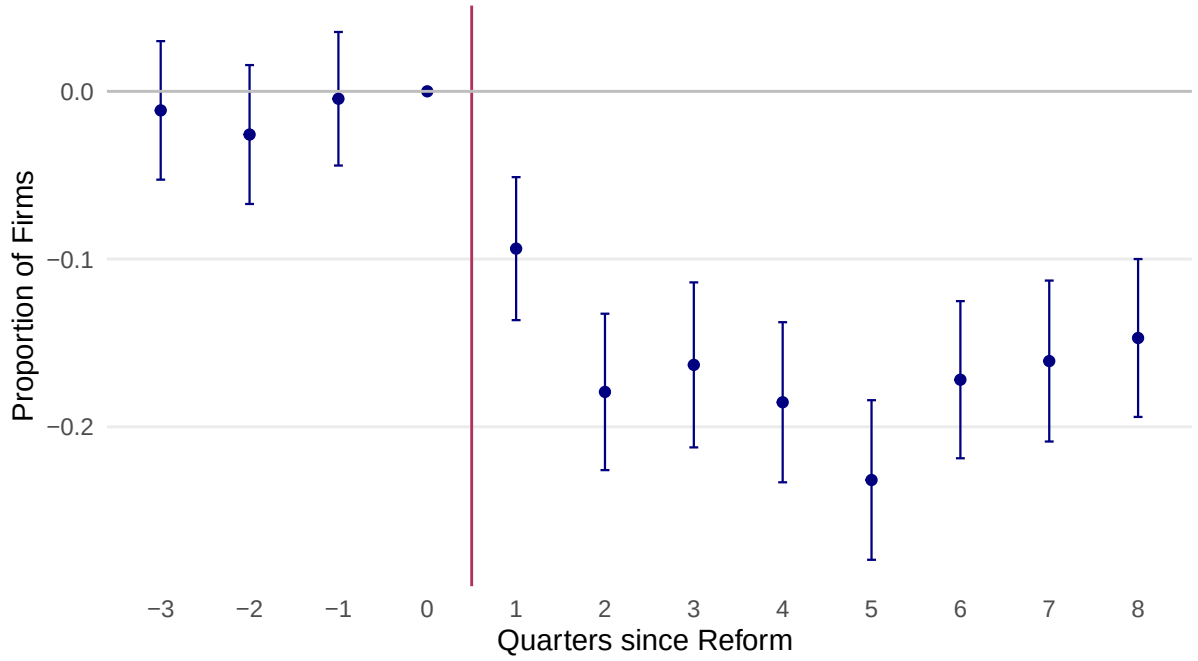
Notes: The figure represents the univariate distribution of the variable *Exposure* calculated for sellers with at least one link with an affected buyer. The variable $Exposure$ represents the intensity ot the treatment effect for each and it is defined as the share of pre-reform sales going to affected clients (Section 3.4.1) This variables is defined using data from 2014, before the introduction of the reform.

Figure 3.2: Size Distribution of Firms in the Analysis Sample



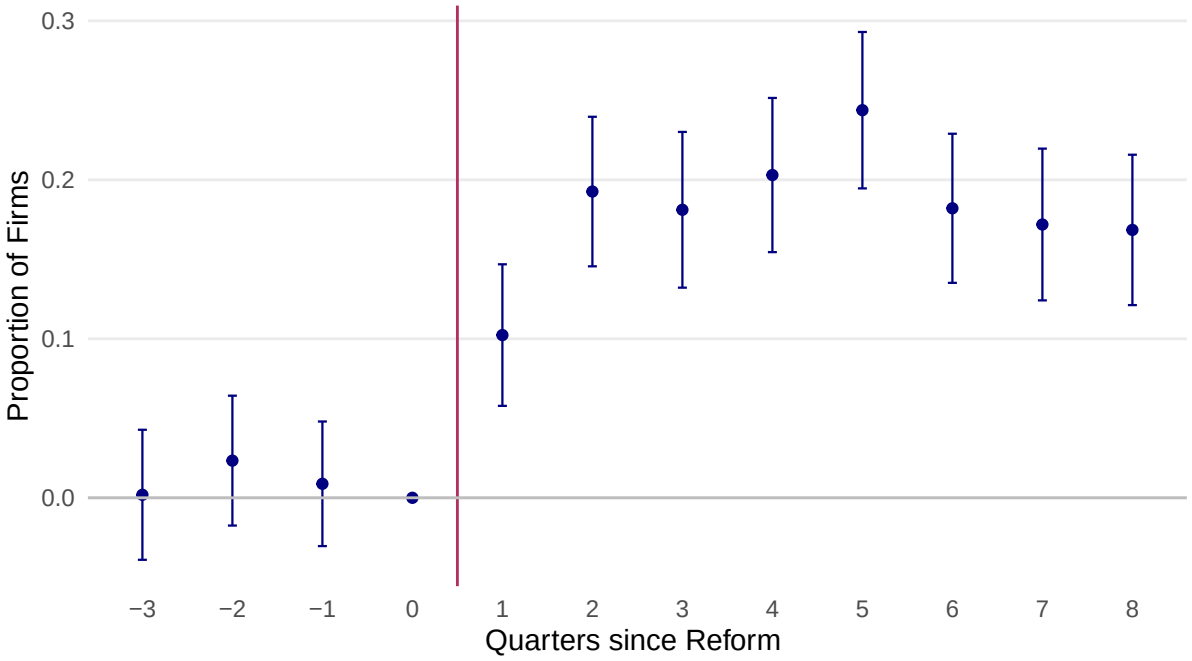
Notes: The figure shows the distribution of firms according to total annual sales, separately for firms with pre-reform relations with affected clients ("*Exposed*") and firms with pre-reform relations with non-affected clients ("*Not-exposed*"). The proportion of firms in each size group is calculated with respect to the total count of firms in each group. Total sales is defined as the sum of business sales and sales to final consumers. This graph pertains to the distribution of firms in 2014, before the introduction of the reform.

Figure 3.3: Firms Reduce their VAT Payments on the Extensive Margin



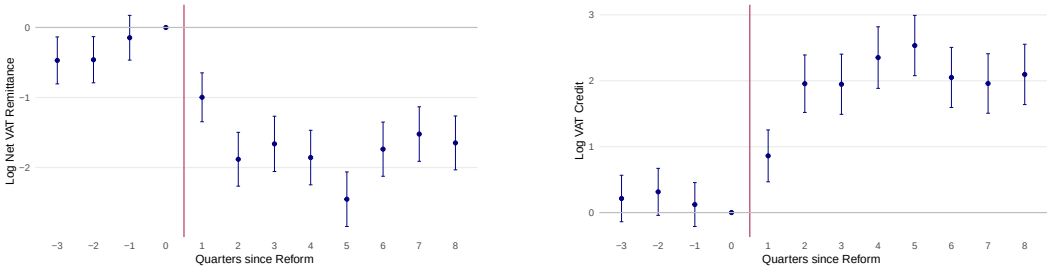
Notes: This figure plots the estimated β_t of event-study coefficients from a regression specification given in equation 3.1. The dependent variable is an indicator variable equal to 1 if the firm remits payments of VAT in a filing period. The reform is enacted in January 2015 and the coefficient corresponding to the 4th quarter of 2014 (β_0) is normalized to 0. The specification includes fixed effects for industry by filing-period, province by filing-period, and firm. The vertical blue lines represents 95 percent confidence interval. The red vertical lines highlights the timing of the introduction of the reform. The coefficient plotted correspond to Column (1) in Table C.3. The sample is made of monthly filers. Standard errors are clustered at the firm level.

Figure 3.4: Firms Increase their VAT Credit on the Extensive Margin



Notes: This figure plots the estimated β_t of event-study coefficients from a regression specification given in equation 3.1. The dependent variable is an indicator variable equal to 1 if the firm reports a VAT credit in a filing period. The reform is enacted in January 2015 and the coefficient corresponding to the 4th quarter of 2014 (β_0) is normalized to 0. The specification includes fixed effects for industry by filing-period, province by filing-period, and firm. The vertical blue lines represents 95 percent confidence interval. The red vertical lines highlights the timing of the introduction of the reform. The coefficient plotted correspond to Column (4) in Table C.3. The sample is made of monthly filers. Standard errors are clustered at the firm level.

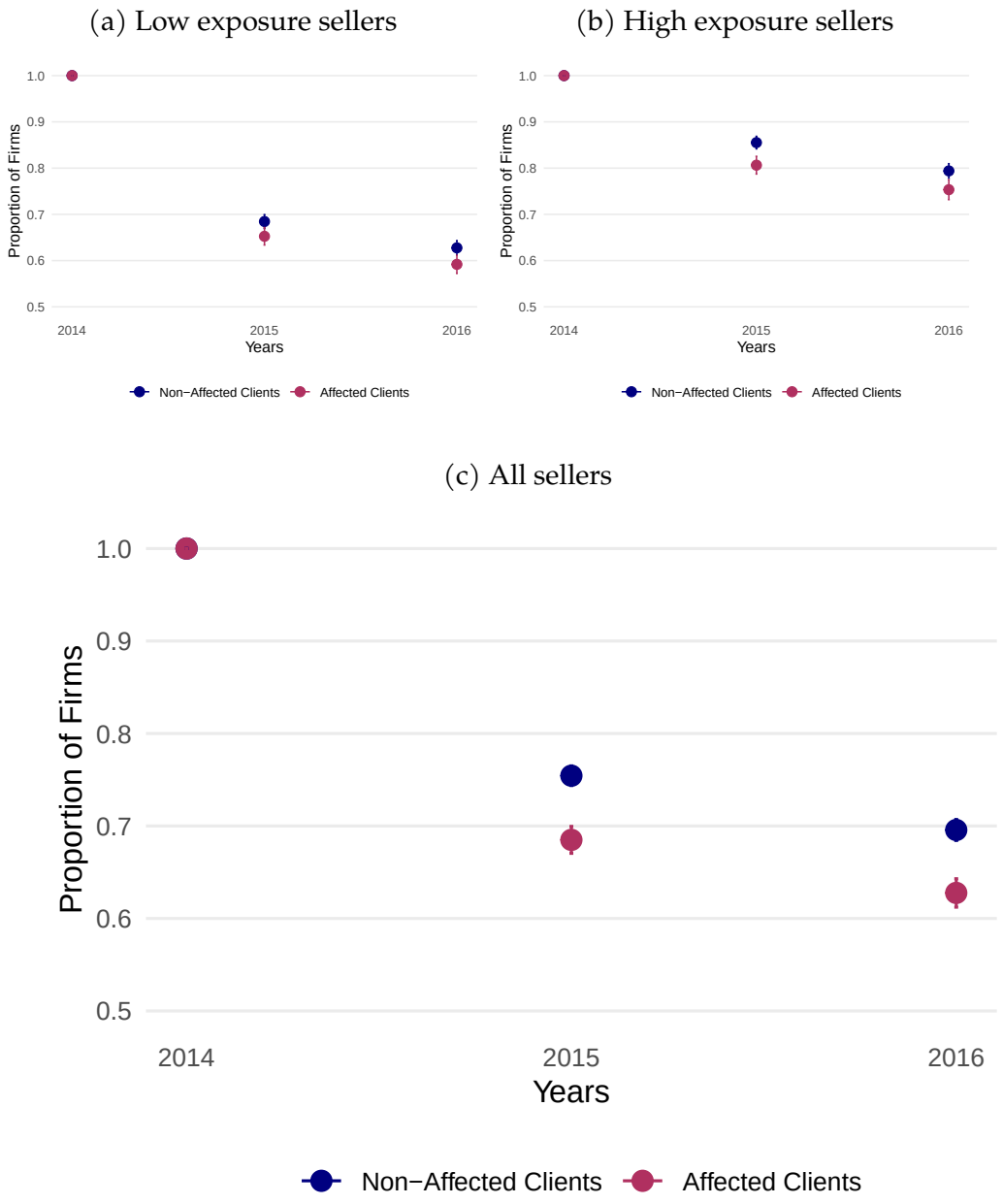
Figure 3.5: Firm Reduce VAT Payments and Increase VAT Credits



