FISCAL AND MONETARY COMPETITION: THEIR INTERACTIONS AND EFFECTS

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To my mother, Müren Önder, and my father, Izzettin Önder

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

An important research area in economics is the study of interaction between jurisdictions' economic policies, and how these interactions affect individuals. Strategic interactions between fiscal and monetary policies, and their effects on governments and individuals are investigated in this dissertation. Governments use fiscal and monetary policies to enhance the welfare of individuals living within their jurisdictions' boundaries. In order to be able to supply public goods that are demanded by individuals, governments need to raise revenue. Main findings are that monetary competition leads to lower inflation rates; low tax rates as well as local amenities are important factors in attracting migrants into a jurisdiction; monetary unification leads to oversupply of public goods; and monetary policy of a monetary union is affected by accession countries' inflation rates.

In the second chapter, interactions between the capital tax rate and the inflation rate are investigated. A model is presented that allows for international trade in goods markets as well as in money markets. It is shown that interactions of capital tax rate and inflation rate create horizontal and vertical externalities. Optimal levels of the capital tax rate and the inflation rate depend on how these externalities dominate one another. If a currency union is formed, the inflation rate that prevails across the currency union will be higher than the inflation rate in either country under monetary independence, and national public good provision will be suboptimally high. Inflation elasticities of the demand for a country's national currency determine whether capital taxes will be higher or lower under single currency in that country.

The third chapter provides empirical evidence about the effect of local fiscal variables on individuals' choice of location. Empirical results obtained from the 2000 Census elderly migration data using a general gravity model of migration flows confirm earlier findings of the 'same sign problem' in the literature, which means that the elderly both migrate from and to states where taxes are higher. The same sign problem can be attributed to the heterogeneity of in- and out-migrating groups. It is proposed here that it is possible to control for heterogeneity of migrating groups by controlling for some characteristics of either the origin or the destination state. In a gravity equation estimation for elderly migration, when controlled for heterogeneity of migrants, the same sign problem fades away, and the gravity equation shows clearer patterns for elderly migration. In particular, local amenities, tax exemptions, and low inheritance taxes are shown to be significant variables in attracting the elderly into a state.

The fourth chapter addresses a crucial question: What is an optimal monetary policy for a candidate country and the monetary union to follow prior to accession? In a hypothetical setting, where there are no pre-accession monetary rules for accession countries, effect of bilateral exchange rates between the currency union's currency and accession countries' currencies on the currency union's inflation target is being investigated here. A nominal exchange rate based criterion both for welfare of the accession country and for currency union's monetary policy target is presented. An accession country with an appreciating currency will find it non-optimal to join the currency union, and in case of an accession, currency union's monetary authority will need to adjust its optimal target criterion for inflation to a higher level. Accession of a country with a depreciating currency will lower the optimal target for the currency union.

Finally, the fifth chapter provides fundamental conclusions.

CHAPTER II

INFLATION TAX COMPETITION AND ITS EFFECTS ON NATIONAL CAPITAL TAXES

Introduction

Although interregional tax competition has been a widely investigated area of research in public economics since Zodrow and Mieszkowski (1986) and Wilson (1986), research focusing on how different monetary regimes affect interregional tax competition, and how monetary policy itself is affected by the tax competition caught surprisingly little attention.

Governments have two broad sources of revenue: Taxation and seignorage. Seignorage is obtained by simply printing money, which can be an inflationary practice under many circumstances. As a result, seignorage imposes a tax on agents' nominal money balances to the degree that it creates inflation, because inflation erodes the purchasing power of nominal money balances. The idea that inflation is not only a monetary problem, but also an element of government finance, is not a new one. According to the public finance view of inflation, pioneered by Phelps (1973), inflation should actually be derived as part of the public finance problem along with other optimal tax rates. The central question of this paper is: Given that inflation is an integral part of government finance, and that governments can use inflation rate as well as capital tax rate as strategical variables in financing a national public good, how will monetary unification affect inflation rate and capital tax rate?

The fundamental argument of this paper is that governments compete in inflation in a similar fashion as they would compete in other conventional taxes, if agents in each country can keep at least some fraction of their savings in a foreign currency and then use their foreign currency holdings to purchase foreign products. Intuition is easy: Competition in inflation will lead to low inflation levels, because a country with high inflation rate will lose its inflation tax base, which is defined as balances held in that country's currency. Each country will end up with low inflation levels in a non-cooperative Nash equilibrium.

Inflation is an important concern in currency unions. As an example, the monetary authority of the Eurozone, European Central Bank (ECB) adopts very strong anti-inflationary policies and is almost desparate to keep its inflation level below 2% annualy. However, taking a closer look at inflation performance of the Eurozone, one observes that the Eurozone is not doing particularly well compared to similar economies. This paper provides an explanation for the case that a currency union can actually create a higher inflation rate for its members: Due to creation of a currency union, incentives for inflation tax competition will obviously be absent, and a higher inflation rate will prevail across the union. Moreover, this will affect other taxe rates, such as the capital tax rate, as well.

In a model that allows for international trade in goods markets as well as in money markets, interactions of the capital tax rate and the inflation rate are investigated. It is shown that the capital tax rate set by a national government creates a horizontal externality for the other country's national government, and this effect pushes the equilibrium level of capital tax rates in both countries down. A similar effect is present for the inflation rate of the domestic currency chosen by the national central bank. We will call this phenomenon 'inflation tax competition'. Inflation tax competition pushes equilibrium level of inflation rates in both countries down. However, there is a vertical externality created by

the interaction between capital taxe rates and inflation rates, which leads to higher capital tax rates in both countries. Equilibrium levels of capital tax and inflation rates depend on which of these opposing effects will dominate. If the two countries form a currency union, then the inflation rate that prevails across the currency union, as determined optimally by the choice of single currency's growth rate by the central bank will be higher than the inflation rate that would prevail in either country under monetary independence. Although inflation rate will be higher, individual countries will choose a lower capital tax rate than under monetary independence.

Capital taxes also play an important role in international policy decisions. Especially, since the capital account liberalization movements of 1970s and 1980s, free trade in foreign currencies has been made possible through free trade in capital assets. As a result, inflation tax competition as it will be discussed in this paper cannot be thought of as being immune to capital market considerations. In this paper, we have a simple capital market that pays an international real interest rate to those who invest in capital. It will be shown that the vertical externality created by capital taxe rates and inflation rates is actually a direct effect of international real interest rate on households' disposable incomes.

With increasing international integration and financial liberalization, foreign currencies, especially those which yield a more stable return than the domestic currency, occupy some non-trivial fractions of individuals' portfolios. In such a financially integrated environment, governments will find it profitable to provide a strong currency, that is, a currency subject to a lower inflation, and expand the tax base for inflation tax. This is the way two or more governments with independent currencies engage in 'inflation tax competition'.

There is one important remark we need to make here. Data shows that inflation tax makes up a relatively small proportion of government revenues, especially in most of the

developed countries. For example, from 1987 to 1996, inflation tax accounted only for 0.44% of all tax revenues in UK, and 1.74% of all tax revenues in Germany. Although inflation tax revenues don't account for too great shares of government revenues, especially in most of the developed countries, the benefits of a strong and stable currency is not limited to increasing the inflation tax revenue only. The actual competition between different currencies is to determine which one will become a reserve currency, which implies control over the international capital markets in the long run, because international capital markets are mainly under control of the supplier of the reserve currency. Our model is too simple to capture all these scenarios, and it is our ongoing project to explain the creation of a reserve currency in a coalition formation setting. We just need to underline at this point that we are aware of the empirical facts about the inflation tax revenues. Hence the inflation tax competition, as it is defined in this paper, can be understood as an analogy to competition among currencies for gaining the trust of international markets.

The main argument of this paper is that when a monetary union is formed between countries who have been competing in inflation rates, the union-wide inflation rate will be higher than what individual countries would have obtained. This is a direct result of cease of inflation tax competition across members of a monetary union. Capital taxes will have to adjust accordingly.

Background

Capital tax competition literature first focused on horizontal externalities across jurisdictions discussed by Zodrow and Mieszkowski (1986). If the tax base is mobile, then different regions compete against each other to capture most of the mobile tax base. In equilibrium, overall tax rate will be low. Moreover, since public good provision is based on

government revenues, public goods will be undersupplied. This result simply follows from the fact that competing jurisdictions of the same rank will engage in horizontal competition, and an increase in one jurisdiction's tax rate will increase the tax base that is available to other jurisdictions.

Keen and Kotsogiannis (2002) show that tax competition doesn't have to lead to inefficiently low taxes, and it can lead to high taxes instead, if the competing agents are different layers of the state. That is, the same tax base can be double taxed by two different layers of government (say, by the local government, as well as by the federal government), and in that can equilibrium tax rates will be too high. When vertically connected jurisdictions, such as state and federal governments, compete for a mobile tax base, then each of them will be subject to vertical externalities. That is, an increase in one jurisdiction's tax rate will result in a decrease rather than an increase in the tax base that is available to the other jurisdiction. In most cases horizontal and vertical externalities are found together, and whether the equilibrium tax rates will be too low or too high depends on whether horizontal or vertical externalities dominate. [1]

Another source of vertical externalities is decentralization, as analyzed by Wilson and Janeba (2005). In their model, the mix of horizontal and vertical externalities is determined by the degree of decentralization, and they find that 'in contrast to standard tax competition models, decentralizing the provision of public goods may improve welfare' (p.1211).

Makris (2006) investigates what happens to capital tax rates if countries share a common currency. This paper is close to ours, however we differ in our fundamental assumptions. Makris (2006) assumes that there is only a single composite commodity and

[1]Devereux, Lockwood and Redoano (2007), Lockwood and Makris (2006) provide empirical evidence that support the theory of vertical tax competition, and how it compares to the effects of the horizontal tax competition.

there is autarky in money markets. Hence, his model cannot distinguish between the two cases of many countries with many currencies and many countries with a single currency. Our results, as far as effects of single currency on capital tax rates are considered, are in line with Makris (2006), however we allow for trade in money markets, and as a result, we are able to focus on inflation as a strategic variable.

Several papers investigate the strategic interaction of jurisdictional fiscal authorities and monetary authority in a monetary union. They reach different results depending on specific assumptions they make. Cooper and Kempf (2003) consider a two world country in an overlapping generations model, where agents need to accumulate foreign currency in the first period if they want to consume foreign goods in the second period. Such a cash constraint imposed by both countries creates an opportunity for both governments to export their inflation to the other country. When these countries are in a monetary union, no such cash constraints will be available, hence there will optimally be no inflation. Bottazzi and Manasse (2002) show that, when the monetary authority of the monetary union cannot commit to a lump-sum redistribution of seignorage, then excessive inflation will result. Their model, however, doesn't incorporate any trade relations.

It is not trivial to bring in money into the canonical tax competition model of Zodrow and Mieszkowski (1986). Makris (2006) does so by employing a utility function where money is an argument and provides positive marginal utility. Introducing money in the utility function can be justified by the underlying assumption that there exist frictions in the money market. Actually, Feenstra (1986) shows that there exists a functional equivalence between having money as an argument in the utility function and introducing liquidity costs in households' budget constraints. Such frictions, however, don't play a crucial role for our model, which focuses on transactions role of money. The very reason why households

hold money constitutes an important factor for understanding how exactly the competition in inflation tax works. As a result, we need to clarify not only what the money demand is, but also why households hold money. As Ostroy and Starr (1990) discuss it in great detail, the transactions role of money cannot be separated from its role as the store of value. For purposes of this study, the demand for money should emerge as a direct result of these two functions of money.

Sibert and Liu (1998) present a model where central banks of home and foreign countries act like providers of differentiated goods in a Bertrand model. They show that when two currencies can be substituted for one another, money growth can either be too high or too low depending on how substitutable they are. In our model, we assume perfect substitutability between currencies, however we also assume that households are perfectly informed about central bank policies, so that we don't obtain a race to the bottom in inflation tax competition.

There is a significant portion of literature on currency unions, claiming that establishment of currency union will lower the optimal inflation rate for its members. Cooper and Kempf (2003), Sibert (1992), Cardarelli and Vidal (1999) are examples of this view. These papers either ignore the vertical externalities created by interactions of inflation and other taxes, or in their models, there are too strong assumptions which ensure that a country will have enough incentive to export its inflation tax. That is, in a cash in advance model, where public good is financed by goverment revenues, inflation tax is a good source of income, because altough it taxes foreigners who are holding domestic currency, its benefits (that is, public good provision) are not shared with foreigners. In our paper, we stress the fact that foreigners may abandon the domestic currency, if it is too costly to hold. To the best of our knowledge, this paper is the first investigation of horizontal and vertical tax external-

ities that are borne by interactions of capital taxes and inflation rates under a regime of independent but tradable currencies and under a regime of a single currency.

Model

There are two countries, country 1 and country 2, and each country is populated by a representative household. Each country has a national government that decides at which rate to tax domestically employed capital. Trade of goods and money takes places at the central exchange of each country. Central exchange of either country issues a national fiat currency. National currency of country 1 will be called currency 1, and national currency of country 2 will be called currency 2. Revenue from inflation tax is transferred to the corresponding national government, and revenue from capital taxation as well as inflation tax revenue are used in financing a national public good. Both countries impose a local currency constraint. That is, country specific private consumption goods can be bought only using domestic currency.

Households

Each household is endowed with a mobile factor, capital, and an immobile factor, labor. Amount of capital endowed to a household in either country is Ω. Endowment of labor for either household is 1 unit, and it is supplied inelastically.

This is a two period model. In the first period, households receive labor and capital income, and decide what proportion of their income they want to keep in currency 1, and what proportion in currency 2. In second period, households use their currency 1 and currency 2 holdings to purchase private consumption goods of country 1 and country 2, respectively.

The firm located in country i will be called firm i, and private consumption good produced in country i will be called good i. Demand for good i by the household in country j is denoted by $x^{i,j}$. Preferences of the household in country i is given by $u\left(x^{i,i}, x^{i,j}\right) + v\left(g_i\right)$.

Household's utility function has standard properties: $u\left(0,0\right) = 0,\ u_1 > 0,\ u_2 > 0,\ u_{11} < 0,\ u_{22} < 0$, where u_1 and u_2 denote marginal utilities of home and foreign private consumption, respectively. Moreover $v\left(0\right) = 0,\ v' > 0,\ v'' < 0$.

Budget constraint for first period is given as $y_i \equiv p_i w_i + p_i r_i \Omega = m^{i,i} + e_i m^{i,j}$, and for second period $x^{i,i} = \frac{m^{i,i}}{p_i'},\ \ x^{i,j} = \frac{m^{i,j}}{p_j'}$.

First period budget constraint shows that nominal holdings of money balances in terms of currency i should be equal to household's income expressed in terms of currency i. p_i is price of good i in the first period, and p_i' is price of good i in the second period. w_i is real wage income earned by household i, r_i is the real return to capital when it is sold to firm i, e_{ij} is the nominal exchange rate for currency j in terms of currency i, and finally, $m^{i,j}$ denotes nominal currency j holdings of houshold i.

Production

Production in both countries is performed by perfectly competitive firms, and it is subject to no uncertainty. Since one unit of labor is supplied inelastically by the representative household in country i to the firm in country i, capital employed by a firm will equivalently be capital per labor, and we will denote it by k_i. Capital is perfectly mobile across the two countries, and as a result, whether household i decides to sent its capital to firm 1 or firm 2, capital has to earn the same marginal income. Hence we formulate a non-arbitrage condition as: $p_i r_i = e_{ij} p_j r_j$.Law of one price holds, and there are no arbitrage opportunities. As a result, an international real interest rate of ρ prevails in the international

capital market.