(a) VAT Remittance (b) VAT Credit

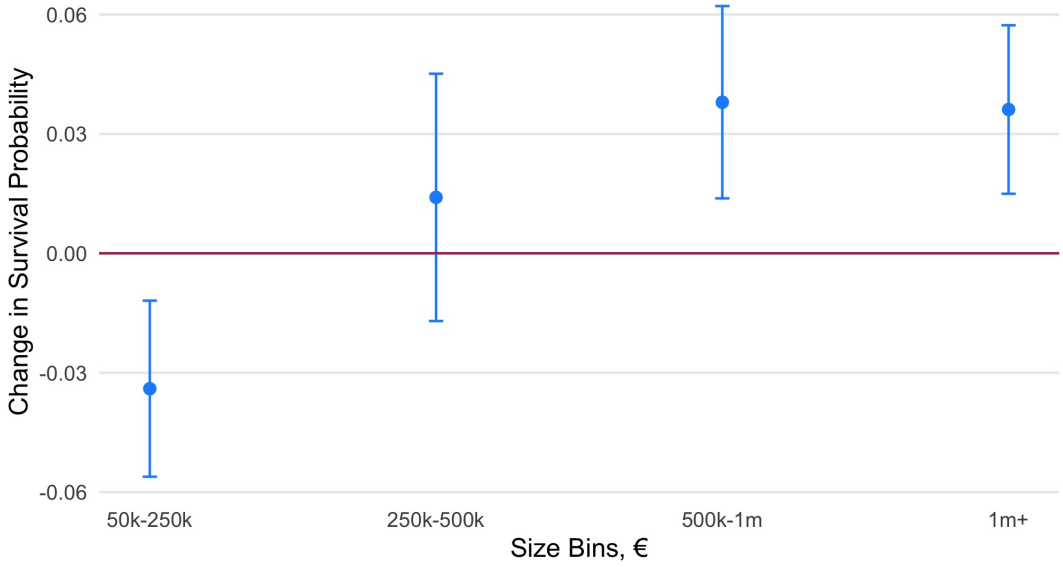
Notes: This figure plots the estimated β_t of event-study coefficients from a regression specification given in equation 3.1. The dependent variable is the value of periodic VAT remittances in panel (a) and the value of periodic VAT credit in panel (b). The reform is enacted in January 2015 and the coefficient corresponding to the 4th quarter of 2014 (β_0) is normalized to 0. The specification includes fixed effects for industry by filing-period, province by filing-period, and firm. The vertical blue lines represents 95 percent confidence interval. The red vertical lines highlights the timing of the introduction of the reform. The coefficients plotted in panel (a) correspond to Column (4) in Table C.4, while the coefficients plotted in panel (b) correspond to Column (4) in Table C.5. The sample is made of monthly filers. Standard errors are clustered at the firm level.

Figure 3.6: The Composition of Buyers Changed for Firms More Exposed to the Reform



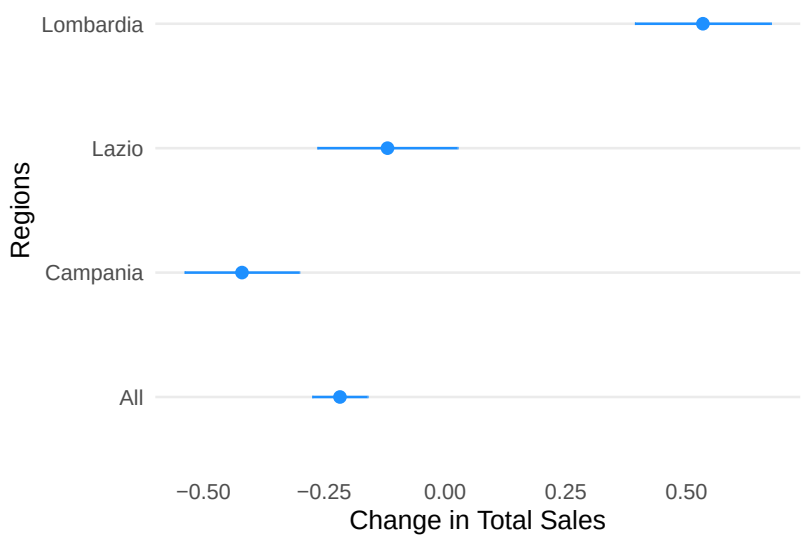
Notes: This figures represent the conditional probability of selling to the same type of client for firms with pre-reform relationships with affected clients and for firm with pre-reform relationship with non-affected clients. The unit of observation is a seller. Panel (a) includes firms with a pre-reform share of sales to affected or non-affected clients below 0.2, panel (b) includes firms with a pre-reform share of sales to affected clients above 0.2, panel (c) includes all firms. Standard errors are clustered at the seller level.

Figure 3.7: Size Heterogeneity in Exit Rates



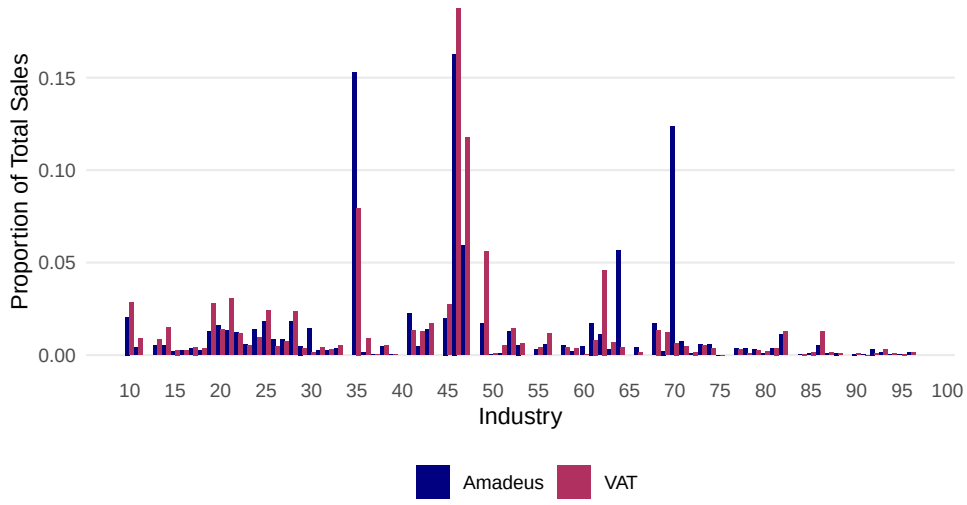
Notes: This figures plots the coefficients from a regression where the dependent variable is an indicator variable equal to 1 when the firm is active. An active firm is defined as a firm reporting at least €50,000 in annual sales. The unit of observation is a seller. The estimation is performed on the sample of firms that are active in 2014. The regression specification includes the following explanatory variables: a dummy variable *Post* equal to 1 for years 2015 and 2016, a categorical variable that assigns each firm to one of the four size bins based on pre-reform annual sales, and interaction terms. The four size groups correspond to the following intervals: €50,000-250,000; €250,000-500,000; €500,000-1,000,000; and above €1,000,000. The number of firms in each bin is 6,853; 2,731; 2,305; 4,153, respectively. Each specification includes fixed effects for industry by year and province by year. Standard errors are clustered at the seller level.

Figure 3.8: Geographic Heterogeneity



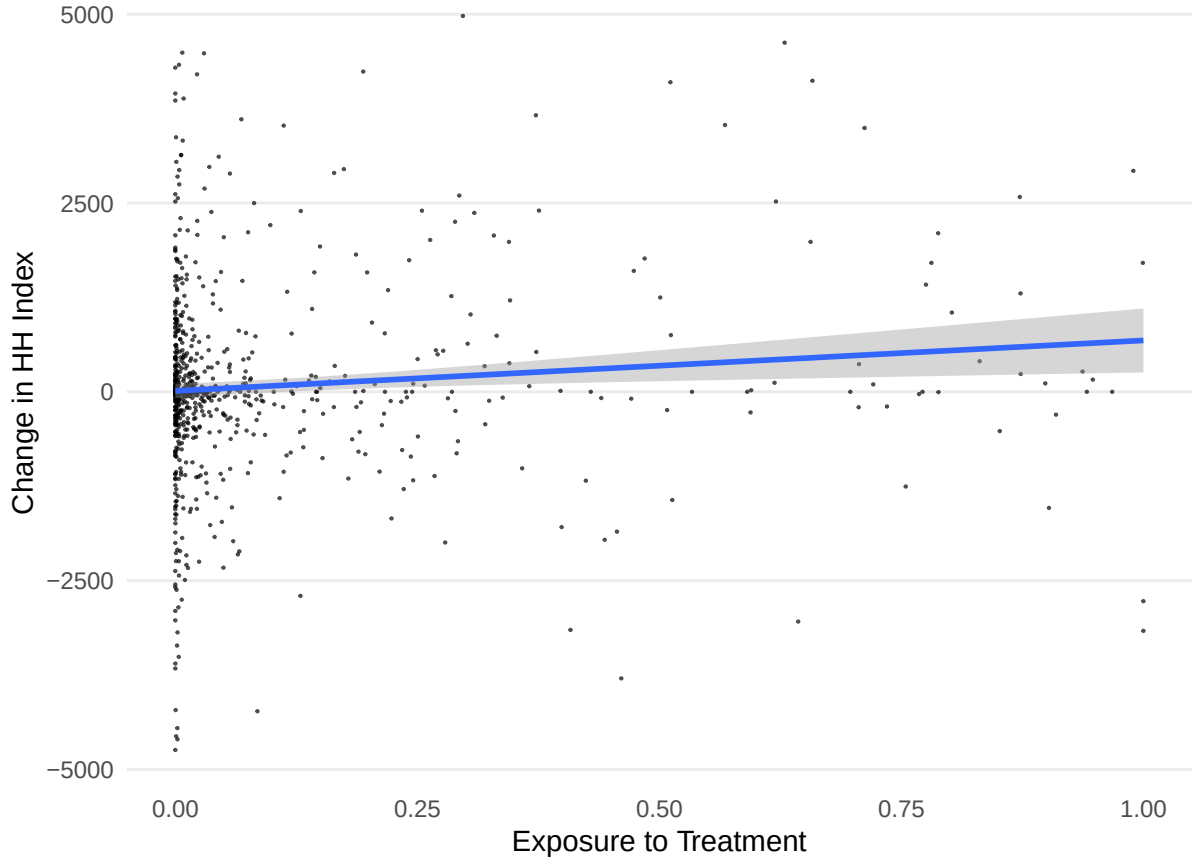
Notes: This figures plots the coefficients from a regression where the dependent variable is *Business sales*. The unit of observation is a firm. The specification includes the interaction between the variable $Exposure_f$ which represents the share of pre-reform business sales subject to the reform, the dummy $After_t$ equal to 1 for years 2015 and 2016, and a categorical variable for the location of the firm. Lombardia, Lazio, and Campania are the three Italian regions in the sample. Each specification includes fixed effects for industry by year and province by year. Standard errors are clustered at the seller level.

Figure 3.9: Distribution of Sales By Industry



Notes: The figure plots the distribution of sales across 2-digit industries. Each bar represents one industry. The height is each industry's share of total sales. The blue series is obtained using data from financial accounts (Amadeus dataset), while the red series comes from the VAT dataset.

Figure 3.10: Markets Became More Concentrated



Notes: This figure plots the change in the HH index from 2014 to 2016 in each market against the exposure to the reform, defined in Section (3.9.1). The unit of analysis is a market, defined as an industry-province pair. The fitted is obtained via OLS and the shaded area represents the 95-percent confidence interval. Standard errors are clustered at the market level.

Tables

Table 3.1: Summary Statistics for Firms in the Analysis Sample

	Mean	P10	Median	P90
Total Sales (000s)	1,501.74	56.66	306.59	3,468.80
Business Sales (000s)	789.21	14.19	111.11	1,675.42
Total Purchases (000s)	1,082.24	12.83	166.35	2,430.25
Total Purchases / Sales	0.55	0.15	0.57	0.92
Taxable Sales (000s)	1,167.65	45.48	272.41	2,852.50
Taxable Sales / Sales	0.89	0.59	1.00	1.00
Taxable Purchases (000s)	16.54	0.00	0.00	1.98
Taxable Purchases / Sales	0.01	0.00	0.00	0.00
Value Added (000s)	406.37	17.63	112.57	966.63
Value Added / Sales	0.45	0.08	0.43	0.85
Tax Base / Sales	0.88	0.58	1.00	1.00
Tax Base (000s)	1,127.04	44.30	267.54	2,836.94
Firms	14,987			

Notes: This table reports summary statistics for firms in the analysis sample. Except for ratios, variables are expressed in Euros. Variables are defined in Appendix D. The columns report the mean (labeled "*Mean*"), the 10th percentile ("*P10*"), the median ("*Median*") and the 90th percentile ("*P90*"). Summary statistics are reported at baseline, in 2014. Continuous variables are winsorized at the 99th percentile. Variables that represent ratios are scaled by the value of total sales in 2014 and then censored at 0 and 1.