Production technology in country $i = \{1, 2\}$ is subject to constant returns to scale, and it is given by a twice differentiable production function $f(k_i)$, which satisfies $f(0) = 0$, $f' > 0$, and $f'' < 0$.

Firm i produces a total output of $f(k_i)$, and it pays $r_i k_i$ as capital income, w_i as labor income, $t_i k_i$ as tax on capital. Thus the first order condition for the profit maximization problem of firm i yields that the marginal product of capital has to be equal marginal cost of hiring capital, which is stated as $f'(k_i) = (r_i + t_i)$. As a result, optimum level of capital employed by a firm through international capital market is a function of real interest rate and domestic capital tax rate: $k_i = k(r_i + t_i)$.

Income to immobile factor, namely labor, is given by

$$w_i \equiv w(r_i + t_i) = f(k(r_i + t_i)) - f'(k(r_i + t_i))\, k(r_i + t_i)$$

meaning that labor income is a function of the marginal cost of capital.

Households receive labor and capital income at the end of the first period, and their disposable income will be denoted by $y(r_i, t_i)$. Each household uses its disposable income to purchase currency 1 and currency 2:

$$y(r_i, t_i) \equiv p_i w(r_i + t_i) + p_i r_i \Omega = m^{i,i} + em^{1,j}$$

The basic question a household faces at the end of the first period is, what fraction of disposable income do they want to hold in home currency, and what fraction in foreign currency. Demand for currency 1 and currency 2 are derived demand from demand for

either private consumptions. Given currency 1 and currency 2 stocks chosen by household i, it will be able to purchase $x^{i,i} = \frac{m^{i,i}}{p_1'}$ and $x^{i,j} = \frac{m^{i,j}}{p_2'}$ units of good i and j, respectively.

Monetary Policy

Each country has a central exchange that acts as the market place for domestically produced private good, for currency exchange, and as the sole issuer of national currency. Real revenue from money creation is transferred from the central exchange of a country to the government of that same country. Revenue from money creation is called seignorage[2].

In this model, we will define money as the commodity with the highest 'saleableness', following the definition of Menger (1894), and we will separate the periods of buying and selling in goods markets so that money will have a strictly positive value in equilibrium, which builds on the general equilibrium model introduced by Magill and Quinzii (1992). At the end of the first period, individuals bring their disposable incomes, which is kept in terms of country specific private consumption good, to the central exchanges of country 1 and country 2 in order to acquire currency 1 and currency 2, respectively. In either of the two central exchanges, households exchange their disposable incomes for fiat currency issued by the respective central exchange. Let $m^{i,j}$ denote the amount of country i currency demanded by the household in country j. The household in country 1 decides what fraction of its income to keep in country 1 currency, $m^{1,1}$, and sells this fraction to the central bank of country 1 in exchange for country 1 currency. It sells the rest of its disposable income to the central bank of country 2 in exchange for country 2 currency, $m^{1,2}$. Same applies to the household in country 2. Both households use their currency holdings to buy private consumption goods of country 1 and country 2 in the second period. Thus total monetary

[2]Since there is no economic growth in this model, there won't be any difference between seignorage and inflation tax.

holdings of household in country i is given by $\left(m^{i,i} + e_{ij}m^{i,j}\right)$, measured in currency i.Total stock (across the two countries) of currency i is given by $m^i = m^{i,i} + m^{j,i}$.

In the second period, both households buy country 1 and country 2 private consumption goods from the central exchanges of country 1 and country 2, respectively. Central exchange in either country decide at what rate they want to increase the monetary base, which is simply the money they created during the first period by buying households' disposable incomes. Central exchange of country i decides to expand the monetary base by a ratio of σ_i. Hence the seignorage revenue of the central bank in country i is given by $\sigma_i \left(m^{i,i} + m^{j,i}\right)$. Central exchange of country i uses the newly printed currencies to purchase some the domestic private consumption good, and transfers it to the local government, as the inflation tax revenue.

Since we will mention some basic characteristics of an equilibrium, we need to define an equilibrium first.

Equilibrium is defined for a given set of prices (p_1, p_2) as a vector of $(\phi_i,\ \phi_j,\ \pi_i,\ \pi_j,\ t_i,\ t_j,\ e_{ij})$, where shares of domestic currency holdings in total currency holdings of households (ϕ), inflation rates (π), capital tax rates (t), and exchange rate between currencies (e) clear all markets (2 goods markets, 2 money markets, and an exchange rate market), and no household, no national government, and no central bank can be better off by deviating.

Both central exchanges determine the growth rate of their national currencies. However, by doing so, in equilibrium, they are determining the domestic inflation rate.

Lemma 1 *In both countries, choosing the growth rate of national currencies, denoted by σ_i for $i = \{1, 2\}$, is equivalent to choosing the domestic inflation rate, π_i, in equilibrium.*

Proof. Ratio of currency i in the second period to currency i in the first period is given by

$$\frac{\left(m^{i,i}+m^{j,i}\right)+\sigma_i\left(m^{i,i}+m^{j,i}\right)}{\left(m^{i,i}+m^{j,i}\right)}=(1+\sigma_i)$$

At the end of first period, we have $p_i\left(f\left(k_i\right)-t_ik_i\right)=m^{i,i}+m^{j,i}$, and at the beginning of the second period, we have $p_i'\left(f\left(k_i\right)-t_ik_i\right)=(1+\sigma_i)\left(m^{i,i}+m^{j,i}\right)$.

Hence,

$$\frac{(1+\sigma_i)\left(m^{i,i}+m^{j,i}\right)}{p_i'}=\frac{m^{i,i}+m^{j,i}}{p_i}$$

Using the definition of inflation rate $\pi_i=\frac{p_i'-p_i}{p_i}$, we conclude that $\pi_i=\sigma_i$. ■

It is crucial to realize that growth of money will necessarily become inflation, because there is no economic growth in this model. Although monetary policy tool is the growth rate of money, no real growth implies that money growth will turn into inflation, hence central bank sets the domestic inflation rate when it chooses the growth rate domestic money supply.

In both countries, the second period money creation by the central exchange is nothing but a tax on households' wealth, because money creation in second period erodes households' currencies' purchasing power.

When central exchanges transfer the real revenue from second period money creation to their national governments, national governments use the inflation tax revenue together with capital tax revenue in financing a national public good. National public good supply in country i is given by: $g_i=t_ik_i+\pi_i\left(m^{i,i}+m^{j,i}\right)$, where π_i denotes the inflation rate in country i, and it is defined by $\pi_i=\frac{p_i'-p_i}{p_i}$, where p_i' denoted price level in country i in the second period. For simplicity, and without loss of generality, we can assume that the

central exchange in country i decides to issue one unit of its national currency in order to buy households' disposible income.

As it has widely been studied in international economics literature, once individuals' monetary holdings are determined, central banks have every incentive to use inflation tax excessively. As Hamada (1976) has shown, monetary expansion can take on the nature of public bad, and lead to high inflation rates in both countries. At this point it is useful for purposes of this paper to assume that central exchanges can credibly commit to a money growth rate. That is, both households are well informed about what the growth rate of money (hence inflation) is going to be in the second period, and they adjust their currency holdings accordingly. Once households sold their disposable income, central exchanges do not alter their pre-announced money growth rates.

At the beginning of the second period, the central exchange of country i issues a total stock of new currencies that has $\sigma_i \left(m^{i,i} + m^{j,i}\right)$ in nominal value. Since $\sigma_i = \pi_i$ real currency holdings of households in both countries will depreciate by $(1 + \pi_i)$. The real revenue from second period money creation, $\pi_i \left(m^{i,i} + m^{j,i}\right)$ is then transferred to the national government.

National Welfare

National policies consist of capital tax rate and money growth rate. As explained above, we will simply refer to inflation rate instead of the money growth rate in what follows. Government chooses the capital tax rate which must be paid by the national firm to the national government, at a constant rate per capital it employs. Central exchange chooses the inflation rate, and transfers the inflation tax revenue to the national government. National government supplies the nation with a public good that is produced by a linear technology

using capital tax and inflation tax revenues. In both countries, the government as well as the central exchange are benevolent, that is, their objective is to maximize their citizens' welfare.

Capital market equilibrium is given by $\sum_{i=1}^{2} k\left(r+t_i\right)=2\Omega$. Total capital endowment of home and foreign countries is given by 2Ω, and total demand for capital by firms has to be equal to total capital endowment so that the international capital market is in equilibrium. Capital market equilibrium makes it easy to see that real interest rate is necessarily a function of home and foreign capital tax rates, $r=r\left(t_1,t_2\right)$. Moreover, in a symmetric equilibrium we have $t=t_1=t_2$, and as a result, we have $r=r\left(t\right)$, with $\frac{dr}{dt}=r'=-\frac{1}{2}$.

Considering the equilibrium in currency i market, total supply of currency i in first period is determined by what fraction of their disposable both households want to keep in currency i. Let ϕ_i denote the fraction of country i household's disposable income exchanged for currency i at the central exchange of country i, and fraction of country j household's disposable income exchanged for currency i is denoted by $\left(1-\phi_j\right)$, so that we have

$$\phi_i y\left(r\left(t_i,t_j\right),t_i\right)+\left(1-\phi_j\right)y\left(r\left(t_i,t_j\right),t_j\right)=m^{i,i}+m^{j,i}$$

At the end of money creation process in the first period, the two central exchanges swap their holdings foreign currency which has been delivered by household in exchange of some fraction of their currency holdings.

Lemma 2 *In equilibrium, there will be a unique exchange rate. Indeterminacy of exchange rate will only be the case, when currency i is held only in country i, for $i\in\{1,2\}$.*

Proof. At the end of first period, central exchange of country i owns private consumption good of country j, sold to it by the household from country j. The private consumption good produced by country j and owned by the central exchange of country i

is equivalent to $\left(1-\phi_j\right) y\left(r\left(t_i,t_j\right),t_j\right)$ in real value. When the two central exchanges swap those foreign private consumption good holdings, they establish an equilibrium exchange rate as:

$$e_{i,j}=\frac{\left(1-\phi_i\right) y\left(r\left(t_i,t_j\right),t_i\right)}{\left(1-\phi_j\right) y\left(r\left(t_i,t_j\right),t_j\right)}$$

which has a strictly positive and unique value for $y\left(r\left(t_i,t_j\right),t_1\right)>0$, $y\left(r\left(t_i,t_j\right),t_2\right)>0$, $\phi_1\in(0,1)$, and $\phi_2\in(0,1)$. It is important to note that however that if $(\phi_1,\phi_2)=(1,1)$, then exchange is undeterminate. ■

Although money growth rates, and thus inflation rates don't play a role in the above statement, we need to alter money demand to include the perfect information of second period's inflation rate. This doesn't change the fundamental lesson of the above lemma, however money demand becomes equivalent to demand for country specific consumption goods. Since we will deal with symmetric equilibria, the following lemma will be useful:

Lemma 3 *In a symmetric equilibrium, when both central exchanges set the nominal price of their national output at 1 unit of local currency, then we have* $e_{ij}=1$.

In a symmetric equilibrium, the household in country i will hold some fraction ϕ_i of its disposable income in currency i, and some fraction, namely $(1-\phi_i)$ in currency j, so that we have:

$$x^{i,i}=\frac{\phi_i y\left(r\left(t_i,t_j\right),t_i\right)}{1+\pi_i},\quad x^{i,j}=\frac{\left(1-\phi_i\right) y\left(r\left(t_i,t_j\right),t_i\right)}{1+\pi_j}$$

Since the household in country i will use its currency i and currency j balances, denoted by $m^{i,i}$ and $m^{i,j}$, to purchase country i and country j private consumption goods $x^{i,i}$ and $x^{i,j}$, respectively, and since there is perfect foresight (or central bank's perfect commitment to announced money growth rate) this necessarily leads to:

$$\frac{m^{i,i}}{p_i'} = x^{i,i} = \frac{\phi_i y\left(r\left(t_i,t_j\right),t_i\right)}{1+\pi_i}, \quad \frac{m^{i,j}}{p_j'} = x^{i,j} = \frac{\left(1-\phi_i\right) y\left(r\left(t_i,t_j\right),t_i\right)}{1+\pi_j}$$

The optimization problem of household i is:

$$\phi_i = \arg\max\ u\left(\frac{\phi_i y\left(r\left(t_i,t_j\right),t_i\right)}{1+\pi_i}, \frac{\left(1-\phi_i\right) y\left(r\left(t_i,t_j\right),t_i\right)}{1+\pi_j}\right)$$

First order condition of household's optimal choice of ϕ_i yields in a symmetric equilibrium:

$$u_1\left(x^{i,i},x^{i,j}\right) = \frac{1+\pi_i}{1+\pi_j} u_2\left(x^{i,i},x^{i,j}\right)$$

By the envelope theorem,

$$\phi_i = \phi_i\left(\pi_i,\pi_j\right), \quad \text{and} \quad \frac{\partial \phi_i}{\partial \pi_i} < 0, \frac{\partial \phi_i}{\partial \pi_j} > 0$$

This leads to the following total demand function for currency i, denoted by m^i:

$$m^{i,i} + m^{j,i} = \phi_i y\left(r\left(t_i,t_j\right),t_i\right) + \left(1-\phi_j\right) y\left(r\left(t_i,t_j\right),t_j\right) = m^i\left(\pi_1,\pi_2,t_1,t_2\right)$$

The following lemma will be useful in analyzing the effects of marginal changes in capital tax rates and inflation rates in either or both countries. The lemma's proof is provided in the appendix.