Table 3.2: Summary Statistics by Type of Pre-reform Relationship

	Mean		
Variables	No Relation	With Relation	T-stat
Total Sales (000s)	1,528	1,482	-0.82
Total Purchases (000s)	1,099	1,070	-0.64
Business Sales (000s)	822	765	-1.64
Taxable Sales (000s)	1,121	1,164	1.08
Taxable Purchases (000s)	17	16	-0.35
Value Added (000s)	418	397	-1.53
Tax Base (000s)	1,102	1,146	1.12
Value Added Scaled	0.39	0.41	1.55
Tax Base Scaled	0.88	0.90	2.63
Firms	6,458	8,529	

Notes: This table reports the mean of variables for firms in the analysis sample. The column labeled "*No Relationship*" refers to firms with no pre-reform relationship with affected clients, while the column "*With Relationship*" refers to firms with pre-reform relationship with affected clients. The column "*T-stat*" reports the t-statistics for a two-sided t test. Variables are defined in Appendix D. Summary statistics are reported at baseline, in 2014. Continuous variables are winsorized at the 99th percentile. Variables that represent ratios are scaled by the value of total sales in 2014 and then censored at 0 and 1. Except for ratios, variables are expressed in Euros.

Table 3.3: Firm-to-Firm Links with Affected Clients Are More Likely to Become Inactive

	Survival Rate of Firm-to-Firm Links				
	(1)	(2)	(3)	(4)	(5)
Affected Client	-0.042**	-0.035**	-0.037**	-0.036***	-0.025***
	(0.013)	(0.012)	(0.011)	(0.011)	(0.005)
Observations	577084	577084	577084	577084	577084
Clusters (Seller)	13,590	13,590	13,590	13,590	13,590
Seller Controls		Y	Y	Y	Y
Industry × Year FE			Y	Y	Y
Province × Year FE				Y	Y
Seller FE					Y

Notes: This table reports the survival probability that a link between a seller and an affected client remains active after the reform relative to links between a seller and a non-affected client. The unit of observation is a firm-to-firm link. Affected links are firm-to-firm links between a seller and a client subject to the new rule on VAT collection, while unaffected links are the other firm-to-firm links. Control variables are the log of pre-reform business sales for each seller and the log of the pre-reform number of links for each seller. Specifications may include fixed effects for industry by year, province by year, and firm, as indicated in each column. The sample includes firm-to-firm links that account for at least 0.1% of each seller's business sales in 2014. The sample includes all sellers in the analysis sample. An active link is defined as a link with an annual value of at least €1,000. Standard errors are clustered at the seller level.

Table 3.4: Survival Rates Links, by Importance of the Link

	Survival Probability
Group 1	-0.022***
	(0.006)
Group 2	-0.029*
	(0.015)
Group 3	-0.040
	(0.023)
Group 4	-0.086**
	(0.031)
Group 5	-0.115**
	(0.040)
Observations	577,084
Clusters (Sellers)	13,590
Seller Controls	Y
Industry × Year FE	Y
Province × Year FE	Y
Seller FE	Y

Notes: This table reports the survival probability that a link between a seller and an affected client remains active after the reform relative to links between a seller and a non-affected client. Every link is assigned to one of 5 groups based on its share of the seller's total business sales before the reform. Group 1 corresponds to values in the interval 0-0.2; Group 2 to 0.2-0.4; Group 3 to 0.4-0.6; Group 4 to 0.6-0.8; Group 5 to 0.8-1. The unit of observation is a firm-to-firm link. Affected links are firm-to-firm links between a seller and a client subject to the new rule on VAT collection, while unaffected links are the other firm-to-firm links. Control variables are the log of pre-reform business sales for each seller and the log of the pre-reform number of links for each seller. Specifications may include fixed effects for industry by year, province by year, and firm, as indicated in each column. The sample includes firm-to-firm links that account for at least 0.1% of each seller's business sales in 2014. The sample includes all sellers in the analysis sample. An active link is defined as a link with an annual value of at least €1,000. Standard errors are clustered at the seller level.

Table 3.5: Survival Rates Links, by Size of the Link

	Survival Probability
Group 1	-0.008
	(0.009)
Group 2	-0.054***
	(0.011)
Group 3	-0.050***
	(0.012)
Group 4	-0.037**
	(0.012)
Group 5	-0.022*
	(0.011)
Observations	577,084
Clusters (Sellers)	13,590
Seller Controls	Y
Industry × Year FE	Y
Province × Year FE	Y
Seller FE	Y

Notes: This table reports the survival probability that a link between a seller and an affected client remains active after the reform relative to links between a seller and a non-affected client. Every link is assigned to a quintile of the size distribution of the value of firm-to-firm links before the reform. Group 1 corresponds to values in the interval €1,000-2,035; Group 2 to €2,036-4,004; Group 3 to €4,005-8,756; Group 4 to 8,756-26,856; Group 5 above €26,856 . The unit of observation is a firm-to-firm link. Affected links are firm-to-firm links between a seller and a client subject to the new rule on VAT collection, while unaffected links are the other firm-to-firm links. Control variables are the log of pre-reform business sales for each seller and the log of the pre-reform number of links for each seller. Specifications may include fixed effects for industry by year, province by year, and firm, as indicated in each column. The sample includes firm-to-firm links that account for at least 0.1% of each seller's business sales in 2014. The sample includes all sellers in the analysis sample. An active link is defined as a link with an annual value of at least €1,000. Standard errors are clustered at the seller level.

Table 3.6: Effects on Value of Firm-to-firm Links

	LHS: Log Firm-to-Firm Sales				
	(1)	(2)	(3)	(4)	(5)
Affected Client	0.604***	0.153***	0.153***	0.153***	0.060*
	(0.147)	(0.044)	(0.043)	(0.041)	(0.030)
Affected Client × Post	-0.040	-0.040	-0.031	-0.034	-0.034
	(0.021)	(0.021)	(0.019)	(0.019)	(0.019)
Observations	411,675	411,675	411,675	411,675	411,675
Clusters (Seller)	11,775	11,775	11,775	11,775	11,775
Seller Controls		Y	Y	Y	Y
Industry × Year FE			Y	Y	Y
Province × Year FE				Y	Y
Seller FE					Y

Notes: This table reports coefficients estimate from equation 3.2. The dependent variable is the Log value of firm-to-firm links. The coefficient labeled "*Affected Client* × *Post*" represents the causal effect of the reform. The unit of analysis is a firm-to-firm link. Control variables are the log of pre-reform business sales for each seller and the log of the pre-reform number of links for each seller. Specifications may include fixed effects for industry by year, province by year, and firm, as indicated in each column. The sample includes active firm-to-firm links that account for at least 0.1% of each seller's business sales in 2014. The sample includes all sellers in the analysis sample. An active link is defined as a link with an annual value of at least €1,000. Standard errors are clustered at the seller level.

Table 3.7: Firms Adjust their Customer Base

	Conditional Prob of Selling to	
	Affected Clients	Non-affected Clients
Year 2015	-0.306***	-0.208***
	(0.005)	(0.004)
Year 2016	-0.361***	-0.259***
	(0.005)	(0.004)
Observations	25587	31218
Clusters (firms)	8,529	10,406

Notes: This table shows the difference in the probability of trading with affected clients or non-affected clients. The probability is estimated separately for firms with pre-reform relationships with affected clients and firms with pre-reform relationships with non-affected clients. The specification includes fixed effects for industry by year, province by year and firm. The sample is made of firms in the analysis sample. Standard errors are clustered at the seller level.

Table 3.8: Firms Exposed to the Reform Experienced Lower Business Sales

	LHS variable: Business Sales				
	(1)	(2)	(3)	(4)	(5)
Exposure × Post	0.029	-0.140*	-0.015	-0.150**	-0.218***
	(0.047)	(0.057)	(0.047)	(0.057)	(0.055)
Exposure	-1.178***	-0.856***	-0.940***	-0.669***	
	(0.073)	(0.080)	(0.074)	(0.080)	
Observations	44137	44134	44137	44134	43998
Clusters (sellers)	14,986	14,985	14,986	14,985	14,849
Industry × Year FE		Y		Y	Y
Province × Year FE			Y	Y	Y
Firm FE					Y

Notes: This table reports the coefficients from specification 3.3. The unit of observation is a seller. The dependent variable is *Business Sales*. The variable *Exposure* is defined as the share of business sales that would be subject to the new rules of VAT collection, as explained in Section 3.4.1. The variable *Post* is dummy equal to 1 for the years 20015 and 2016. Specifications may include fixed effects for industry by year, province by year, and firm, as indicated in each column. The sample includes firms in the analysis sample. Standard errors are clustered at the seller level.

Table 3.9: Firms Exposed to the Reform Have Lower Probability of Survival

	LHS variable: Prob(Total Sales > 50000)			
	(1)	(2)	(3)	(4)
Exposure × Post	-0.158***	-0.133***	-0.141***	-0.114***
	(0.010)	(0.012)	(0.011)	(0.012)
Observations	48129	48129	48129	48129
Clusters (Sellers)	16,043	16,043	16,043	16,043
Industry × Year FE		Y		Y
Province × Year FE			Y	Y

Notes: This table reports the survival probability that a seller more exposed to the reform remains active after the reform relative to a less exposed seller. The unit of analysis is a seller. The sample is the analysis sample. The variable *Exposure* is defined as the share of business sales that would be subject to the new rules of VAT collection, as explained in Section 3.4.1. The variable *Post* is dummy equal to 1 for the years 20015 and 2016. Specifications may include fixed effects for industry by year, province by year, and firm, as indicated in each column. Standard errors are clustered at the seller level.

Table 3.10: Smaller Firms Are More Likely to Become Inactive

	Survival Probability
Group 1	-.0981
	(.0159)
Group 2	-.0396
	(.0266)
Group 3	.0509
	(.0251)
Group 4	.0632
	(.0198)
Observations	48129
Clusters (Sellers)	16043
Industry × Year	Y
Province × Year	Y

Notes: This table reports the survival probability that a seller more exposed to the reform remains active after the reform relative to a less exposed seller. Every seller is assigned to one of four groups based on its pre-reform total sales. Group 1 includes sellers with sales in the interval €50,000-250,000; Group 2 to €250,000-500,000; Group 3 to €500,000-1,000,000; Group 4 above €1,000,000. The unit of observation is a firm. The sample is the analysis sample. The variable *Exposure* is defined as the share of business sales that would be subject to the new rules of VAT collection, as explained in Section 3.4.1. The variable *Post* is dummy equal to 1 for the years 20015 and 2016. The specification includes fixed effects for industry by year and province by year. Active firms are defined as firms with at least €50,000 in annual sales. Standard errors are clustered at the seller level.

Table 3.11: Larger Firms Experience a Larger Decline in Business Sales

	Business Sales
Group 1	-.2678
	(.0729)
Group 2	-.1224
	(.1257)
Group 3	-.6592
	(.1032)
Group 4	-.5324
	(.0925)
Observations	43998
Clusters (Sellers)	14849
Industry × Year	Y
Province × Year	Y
Seller FE	Y

Notes: This table reports the coefficients $\beta_{1,g}$ from specification 3.4. The dependent variable is "*Business Sales*". Every seller is assigned to one of four groups based on its pre-reform total sales. Group 1 includes sellers with sales in the interval €50,000-250,000; Group 2 to €250,000-500,000; Group 3 to €500,000-1,000,000; Group 4 above €1,000,000. The unit of observation is a firm. The sample is the analysis sample. The variable *Exposure* is defined as the share of business sales that would be subject to the new rules of VAT collection, as explained in Section 3.4.1. The variable *Post* is dummy equal to 1 for the years 20015 and 2016. The specification includes fixed effects for industry by year, province by year, and firm. Standard errors are clustered at the seller level.

Table 3.12: Summary Statistics for Markets

Variables	Min	P10	Mean	Median	P90	Max
Total Sales (000s)	21	152	20,810	3,495	48,247	1,844,049
Total Purchases (000s)	0	70	14,993	1,980	35,497	1,458,888
Value Added (000s)	-894,989	46	15,953	1,159	18,518	2,435,801
Tax Base (000s)	-28,939	100	62,893	2,627	58,161	7,812,190
HHI	92	1,152	5,460	5,019	10,000	10,000
Affected Sales (%)	0.0	0.0	0.088	0.011	0.26	1.0

Notes: This table reports summary statistics for key variables at the market level. Markets are defined as pairs of industry and provinces. The variables *Total Sales, Total Purchases, Value Added, Tax Base* are created by summing up the corresponding firm level variables. The variable *HHI* represents the Herfindahl-Hirschman Index of total sales for each market. The variable *Affected Sales* represents the share of pre-reform total sales that would be subject to the new rules.

Table 3.13: Market Concentration Increases After the Reform

	LHS Variable: HH Index			
	(1)	(2)	(3)	(4)
Exposure × Post	420.4	420.4	420.4	420.4
	(124.3)	(126.0)	(124.8)	(126.5)
Observations	2,736	2,736	2,736	2,736
Industry FE		Y		Y
Province FE			Y	Y

Notes: This table reports the coefficient β_1 from specification 3.5. The unit of analysis is a market, defined as a pair of industry and province. There are 1,129 markets. The variable *Exposure* is equal to the share of pre-reform business sales of each market that would be subject to the new rules on VAT collection. The variable *Post* is equal to 1 for years 2015 and 2016. The dependent variable is the Herfindahl-Hirschman (HH) Index defined in Section 3.9.2. Standard errors are clustered at the market level.

Table 3.14: Market Concentration Increases After the Reform

	LHS Variable: Market Share Top 3 Firms			
	(1)	(2)	(3)	(4)
Exposure × Post	0.056	0.056	0.056	0.056
	(0.014)	(0.014)	(0.014)	(0.014)
Observations	2,736	2,736	2,736	2,736
Industry FE		Y		Y
Province FE			Y	Y

Notes: This table reports the coefficient β_1 from specification 3.5. The unit of analysis is a market, defined as a pair of industry and province. There are 1,129 markets. The variable *Exposure* is equal to the share of pre-reform business sales of each market that would be subject to the new rules on VAT collection. The variable *Post* is equal to 1 for years 2015 and 2016. The dependent variable is the share of market sales made by the 3 largest firms. Standard errors are clustered at the market level.

Table 3.15: Tax Base Increased in Markets More Exposed to the Reform

	LHS Variable: Tax Base Scaled			
	(1)	(2)	(3)	(4)
Exposure × Post	0.03	0.03	0.03	0.03
	(0.033)	(0.034)	(0.033)	(0.034)
Observations	2,736	2,736	2,736	2,736
Industry FE		Y		Y
Province FE			Y	Y

Notes: This table reports the coefficient β_1 from specification 3.5. The unit of analysis is a market, defined as a pair of industry and province. There are 1,129 markets. The variable *Exposure* is equal to the share of pre-reform business sales of each market that would be subject to the new rules on VAT collection. The variable *Post* is equal to 1 for years 2015 and 2016. The dependent variable is the ratio of the tax base to pre-reform sales. Standard errors are clustered at the market level.

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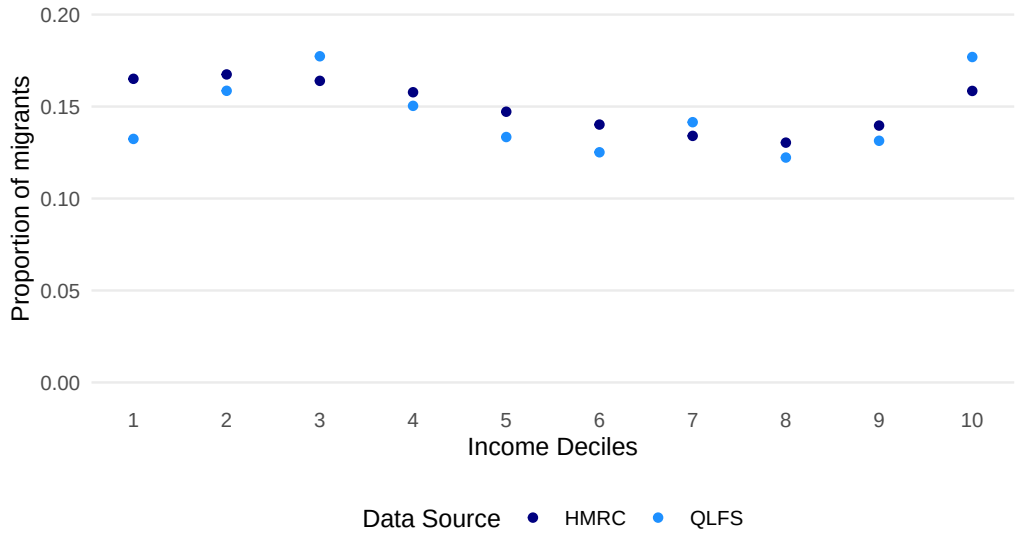
Appendix A: Additional Exhibits for Chapter 1

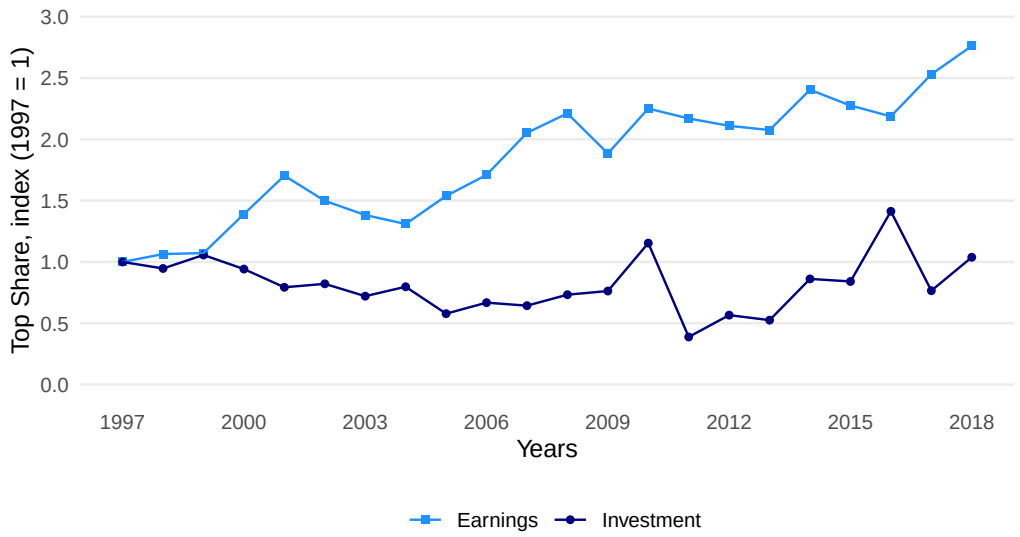
Figure A.1: Similar trend but lower level of migrants across income distribution, comparing survey data to administrative data



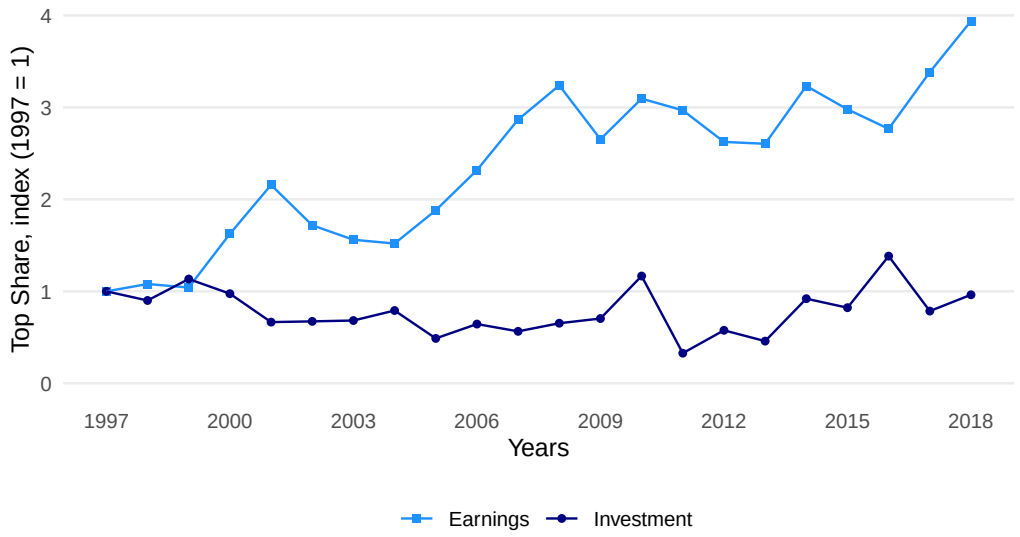
Notes: The figure shows the proportion of migrants at each decile of the income distribution, for those paying income tax–clearly no comparison is possible for those not paying income tax, since they do not appear in HMRC data. The series labelled "HMRC" is based on confidential tax micro-data on the population of income tax filers, for tax year 2016-17. The series labelled "QLFS" comes from the Quarterly Labour Force Survey – a representative sample of the UK population – using the four quarters from the 2016-17 tax year (2016 Q2, Q3, Q4, and 2017 Q1). Deciles boundaries are defined using the publicly available data from HMRC's Survey of Personal Incomes.

Figure A.2: Migrants' earnings share increased more further up the income distribution

(a) Cumulative increase in share of earnings and investment of migrants in top 0.1%

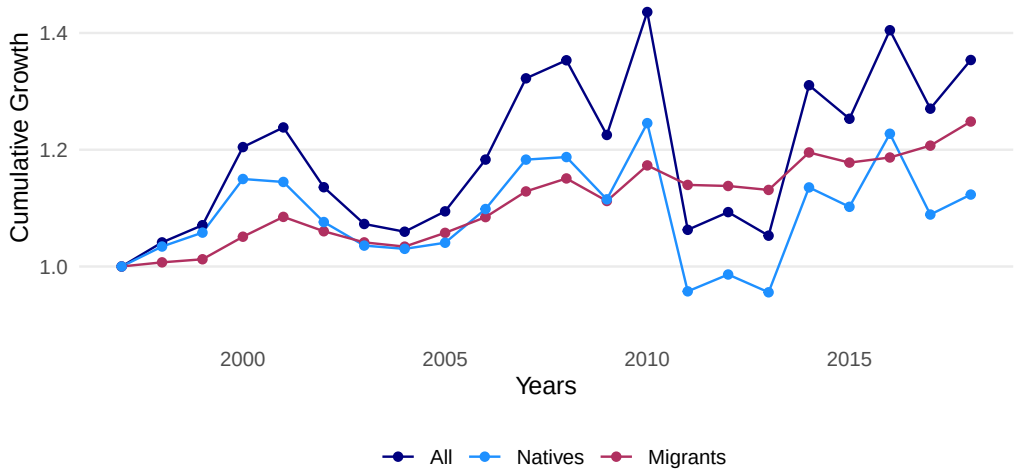


(b) Cumulative increase in share of earnings and investment of migrants in top 0.01%



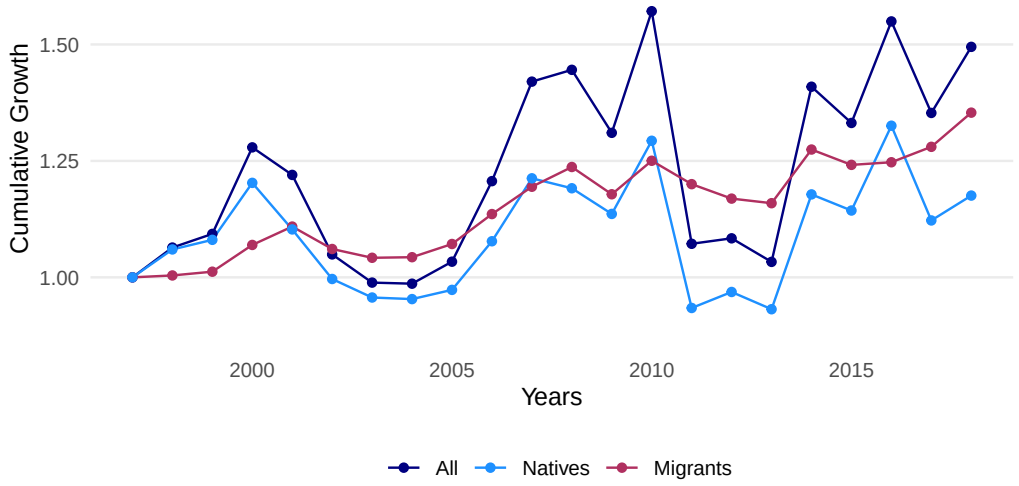
*Notes:*The figure shows the cumulative growth rate from 1997 to 2018 for two time series described below for migrants in the top 0.1% (Panel a) and in the top 0.01% (Panel b). The series labeled "earnings" represents the cumulative increase in migrants' earning share of top share income, and the series labeled "investment" represents the cumulative increase in migrants' investment income share of top share income. Each time series is normalized to 1 in 1997. The unit of analysis is an individual. A migrant is identified as a taxpayer who received their National Insurance Number (NINO) at the age of 18 or older. All top shares are defined relative to the total number of individuals aged 18 or older in the population living in the UK.