Lemma 4 *Demand for currency i is given by $m^i = m^i\left(\pi_i,\pi_j,t_i,t_j\right)$, for which we have:*

$$\frac{\partial m^i}{\partial \pi_i} < 0, \frac{\partial m^i}{\partial \pi_j} > 0, \frac{\partial m^i}{\partial t_i} < 0, \frac{\partial m^i}{\partial t_j} < 0$$

Proof. Recall that $m^i = m^i(\pi_i, \pi_j, t_i, t_j) = m^i(\phi_i(\pi_i, \pi_j), y(r(t_i, t_j), t_i))$, and observe that $\frac{\partial m^i}{\partial \phi_i} > 0$, $\frac{\partial \phi_i}{\partial \pi_i} < 0$, $\frac{\partial \phi_i}{\partial \pi_i} > 0$, $\frac{\partial m^i}{\partial y} > 0$, $\frac{\partial y}{\partial r} > 0$, $\frac{\partial y}{\partial t_i} < 0$, $\frac{\partial r}{\partial t_i} < 0$, $\frac{\partial r}{\partial t_j} < 0$ Using the envelope theorem, we obtain: $\frac{\partial m^i}{\partial \pi_i} = \frac{\partial m^i}{\partial \phi_i}\frac{\partial \phi_i}{\partial \pi_i} < 0$, $\frac{\partial m^i}{\partial \pi_j} = \frac{\partial m^i}{\partial \phi_i}\frac{\partial \phi_i}{\partial \pi_j} > 0$, $\frac{\partial m^i}{\partial t_i} = \frac{\partial m^i}{\partial y}\frac{\partial y}{\partial r}\frac{\partial r}{\partial t_i} + \frac{\partial m^i}{\partial y}\frac{\partial y}{\partial t_i} < 0$, $\frac{\partial m^i}{\partial t_j} = \frac{\partial m^i}{\partial y}\frac{\partial y}{\partial r}\frac{\partial r}{\partial t_1} < 0$. ■

Simplifying, national welfare of country i depends on capital taxes and inflation rates of both countries:

$$W_i(t_i, t_j, \pi_i, \pi_j) = u\left[\frac{\phi_i(\pi_i, \pi_j)\, y(r(t_i, t_j), t_i)}{1+\pi_i}, \frac{(1-\phi_i(\pi_i, \pi_j))\, y(r(t_i, t_j), t_i)}{1+\pi_j}\right] + v[g_i] \tag{II.1}$$

where public good in country i is given by:

$$\begin{aligned} g_i &= t_i k(r(t_i, t_j) + t_i) + \\ &\quad + \pi_i \left(m^{i,i}(\phi_i(\pi_i, \pi_j), y(r(t_i, t_j), t_i)) + m^{j,i}\left(\left(1-\phi_j(\pi_i, \pi_j)\right), y(r(t_i, t_j), t_j)\right)\right) \end{aligned}$$

In the above equation, it is clearly shown that the public good is financed by two sources: capital tax revenue and inflation tax revenue. National government of country i has a capital tax revenue of $t_i k(r(t_i, t_j) + t_i)$, and the central bank of country 1 transfers its inflation tax revenue to the national government, which is given by:

$$\pi_i \left(m^{i,i}(\phi_i(\pi_i, \pi_j), y(r(t_i, t_j), t_i)) + m^{j,i}\left(\left(1-\phi_j(\pi_i, \pi_j)\right), y(r(t_i, t_j), t_j)\right)\right)$$

Seignorage and Capital Taxation

How inflation and capital taxes interact under different monetary regimes will be

discussed in this section.

There are two monetary regimes: Either a country has its own national currency, or it forms a currency union with the other country. Independent national currency is governed by the national central bank. Real revenue from money creation is transferred to national government where it is used for financing a national public good. This regime will be called 'monetary independence'. When country 1 and country 2 form a currency union, there will be a single central bank of the currency union. Central bank of the currency union is also benevolent, and real revenue from money creation will be equally distributed between the two national governments. This regime will be called 'currency union'.

Competition in inflation tax exists only under the regime of monetary independence, and it is lost with the creation of a currency union. Although vertical externalities between the capital tax rate and the inflation tax rate, or equivalently, the inflation rate, don't change their nature from one regime to the other, the horizontal externalities are affected directly by the creation of a currency union. It is due to the horizontal externalities between the two countries that keeps the inflation rates in both countries down. However, with creation of a currency union, there will be no competition in inflation, hence the central bank of the currency union will be able to internalize the horizontal externalities, and create a higher level of inflation. Hence, lack of competition in inflation tax is not necessarily an adverse affect. This result is pretty intuitive, because otherwise, the two countries wouldn't create a currency union.

Although central banks are benevolent and they transfer their real revenues to national governments, this doesn't necessarily mean that central banks are under control of national governments. We will assume in this section that central banks, whether national or currency union wide, are independent in the sense that money growth rate and capital

tax rate are chosen non-cooperatively by different authorities. Policy vector that consists of money growth rate (or equivalently, inflation rate) and capital tax rate, is the Nash equilibrium of non-cooperative game between central bank and government.

Seignorage and Capital Tax Revenue under National Currencies

Welfare of household in country i under monetary independence is given by (II.1). National government as well as the central exchange of country i are benevolent, hence they aim to maximize the welfare of the representative household living in country i. For this purpose, central exchange in country i solves $\frac{\partial W_i}{\partial \pi_i} = 0$ for given policy variables of countries 1 and 2 (t_1, π_2, t_2), and the government solves $\frac{\partial W}{\partial t_i} = 0$ for given policy variables of countries 1 and 2 (π_1, π_2, t_2).

Aim of this paper is to compare small changes in domestic inflation rate and capital tax rate to their non-cooperative equilibrium levels, for this purpose, we will focus on marginal changes in the welfare function of country i with respect to inflation rate and capital tax rate. In this section we will investigate how a small change in inflation rate and capital tax rate affect the national welfare, and in the next section where we focus on the case of a currency union, we will take our findings under monetary independence as a benchmark, and compare our findings under currency union to those under monetary independence.

The central exchange of country i takes foreign policy variables which are inflation rate and capital tax rate of country j, (π_j, t_j), as well as the capital tax rate set by the national government of country i, t_i, as given, and maximizes national welfare of country i by solving the following first order condition:

$$\frac{\partial W_i}{\partial \pi_i} = \left(\frac{y_i}{1+\pi_i}\frac{\partial \phi_i}{\partial \pi_i} - \frac{\phi_i y_i}{(1+\pi_i)^2}\right) u_1 - \left(\frac{y_i}{1+\pi_j}\frac{\partial \phi_i}{\partial \pi_i}\right) u_2 + \\ + v'\left(m^i + \pi_i\left(\frac{\partial \phi_i}{\partial \pi_i} y_i - \frac{\partial \phi_j}{\partial \pi_i} y_j\right)\right) \tag{II.2}$$

Solving for $\frac{\partial W_i}{\partial \pi_i} = 0$ yields the Nash inflation tax level for country i, and rearranging, we obtain

$$MRS^i_{g,x} = \frac{1}{(1+\pi_i)\left(\frac{1}{\phi_i} + \varepsilon^i_{\pi_i} - \varepsilon^j_{\pi_i}\right)} \tag{II.3}$$

where $MRS^i_{g,x}$ is the marginal rate of substitution of public for private good in country i. $\varepsilon^i_{\pi_i}$ and $\varepsilon^j_{\pi_i}$ are country i inflation elasticities of demand for currency i and demand for currency j, respectively.

Horizontal externality of domestic inflation is evident in the above equation. As the inflation rate associated with currency i increases, this will affect not only currency holdings of the representative household in country i, but also currency holding decision of the household in country j is affected. As a result, inflation tax revenue of central exchange in country i erodes faster than it would erode in case of autarky. This is the horizontal externality associated with domestic inflation rates that leads to lower inflation rates in both countries. Hence the very idea of the "inflation tax competition" is embodied in this response as described above.

National government of country i takes foreign policy variables as well as the inflation rate set by the central exchange of country i as given, and maximizes national welfare by choosing a capital tax rate. The first order condition for the of national government's optimization problem country i yields:

$$\begin{aligned}\frac{\partial W_i}{\partial t_i} &= \phi_i\left(\frac{\partial y\left(r\left(t_i,t_j\right),t_i\right)}{\partial r}\frac{\partial r}{\partial t_i}+\frac{\partial y\left(r\left(t_i,t_j\right),t_i\right)}{\partial t_i}\right)u_1+\\ &+\left(1-\phi_i\right)\left(\frac{\partial y\left(r\left(t_i,t_j\right),t_i\right)}{\partial r}\frac{\partial r}{\partial t_i}+\frac{\partial y\left(r\left(t_i,t_j\right),t_i\right)}{\partial t_i}\right)u_2+\\ &+\left(\left(\frac{\partial y\left(r\left(t_i,t_j\right),t_i\right)}{\partial r}\frac{\partial r}{\partial t_i}+\frac{\partial y\left(r\left(t_i,t_j\right),t_i\right)}{\partial t_i}\right)+\frac{\partial y\left(r\left(t_i,t_j\right),t_i\right)}{\partial r}\frac{\partial r}{\partial t_i}\right)\frac{\partial m^{i,i}}{\partial y}v'\end{aligned} \tag{II.4}$$

Solving for $\frac{\partial W_i}{\partial t_i}=0$ yields the Nash capital tax level for country i, and rearranging we obtain

$$\frac{v'}{u_1}=MRS^i_{g,x}=\frac{1}{\left(1+\pi_i\right)\left(1+\frac{1}{2}\varepsilon^i_k+\pi_i\phi_i\right)} \tag{II.5}$$

where ε^i_k is the capital tax elasticity of demand for capital in country i.

Horizontal externality created by non-cooperative choice of the capital tax rate in country i manifests itself in its effect on international real interest rate, r. We have shown in previous section that in a symmetrical equilibrium for capital tax rates, an increase in the capital tax rate of country i will decrease international real interest rate by $\left(-\frac{1}{2}\right)$. As a result, an increase in the capital tax rate of country i not only decreases representative household's disposable income in country i, it also decreases the real value of the disposable income of household in country j. This is the very link that gives rise to a vertical externality between capital tax rate and inflation rate, captured by the term $\left(\frac{\partial m^{i,i}}{\partial y}\right)$ in (II.4).

The optimal choice of the capital tax rate of country i can be separated in two: Horizontal externality due to capital tax competition between the two countries, and the vertical externality created by the existance of the inflation tax. Horizontal externality is represented by the following term:

$$\phi_i \left(\frac{\partial y\left(r\left(t_i,t_j\right),t_i\right)}{\partial r}\frac{\partial r}{\partial t_i} + \frac{\partial y\left(r\left(t_i,t_j\right),t_i\right)}{\partial t_i} \right) u_1 +$$
$$+ \left(1-\phi_i\right) \left(\frac{\partial y\left(r\left(t_i,t_j\right),t_i\right)}{\partial r}\frac{\partial r}{\partial t_i} + \frac{\partial y\left(r\left(t_i,t_j\right),t_i\right)}{\partial t_i} \right)$$

Vertical externality created by the existance of the inflation tax is represented by:

$$\left(\left(\frac{\partial y\left(r\left(t_i,t_j\right),t_i\right)}{\partial r}\frac{\partial r}{\partial t_i} + \frac{\partial y\left(r\left(t_i,t_j\right),t_i\right)}{\partial t_i} \right) + \frac{\partial y\left(r\left(t_i,t_j\right),t_i\right)}{\partial r}\frac{\partial r}{\partial t_i} \right) \frac{\partial m^{i,i}}{\partial y} v'$$

As the capital tax rate of country i increases , country i household's demand for currency decreases. This is a direct result of the decrease in household's disposable income.

Seignorage and Capital Tax Revenue under a Single Currency

In this subsection, we will investigate how the case of a currency union differs from that of monetary independence. When country 1 and country 2 form a currency union, they abandon their national currencies as well as their national central banks, and there will be only one central bank that issues the common currency of the currency union.

There will be a single central exchange when a currency union is formed, and it will serve in the same manner just like national central exchanges did under monetary independence. The two households in both countries sell their disposable income to the central exchange of the currency union in exchange for common currency, and in the second period they purchase private consumption goods using the common currency. Central exchange of the currency union chooses a money growth rate (necessarily same as the inflation rate) for the common currency in order to maximize the joint welfare of both countries, and it distributes real revenue from currency creation equally to the national governments of

country 1 and country 2.

National governments still retain their authority of choosing a capital tax rate for the domestic use of capital. National governments' objective is to maximize the welfare of their citizen household. National governments' objective function is given by

$$W_i^C = u\left(x^{i,i}\left(t_i, t_j, \pi^c\right),\ x^{i,j}\left(t_i, t_j, \pi^c\right)\right) + v\left[t_i k\left(r\left(t_i, t_j\right) + t_i\right) + \frac{1}{2}\pi^c m^c\right]$$

where $m^c = y\left(r\left(t_i, t_j\right), t_i\right) + y\left(r\left(t_i, t_j\right), t_j\right)$

The first order condition of national government's optimization problem in country i is not very different from the case of monetary independence, and it is given by:

$$\begin{aligned}\frac{\partial W_i^c}{\partial t_i} &= \left(\frac{\partial y\left(r\left(t_i, t_j\right), t_i\right)}{\partial r}\frac{\partial r}{\partial t_i} + \frac{\partial y\left(r\left(t_i, t_j\right), t_i\right)}{\partial t_i}\right)\left(u_1 + u_2\right) + \\ &+\frac{1}{2}\left(\frac{\partial y\left(r\left(t_i, t_j\right), t_i\right)}{\partial r}\frac{\partial r}{\partial t_i} + \frac{\partial y\left(r\left(t_i, t_j\right), t_i\right)}{\partial t_i}\right)\frac{\partial m^c}{\partial y}v' + \qquad \text{(II.6)} \\ &+\frac{\partial y\left(r\left(t_i, t_j\right), t_i\right)}{\partial r}\frac{\partial r}{\partial t_i}\frac{\partial m^c}{\partial y}v' \qquad \text{(II.7)}\end{aligned}$$

where W_i^c denotes the welfare of country i under currency union, and m^c denoted the aggregate demand for the common currency in both countries, and equilibrium tax rate is found by solving $\frac{\partial W_i^c}{\partial t_i} = 0$. Rearranging, we obtain the marginal rate of substitution of public for private good in country i as follows

$$MRS_{g,x}^i = \frac{1}{\left(1 + \pi^c\right)\left(1 + \varepsilon_k^i + \pi^c\right)} \qquad \text{(II.8)}$$

The only difference between (II.4) and (II.6) is that in (II,6) vertical externality

between domestic tax rate and inflation rate has greater effect on country 2, because the common inflation rate is affected through the term $\left(\frac{\partial m^c}{\partial y}\right)$.

Central bank of currency union maximizes the joint welfare of both countries, and solves the following first order condition:

$$\sum_{j\in\{1,2\}} \frac{\partial W_j^c}{\partial \pi^c} = 2\left(u_1+u_2\right)\frac{\partial m^c}{\partial \pi^c} + \left(m^c + \pi^c \frac{\partial m^c}{\partial \pi^c}\right) v' = 0 \tag{II.9}$$

which yields

$$MRS_{g,x}^i = \frac{1}{(1+\pi^c)} \tag{II.10}$$

Comparing (II.2) to (II.9), one observes that non-cooperative inflation rate under currency union has to be higher than that under monetary independence. Intuition is simple: Central bank of the currency union doesn't face an as severe threat of losing its tax base, which is demand for its monetary base, as a national central bank faces, when it increases the inflation rate associated with its currency. Hence this is inflation tax competition, and this very simple model demonstrates how inflation tax competition can yield lower inflation rates in line with the arguments of Hayek (1976) favoring monetary competition.

Theorem 1 *Under currency union, public good provision will be sub-optimally high.*

Efficient provision of public good will be satisfied when $MRS_{g,x}^i = 1$. This is only true when $\pi^c = 0$, which cannot be the case. Hence, we have $MRS_{g,x}^i < 1$, and the level of public good provision under a currency union is sub-optimally high.