Figure A.3: Decomposition of total growth of top 0.1% share



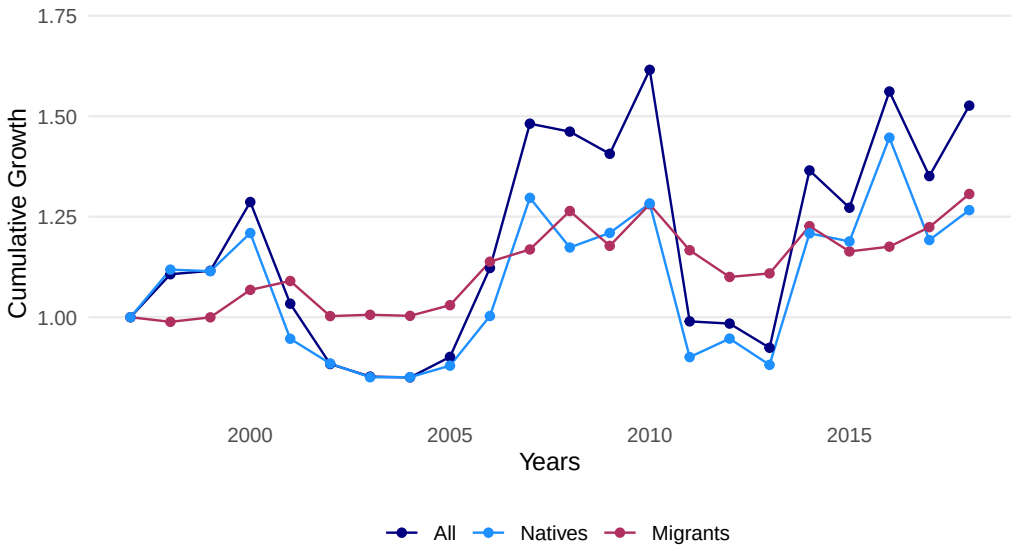
Notes: The figure shows the decomposition of the cumulative growth rate in the top 0.1% share from 1997 up to each subsequent year. The decomposition is described in section 1.4.1. The unit of analysis is an individual. Income is defined as the sum of earnings and investment income. A migrant is identified as a taxpayer who received their National Insurance Number (NINO) at the age of 18 or older. All top shares are defined relative to the total number of individuals aged 18 or older in the population living in the UK.

Figure A.4: Decomposition of total growth of top 0.01% share



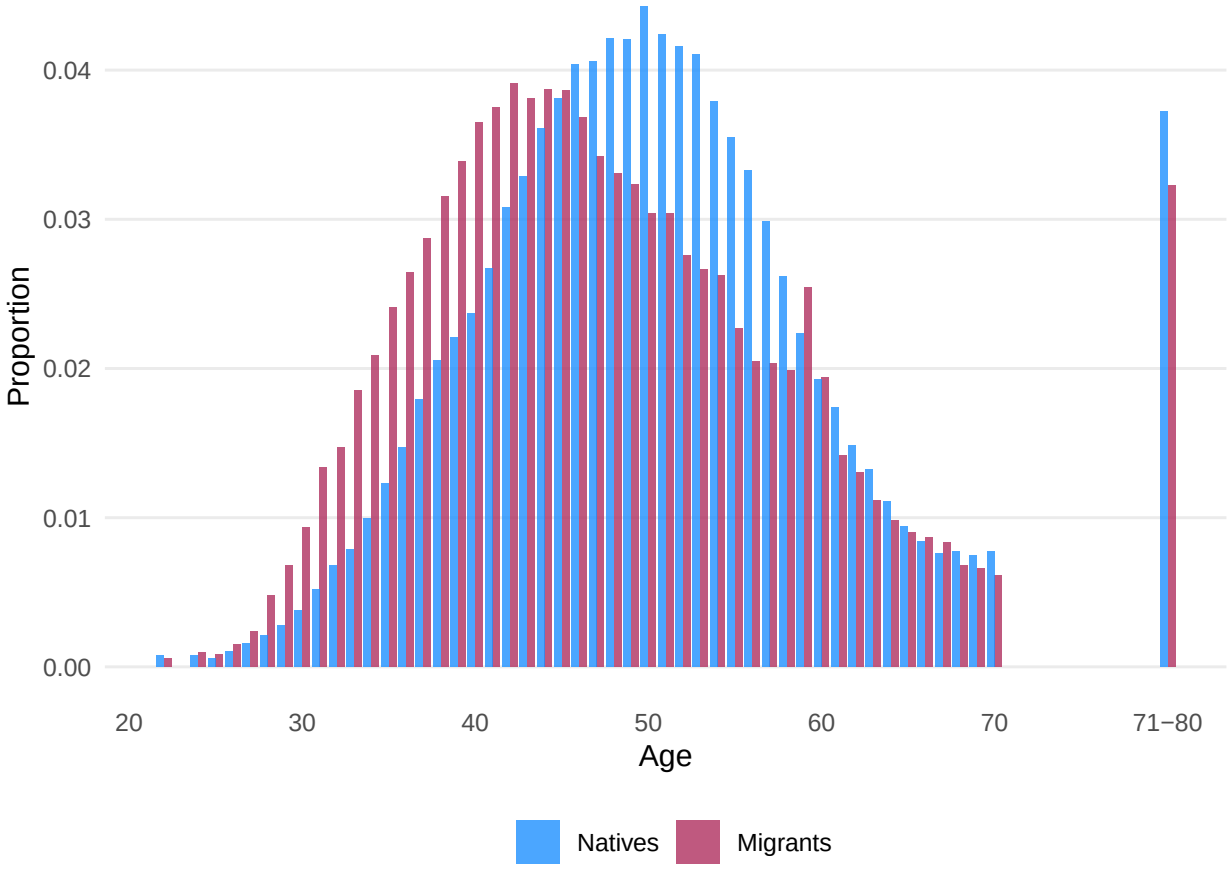
Notes: The figure shows the decomposition of the cumulative growth rate in the top 0.01% share from 1997 up to each subsequent year. The decomposition is described in section 1.4.1. The unit of analysis is an individual. Income is defined as the sum of earnings and investment income. A migrant is identified as a taxpayer who received their National Insurance Number (NINO) at the age of 18 or older. All top shares are defined relative to the total number of individuals aged 18 or older in the population living in the UK.

Figure A.5: Decomposition of total growth of top 0.001% share



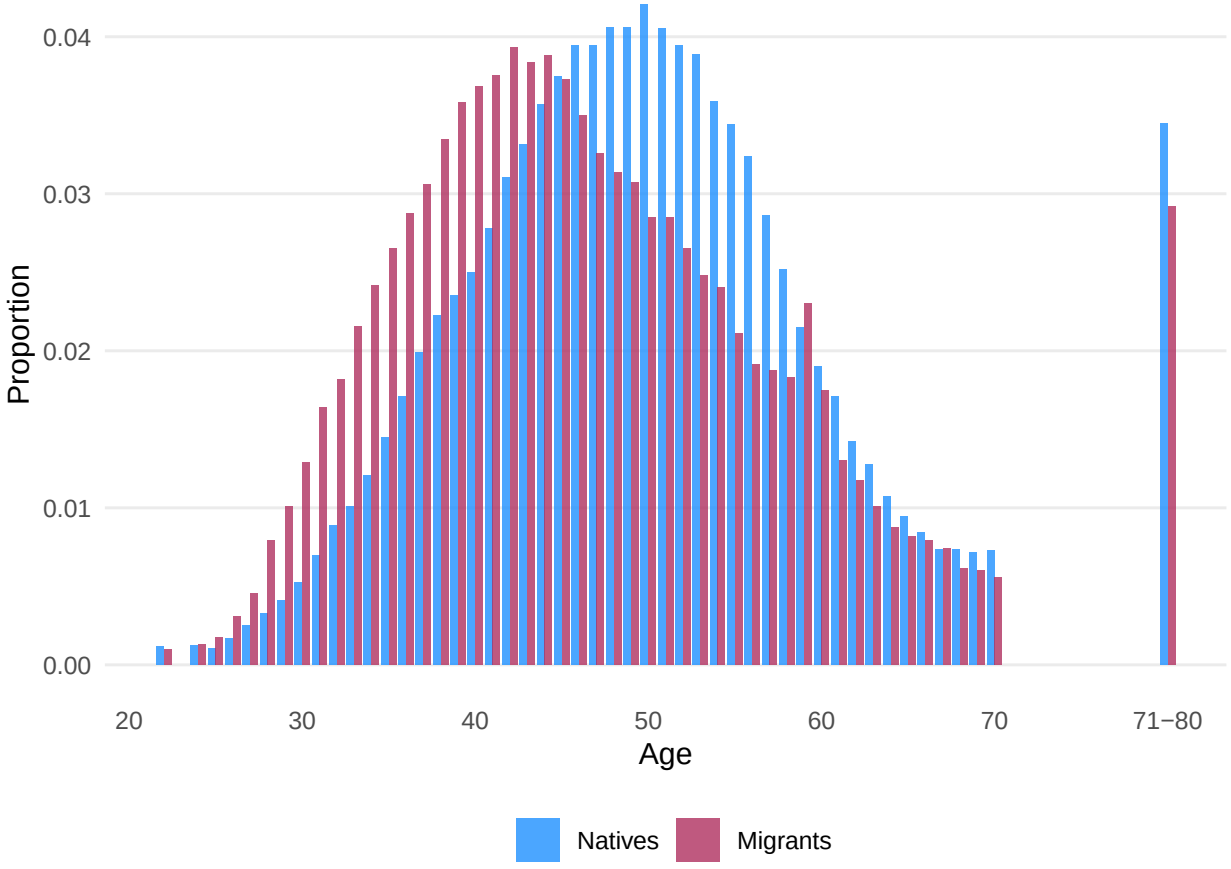
Notes: The figure shows the decomposition of the cumulative growth rate in top 0.001% share from 1997 up to each subsequent year. The decomposition is described in section 1.4.1. The unit of analysis is an individual. Income is defined as the sum of earnings and investment income. A migrant is identified as a taxpayer who received their National Insurance Number (NINO) at the age of 18 or older. All top shares are defined relative to the total number of individuals aged 18 or older in the population living in the UK.

Figure A.6: Age distribution for stayers



Notes: The figure shows the age distribution of individuals in the top 1% of the income distribution in 2017, aged 20-80. It shows the distribution for migrants and natives separately. This figure shows the age distribution for 'stayers': individuals that were in the top 1% in 2016 and remained in the top 1% in 2017. Each bar represents one year of age, except for years of age between 20-24 that are grouped into two-year bins and for ages between 70-80 that are grouped into a single bin labeled "71-80" in the figure, to avoid disclosure. The unit of analysis is an individual. A migrant is identified as a taxpayer who received their National Insurance Number (NINO) at the age of 18 or older. All top shares are defined relative to the total number of individuals aged 18 or older in the population living in the UK.