Moreover, under currency union we have: $-\varepsilon_k^i = \pi^c$

Theorem 2 *Inflation rate associated with the common currency of the currency union will be higher than inflation rates that exist under monetary independence.*

Proof. Suppose that in a symmetric equilibrium, for any given capital tax rate in country 1 and country 2, the optimal inflation rate under monetary independence is higher than that under common currency, namely $\pi_i^* \geq \pi^{c*}$ for $i \in \{1,2\}$. Substituting these inflation rates into the first order conditions of the optimization problem of central exchange in country i under monetary independence, and into that of central exchange of the currency union, the following must be true under any capital tax rates: $\frac{1}{2}\left(m^c + \pi^{c*}\frac{\partial m^c}{\partial \pi^c}\right) > \left(\left(m^{i,i} + m^{j,i}\right) + \pi_i^*\left(\frac{\partial m^{i,i}}{\partial \pi_i} + \frac{\partial m^{j,i}}{\partial \pi_i}\right)\right)$

This requires the following to hold: $v'\left(g_i\left(t_i^c, t_j^c, \pi^{c*}\right)\right) < v'\left(g_i\left(t_i, t_j, \pi_i^*, \pi_j^*\right)\right)$, and hence $g_i\left(t_i^c, t_j^c, \pi^{c*}\right) > g_i\left(t_i, t_j, \pi_i^*, \pi_j^*\right)$. This, however implies that $t_i < t_i^c$ which is a contradiction. Hence $\pi_i^* < \pi^{c*}$ for $i \in \{1,2\}$. ■

Theorem 3 *Inflation elasticities of national currencies determine whether capital taxes will be higher or lower under currency union.*

Proof. First order conditions obtained from optimization problems of government and central exchange under monetary independence yield:

$MRS_{g,x}^i = \frac{1}{(1+\pi_i)\left(1+\frac{1}{2}\varepsilon_k^i + \pi_i\phi_i\right)}$ and $MRS_{g,x}^i = \frac{1}{(1+\pi_i)\left(\frac{1}{\phi_i} + \varepsilon_{\pi_i}^i - \varepsilon_{\pi_i}^j\right)}$

This yields: $\frac{1}{2}\varepsilon_k^i\left(t_i^*\right) = \frac{1-\phi_i}{\phi_i} + \varepsilon_{\pi_i}^i - \varepsilon_{\pi_i}^j - \pi_i^*\phi_i$

Suppose we increase π_i to π^c. Then we have:

$\Delta\varepsilon_k^i\left(t_i^*\right) = \Delta\left(\varepsilon_{\pi_i}^i - \varepsilon_{\pi_i}^j\right) - \phi_i\Delta\pi_i^*$

Since the elasticity of capital is monotonic in t_i, i.e. $\frac{\partial\varepsilon_k^i}{\partial t_i} < 0$, we have:

$\Delta t_i^* < 0$ if $\Delta\left(\varepsilon_{\pi_i}^i - \varepsilon_{\pi_i}^j\right) > \phi_i\Delta\pi_i^*$

$\Delta t_i^* > 0$ if $\Delta\left(\varepsilon_{\pi_i}^i - \varepsilon_{\pi_i}^j\right) < \phi_i\Delta\pi_i^*$ ■

CHAPTER III

ELDERLY MIGRATION AND STATE TAXES

Introduction

In a federal system, jurisdictions will differ in their provision of public goods and in their imposition of taxes. If individuals can move freely from jurisdiction to jurisdiction, then all else equal, each individual will move to a jurisdiction that best suits his or her preferences for public goods and taxes. This idea constitutes the essence of the 'Tiebout Hypothesis'. According to Tiebout (1956):

> "The consumer-voter may be viewed as picking that community which best satisfies his preference pattern for public goods. [...] At the local level various governments have their revenue and expenditure patterns more or less set. Given these revenue and expenditure patterns, the consumer-voter moves to that community whose local government best satisfies his set of preferences." (p.418)

It is thus natural to ask: in exactly what way do local governments' public-good-provision and tax policies affect individuals' migration decisions? This question can perhaps best be answered by investigating the effect of local government policies on the interstate migration of the elderly population in the US.

The primary benefit of focusing on elderly migration is that the elderly population consists primarily of retirees, and as a group retirees are relatively immune to labor market causalities and to other factors that affect the income stream of the working population.

Although positive labor market aspects and high levels of expected income may be inviting for younger migrants, elderly migrants do not need to consider labor market aspects in their migration decision. With labor market considerations left aside, one would expect public finance variables and local amenities to manifest themselves more clearly in the migration decisions of elderly migrants than in those of younger migrants. Thus, by focusing on elderly migration, one is left with a relatively clear and undistorted view of the effects of state governments' policy decisions on interstate migration.

There is in addition a second more practical benefit of focusing research on elderly migration: the empirical results obtained can be expected to have significant policy implications. The share of the elderly population is increasing, and according to the Bureau of Census reports, it is expected to increase further. In order to take advantage of the opportunities posed by such increase, and conversely to face the challenges posed by such increase, governments at the state and local level (and indeed also at the federal level) will need to focus more thought and resources on the elderly population.

This paper investigates the effects of state and local government policies on the migration decisions of the elderly. What policies attract the elderly and what policies drive them away? How do the elderly react to different types of taxes? How do amenities and specific tax exemptions affect their migration decisions?

Under the assumption that individuals, on average, behave in a way that maximizes their utility, they eventually reveal their preferences by the choices they make. This revelation principle lies at the core of the Tiebout Hypothesis. When faced with alternative 'fiscal menus,' that is, with various combinations of local public goods and local taxes to finance these local public goods, individuals will sort themselves into jurisdictions on the basis of their preferences for such menus. Using a gravity model for migration, this paper

investigates what kinds of 'fiscal menus' are popular among elderly migrants in the U.S., and what kinds are not.

We employ the elderly migration dataset published in a 2003 special report of the 2000 Census, entitled "Internal Migration of the Older Population." We overlay the data of elderly migration flows between states with data about state characteristics, in particular data about state and local government finances, but also data about certain state-specific amenities. That way, we constructed a gravity equation that takes into account pushing effects of the origin state's characteristics as well as pulling effects of destination state's characteristics.

Most of the previous studies that investigate interstate migration using gravity models have shown that when state level data is used for migration analysis, a problem known as the 'same sign problem' occurs. In a gravity model of interstate migration, pushing and pulling effects are expected to have opposite signs: if some characteristic of a state positively affects out-migrants' decisions to move out, the same characteristic should not also positively affect in-migrants' decisions to move in. The 'same sign problem' refers to the phenomenon that pushing and pulling effects often turn out to have the same sign. The same sign problem can generally be attributed either to aggregation, which is an inevitable result of using state level data, or to the heterogeneity of in- and out-migrating populations.

Our main contribution is to demonstrate that the relative attractiveness of states' 'fiscal menus' becomes more apparent when migrations over very short distances and very long distances are left out of the regressions. The same is also true when outmigration solely from higher per-capita income states is considered. The probable reason for this is that these two methods provide some correction for the heterogeneity within the population of elderly migrants. Migrations over either very short distances or very long distances might be noisy

because they are more heavily influenced by non-fiscal considerations, such as the cost of moving or the location of children or grandchildren. In the case of restricting the analysis to outmigration from higher income states, the likelihood is that the focus is predominantly on more affluent migrants, and thus not on 'counter-stream' migrants who might be able to successfully free ride on the higher amenity offerings of high tax states.

Background

Most empirical research on elderly migration focuses on determining the main factors that attract elderly migrants. Graves (1979) investigates in-migration rates across different age groups for large metropolitan areas and finds that the main attractions for migrants differ significantly by age group: young migrants' decisions are affected by economic opportunities presented by a location, while elderly migrants tend to be attracted by the amenities of a location. Similarly, Clark and Hunter (1992) compare different age groups' migration decisions and find that the existence of amenities affects migration decisions of older migrants more than that of younger migrants.

Elderly migration is necessarily affected by the costs and benefits of migration. The benefits are a location's amenities, including local public goods; the costs are the taxes that must be paid when living in that specific location. Focusing on taxes, Cebula (1990) shows that the mere existence of a state income tax has a significant negative effect on the volume of elderly in-migration. Conway and Houtenville (2001) confirm that the elderly are attracted to states with amenities, including suitable climate conditions and a low cost of living. In addition, they show that an exemption of food from sales tax induces elderly in-migration. Somewhat less intuitively, they also report that lower spending on public welfare induces elderly in-migration.

No matter if one uses two separate equations for in-migration and out-migration, or a single gravity equation, a given explanatory variable would be expected to have opposite signs for the case of in-migration and for the case of out-migration. That is, if a given variable is found to be a significant factor driving the elderly out of a jurisdiction, then one would expect this very same variable to be a significant factor keeping the elderly from migrating into a jurisdiction. Conway and Houtenville (1998) use in-migration and out-migration estimations for testing the effects of several fiscal variables on elderly migration across states. Surprisingly, they find that all tax variables – property tax, sales tax and income tax – have the same sign in both the in-migration and the out-migration estimations:

> "All of the tax share coefficients are positive and statistically significant. ... [Moreover] these results cannot be dismissed; the public sector variables are almost always jointly statistically significant." (pp.678-9)

Conway and Houtenville (2001) employ a gravity model of migration, and this model confirms the results in Conway and Houtenville (1998), including the 'same sign problem.' A descriptive explanation for this phenomenon is offered in Conway and Houtenville (2001), and some insight can be found in Voss et al. (1988) as well. As it turns out, the states that have the highest in-migration rates also happen to be the states that have the highest out-migration rates. Voss et al (1988) refer to the highly positive correlation between in-migration and out-migration as 'counter-stream migration.' It is due to 'counter-stream migration' that the regression results carry the same signs for in-migration and out-migration. While this may well be true as a descriptive matter, it fails to provide a satisfactory explanation for the causes underlying the phenomenon.

Some research has put forward the theory that the availability of amenities in a jurisdiction may be partially (or even completely) compensated for in such jurisdiction's

labor and real estate markets. That is, if amenities vary across jurisdictions, then in general equilibrium we would expect some wage and rent compensation to occur, for otherwise everyone would live solely in amenity-rich jurisdictions. See for example, Haurin (1980) and Roback (1982). Graves and Waldman (1991) examine this theory under the plausible assumption that the elderly constitute a small group, whose migration decision cannot affect the wage structure in the jurisdiction to which they are migrating. They provide empirical evidence to show that "in a world in which compensation for amenities occurs in varying degree in land and labor markets at alternative sites and there are no moving costs, retirement migration will be toward areas in which more of the compensation for amenities is in wages." (p.1376). This is not surprising: the elderly generally can free ride to the extent that compensation for amenities occurs in the labor market, but they generally cannot free ride to the extent that compensation occurs in the real estate market.

Conway and Rork (2006) focus on another important factor that could affect elderly migration: estate, inheritance and gift taxes. Using panel data, they surprisingly discover that estate, inheritance and gift tax policies do not affect elderly migration.

In this paper, we use indicator variables for the exemption of social security payments from state income taxation, the exemption of pension income from state income taxation, the exemption of drug sales from state sales taxes, and for the existence of atypical state inheritance or gift taxes. The indicator variable for inheritance or gift taxes turns out to be significant for most of the specifications; moreover, it does not have a same sign problem.

Model

There are J states, and N retirees. A retiree, n, derives utility from private

consumption x, and from bundle of state specific public good G and amenities A, so that the utility function of retiree n is given by: $U_n(x, G, A)$

Axiom 1 *$U_n(x, G, A)$ is a twice differentiable, and concave function in all of its arguments.*

Axiom 2 *$U_n(x, G, A)$ is strictly increasing in x.*

Axiom 3 *There exist G^* such that $\frac{\partial U_n(x,G^*,A)}{\partial G} = 0$ for given x and A, and there exists A^* such that $\frac{\partial U_n(x,G,A^*)}{\partial A} = 0$ for given x and G. Moreover, for every $G^0 < G^*$, $\frac{\partial U_n\left(x,G^0,A\right)}{\partial G} > 0$, and for every $G^1 > G^*$, $\frac{\partial U_n\left(x,G^1,A\right)}{\partial G} < 0$. Similarly, for every $A^0 < A^*$, $\frac{\partial U_n\left(x,G,A^0\right)}{\partial A} > 0$, and for every $A^1 > A^*$, $\frac{\partial U_n\left(x,G,A^1\right)}{\partial A} < 0$.*

If a retiree chooses to reside in state i, she will enjoy state specific public goods and amenities, G_i and A_i, and the utility of retiree n in state i is given by $U_n(x_i, G_i, A_i)$. However she will have to face state specific price level p_i as well as state taxes t_i and t_{I_i}. State taxes are grouped in two broad classes: Taxes related to consumption and living expenses, and taxes related to wealth and income. Sales taxes and property taxes can be examples for taxes related to consumption and living expenses. As far taxes related to wealth and income are concerned, retirees are not wage earners, however they may be receiving pension and/or social security payments, which are subject to income tax as well.

Price level and taxes in a state affect an individual's budget constraint for private consumption. Even though a state's public good provision and amenities may be attractive to a retiree, if price level and menu of taxes restrict her private good consumption considerably, she may not choose to move to that state.

Another variable affecting a retiree's decision to move from state i to j is the moving cost, which is a function of the distance, d_{ij}, between state i and state j, denoted by $c(d_{ij})$.

Axiom 4 *Moving cost function $c(d_{ij})$ from state i to state j is strictly increasing and convex in distance, d_{ij}.*

Suppose that a retiree n is initially residing in state i. The solution of the following optimization problem shows her utility, if she moves from state i to state j.

$$U_n^{ij} = \max_x U_n\left(x, G_j, A_j\right). \text{ such that } \quad \left(p_j + t_j\right) x \leq w_n\left(1 - t_{I_j}\right) - c\left(d_{ij}\right)$$

where w_n is wealth of retiree n which she has accumulated for her retirement.

It is easy to see that the optimization problem (1)-(2) yields the following outcome:

$$U_n^{ij} = U_n\left(\frac{w_n\left(1 - t_{I_j}\right)}{p_j + t_j} - \frac{c\left(d_{ij}\right)}{p_j + t_j}, G_j, A_j\right) \tag{III.1}$$

If retiree n chooses to stay in state i, her initial location, then her utility will be:

$$U_n^i = U_n\left(\frac{w_n\left(1 - t_{I_i}\right)}{p_i + t_i}, G_i, A_i\right) \tag{III.2}$$

Retiree n decides whether to stay or to move to another state as follows: Let U_n^* denote the set of retiree n's best possible alternatives to staying in state i, so that:

$$U_n^* = \max\left(U_n^{i1}, U_n^{i2}, ..., U_n^{ii-1}, U_n^{ii+1}, ...U_n^{iJ}\right) \tag{III.3}$$

Hence retiree n moves from state i to state j if and only if $U_n^{ij} \in U_n^* \ and \ U_n^{ij} > U_n^i$.

A retiree makes her decision of relocation from state i to state j based on vector of parameters $\left(p_j, t_j, t_{I_j}, G_j, A_j, d_{ij}\right)$ offered by state j. These parameters of state j are price level, consumption tax, income tax, public good provision, amenities, and distance to origin state. Suppose that retiree n is initially residing in state i, and conditions of migration are satisfied for state j, that is: $U_n^{ij} \in U_n^*$ and $U_n^{ij} > U_n^i$.

It is interesting to see how these parameters should interact in order to keep utility derived from migration constant, other things being equal. The following three propositions focus on parameters' pairwise interactions, that are of interest especially in our empirical analysis. Their proofs are in appendix.