Figure A.7: Pooled age distribution



Notes: The figure shows the age distribution of individuals in the top 1% of the income distribution in 2017, aged 20-80. It shows the distribution for migrants and natives separately. The graph shows the age distribution of all individuals in the top 1% in 2017 wherever they were in 2016. Each bar represents one year of age, except for years of age between 20-24 that are grouped into two-year bins and for ages between 70-80 that are grouped into a single bin labeled "71-80" in the figure, to avoid disclosure. The unit of analysis is an individual. A migrant is identified as a taxpayer who received their National Insurance Number (NINO) at the age of 18 or older. All top shares are defined relative to the total number of individuals aged 18 or older in the population living in the UK.

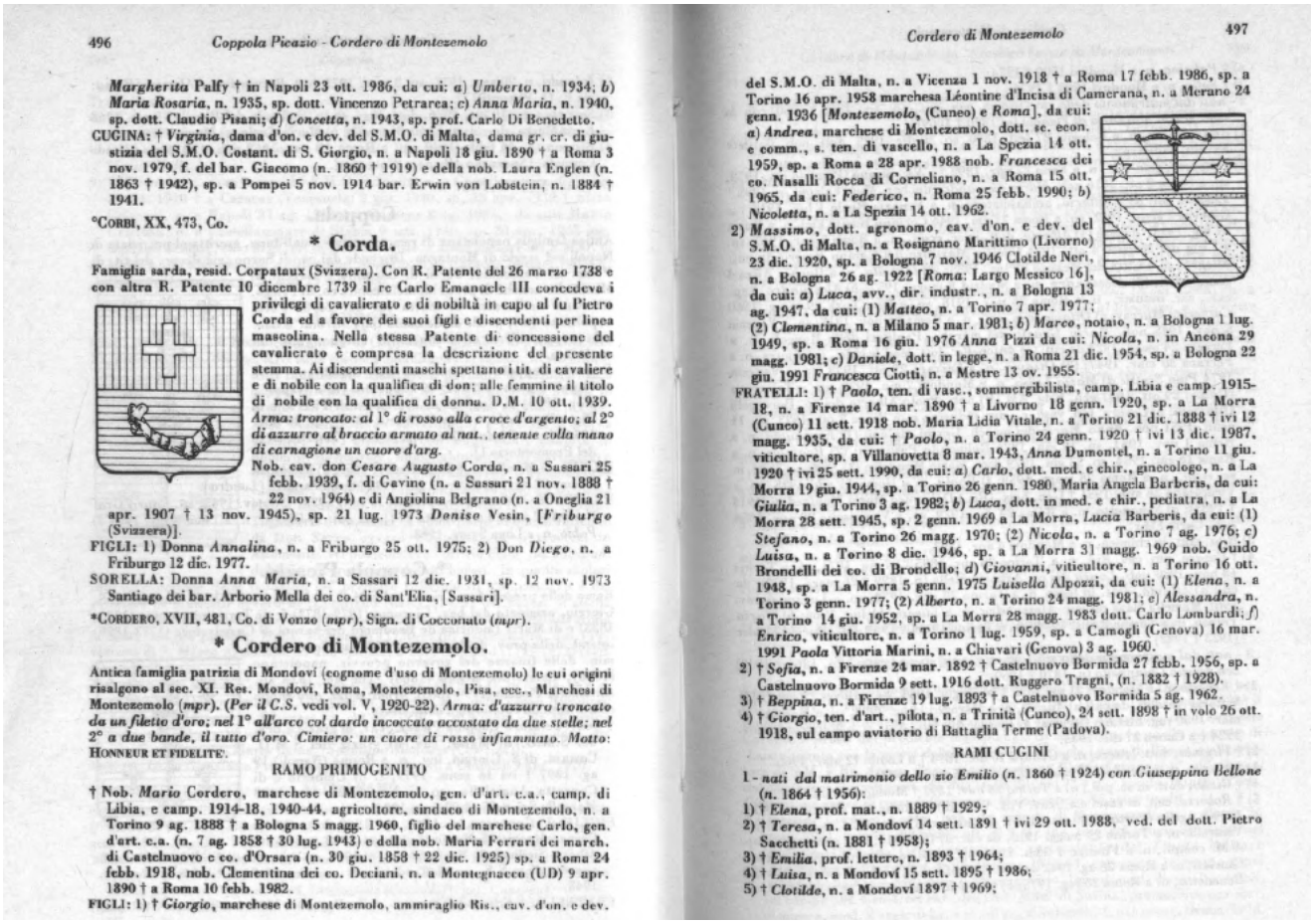
Table A.1: Number of non-domiciled individuals claiming the remittance basis

Year	Count of non-doms
2009	48,500
2010	45,600
2011	49,200
2012	48,900
2013	48,000
2014	53,000
2015	55,100
2016	55,100
2017	53,700
2018	45,700

Notes: This table shows the number of non-domiciled individuals claiming the remittance basis. The remittance basis allows eligible individuals to avoid reporting, or being taxed on, investment income arising outside the UK. The source of this table is "Statistics on Non-Domiciled Taxpayers in the UK 2007-08 to 2018-19" published by HMRC in July 2020.

Appendix B: Additional Exhibits for Chapter 2

Figure B.1: Pages from *Libro d'oro della Nobiltà italiana*



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Margherita Palfy † in Napoli 23 ott. 1986, da cui: *a*) ***Umberto***, n. 1934; *b*) ***Maria Rosaria***, n. 1935, sp. dott. Vincenzo Petrarca; *c*) ***Anna Maria***, n. 1940, sp. dott. Claudio Pisani; *d*) ***Concetta***, n. 1943, sp. prof. Carlo Di Benedetto.

CUGINA: † ***Virginia***, dama d'on. e dev. del S.M.O. di Malta, dama gr. cr. di giustizia del S.M.O. Costant. di S. Giorgio, n. a Napoli 18 giu. 1890 † a Roma 3 nov. 1979, f. del bar. Giacomo (n. 1860 † 1919) e della nob. Laura Englen (n. 1863 † 1942), sp. a Pompei 5 nov. 1914 bar. Erwin von Lobstein, n. 1884 † 1941.

°CORBI, XX, 473, Co.

* Corda.

Famiglia sarda, resid. Corpataux (Svizzera). Con R. Patente del 26 marzo 1738 e con altra R. Patente 10 dicembre 1739 il re Carlo Emanuele III concedeva i privilegi di cavalierato e di nobiltà in capo al fu Pietro Corda ed a favore dei suoi figli e discendenti per linea mascolina. Nella stessa Patente di concessione del cavalierato è compresa la descrizione del presente stemma. Ai discendenti maschi spettano i tit. di cavaliere e di nobile con la qualifica di don; alle femmine il titolo di nobile con la qualifica di donna. D.M. 10 ott. 1939. *Arma: troncato: al 1° di rosso alla croce d'argento; al 2° di azzurro al braccio armato al nat., tenente colla mano di carnagione un cuore d'arg.*

Nob. cav. don ***Cesare Augusto*** Corda, n. a Sassari 25 febb. 1939, f. di Gavino (n. a Sassari 21 nov. 1888 † 22 nov. 1964) e di Angiolina Belgrano (n. a Oneglia 21 apr. 1907 † 13 nov. 1945), sp. 21 lug. 1973 ***Denise*** Vesin, [***Friburgo*** (Svizzera)].

FIGLI: 1) Donna ***Annalina***, n. a Friburgo 25 ott. 1975; 2) Don ***Diego***, n. a Friburgo 12 dic. 1977.

SORELLA: Donna ***Anna Maria***, n. a Sassari 12 dic. 1931, sp. 12 nov. 1973 Santiago dei bar. Arborio Mella dei co. di Sant'Elia, [Sassari].

*CORDERO, XVII, 481, Co. di Venzo (*mpr*), Sign. di Cocconato (*mpr*).

* Cordero di Montezemolo.

Antica famiglia patrizia di Mondovì (cognome d'uso di Montezemolo) le cui origini risalgono al sec. XI. Res. Mondovì, Roma, Montezemolo, Pisa, ecc., Marchesi di Montezemolo (*mpr*). (*Per il C.S.* vedi vol. V, 1920-22). *Arma: d'azzurro troncato da un filetto d'oro; nel 1° all'arco col dardo incoccato accostato da due stelle; nel 2° a due bande, il tutto d'oro. Cimiero: un cuore di rosso infiammato. Motto:* HONNEUR ET FIDELITE'.

RAMO PRIMOGENITO

† Nob. ***Mario*** Cordero, marchese di Montezemolo, gen. d'art. c.a., camp. di Libia, e camp. 1914-18, 1940-44, agricoltore, sindaco di Montezemolo, n. a Torino 9 ag. 1888 † a Bologna 5 magg. 1960, figlio del marchese Carlo, gen. d'art. c.a. (n. 7 ag. 1858 † 30 lug. 1943) e della nob. Maria Ferrari dei march. di Castelnuovo e co. d'Orsara (n. 30 giu. 1858 † 22 dic. 1925) sp. a Roma 24 febb. 1918, nob. Clementina dei co. Deciani, n. a Montegnacco (UD) 9 apr. 1890 † a Roma 10 febb. 1982.

FIGLI: 1) † ***Giorgio***, marchese di Montezemolo, ammiraglio Ris., cav. d'on. e dev.

Cordero di Montezemolo 497

del S.M.O. di Malta, n. a Vicenza 1 nov. 1918 † a Roma 17 febb. 1986, sp. a Torino 16 apr. 1958 marchesa Léontine d'Incisa di Camerana, n. a Merano 24 genn. 1936 [***Montezemolo***, (Cuneo) e ***Roma***], da cui:

a) ***Andrea***, marchese di Montezemolo, dott. sc. econ. e comm., s. ten. di vascello, n. a La Spezia 14 ott. 1959, sp. a Roma a 28 apr. 1988 nob. ***Francesca*** dei co. Nasalli Rocca di Corneliano, n. a Roma 15 ott. 1965, da cui: ***Federico***, n. Roma 25 febb. 1990; *b*) ***Nicoletta***, n. a La Spezia 14 ott. 1962.

2) ***Massimo***, dott. agronomo, cav. d'on. e dev. del S.M.O. di Malta, n. a Rosignano Marittimo (Livorno) 23 dic. 1920, sp. a Bologna 7 nov. 1946 Clotilde Neri, n. a Bologna 26 ag. 1922 [***Roma***: Largo Messico 16], da cui: *a*) ***Luca***, avv., dir. industr., n. a Bologna 13 ag. 1947, da cui: (1) ***Matteo***, n. a Torino 7 apr. 1977; (2) ***Clementina***, n. a Milano 5 mar. 1981; *b*) ***Marco***, notaio, n. a Bologna 1 lug. 1949, sp. a Roma 16 giu. 1976 ***Anna*** Pizzi da cui: ***Nicola***, n. in Ancona 29 magg. 1981; *c*) ***Daniele***, dott. in legge, n. a Roma 21 dic. 1954, sp. a Bologna 22 giu. 1991 ***Francesca*** Ciotti, n. a Mestre 13 ov. 1955.

FRATELLI: 1) † ***Paolo***, ten. di vasc., sommergibilista, camp. Libia e camp. 1915-18, n. a Firenze 14 mar. 1890 † a Livorno 18 genn. 1920, sp. a La Morra (Cuneo) 11 sett. 1918 nob. Maria Lidia Vitale, n. a Torino 21 dic. 1888 † ivi 12 magg. 1935, da cui: † ***Paolo***, n. a Torino 24 genn. 1920 † ivi 13 dic. 1987, viticultore, sp. a Villanovetta 8 mar. 1943, ***Anna*** Dumontel, n. a Torino 11 giu. 1920 † ivi 25 sett. 1990, da cui: *a*) ***Carlo***, dott. med. e chir., ginecologo, n. a La Morra 19 giu. 1944, sp. a Torino 26 genn. 1980, Maria Angela Barberis, da cui: ***Giulia***, n. a Torino 3 ag. 1982; *b*) ***Luca***, dott. in med. e chir., pediatra, n. a La Morra 28 sett. 1945, sp. 2 genn. 1969 a La Morra, ***Lucia*** Barberis, da cui: (1) ***Stefano***, n. a Torino 26 magg. 1970; (2) ***Nicola***, n. a Torino 7 ag. 1976; *c*) ***Luisa***, n. a Torino 8 dic. 1946, sp. a La Morra 31 magg. 1969 nob. Guido Brondelli dei co. di Brondello; *d*) ***Giovanni***, viticultore, n. a Torino 16 ott. 1948, sp. a La Morra 5 genn. 1975 ***Luisella*** Alpozzi, da cui: (1) ***Elena***, n. a Torino 3 genn. 1977; (2) ***Alberto***, n. a Torino 24 magg. 1981; *e*) ***Alessandra***, n. a Torino 14 giu. 1952, sp. a La Morra 28 magg. 1983 dott. Carlo Lombardi; *f*) ***Enrico***, viticultore, n. a Torino 1 lug. 1959, sp. a Camogli (Genova) 16 mar. 1991 ***Paola*** Vittoria Marini, n. a Chiavari (Genova) 3 ag. 1960.

2) † ***Sofia***, n. a Firenze 24 mar. 1892 † Castelnuovo Bormida 27 febb. 1956, sp. a Castelnuovo Bormida 9 sett. 1916 dott. Ruggero Tragni, (n. 1882 † 1928).

3) † ***Beppina***, n. a Firenze 19 lug. 1893 † a Castelnuovo Bormida 5 ag. 1962.

4) † ***Giorgio***, ten. d'art., pilota, n. a Trinità (Cuneo), 24 sett. 1898 † in volo 26 ott. 1918, sul campo aviatorio di Battaglia Terme (Padova).

RAMI CUGINI

1 - ***nati dal matrimonio dello zio Emilio*** (n. 1860 † 1924) ***con Giuseppina Bellone*** (n. 1864 † 1956):

1) † ***Elena***, prof. mat., n. 1889 † 1929;

2) † ***Teresa***, n. a Mondovì 14 sett. 1891 † ivi 29 ott. 1988, ved. del dott. Pietro Sacchetti (n. 1881 † 1958);

3) † ***Emilia***, prof. lettere, n. 1893 † 1964;

4) † ***Luisa***, n. a Mondovì 15 sett. 1895 † 1986;

5) † ***Clotilde***, n. a Mondovì 1897 † 1969;

Notes: This figure shows two pages of *Libro d'oro della nobiltà italiana*, Issue XX, Volume XXI, used to obtain biographical information on noble descendants and on family trees of dynasties.

Table B.1: Difference in Median and Mean Income by Age Bin

	Median Income		Mean Income	
Age Bin	Common	Noble	Common	Noble
[16, 20)	84	0	1,681	0
[20, 25)	2,164	46	5,671	2,450
[25, 30)	8,047	8,027	11,776	11,674
[30, 35)	13,597	17,216	18,688	26,470
[35, 40)	15,473	36,206	25,034	51,972
[40, 45)	16,092	34,922	30,223	62,408
[45, 50)	17,923	53,790	32,896	84,313
[50, 55)	18,835	39,871	32,201	138,682
[55, 60)	17,086	54,470	31,097	100,961
[60, 65)	14,426	35,723	27,592	67,570
[65, 70)	12,101	51,720	24,165	75,308
[70, 75)	10,196	67,550	20,247	140,898
[75, 80)	9,940	54,153	16,711	92,696
[80, 85)	9,562	42,304	15,342	54,647
[85, 90)	8,444	65,672	12,890	64,584
[90, 95)	7,522	18,818	11,397	62,551
[95, 100]	6,290	46,879	10,494	46,879

Notes: This table represents the median and mean taxable income for all taxpayers falling into the specified age bins. The statistics are reported separately for commoner and noble taxpayers. The unit of analysis is an individual taxpayer. This table presents the underlying data from Figure 2.3.

Appendix C: Additional Exhibits for Chapter 3

Table C.1: Firms Exposed to the Reform Have Lower Probability of Survival

	LHS variable: Prob(Total Sales > 15000)			
	(1)	(2)	(3)	(4)
Exposure × Post	-0.169***	-0.147***	-0.149***	-0.126***
	(0.009)	(0.010)	(0.010)	(0.010)
Observations	54621	54621	54621	54621
Clusters (Sellers)	18,207	18,207	18,207	18,207
Industry × Year FE		Y		Y
Province × Year FE			Y	Y

Notes: This table reports the survival probability that a seller more exposed to the reform remains active after the reform relative to a less exposed seller. The unit of analysis is a seller. The sample is the analysis sample. The variable *Exposure* is defined as the share of business sales that would be subject to the new rules of VAT collection, as explained in Section 3.4.1. The variable *Post* is dummy equal to 1 for the years 20015 and 2016. Specifications may include fixed effects for industry by year, province by year, and firm, as indicated in each column. An active firm is defined as a firm with more than €15,000 in total sales. Standard errors are clustered at the seller level.

Table C.2: Firms Adjust their Customer Base

	Conditional Prob of Selling to	
	Affected Clients	Non-affected Clients
Year 2015	-0.160***	-0.120***
	(0.007)	(0.005)
Year 2016	-0.201***	-0.179***
	(0.008)	(0.006)
Observations	7572	11109
Clusters (firms)	2,524	3,703

Notes: This table shows the difference in the probability of trading with affected clients or non-affected clients. The probability is estimated separately for firms with pre-reform relationships with affected clients and firms with pre-reform relationships with non-affected clients. The specification includes fixed effects for industry by year, province by year and firm. The sample is made of firms in the analysis sample with at least 20 percent of their sales to either non-affected clients or affected clients. Standard errors are clustered at the seller level.

Table C.3: Fewer Firms Remit VAT after the Reform

	VAT Remittance			VAT Credit		
	(1)	(2)	(3)	(4)	(5)	(6)
Treat × Q1 2014	-0.052*	-0.031	-0.040	0.044*	0.022	0.032
	(0.022)	(0.026)	(0.025)	(0.022)	(0.026)	(0.025)
Treat × Q2 2014	-0.054*	-0.057*	-0.035	0.055*	0.055*	0.037
	(0.022)	(0.026)	(0.022)	(0.022)	(0.025)	(0.023)
Treat × Q3 2014	-0.016	-0.016	0.013	0.025	0.023	0.001
	(0.021)	(0.026)	(0.021)	(0.021)	(0.025)	(0.021)
Treat × Q1 2015	-0.113***	-0.097***	-0.083**	0.114***	0.097***	0.079**
	(0.025)	(0.027)	(0.028)	(0.025)	(0.027)	(0.029)
Treat × Q2 2015	-0.183***	-0.177***	-0.198***	0.192***	0.186***	0.207***
	(0.026)	(0.029)	(0.029)	(0.026)	(0.028)	(0.029)
Treat × Q3 2015	-0.159***	-0.162***	-0.198***	0.174***	0.174***	0.214***
	(0.027)	(0.031)	(0.029)	(0.027)	(0.030)	(0.030)
Treat × Q4 2015	-0.196***	-0.194***	-0.239***	0.203***	0.203***	0.244***
	(0.026)	(0.029)	(0.029)	(0.027)	(0.029)	(0.030)
Treat × Q1 2016	-0.258***	-0.234***	-0.266***	0.263***	0.247***	0.271***
	(0.027)	(0.029)	(0.031)	(0.028)	(0.030)	(0.033)
Treat × Q2 2016	-0.176***	-0.179***	-0.262***	0.180***	0.179***	0.262***
	(0.027)	(0.030)	(0.031)	(0.027)	(0.029)	(0.032)
Treat × Q3 2016	-0.159***	-0.161***	-0.216***	0.163***	0.158***	0.218***
	(0.027)	(0.030)	(0.031)	(0.027)	(0.029)	(0.033)
Treat × Q4 2016	-0.162***	-0.161***	-0.235***	0.171***	0.169***	0.245***
	(0.027)	(0.030)	(0.031)	(0.027)	(0.029)	(0.033)
Observations	88956	88668	88956	88956	88668	88956
Clusters (Sellers)	2471	2463	2471	2471	2463	2471
Baseline Mean	.68	.68	.55	.30	.30	.42

Notes: This table reports the coefficients β_s from specification 3.1. The dependent variable is an indicator variable equal to 1 if the firm remits payments of VAT in a filing period for Columns (1)-(3), while it is an indicator variable equal to 1 if the firm reports VAT credit for Columns (4)-(6). The dependent variable is calculated on a net basis in Columns (1), (2), (4) and (5), while it is calculated on a gross basis in Columns (3) and (6). The reform is enacted in January 2015 and the coefficient corresponding to the 4th quarter of 2014 (β_0) is normalized to 0. All specifications include fixed effects for industry by year, province by year and firm, except for Columns (2) and (5) that includes fixed effects for industry by filing period, province by filing period and firm. The sample is made of monthly filers. Standard errors are clustered at the firm level.

Table C.4: Firms Reduce their VAT Payments after the Reform

	VAT Remittance		Net Remittance	
	(1)	(2)	(3)	(4)
Treat × Q1 2014	-0.374	-0.176	-0.514**	-0.272
	(0.216)	(0.216)	(0.193)	(0.192)
Treat × Q2 2014	-0.382*	-0.256	-0.540**	-0.411*
	(0.191)	(0.191)	(0.186)	(0.184)
Treat × Q3 2014	0.120	0.180	-0.173	-0.125
	(0.180)	(0.180)	(0.183)	(0.182)
Treat × Q1 2015	-0.854***	-0.655**	-1.054***	-0.812***
	(0.242)	(0.242)	(0.212)	(0.214)
Treat × Q2 2015	-1.861***	-1.735***	-1.686***	-1.558***
	(0.248)	(0.249)	(0.223)	(0.224)
Treat × Q3 2015	-1.844***	-1.784***	-1.503***	-1.455***
	(0.256)	(0.257)	(0.230)	(0.230)
Treat × Q4 2015	-2.259***	-2.259***	-1.790***	-1.790***
	(0.254)	(0.254)	(0.226)	(0.226)
Treat × Q1 2016	-2.413***	-2.214***	-2.371***	-2.130***
	(0.273)	(0.273)	(0.230)	(0.231)
Treat × Q2 2016	-2.411***	-2.285***	-1.596***	-1.468***
	(0.274)	(0.275)	(0.229)	(0.230)
Treat × Q3 2016	-1.999***	-1.939***	-1.439***	-1.392***
	(0.276)	(0.277)	(0.229)	(0.230)
Treat × Q4 2016	-2.179***	-2.179***	-1.540***	-1.540***
	(0.273)	(0.273)	(0.229)	(0.229)
Observations	88956	88956	88956	88956
Clusters (firms)	2471	2471	2471	2471
Baseline Level	47726		42444	

Notes: This table reports the coefficients β_s from specification 3.1. The dependent variable is the value of periodic VAT remittances. The dependent variable is calculated on a gross basis in Columns (1)-(2), while it is calculated on a net basis in Columns (3)-(4). The reform is enacted in January 2015 and the coefficient corresponding to the 4th quarter of 2014 (β_0) is normalized to 0. All specifications include fixed effects for industry by year, province by year and firm. Columns (2) and (4) control for industry-specific quadratic trends.The sample is made of monthly filers. Standard errors are clustered at the firm level.

Table C.5: Firms Increase their VAT Credit after the Reform

	VAT Credit		Net Credit	
	(1)	(2)	(3)	(4)
Treat × Q1 2014	0.183	0.045	0.263	0.086
	(0.225)	(0.224)	(0.203)	(0.202)
Treat × Q2 2014	0.255	0.122	0.415*	0.267
	(0.199)	(0.199)	(0.200)	(0.197)
Treat × Q3 2014	0.026	−0.061	0.258	0.170
	(0.177)	(0.177)	(0.189)	(0.187)
Treat × Q1 2015	0.554*	0.416	0.819***	0.642**
	(0.264)	(0.263)	(0.230)	(0.230)
Treat × Q2 2015	1.861***	1.727***	1.713***	1.566***
	(0.273)	(0.273)	(0.248)	(0.249)
Treat × Q3 2015	2.175***	2.088***	1.759***	1.670***
	(0.282)	(0.283)	(0.256)	(0.257)
Treat × Q4 2015	2.620***	2.620***	2.171***	2.171***
	(0.291)	(0.291)	(0.263)	(0.263)
Treat × Q1 2016	2.424***	2.286***	2.343***	2.165***
	(0.314)	(0.313)	(0.266)	(0.267)
Treat × Q2 2016	2.546***	2.412***	1.760***	1.613***
	(0.319)	(0.320)	(0.266)	(0.265)
Treat × Q3 2016	2.338***	2.250***	1.732***	1.644***
	(0.322)	(0.323)	(0.264)	(0.264)
Treat × Q4 2016	2.606***	2.606***	1.862***	1.862***
	(0.324)	(0.324)	(0.269)	(0.269)
Observations	88,956	88,956	88,956	88,956
Clusters (firms)	2,471	2,471	2,471	2,471
Baseline Level	37,309		14,430	

Notes: This table reports the coefficients β_s from specification 3.1. The dependent variable is the value of periodic VAT credits. The dependent variable is calculated on a gross basis in Columns (1)-(2), while it is calculated on a net basis in Columns (3)-(4). The reform is enacted in January 2015 and the coefficient corresponding to the 4th quarter of 2014 (β_0) is normalized to 0. All specifications include fixed effects for industry by year, province by year and firm. Columns (2) and (4) control for industry-specific quadratic trends.The sample is made of monthly filers. Standard errors are clustered at the firm level.