Proposition 1 *(Public Goods or Amenities vs. Consumption or Income Tax): An increase in public good provision in a state may be accompanied by either an increase or decrease in taxes to keep constant the attractiveness of state for a given retiree. Since preferences are single peaked in public goods and amenities, whether an increase or decrease is necessary in taxes, depends on how levels of public goods and amenities compare to their most optimal levels.*

Proof. We obtain from (III.1) by total differentiation:

$$\begin{aligned} dU_n^{ij} &= \frac{1}{p_j + t_j}\frac{\partial U_n}{\partial x}\left(-w_n dt_{I_j} - c'dd_{ij} + \frac{c\left(d_{ij}\right) - w_n\left(1 - t_{I_j}\right)}{p_j + t_j}\left(dt_j + dp_j\right)\right) + \\ &+ \frac{\partial U_n}{\partial G_j}dG_j + \frac{\partial U_n}{\partial A_j}dA_j \end{aligned}$$

Holding other variables constant, we compare a change in public good provision and a change in income tax, which is necessary to keep U_n^{ij} constant:

$$dt_{I_j} = \frac{p_j + t_j}{w_n}\frac{\frac{\partial U_n}{\partial G_j}}{\frac{\partial U_n}{\partial x}}dG_j$$

From axiom 3, we know that any retiree's preferences over public good provision are single peaked, that is "there exist G^* such that $\frac{\partial U_n(x,G^*,A)}{\partial G} = 0$ for given x and A, and there exists A^* such that $\frac{\partial U_n(x,G,A^*)}{\partial A} = 0$ for given x and G. Moreover, for every $G^0 < G^*$, $\frac{\partial U_n\left(x,G^0,A\right)}{\partial G} > 0$, and for every $G^1 > G^*$, $\frac{\partial U_n\left(x,G^1,A\right)}{\partial G} < 0$." Then, $dt_{I_j} > 0$ if $\frac{\partial U_n}{\partial G_j} > 0$, and $dt_{I_j} < 0$ if $\frac{\partial U_n}{\partial G_j} < 0$.

Similarly, comparing change in level of amenities and change in income tax:

$$dt_{I_j} = \frac{p_j + t_j}{w_n} \frac{\frac{\partial U_n}{\partial A_j}}{\frac{\partial U_n}{\partial x}} dA_j$$

Since any retiree's preferences over level of amenities are single peaked, it follows that $dt_{I_j} > 0$ if $\frac{\partial U_n}{\partial A_j} > 0$, and $dt_{I_j} < 0$ if $\frac{\partial U_n}{\partial A_j} < 0$.

Using the same methodology, one can easily establish the relation between consumption tax and level of amenities or public goods, and the sign of this relation mainly depends on whether $A_j < A^*$ or $G_j < G^*$. ■

Proposition 2 *(Price Level vs. Consumption Tax): In order to keep constant the attractiveness of a state for any retiree, an increase in price level needs to be matched by a one to one consumption tax decrease.*

Proof. From (III.2) we obtain $(dt_j + dp_j) = 0$ by total differentiation. Hence $dt_j = -dp_j$. ■

Proposition 3 *(Distance vs. Consumption or Income Tax): If two states have the same attractiveness for a retiree, and have different distances from retiree's state of origin, then, other things equal, the further away state has lower consumption and income taxes. Difference in income tax is proportional to marginal cost of moving, and inversely related to retiree's wealth. Difference in consumption tax is proportional to marginal cost of moving as well, but it is inversely related to net wealth, and proportional to price level.*

Proof. Using the total differential of U_n^{ij} we obtain the following result for changes in distance and income tax:

$$dt_{I_j} = \frac{-c'}{w_n} dd_{ij}$$

Using the total differential of U_n^{ij} we obtain the following result for changes in distance and consumption tax:

$$dt_j = \frac{-c'(p_j + t_j)}{w_n\left(1 - t_{I_j}\right) - c(d_{ij})} dd_{ij}$$

■

Data and Methodology

Interstate migration data of the elderly population between years 1995 and 2000 are provided by the 2000 Census. Migration flows are determined by the change in residence of the elderly from 1995 to 2000, and the dataset is displayed as state of residency in 2000 is shown sorted by the state of residency in 1995. Elderly population contains those who are 65 years old and older, and this data doesn't contain migration flow from outside the US.

Data about the local and state government finances is obtained from the US Census Bureau's "Local and State Governments' Finances, 1993-94" online dataset. State population and state personal income data are from the Bureau of the Economic Analysis.

Cost of living index is obtained from state level consumer price indexes constructed by Berry et al (2000), and we used these consumer price indexes to obtain state real personal income figures.

We use a gravity equation of the following form:

$$
\begin{aligned}
\ln m_{ij} \quad = \quad & \alpha + \beta_1 \ln dist_{ij} + \beta_2 neigh_{ij} + \gamma_1 \ln pop_i + \gamma_2 \ln pop_j + \\
& + \gamma_3 dens_i + \gamma_4 dens_j + \gamma_5 urban_i + \gamma_6 urban_j + \\
& + \gamma_7 \ln crime_i + \gamma_8 \ln crime_j + \gamma_9 temp_i + \gamma_{10} temp_j + \\
& + \gamma_{11} \ln price_i + \gamma_{12} \ln price_j + \\
& + \gamma_{13} A_i + \gamma_{14} A_j + + \gamma_{15} TAX_i + \gamma_{16} TAX_j + \\
& + \gamma_{17} revenue_i + \gamma_{18} revenue_j \\
& + \gamma_{19} exempt_i + \gamma_{20} exempt_j + \gamma_{21} PUBSP_i + \gamma_{22} PUBSP_j + \\
& + \gamma_{23} intact1_i + \gamma_{24} intact1_j + \gamma_{25} intact2_i + \gamma_{26} intact2_j + \varepsilon
\end{aligned}
$$

Dependent variable is the natural logarithm of number of elderly migrants from state i to state j. Description of independent variables: (α is the constant term; independent variables in lower case letters denote natural logarithm)

$dist_{ij}$: Distance of population centers between states i and j.

$neigh_{ij}$: A dummy variable for neighbor states. If states i and j share a common border, it becomes one, otherwise it is zero.

pop : Total population of respective state

$dens$: Population density of respective state, found by dividing state's total population by its area.

$urban$: Ratio of urban population to total population in a state.

$crime$: Crime rate in a state

$temp$: Annual average temperature in major locations in a state.

$price$: Consumer price index in a state

A : An indicator variable for amenities. If a state is an amenity-rich, A=1, and if a state is amenity-poor, A=0, following the indicator developed by Greenwood et al (1991).

TAX : Vector consisting of property tax (state average), general sales tax, individual income tax, corporate income tax, and other tax revenue. All tax rates are calculated using 'State and Local Goverment Finances' data, by taking the ratio of revenue from each type of tax to state personal income. Inheritance tax is included in form of an indicator variable, taking the value 1 if a state imposes inheritance tax, and 0 if not.

revenue : This vector includes two revenue items that are not covered by state and local government revenue obtained by taxation. These are revenue from federal transfers (calculated as a ratio to state personal income), and total charges (calculated as a ratio to state population).

exempt : This is a vector of three indicator variables that indicate whether social security payments, pensions, and drug sales are exempt from income and sales tax, respectively.

$PUBSP$: Public spending vector- includes expenditures on education, health, hospitals, highways, public transport, police, fire protection, parks and recreation. All variables are calculated by dividing the total expenditure of state and local governments by population of the state, hence expenditure variables are stated in per capita terms.

*intact*1 : (denoted by inter11 in regression results) This is the interaction term for individual income tax rate and pension exemption.

*intact*2 : (denoted by inter14a in regression results) This is the interaction term for logarithm of crime and urbanization ratio.

Before we proceed to estimation results in next section, it is worthwhile to make some comments about the dataset. We look at the migration inflow and outflow of 48 states

(that is, excluding Alaska, Hawaii and District of Columbia), and the gravity equation estimation uses a total of $48 \times 47 = 2256$ observations. We don't consider within state migrations, and we drop those migration state-pairs which indicate zero migration for 1995-2000 period.

As it can be seen from figure 1, different states enjoy different levels of elderly in- and outmigration. A reasonable suspect that might cause such differences across states is state and local level public finance variables.

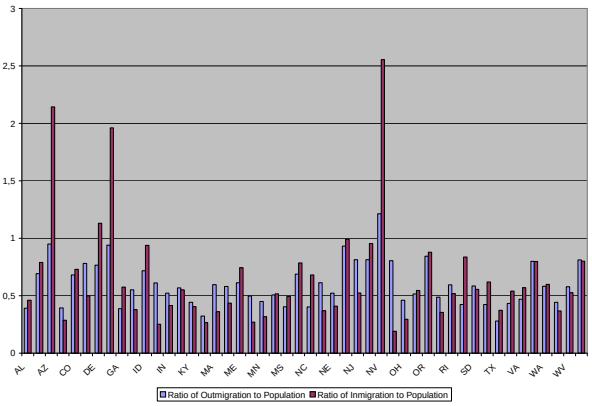

Figure 1. Elderly Migration in and out of states as a percentage total elderly population

Empirical Findings

Tables 1 through 6, that are located at the end of this chapter, display the regression results for three different specifications of elderly migration data. All three specifications pass Pregibon's link test, so that they do not contain a specification error with 95% confidence.

Column (1) is based on total migration between states. As explained in the theoretical section, differences between origin and destination states' policy variables are likely to become clearer as moves over greater distances are considered, since such differences

must be sufficient to overcome the costs of moving. In particular, since the migration cost function is assumed to be convex, regression analysis of shorter distance migrations will be very noisy.

Accordingly, Columns (3) and (4) show regression results that are run under certain restrictions on distance. Distance between two states is measured as the distance between the population centers of the two states.

Column (2) contains only net migration numbers, where net migration is equal to the difference between in-migrants and out-migrants.

Column (5) seeks to reduce the noise in the net migration regression. Thus, we include only those state pairs that have significant net migration, to wit a net migration ratio of at least 0.13. In addition, we include only origin states with relatively affluent per capita income of between $20,000 and $30,000. The rationale for this restriction is that it reduces the likelihood that the analysis will be too noisy due to less affluent 'counter-stream' migrants who might seek to free ride on the higher amenity offerings of high tax states.

Finally, the regression displayed in Column (6) is also based on net migration data. It contains all state pairs that have a net migration rate of at least 0.14. This time there is no constraint on distance or on the origin state's per capita income. We show this regression mainly to stress how it can differ from the regression in Column (2), and how noisy the results can get, even when we are dealing with net migration data.

The regressions show that there is more elderly migration to neighboring states than to more distant states. Moreover, if neighboring states are removed from the data set (and even if they are not), the amount of elderly migration between two states decreases as the distance between such states increases. This is hardly surprising – Conway-Houtenville (2001) report the same results – and is likely due to the confluence of a number of factors.

For example, the direct costs of moving surely increase with distance. In addition, the degree of familiarity with prospective destinations almost surely decreases with distance, and that in turn should have a depressing effect on long-distance migration. Note however that latter explanation is likely to become less significant over time: as the fraction of the elderly who are proficient users of the internet increases, the costs associated with becoming familiar with prospective distant destinations will decrease. Thus, we would expect the negative effect of distance on elderly migration to moderate somewhat in the future.

Our regressions show that the elderly both migrate to states with larger populations and migrate away from states with larger populations. These results confirm an identical 'same sign problem' reported in Conway-Houtenville (2001). There may be a simple explanation. People are social animals; they like to go where there are other people. (Indeed, they like to go where there are other people like themselves, as Gale-Heath report in the case of the elderly. That study, too, is consistent with our results.) But they also necessarily predominantly come from places where there are other people. Nor does this explanation lose its force when examining net migration. For example, while the gross flow from New York to West Virginia may not be significantly different from the net flow, whereas the gross flow from New York to Florida may be vastly greater than the net flow, nevertheless even on a net basis New Yorkers are much more likely to go to Florida than West Virginia.

This variable presents another same sign problem. In the case of gross migration, the elderly tend to avoid migrating to states with higher population densities, but they also tend to remain in states with higher population densities. One possible explanation is that these results reflect two separate flows: one from cities to suburbs and the other from the country to suburbs.

Our regressions show somewhat mixed results of the effects of temperature on elderly migration. On balance, the elderly prefer to move to warmer climes, and the findings are at least in some of the regressions weakly significant. This is unsurprising, and is not inconsistent with Gale-Heath, who report a statistically significant avoidance by migrants of states with a greater number of heating days, i.e., of colder states. Moreover, in four of our regressions, the elderly also exhibit a reluctance to migrate away from warmer climes, although these results are not significant. However, our two remaining regressions, the elderly behave unexpectedly: they strongly significantly move away from warmer climes. We could perhaps tell a story of the happy middle: the elderly may prefer more temperate climes to both colder and hotter ones. In any event, similarly inconsistent results occur in Conway-Houtenville (1998) and Conway-Houtenville (2001). Both of those studies use three different weather-related variables: sun, heating degrees and cooling degrees. The 1998 study reported as significant findings both that the elderly avoid migrating to the sun, but also that they migrate to states with a larger number of cooling degrees; the latter finding, but not the former, indicates a preference for states that are warmer. In addition, the 1998 study reported that the elderly migrate to states with a larger number of heating degrees; that would seem to indicate a preference for states that are cooler. The 2001 study does not clarify matters: the results abound in same sign issues and uniformly contradict the significant findings from 1998.

Our regressions show that there is more elderly migration to states with higher property taxes. This result, which is strongly significant, is inconsistent with that reported by Gale-Heath, but is consistent with that reported in Conway-Houtenville (1998) and in Conway-Houtenville (2001). While the result is at first counterintuitive, it may be the result of one of two factors. First, higher property taxes are generally strongly correlated

with higher levels of locally provided amenities, and it may simply be the case that the elderly migrate towards such amenities. Second, property taxes are usually an increasing function of the value and hence generally of the size of the property. Since the elderly are predominantly empty-nesters, they may own properties that are on average smaller than those that predominate in a given locale. If this were so, the elderly may to some extent be able to "free ride" off of the property taxes paid by others. Moreover, their ability to successfully engage in such free-riding will be greater the higher the level of property taxes. The likelihood that one of these phenomena (or something very much like one of these phenomena) explains our results is enhanced by a glance at the net migration regressions. These regressions generally report (albeit not significantly) that the elderly migrate away from low property tax states. Assuming a modicum of rationality, the elderly would only flee from low taxation if they are well compensated for such flight. Finally, in the case of gross migration, a same sign problem appears; the elderly weakly significantly move away from high property taxes. This same sign problem also appears in Conway-Houtenville (1998) and in Conway-Houtenville (2001). A possible explanation may be a general preference for retiring in suburbia. Thus, when the elderly are confronted with the very high property taxes of big cities, they move away. But once outside of the big city setting, they may prefer more amenities to fewer.

In the case of general sales tax data, our regression results present a same sign problem. The elderly migrate to states where sales taxes are low. That is surely uncontroversial. But they also migrate away from states where sales taxes are low. Both of these results are significant only for gross migration, but they do retain their sign for net migration. One possibility is that more nuanced data would provide an explanation, but this is pure speculation on our part. For example, the elderly are likely to be disproportionately

affected by sales taxes on food and medicine. If so, they could rationally prefer a state that collects a high overall amount of sales tax, but that imposes a low rate of tax on food and medicines, to a state that collects a low overall amount of sales tax, but that does not grant preferential treatment to food and medicine. This is because the elderly could free ride off sales tax revenues in the first posited state, but not the second. Moreover, the existence of states, and even more of localities within states, that differ along these two dimensions means that it is simultaneously possible for some elderly to move to low sales tax states that also offer a generalized respite from high taxation, while others leave low sales tax states that, in spite of their generally low sales taxes, offer no particular benefits to consumers of food and medicine. Our data cannot definitively speak to the foregoing conjecture. However, we do have a dummy variable that measures whether or not a state exempts drug sales from its general sales tax. Thus, we can confirm that the elderly migrate to states that exempt drugs from their general sales tax. However, our data also show that the elderly migrate away from states that exempt drugs from their general sales tax. Both of these results are uniformly significant in the case of gross migrations, but not in the case of net migrations. Moreover, since only five states, and only one state with a significant population (Illinois), do not provide a sales tax exemption for drugs, the results may be suspect.

Comparing our results to other studies, Gale-Heath do not report a result that is statistically significant with respect to the level of sales taxes. However, they do report that a positive change in sales tax rates, i.e., a sales tax increase, significantly reduces the amount of net in-migration. Conway-Houtenville (1998), in turn, report a same sign problem, albeit the opposite one we confront: their elderly statistically significantly migrate to states with high sales taxes; they insignificantly migrate away from states with high sales

taxes. Conway-Houtenville (2001) confirm their 1998 result for gross migration flows, but for net migration flows obtain the least intuitively appealing result possible, namely that higher sales taxes tend both to attract elderly migrants to a state and to keep potential elderly migrants from migrating out of a state. However, neither of these last two results is significant.

In our study, we coupled the individual income tax data with the data on meaningful income tax exemptions for pension or retirement income by means of an interaction variable. While the results are not uniform across the various regressions, and mostly not significant, at least some tell an intuitively appealing story. Thus, in the case of net migrations, two of the three regressions show that the elderly do not migrate to high income tax states that do not offer a meaningful pension exemption, but do migrate to high income tax states that offer such an exemption. Moreover, two of the three regressions show that the elderly migrate out of states that couple high income taxes with no meaningful pension exemption, but tend to stay in states that couple high income taxes with a meaningful pension exemption. Thus, the elderly appear to dislike income taxes if and only if they are the ones who are required to pay them! Nirvana is a state with high income taxes that are disproportionately paid by others.

Turning to the gross migration data, the elderly significantly avoid migrating to high income tax states, but their aversion to such states is mitigated somewhat if the state offers a meaningful income tax exemption for some pension income. In addition, the elderly tend to stay in states with high income taxes; a tendency that becomes even more pronounced if the state couples high income taxes with a meaningful pension exemption. We suspect this same sign problem has an explanation along the lines suggested by our analysis of the pension exemption in the prior paragraph. While our data set treats the elderly as

a single group, the fact remains that the elderly are not homogenous. Specifically, we can think of two distinct subsets that might react very differently to state income tax rules: the wealthy elderly and the poor elderly. The wealthy elderly continue to earn significant amounts of income, not just from pensions, but also from investments and other sources; the poor elderly have little income beyond that provided by Social Security. All else equal, we would expect the wealthy elderly to avoid states with high income taxes. But we would not expect similar behavior from the poor elderly, as they are not the ones paying the high income taxes and as they presumably get at least some measure of amenity benefit from the state expenditures financed by the high income taxes imposed on others.

Comparing our results with those obtained by others, we note that Conway-Houtenville (1998) report the opposite same sign problem that we confront, albeit the same one they reported for general sales taxes. That is, their elderly significantly migrate away from states with high income taxes, but also strongly significantly migrate to states with high income taxes. They further report that 'provisions in the income tax code that exempt pension income have no bearing on either in-migration or out-migration,' but do not explain how they arrived at this conclusion. Conway-Houtenville (2001) in turn confirms the same sign problem of their earlier study, but the results are not significant.

Finally, we also looked at the response of the elderly to a complete exemption of Social Security receipts from state income taxation. We found that while the elderly migrate to states that do not tax social security receipts, they also migrate away from states that do not tax such receipts. While these results are significant in the case of gross migration, it is difficult to ascribe much meaning to them. The reason is that while 'only' thirty-five states exempt all social security receipts from taxation, those states include all of the biggest states in terms of population as well as every single state that falls into the category of being a

traditional retirement haven.

Our regressions based on net migration data show that the elderly significantly migrate to states that collect higher amounts of corporate income tax, but they also albeit not significantly migrate out of states that collect higher amounts of corporate income tax. The former result is intuitively appealing, since corporate income taxes present perhaps the ultimate opportunity for a free ride on the part of the elderly. The latter result, were it significant, might prove difficult to explain; perhaps high corporate income tax collections are correlated with some other undesirable feature of a state, such as having a rust-belt economy. But it is not significant. Finally, our regressions based on gross migration data report the perverse result that the elderly do not migrate to states with high corporate income tax collections and moreover migrate away from states with high corporate income tax collections. Fortunately, neither of these results is significant.

Our regressions show that both in terms of gross migration and in terms of net migration, the elderly strongly significantly migrate to states with high levels of so-called 'other taxes'; no similarly significant results were obtained for out-migration. The significant results are intuitively appealing when we consider a tax such as a natural resources severance tax or a documentary or stock transfer tax; such taxes provide a clear opportunity for free-riding on the part of the elderly. The results seem less appealing in the case of a death tax or a gift tax, both of which are also conflated into the 'other taxes' category, albeit as a small piece thereof. Thus, we separately tested the response of the elderly to what we call inheritance taxes, which include any taxes above and beyond the common baseline determined by the IRC Section 2011 credit. We find that the elderly strongly significantly migrate to states that do not impose any such incremental tax on bequests or other transfers. This is an intuitively appealing result, for while only a small fraction of the

elderly population is subject to such transfer taxes, that fraction of the population is both mobile (they are wealthy) and motivated to avoid such incremental taxes. Our results for migration out of states on the basis of incremental transfer taxes are not similarly significant; in the case of net migration, the sign is the expected sign; in the case of gross migration, it is not. Finally, note that Conway-Houtenville (2001) confirms that the elderly do not move to states with high 'death taxes.'

Our regressions produce only a handful of significant results for the various government spending variables. First, the elderly do not like to migrate to states with high per capita spending on education. This result is intuitively appealing, as the elderly no longer have children who are likely to be beneficiaries of such education spending. Moreover, the same result appears in Conway-Houtenville (1998) and Conway-Houtenville (2001). However, those studies both report that the elderly are also reluctant to leave states with high levels of education spending. While some of our regressions confirm this same-sign problem, the results are not significant.

Second, the elderly prefer to migrate to states with high per capita government spending on health care and hospitals. This is intuitively appealing, as the elderly make disproportionate use of health care and hospitals. Surprisingly, Conway-Houtenville (1998) and Conway-Houtenville (2001) obtain the opposite result. Nonetheless, their results indicated that the elderly migrated away from states with low spending on hospitals.

Third, the elderly prefer to migrate to states with high per capita government spending on police. This too is appealing: the elderly are surely disproportionately vulnerable and thus would be expected to place additional value on police protection. Note, however, that in the case of gross migration, there is also a significant tendency for the elderly to move away from states with high per capita spending on police. A possible expla-

nation is that high expenditures for police may be correlated with some other undesirable characteristic of a state, such as being highly urban and therefore having high crime rates.

Finally, the elderly prefer to migrate to states that have higher per capita government spending on parks and recreation. This is again an appealing result, since the elderly as a class have more leisure time to enjoy such amenities. Nonetheless, the news here is not unambiguous, as in the case of gross migration, the elderly also significantly move away from states with high per capita spending on parks and recreation. As with most same sign problems, these results may be masking some heterogeneity either in the elderly or in the variable itself. That is, while some of the elderly may benefit from spending on parks and recreation, others may be unwilling or unable to use public recreation facilities. Moreover, in some states, the funded facilities may be of the sort that are attractive to the elderly, while in others they might be of the sort that are more attractive to the young (e.g., rugged hiking paths or playgrounds).

A significant and surprising finding is that the elderly do not appear to be attracted to states that derive a larger share of their revenues from the Federal government. One would expect the reverse to be true: from the vantage of a state's residents, funds received from the Federal government allow the state to provide amenities without any need for the state to impose any directly corresponding taxes or fees. Why would the elderly eschew such a free ride? A possible explanation is that the mere fact of greater Federal revenues may be masking some other undesirable feature of a state. For example, a state may receive greater Federal revenues because it is poor and therefore has a greater need for such revenues. Or a state may receive greater Federal revenues because it has a more powerful and perhaps concomitantly more corrupt political establishment (in which case the funds may not be spent in a manner that benefits the residents at large). In either of these cases, a rational

retiree might well choose to avoid the Federal handout.

Our regressions show that he elderly are less likely to migrate to states that impose higher fees and other charges. It is somewhat unclear whether this is an expected result. One can imagine three possibilities with respect to a service that a state could provide and that is targeted to the elderly. First, the state could choose not to provide the service, and thus force the cost of the service onto the elderly. Second, the state could provide the service, but could charge the elderly an appropriate fee. Third, the state could provide the service, but could pay for it out of general revenues. The first and the third possibility involve low government fees, but only the third actually benefits the elderly. Similarly, one can imagine three possibilities with respect to a service that a state could provide and that is not targeted to the elderly. First, the state could choose not to provide the service, and thus force the cost of the service onto those who make use of the service. Second, the state could provide the service, but could charge the users an appropriate fee. Third, the state could provide the service, but could pay for it out of general revenues. The first and the third possibility involve low government fees, but now the third actually operates against the interests of the elderly. Finally, note that, at least in the case of gross migration, our regressions also show that the elderly tend to stay in states that impose higher fees and other charges. As suggested by the foregoing discussion, and particularly given the wide variety of fees and charges, an explanation based on the heterogeneity of the elderly is the likely cause of this same sign problem.

While not all of our results are significant, our regressions show that the elderly tend to migrate to states with a lower cost of living and away from states with a higher cost of living. Since many of the elderly live on a fixed income – i.e., an income that does not change in response to changes in price levels – this is exactly the behavior we would expect:

retirees move to states where their incomes go farther. Our results are consistent with those reported in Gale-Heath, Conway-Houtenville (1998) and Conway-Houtenville (2001).

Table 1. Gravity Regression Results-1

	(1)	(2)	(3)
	lnmig	lnnetmig	lnmig
neighbor	0.8162	0.3547	
	(12.97)**	(2.22)*	
lndistance	-1.0804	-0.9967	-1.1483
	(40.76)**	(15.14)**	(36.17)**
lnpopulationto	0.8393	0.6054	0.8064
	(18.83)**	(5.11)**	(16.80)**
lnpopulationfrom	0.9363	0.7782	0.9232
	(20.51)**	(6.81)**	(18.64)**
urbanto	-27.8890	-55.8080	-32.8224
	(4.82)**	(4.48)**	(5.30)**
urbanfrom	-12.7542	-22.7924	-15.8463
	(2.12)*	(1.68)	(2.44)*
lncrimeto	-1.3810	-3.1073	-1.8560
	(2.89)**	(3.07)**	(3.65)**
lncrimefrom	-0.5408	-1.7943	-0.7788
	(1.05)	(1.46)	(1.42)
temperatureto	0.0012	0.0023	0.0013
	(2.06)*	(1.62)	(2.19)*
temperaturefrom	0.0020	-0.0016	0.0020
	(3.31)**	(1.05)	(3.22)**
propertytaxincomeratioto	17.2457	40.6023	20.0104
	(3.86)**	(4.59)**	(4.18)**
propertytaxincomeratiofrom	11.6799	27.6537	10.6682
	(2.55)*	(2.57)*	(2.15)*
generalsalestaxincomeratioto	-11.3800	-0.4516	-10.1263
	(3.27)**	(0.06)	(2.64)**
generalsalestaxincomeratiofrom	-11.6041	3.6990	-12.7523
	(3.11)**	(0.42)	(3.06)**
indincometaxincomeratioto	-19.0123	-3.9341	-19.2020
	(4.37)**	(0.47)	(4.09)**
indincometaxincomeratiofrom	-8.9443	3.3779	-9.9360
	(1.99)*	(0.25)	(2.02)*
corpincometaxincomeratioto	-10.5176	22.3682	-3.2890
	(0.90)	(0.71)	(0.26)
corpincometaxincomeratiofrom	8.6123	-0.3056	10.0896
	(0.74)	(0.01)	(0.78)
othertaxincomeratioto	38.2787	81.6333	42.1656
	(5.13)**	(4.89)**	(5.15)**
othertaxincomeratiofrom	12.6657	30.7428	12.9909
	(1.63)	(1.94)	(1.51)

Table 2. Gravity Regression Results-2

	(1)	(2)	(3)
	lnmig	lnnetmig	lnmig
socialsecto	0.1976	-0.0998	0.1935
	(3.70)**	(0.90)	(3.42)**
socialsecfrom	0.1776	0.0753	0.1773
	(3.35)**	(0.61)	(3.14)**
pensionto	-0.5200	-0.8063	-0.6212
	(4.02)**	(3.46)**	(4.56)**
pensionfrom	-0.0363	-0.1412	-0.0561
	(0.27)	(0.32)	(0.38)
drugsaleto	1.0240	0.3771	1.1445
	(11.01)**	(1.61)	(11.37)**
drugsalefrom	0.6028	0.2104	0.6905
	(6.86)**	(0.94)	(7.47)**
inheritanceto	0.2492	0.6628	0.2601
	(5.59)**	(6.01)**	(5.41)**
inheritancefrom	0.0167	-0.1315	0.0135
	(0.38)	(1.18)	(0.28)
reducationpercapto	-12.5675	-80.8115	-13.3170
	(0.59)	(2.08)*	(0.58)
reducationpercapfrom	15.7676	-130.1967	21.7125
	(0.72)	(2.45)*	(0.89)
rhighwayspercapto	12.8896	-96.9277	-19.0536
	(0.35)	(1.20)	(0.47)
rhighwayspercapfrom	63.7847	-7.7981	36.0499
	(1.82)	(0.10)	(0.93)
rhealthhosppercapto	77.6395	166.2222	110.5020
	(2.66)**	(2.67)**	(3.56)**
rhealthhosppercapfrom	-15.0345	-11.6543	5.8780
	(0.51)	(0.16)	(0.19)
rpoliceexppercapto	270.3850	-173.3851	374.3915
	(2.51)*	(0.60)	(3.19)**
rpoliceexppercapfrom	246.4005	462.1275	302.6635
	(2.26)*	(1.82)	(2.61)**
rfireexppercapto	-83.7932	-89.2778	-161.8793
	(0.57)	(0.22)	(0.99)
rfireexppercapfrom	-54.3782	-576.8002	-97.0167
	(0.38)	(1.70)	(0.62)
rparkrecexppercapto	508.2776	1525.0330	642.9306
	(4.01)**	(4.84)**	(4.75)**
rparkrecexppercapfrom	557.2105	298.9487	659.7679
	(4.65)**	(1.10)	(5.22)**

Table 3. Gravity Resgression Results-3

	(1)	(2)	(3)
	lnmig	lnnetmig	lnmig
rtransitexppercapto	3.3696	139.5161	-11.0652
	(0.07)	(1.00)	(0.22)
rtransitexppercapfrom	45.9260	-71.2508	34.8402
	(0.94)	(0.68)	(0.63)
revenuefedincomeratioto	-11.1047	-42.6839	-12.5046
	(3.45)**	(5.61)**	(3.70)**
revenuefedincomeratiofrom	3.2928	14.5643	3.2271
	(0.98)	(1.84)	(0.88)
totchargesrevpercapto	-1.5594	-2.0974	-1.9311
	(4.82)**	(3.07)**	(5.76)**
totchargesrevpercapfrom	-0.7225	0.3054	-0.9965
	(2.34)*	(0.39)	(3.11)**
densityto	-0.0011	0.0002	-0.0012
	(5.90)**	(0.31)	(5.45)**
densityfrom	-0.0011	-0.0005	-0.0012
	(5.54)**	(0.99)	(5.65)**
amenityto	0.4912	0.6016	0.4986
	(9.04)**	(4.47)**	(8.51)**
amenityfrom	0.2898	-0.0152	0.3131
	(5.54)**	(0.12)	(5.60)**
inter11to	8.5227	14.6924	13.3333
	(1.61)	(1.44)	(2.34)*
inter11from	-5.6674	10.5292	-4.5556
	(1.03)	(0.64)	(0.75)
inter14ato	3.4304	6.4977	4.0471
	(4.87)**	(4.26)**	(5.38)**
inter14afrom	1.6330	2.9338	2.0355
	(2.23)*	(1.75)	(2.59)**
lncpito	0.0034	-3.8953	-0.2821
	(0.00)	(2.64)**	(0.39)
lncpifrom	2.6063	1.4157	2.8488
	(3.53)**	(0.86)	(3.46)**
Constant	-19.9365	37.0178	-13.6440
	(2.26)*	(1.84)	(1.42)
Observations	2168	1104	1820
Adjusted R-squared	0.83	0.68	0.82