Table C.6: Total Sales Remained Stable

	LHS variable: Total Sales				
	(1)	(2)	(3)	(4)	(5)
Exposure × Post	-0.002	0.004	-0.006	-0.001	-0.001
	(0.015)	(0.017)	(0.015)	(0.017)	(0.017)
Exposure	-0.969***	-0.820***	-0.784***	-0.625***	0.000
	(0.050)	(0.048)	(0.051)	(0.048)	(.)
Observations	44958	44955	44958	44955	44955
Clusters (sellers)	14,986	14,985	14,986	14,985	14,985
Industry × Year FE		Y		Y	Y
Province × Year FE			Y	Y	Y
Firm FE					Y

Notes: This table reports the coefficients from specification 3.3 where the dependent variable is *Total Sales*. The variable *Exposure* is defined as the share of business sales that would be subject to the new rules of VAT collection, as explained in Section 3.4.1. The variable *Post* is dummy equal to 1 for the years 2015 and 2016. Standard errors are clustered at the seller level.

Table C.7: Total Purchases Remained Stable

	LHS variable: Total Purchases				
	(1)	(2)	(3)	(4)	(5)
Exposure × Post	0.010	-0.002	0.009	-0.003	-0.003
	(0.026)	(0.029)	(0.026)	(0.029)	(0.029)
Exposure	-1.450***	-1.023***	-1.271***	-0.822***	0.000
	(0.075)	(0.066)	(0.076)	(0.065)	(.)
Observations	44958	44955	44958	44955	44955
Clusters (sellers)	14,986	14,985	14,986	14,985	14,985
Industry × Year FE		Y		Y	Y
Province × Year FE			Y	Y	Y
Firm FE					Y

Notes: This table reports the coefficients from specification 3.3 where the dependent variable is *Total Purchases*. The variable *Exposure* is defined as the share of business sales that would be subject to the new rules of VAT collection, as explained in Section 3.4.1. The variable *Post* is dummy equal to 1 for the years 2015 and 2016. Standard errors are clustered at the seller level.

Table C.8: The Effect of Tax Collection on Taxable Sales

	LHS variable: Taxable Sales				
	(1)	(2)	(3)	(4)	(5)
Exposure × Post	0.047	0.043	0.041	0.034	0.034
	(0.039)	(0.038)	(0.038)	(0.038)	(0.038)
Exposure	-1.982***	-1.131***	-1.819***	-0.953***	
	(0.101)	(0.076)	(0.101)	(0.077)	
Observations	44958	44955	44958	44955	44955
Clusters (Sellers)	14,986	14,985	14,986	14,985	14,985
Industry × Year FE		Y		Y	Y
Province × Year FE			Y	Y	Y
Sellers FE					Y

Notes: This table reports the coefficients from specification 3.3. The unit of observation is a seller. The dependent variable is *Taxable Sales*. The variable *Exposure* is defined as the share of business sales that would be subject to the new rules of VAT collection, as explained in Section 3.4.1. The variable *Post* is dummy equal to 1 for the years 20015 and 2016. Specifications may include fixed effects for industry by year, province by year, and firm, as indicated in each column. The sample includes firms in the analysis sample. Standard errors are clustered at the seller level.

Table C.9: The Effect of Tax Collection on Taxable Purchases

	LHS variable: Taxable Purchases				
	(1)	(2)	(3)	(4)	(5)
Exposure × Post	-0.563***	-0.809***	-0.154	-0.367**	-0.367**
	(0.121)	(0.123)	(0.122)	(0.123)	(0.123)
Exposure	-1.310***	-0.643***	-1.104***	-0.465***	
	(0.087)	(0.089)	(0.089)	(0.091)	
Observations	44958	44955	44958	44955	44955
Clusters (Sellers)	14,986	14,985	14,986	14,985	14,985
Industry × Year FE		Y		Y	Y
Province × Year FE			Y	Y	Y
Sellers FE					Y

Notes: This table reports the coefficients from specification 3.3. The unit of observation is a seller. The dependent variable is *Taxable Purchases*. The variable *Exposure* is defined as the share of business sales that would be subject to the new rules of VAT collection, as explained in Section 3.4.1. The variable *Post* is dummy equal to 1 for the years 20015 and 2016. Specifications may include fixed effects for industry by year, province by year, and firm, as indicated in each column. The sample includes firms in the analysis sample. Standard errors are clustered at the seller level.

Table C.10: The Effect of Tax Collection on the Tax Base

	LHS variable: Tax Base scaled				
	(1)	(2)	(3)	(4)	(5)
Exposure × Post	-0.003	-0.030***	0.000	-0.027***	-0.027***
	(0.007)	(0.008)	(0.007)	(0.008)	(0.008)
Exposure	-0.139***	-0.009	-0.149***	-0.016	
	(0.013)	(0.008)	(0.013)	(0.008)	
Observations	44958	44955	44958	44955	44955
Clusters (Sellers)	14,986	14,985	14,986	14,985	14,985
Industry × Year FE		Y		Y	Y
Province × Year FE			Y	Y	Y
Sellers FE					Y

Notes: This table reports the coefficients from specification 3.3. The unit of observation is a seller. The dependent variable is *Taxable Sales*. The variable *Exposure* is defined as the share of business sales that would be subject to the new rules of VAT collection, as explained in Section 3.4.1. The variable *Post* is dummy equal to 1 for the years 20015 and 2016. Specifications may include fixed effects for industry by year, province by year, and firm, as indicated in each column. The sample includes firms in the analysis sample. Standard errors are clustered at the seller level.

Appendix D: Variable Definition

- Total sales: Value of goods and services provided by the firm in a given year. This includes taxable and non-taxable sales, sales to consumers and
- Business sales: Value of sales to business clients located in Italy.
- Taxable sales: The value of taxable goods and services provided by a firm in a given year. This catego

Appendix E: Data Cleaning Steps

1. Eliminate firms with many trailing zeros, 2 firms.

2. Eliminate links with zero or negative sales. 81,990 unique firms have at least one link with strictly positive sales.

3. Eliminate firms with total annual sales ("*volume d'affari*") below the minimum registration threshold. This registration threshold varies according to the industry of the firm. There are 82,259 firms.

4. Take the intersection of firms that have no missing values of Total Sales and no missing value of Spesometro. These are 63,267 firms.

5. **Balanced panel.** Using an active threshold of €15,000, the balanced panel contains 49,632 firms.

Appendix F: Conceptual Framework

The inversion of statutory incidence of VAT might induce a behavioral response at the level of the individual firm through mainly two channels: evasion and cash-flows. Moreover, at the aggregate level, I expect the behavioral response of firm to result in a change in the composition of government suppliers.

First, at the individual level, the inversion of statutory incidence represents a change in the evasion technology available to firms as it eliminates the possibility to evade through late or non-payments. Indeed, the stated goal for the policy intervention considered in this paper was to reduce evasion[1]. Moreover, similar policies increased compliance (Brockmeyer and Hernandez, 2019; Kopczuk et al., 2016), yet others were not entirely successful in preventing evasion. (Carrillo, Pomeranz and Singhal, 2017).

Second, the reform mechanically reduces cash-flows for firms with pre-reform relationships with affected buyers. While some businesses are well positioned to operate with lower cash-flows or are quick to adjust to it, others might need to access (costly) external funds. Others without that option might decide to shut down.

Costly External Finance

A firm is active for two periods. In the first period, the firms produces, sells its output and pays its suppliers. In the second one, it remits any outstanding tax liability to the tax authority. This represents a good approximation to the way actual collection of VAT occurs. Tax deadlines generally fall some weeks or months after the end of the filing period.

[1] A study conducted by the tax authority finds that the policy reduced VAT evasion in the aggregate (Carfora et al., 2017)

The firm's objective function is made of two components: net value added and the cost of external funds. Let's define net value added as the difference between revenues and costs, net of VAT:

$$NVA = (1 - \tau)[y - c(y)]$$

where $c(.)$ is a strictly convex function and τ is the VAT rate.

Now, we consider cash-flows to the firm over two periods. To capture the effect of statutory incidence on cash-flows to the firm, I introduce the parameter μ. This is the share of VAT on sales for which the buyer is responsible to remit. Therefore, cash-flows are:

$$\begin{aligned} CF_1(y) = &\quad (1 - \mu\tau)y - c(y) \\ CF_2(y) = &\quad -\tau(y - c(y)) + \mu\tau y \end{aligned}$$

Two comments. Negative cash-flows in period 2 indicates that the firm remits its outstanding VAT liability to the tax authority, while positive cash-flows implies that it is eligible for a refund. Moreover, total cash-flows over the two periods sum up to net value added.

When $\mu = 0$, statutory incidence of VAT falls entirely on the seller and cash-flows coincide with gross value added. As μ and the proportion of sales subject to the inversion of statutory incidence increase, cash-flows decline. At the extreme, when $\mu = 1$, statutory incidence falls entirely on the buyer and the firm does not remit VAT.

When cash-flows in the first period are negative, the firm need external funds to pay its suppliers and fund its operations. These costs could stem from accessing the credit-lines or short-term loans. Following Gomes (2001) and Strebulaev and Whited (2011), I assume that the costs, defined by the function $\lambda(.)$, are positive and increasing if the firm uses external funds, but they are null if the firm does not use external funds. Therefore,

$$\lambda(CF_1) \begin{cases} = 0 & \text{if } CF_1 \geq 0 \\ > 0 & \text{if } CF_1 < 0 \end{cases}$$

where CF_1 represents cash-flows in the first period[2].

The firm chooses net value added, taking into account the cost of external funds:

$$\max_y \quad (1-\tau)\big[y - c(y)\big] - \lambda(CF_1)$$

When cash-flows are positive, the first order condition is:

$$c'(y^+) = 1$$

Otherwise the first order condition becomes:

$$c'(y^-) = 1 - \frac{\lambda'(CF_1)\mu\tau}{\lambda'(CF_1) - (1-\tau)}$$

The firm reduces output if it needs external finance when $c'(y^-) < c'(y^+)$. This is true when $\lambda'(CF_1) \geq (1-\tau)$. Intuitively, the firm reduces its output when the marginal cost of an additional euro of external funds, $\lambda'(CF_1)$, is higher than the marginal retention rate of output, $(1-\tau)$.

Evasion

The firm may decide to evade parts of its VAT liability by over-reporting its costs. Let's denote reported costs as $\hat{c}$ and the amount evaded as $e = \hat{c} - c(y)$. If it evades, the firm bears a cost which depends on (i) the amount evaded and (ii) the proportion of sales subject to inversion of statutory incidence, μ. Thus the cost of evasion becomes $g(e, \mu)$, which is

[2]To ease notation, I do not indicate that cash-flows depend on output.

strictly increasing in both arguments. Then, the firm's objective function becomes:

$$\Pi = (1-\tau)\big[y - c(y)\big] + te - g(e,\mu) - \lambda(CF)$$

When cash-flows are positive, the first order conditions are:

$$\begin{aligned} c'(y) &= 1 \\ t &= g'(e,\mu) \end{aligned}$$

When cash-flows are negative, the first order conditions are:

$$\begin{aligned} c'(y) &= 1 - \tfrac{\mu t \lambda'(CF(y^*_-))}{\lambda'(CF(y^*_-)) - (1-t)} \\ t &= g'(e,\mu) \end{aligned}$$