Table 4. Gravity Regression Results-4

	(4)	(5)	(6)
	lnnetmig	lnnetmig	lnnetmig
neighbor		0.5339	0.5221
		(3.77)**	(3.49)**
lndistance	-1.0708	-1.0115	-1.0281
	(11.60)**	(17.38)**	(17.45)**
lnpopulationto	0.6199	0.7225	0.7083
	(4.24)**	(5.59)**	(5.47)**
lnpopulationfrom	1.0009	0.7107	0.6952
	(9.35)**	(3.98)**	(3.78)**
urbanto	-43.4324	-43.6510	-45.8763
	(3.37)**	(3.62)**	(3.76)**
urbanfrom	-21.8048	-66.2385	-40.5425
	(1.67)	(1.97)*	(1.24)
lncrimeto	-2.5924	-2.4450	-2.6095
	(2.62)**	(2.52)*	(2.66)**
lncrimefrom	-0.9153	-6.1071	-3.5565
	(0.79)	(1.90)	(1.13)
temperatureto	0.0030	0.0021	0.0017
	(2.07)*	(1.53)	(1.23)
temperaturefrom	-0.0026	-0.0025	-0.0005
	(1.75)	(1.12)	(0.24)
propertytaxincomeratioto	36.7213	36.8904	36.5853
	(3.85)**	(4.20)**	(4.09)**
propertytaxincomeratiofrom	-4.8943	-22.1791	-16.7198
	(0.39)	(1.61)	(1.20)
generalsalestaxincomeratioto	-7.8597	-4.5853	-4.0630
	(0.89)	(0.60)	(0.53)
generalsalestaxincomeratiofrom	-15.9390	-14.2825	-19.7178
	(1.67)	(1.32)	(1.77)
indincometaxincomeratioto	-1.2265	-1.5871	-4.4437
	(0.14)	(0.20)	(0.55)
indincometaxincomeratiofrom	-38.6151	1.2875	13.9309
	(2.57)*	(0.07)	(0.76)
corpincometaxincomeratioto	76.3012	70.9971	67.4549
	(1.98)*	(2.04)*	(1.91)
corpincometaxincomeratiofrom	38.7401	61.6090	35.5446
	(1.65)	(1.13)	(0.65)
othertaxincomeratioto	55.1710	63.4705	60.5194
	(3.15)**	(4.23)**	(3.90)**
othertaxincomeratiofrom	0.6182	-0.2264	-0.5568
	(0.04)	(0.01)	(0.02)

Table 5. Gravity Regression Results-5

	(4)	(5)	(6)
	lnnetmig	lnnetmig	lnnetmig
socialsecto	-0.0095	0.0087	0.0278
	(0.08)	(0.08)	(0.26)
socialsecfrom	0.3275	0.0891	0.1071
	(2.33)*	(0.50)	(0.59)
pensionto	-0.4021	-0.3768	-0.4532
	(1.86)	(1.74)	(2.05)*
pensionfrom	-0.6939	0.3294	0.8376
	(1.49)	(0.52)	(1.47)
drugsaleto	0.4156	0.5210	0.5661
	(1.58)	(2.18)*	(2.31)*
drugsalefrom	0.7427	0.2227	0.3112
	(3.21)**	(0.52)	(0.71)
inheritanceto	0.5231	0.4785	0.4738
	(4.27)**	(4.24)**	(4.07)**
inheritancefrom	-0.0004	-0.1169	-0.2142
	(0.00)	(0.78)	(1.51)
reducationpercapto	-34.9749	-75.8829	-69.7281
	(0.88)	(2.19)*	(1.99)*
reducationpercapfrom	13.4151	-26.2435	-12.1770
	(0.22)	(0.53)	(0.24)
rhighwayspercapto	-74.8913	-63.4880	-57.4101
	(0.89)	(0.84)	(0.75)
rhighwayspercapfrom	155.8296	-0.9777	-29.3559
	(1.94)	(0.01)	(0.25)
rhealthhosppercapto	109.2750	114.7539	124.9705
	(1.64)	(1.83)	(1.96)
rhealthhosppercapfrom	56.8884	145.9241	146.2037
	(0.81)	(1.17)	(1.15)
rpoliceexppercapto	172.3744	198.6687	254.8959
	(0.53)	(0.72)	(0.90)
rpoliceexppercapfrom	160.3986	-249.1431	17.6119
	(0.70)	(0.47)	(0.03)
rfireexppercapto	277.8796	-243.7243	-238.8596
	(0.67)	(0.72)	(0.68)
rfireexppercapfrom	-287.7345	503.5377	181.3242
	(0.89)	(0.63)	(0.22)
rparkrecexppercapto	1307.5490	1286.4180	1247.2560
	(4.30)**	(4.08)**	(3.92)**
rparkrecexppercapfrom	432.9613	141.4861	245.4086
	(1.73)	(0.40)	(0.68)

Table 6. Gravity Regression Results-6

	(4)	(5)	(6)
	lnnetmig	lnnetmig	lnnetmig
rtransitexppercapto	-26.0580	53.8068	62.5001
	(0.14)	(0.30)	(0.34)
rtransitexppercapfrom	74.6250	64.9723	-13.8936
	(0.65)	(0.52)	(0.12)
revenuefedincomeratioto	-29.5959	-26.5199	-27.4769
	(3.53)**	(3.79)**	(3.90)**
revenuefedincomeratiofrom	8.7377	4.7364	4.7703
	(1.13)	(0.34)	(0.34)
totchargesrevpercapto	-1.7999	-1.9278	-2.0174
	(2.38)*	(2.88)**	(3.00)**
totchargesrevpercapfrom	-1.6659	-1.0951	-1.4228
	(1.90)	(0.82)	(1.03)
densityto	-0.0005	-0.0006	-0.0005
	(0.72)	(1.10)	(0.95)
densityfrom	-0.0001	-0.0016	-0.0024
	(0.30)	(1.75)	(2.83)**
amenityto	0.6953	0.6819	0.6455
	(5.02)**	(5.43)**	(5.10)**
amenityfrom	0.3769	0.3226	0.2696
	(2.80)**	(2.19)*	(1.83)
inter11to	-0.7702	2.5695	6.1896
	(0.08)	(0.27)	(0.64)
inter11from	21.5400	-5.5066	-22.3519
	(1.29)	(0.26)	(1.16)
inter14ato	5.2396	5.2444	5.5126
	(3.33)**	(3.55)**	(3.69)**
inter14afrom	2.7151	8.2698	5.1173
	(1.70)	(2.01)*	(1.27)
lncpito	-4.5439	-2.8818	-3.0020
	(2.94)**	(2.20)*	(2.31)*
lncpifrom	2.0229	0.2591	4.5048
	(1.11)	(0.07)	(1.27)
Constant	19.7569	66.4032	27.9667
	(0.98)	(1.50)	(0.67)
Observations	508	608	593
Adjusted R-squared	0.86	0.85	0.85

CHAPTER IV

OPTIMUM MONETARY POLICY DURING CURRENCY UNION ENLARGEMENT

Introduction

When the theory of optimum currency areas was first introduced, it has been considered as a detailed analysis of fixed and flexible exchange rate regimes. Analysis of an appropriate currency area domain and the idea of a single monetary authority governing the monetary policy in this currency area would be too utopic. With realization of the European Economic and Monetary Union, as an idea in 1980s, and as reality with a single currency and a single central bank in 1999, research in this field flourished.

Alesina and Barro (2000), and Bayoumi (1994) provide formal models that help general equilibrium analysis within a currency union. In this paper, I make use of Bayoumi's (1994) set up and the general framework introduced in Obstfeld and Rogoff's (1995) Redux model.

Previous studies have emphasized heterogenity within the currency union, and monetary policy's and exchange rate regime's welfare implications. Corsetti (2005) considers the case of self-validating exchange rate regimes in an optimum currency area, and concludes that different costs of incomplete stabilization in national level among the member countries is an effect of the difference between expected national output level and its efficient level that is consistent with currency area implementations. In this paper, I attribute all disturbances to monopolistic distortions, however, Corsetti (2005) stresses that presence of incomplete stabilization leads to higher distortions than monopolistic framework

would suggest. HughesHallet and Kavanagh (2001) show in a three country setting that pegged exchange rate regimes with an anchor country, the size of the follower country affects the inflation in the anchor country, and the smaller the follower, the lower the inflation in anchor country.

In this study, I focus on the question 'What is an optimal monetary policy for an accession country and the monetary union to follow prior to accession?'. I consider an optimal inflation target in this model, and leave the discussion of Taylor rules to a future research. Laxton and Pesenti (2003) show for small open economies that inflation based rules perform better than conventional Taylor rule. Considering any potential accession country being a small open economy, and given that the European Central Bank implements (implicit) inflation targeting, the analysis presented in this paper, which is based on inflation criterion, will be covering some significant grounds.

Effects of country size and transmission of business cycle fluctuations via disturbances in terms of trade has been captured by Crucini (1997), where it has been shown that higher volatility of business cycle in small countries follows from their interaction with big economies. A similar interaction between economies of different sizes can be found with the help of nominal exchange rates. Nominal exchange rate fluctuations in a given country's currency versus the common currency of the union captures the terms of trade volatility and its effect on a given country's consumption based price index that arises from economic optimization patterns. Accession eliminates this terms of trade effect between an individual country and the union. This effect is captured in Alesina and Barro (2000) in form of costs that exist due to an iceberg technology. However, this does not help us to distinguish between advantages of establishment of currency union and customs union.

In what follows, I set up the Redux analysis with enhancing assumptions. Optimal

monetary policy is set in form of an optimum inflation target criterion, and I analyse the changes in optimal target criterion in case of an accession occuring.

Model

I consider two blocks of countries in a partial equilibrium model, where one is a currency union and the other is a block of candidate countries. There are n_1 countries in the currency union and n_2 countries are candidates. World consists of N countries, and $N = n_1+n_2$. In this model, each country is represented by a household, which is monopolistic supplier of the country specific consumption good. The only input is household's labor, denoted by $X_i \in (0, 1]$. In the optimization problem, the representative household chooses its nominal money holdings, bonds and labor supply.

Countries that form a currency union, namely n_1 countries use a single currency and bilateral (nominal) exchange rate between two countries is given as a ratio of the their local currencies' bilateral exchange rates. Q_i denotes the bilateral exchange between country i and the currency union, similarly Q_j denotes the bilateral exchange rate between country j and the currency union (i.e. price of the currency union's currency in terms of country j's currency). Hence, $\frac{Q_i}{Q_j} = 1$ if both i and j are members of the currency union. Also notice that $\frac{Q_i}{Q_j}$ gives the price of country j's currency in terms of country i's currency. Exchange rate regime of candidate countries is assumed to be chosen by the monetary authority of that country exogenously.

The monetary authority uses nominal interest rates as an instrument to reach its inflation target. The implementation of optimal policy becomes straightforward, once it is assumed that the monetary authority can set the nominal interest rate or at least manipulate it freely. Although this can happen only with great frictions in reality, one can

make such an assumption as in Woodford (2003) without loss of generality.

Representative households in different countries have identical preferences. Although this might seem to be farfetched, it is a standart assumption and will help me to stress the effects of country size.

Representative household in country i maximizes its utility

$$U_{t,i} = \sum_{t=0}^{\infty} \beta^t [\log C_{t,i} + \gamma \log \left(\frac{M_{t,i}}{P_t} \right) - \phi X_{t,i}]$$

subject to the budget constraint:

$$P_t B_{t+1,i} + M_{t,i} + P_t C_{t,i} = P_t(1 + r_t)B_{t,i} + M_{t-1,i} + W_{t,i} X_{t,i}$$

where $W_{t,i}$ is the nominal wage rate in country i and at time t, and

$$C_{t,j} = (\sum_{z=1}^{N} c_{t,j}\,(z)^{\frac{\theta-1}{\theta}})^{\frac{\theta}{\theta-1}}$$

is a constant elasticity of substitution consumption index, where $c_{t,j}(z)$ is the consumption of country z's product at time t in country j. Note that $\theta > 1$ gives the elasticity of substitution between goods that are supplied by different countries. P_t is the consumption based price index for country j in which prices are denominated in country j's currency.

Supply Side

Labor supply X and productivity shocks ε determine the current level of output which is given by $Y_{t,i} = X_{t,i}^{\alpha} e^{\varepsilon_{t,i}}, X_{t,i} \in (0, 1]$, or equivalently in log form $y_{t,i} = \alpha x_{t,i} + \varepsilon_{t,i}$. Labor market is competitive and labor is paid its marginal product value. Hence, firms solve

$\min W_{t,i}X_{t,i}$ where $Y_{t,i} = X_{t,i}^{\alpha}e^{\varepsilon_{t,i}}$. The solution of this optimization yields the following:

$$W_{t,i}Q_{t,i} = \alpha X_{t,i}^{\alpha-1}e^{\varepsilon_{t,i}}p_t(i)$$

where $p_t(i)$ is the price of the good that is supplied monopolistically by country i and representative household earns its wage income $W_{t,i}$ by supplying its labor to this monopolistic firm. Equivalently in log form: $w_{t,i} + q_{t,i} = \log\alpha + (\alpha-1)x_{t,i} + \varepsilon_{t,i} + \log p_t(i)$

The crucial assumption of the model is that the nominal wages are rigid downwards. In particular, a positive productivity shock will lead to an increase in nominal wages, if economy is in full employment level, and a negative productivity shock reduces labor, where nominal wage doesn't change.

Demand

Rearranging the budget constraint:

$$C_{t,i} = (1+r_t)B_{t,i} - B_{t+1,i} - \frac{M_{t,i}}{P_t} + \frac{M_{t-1,i}}{P_t} + \alpha e^{\varepsilon_{t,i}}\frac{p_t(i)}{P_t}X_{t,i}^{\alpha}\frac{1}{Q_{t,i}}$$

Demand is derived from individual j's optimization:

$$Max_{c_z}\{C_{j=}\left(\sum_{z=1}^{N} c_j(z)^{\frac{1-\theta}{\theta}}\right)^{\frac{\theta}{1-\theta}} \quad s.t.\ I_j = \sum_{z=1}^{N} p(z)c_j(z)$$

with the first order condition yielding:

$$c_j(z_1) = \left(\frac{p(z_2)}{p(z_1)}\right)^{\theta} c_j(z_2)$$

Equating the world demand and world supply of country i's output, we get obtain:

$$X_{t,i}^{\alpha} e^{\varepsilon_{t,i}} = \left[\frac{p_t(i)}{P_t}\right]^{-\theta} C_t^W$$

where $C_t^W = \sum_{i=1}^{N} C_t^i$ is the world consumption.

Hence, the budget constraint becomes:

$$C_{t,i} = (1+r_t)B_{t,i} - B_{t+1,i} - \frac{M_{t,i}}{P_t} + \frac{M_{t-1,i}}{P_t} + (C_t^W)^{\frac{1}{\theta}} \frac{1}{Q_{t,i}} \alpha e^{(2\varepsilon_{t,i} - \frac{1}{\theta})} X_{t,i}^{\alpha - \frac{\alpha}{\theta}}$$

Following the procedure in appendix.1, the budget constraint boils down to:

$$C_{t,i} = (1+r_t)B_{t,i} - B_{t+1,i} + \frac{m_{t-1,i}}{\pi_{t-1}+1} - m_{t,i} + (C_t^W)^{\frac{1}{\theta}} \frac{1}{Q_{t,i}} \alpha e^{(2\varepsilon_{t,i} - \frac{1}{\theta})} X_{t,i}^{\alpha - \frac{\alpha}{\theta}}$$

The Redux model is supported here by perfect foresight, and hence representative household will be choosing the level of its real balance holdings accordingy

The representative household in country i solves the following problem:

$$Max_{\{B_{t+1}, m_{t,i}, X_{t,i}\}} [\sum_{t=0}^{\infty} \beta^t (\log C_{t,i} + \gamma \log \frac{M_{t,i}}{P_t} - \phi X_{t,i})]$$

subject to

$$C_{t,i} = (1+r_t)B_{t,i} - B_{t+1,i} + \frac{m_{t-1,i}}{\pi_{t-1}+1} - m_{t,i} + (C_t^W)^{\frac{1}{\theta}} \frac{1}{Q_{t,i}} \alpha e^{(2\varepsilon_{t,i} - \frac{1}{\theta})} X_{t,i}^{\alpha - \frac{\alpha}{\theta}}$$

The representative household takes C^W as given and maximization with respect

to B_{t+1}, $m_{t,i}$, $X_{t,i}$ yields $\beta\left(1+r_{t+1,i}\right)C_{t,i}=C_{t+1,i}$, $m_{t,i}=\left(\frac{1+i_{t,i}}{i_{t,i}}\right)\gamma C_{t,i}$ and finally:

$$X_{t,i}^{\delta}=\mu\frac{1}{Q_{t,i}}\left(C_t^W\right)^{\frac{1}{\theta}}\left(\frac{1}{C_{t,i}}\right)e^{(2\varepsilon_{t,i}-\frac{1}{\theta})}<1 \; or \; X_{t,i}^{\delta}=1 \tag{IV.1}$$

where $\mu=\frac{\alpha}{\phi}\left(\alpha-\frac{\alpha}{\theta}\right),\ \delta=1-\alpha+\frac{\alpha}{\theta}>0.$

In addition to the first order conditions, transversality condition has to hold, so that the three first order conditions given above can describe an equilibrium.

Optimal Inflation Targeting with Inertia

In this section, I discuss central bank's loss function and combine it with the representative household's first order conditions.

It has been shown (Gali and Gertler, 1999) that New Keynesian Phillips Curve, which relates cost-push elements and inflation expectations to current level of inflation, can be expressed by $\pi_t=b_1\tilde{y}_t+b_2E_t(\pi_{t+1})+u_t$ where π_t denotes the currency union-wide inflation, $\tilde{y}$ is the difference between logarithms of natural and current levels of output and u is exogenous cost-push disturbance.

I have to mention at this point a peculiarity of inflation as discussed previously. Inflation in the above discussion of representative household's optimization varies across countries only as a result of movements in the bilateral nominal exchange rates. This can be seen by writing out the consumption based price index for country i explicitly:

$$P_{t,i}=\left(\sum_{j=1,j\neq i}^{N}\left(p_t(j)\frac{Q_{t,i}}{Q_{t,j}}\right)^{1-\theta}\right)^{\frac{1}{1-\theta}}=Q_{t,i}\left(\sum_{j=1,j\neq i}^{N}\left(\frac{p_t(j)}{Q_{t,j}}\right)^{1-\theta}\right)^{\frac{1}{1-\theta}}$$

Since $p_t(j)$ is determined by world demand and world supply, inflation in a given country, as it is measured as the change in consumption based price index P, will be affected

mainly by the bilateral exchange rate movements between country j and other countries. There will be a common inflation rate for the whole currency union, moreover, the greater the union, the more immune it is to nominal exchange rate fluctuations between the union and other countries. One might object to this by viewing currency union as a fixed exchange rate target zone and claim that the convergence and the fixed exchange rate phases come with high adjustment costs and exchange rate risk is inevitably great.

For purposes for this current chapter, I am not looking at the phases where a currency union is constructed. A significant amount of convergence (at least in inflation rates and exchange rate stabilization) must have occured before a country can be considered as a condidate for currency union admission, let alone being a member for a long time. Imposition of the Maastricht Criteria in European Economic and Monetary Union (EMU) can be considered as a case that support this view. Although alterations in the ways mentioned above may enhance our understanding of underlying dynamics, I prefer to leave these fruitfull issues to future research.

Woodford (2003) imposes an objective for monetary policy in Barro-Gordon fashion as follows: The monetary authority aims to minimize the expected value of discounted loss function:

$$Min_L\{E_0 \sum_{t=0}^{\infty} \beta^t L_t\}, where\ L_t = (\pi_t - \varphi\pi_{t-1})^2 + \lambda\tilde{y}_t^2$$

The loss function of the monetary authority embodies its preferences over inflation and output, which is the solution to the loss minization problem of the monetary authority.

Recalling that the production function was given in form of $y_{t,i} = \alpha x_{t,i} + \varepsilon_{t,i}$, and that full employment requires $X_{t,i} = 1$,so that $x_{t,i} = 0$, and $\varepsilon_{t,i} = 0$ (no productivity

shocks), it implies that $y_i^* = 0 \; for \; all \; i$. The specification of monetary objective function as given above takes the same full employment level (namely zero) for all countries, and hence deviation from the full employment in each period will be exactly equal to the current term's output. This is a result of the specifications I made in supply side (in line with Bayoumi (1994). Woodford (2003, p.563) provides a more convinient form of target criterion for the monetary authority by manipulating the above objective function:

$$(\pi_t - \varphi\pi_{t-1}) + \lambda\,(y_t - y_{t-1}) = 0, \;\; \lambda > 0$$

Inflation target criterion is useful for analyzing currency union monetary policy, because the primary empirical interest of this model lies in the Eurozone, where the European Central Bank strictly implements (implicit) inflation targeting.

The presence of inflation lag is useful for justification of high inflation projection for the current period, if inflation has been high in the previous period. I will assume that $0 < \varphi < 1$. It is important to note that $\varphi = 1$ leaves no room for punishing high inflation rates but it only counts for changes in the inflation rate. Full indexation of inertia ($\varphi = 1$) would not necessarily mean a permanent shift in inflation due to a disturbance (Woodford, 2003), but empirical testing of the hybrid version of the New Keynesian Phillips Curve gives results different than one for inertia coefficient (Gali and Gertler, 1999).

Transforming equation (IV.1) such that $\log X_{t,i} = x_{t,i} \quad and \quad A = \frac{1}{\delta}\left(\frac{1}{\theta} - \log\mu\right)$, the following two equations are obtained:

$$x_{t,i} = A - \frac{1}{\delta\theta}\log C_t^W + \frac{1}{\delta}\log Q_{t,i} + \frac{1}{\delta}\log C_{t,i} + \frac{2\varepsilon_{t,i}}{\delta}$$

$$\Delta y_{t,i} = y_{t,i} - y_{t-1.i} = \alpha(x_{t,i} - x_{t-1,i}) + (\varepsilon_{t,i} - \varepsilon_{t-1,i})$$

Substituting the first order condition for $C_{t,i}$, we obtain:

$$x_{t,i} = A - \frac{1}{\delta\theta}\log C_t^W + \frac{1}{\delta}\log Q_{t,i} - \frac{1}{\delta}\log\gamma + \frac{1}{\delta}\log m_{t,i} - \frac{1}{\delta}\log\left(\frac{1+i_{t,i}}{i_{t,i}}\right) + \frac{2\varepsilon_{t,i}}{\delta}$$

Substituting $x_{t,i}$ and $x_{t-1,i}$ as given above into

$$\Delta y_{t,i} = y_{t,i} - y_{t-1.i} = \alpha(x_{t,i} - x_{t-1,i}) + (\varepsilon_{t,i} - \varepsilon_{t-1,i})$$

the following can easily be obtained:

$$\Delta y_{t,i} = \frac{\alpha}{\delta\theta}\log\frac{C_{t-1}^W}{C_t^W} + \frac{\alpha}{\delta}\log\frac{E_{t,i}}{E_{t-1,i}} + \frac{\alpha}{\delta}\log\frac{m_{t,i}}{m_{t-1,i}} - \frac{\alpha}{\delta}\log\left(\frac{\frac{1}{i_{t,i}}+1}{\frac{1}{i_{t-1,i}}+1}\right) + \left(\frac{\delta+2\alpha}{\delta}\right)\ \Delta\varepsilon_{t,i}$$

where $\Delta\varepsilon_{t,i} = (\varepsilon_{t,i} - \varepsilon_{t-1,i})$

Since in this model, nominal exchange rate $Q_{t,i}$ gives the price of the currency union's currency in terms of country i's currency, $Q_{t,i} = 1$ for all values of t if country i is a member of the currency union. We are looking here at the targeting policy of the monetary authority of the currency union, thus $\log\frac{Q_{t,i}}{Q_{t-1,i}} = 0$.

Recall from the equilibrium of world demand and world supply,

$$C_t^W = \sum_{i=1}^{N} C_{t,i} = \sum_{i=1}^{n_1} C_{t,i} + \sum_{i=n_1+1}^{N} C_{t,i}$$

Since underlying preferences are identical, and since every member country has exactly the same bilateral nominal exchange rate to candidate countries, the real consumption

indeces for representative households within the currency union will necessarily be identical, so that:

$$C_t^W = n_1 C_t^{CU} + \sum_{i=n_1+1}^{N} C_{t,i}$$

where C_t^{CU} denotes that real consumption index in any of the member countries of the currency union.

Hence, substituting all of the above manipulations into $\Delta y_{t,i}$, it follows:

$$\Delta y_{t,i} = \frac{\alpha}{\delta} \log \frac{m_{t,i}}{m_{t-1,i}} - \frac{\alpha}{\delta} \log \left(\frac{\frac{1}{i_{t,i}} + 1}{\frac{1}{i_{t-1,i}} + 1} \right) + \frac{\alpha}{\delta\theta} \log \Omega_t + \left(\frac{\delta + 2\alpha}{\delta} \right) \Delta\varepsilon_{t,i} \qquad \text{(IV.2)}$$

where $\Omega_t = \frac{n_1 C_{t-1}^{CU} + \sum_{i=n_1+1}^{N} C_{t-1,i}}{n_1 C_t^{CU} + \sum_{i=n_1+1}^{N} C_{t,i}}$

Since countries within the currency union will have identical consumption patterns, the monetary authority of the currency union can simply take the optimal target criterion that would apply to any member country, if this given country had its own independent monetary policy. The only difference between a single country's monetary policy and that of the currency union's is, since the currency union is economically 'big', the world consumption index C^W need not be taken as exogenous. As C^W is broken down into components as shown above, the currency union's size and currency union-wide consumption actually does matter for the world consumption index.

Following the derivation of $\Delta y_{t,i}$ outlined above, I arrive at the following optimal target criterion:

$$\pi_t = \varphi\pi_{t-1} - \lambda\left(\frac{\alpha}{\delta}\log\frac{m_{t,i}}{m_{t-1,i}} - \frac{\alpha}{\delta}\log\left(\frac{\frac{1}{i_{t,i}}+1}{\frac{1}{i_{t-1,i}}+1}\right) + \frac{\alpha}{\delta\theta}\log\Omega_t + \left(\frac{\delta+2\alpha}{\delta}\right)\Delta\varepsilon_{t,i}\right), \quad \text{(IV.3)}$$

where

$$\Omega_t = \frac{\left(n_1 C_{t-1}^{CU} + \sum_{i=n_1+1}^{N} C_{t-1,i}\right)}{\left(n_1 C_t^{CU} + \sum_{i=n_1+1}^{N} C_{t,i}\right)}$$

For notational simplicity, I denote:

$$\Psi_t = \sum_{i=n_1+1}^{N} C_{t,i}, \quad \text{so that} \qquad \Omega_t = \frac{\left(n_1 C_{t-1}^{CU} + \Psi_{t-1}\right)}{\left(n_1 C_t^{CU} + \Psi_t\right)}$$

Moreover, with the Euler equation in first order conditions:

$$\Omega_t = \frac{\left(n_1 C_{t-1}^{CU} + \Psi_{t-1}\right)}{\left(n_1\beta(1+r_t)C_{t-1}^{CU} + \Psi_t\right)} \quad \text{where } r_t \text{ is the currency union-wide real interest rate.}$$

This equation will be used as a rule in determining the optimal inflation target in this chapter.

Enlargement of the Currency Union: Observations and Mechanics

As mentioned above, the currency union takes changes in C^W endogenous, and change in currency union-wide consumption or enlargement will affect C^W directly. In this case, the monetary authority of the currency union has to set its optimal target criterion accordingly. Analysing partial derivatives of Ω gives a better grasp of optimal monetary policy based on optimal target criterion within the currency union. Two important equations for this matter are, as found in the previous subsection:

$$\pi_t = \varphi\pi_{t-1} - \lambda\left(\frac{\alpha}{\delta}\log\frac{m_{t,i}}{m_{t-1,i}} - \frac{\alpha}{\delta}\log\left(\frac{\frac{1}{i_{t,i}}+1}{\frac{1}{i_{t-1,i}}+1}\right) + \frac{\alpha}{\delta\theta}\log\Omega_t + \left(\frac{\delta+2\alpha}{\delta}\right)\Delta\varepsilon_{t,i}\right), \quad \text{(IV.4)}$$

with $\Omega_t = \frac{\left(n_1 C_{t-1}^{CU} + \Psi_{t-1}\right)}{\left(n_1\beta(1+r_t)C_{t-1}^{CU} + \Psi_t\right)}$

Change in optimal target as Ω changes is given by $\frac{\partial\pi}{\partial\Omega} = -\frac{\lambda\alpha}{\delta\theta}\left(\frac{1}{\Omega}\right) > 0$ since $\delta < 0$

and all other variables are positive.

Considering enlargement of currency union, one can easily see that this process will have two facets. First, Ψ is decreasing in C_i , where i is the accession country to the currency union. This country's consumption based price index will become identical to any of the member countries of the currency union due to adoption of the common currency, and since preferences are identical, it will necessarily follow that the accession country's consumption index will become identical with C^{CU}.

Since the difference in nominal exchange rates determines the difference in price indexes and thus difference in consumption indeces, I will assume, without loss of generality that adjustment from candidate country specific consumption index to currency union members' consumption index happens immediately upon accession. (In what follows, variables without country specific indeces are currency union-wide variables).

One clarification I need to mention is, when I worked the following out for currency union members, I set $\log Q_{t,i} = 0$, so that the nominal exchange rate did not show up in the rest of the expression for an optimum target criterion.

$$x_{t,i} = A - \frac{1}{\delta\theta}\log C_t^W + \frac{1}{\delta}\log Q_{t,i} + \frac{1}{\delta}\log C_{t,i} + \frac{2\varepsilon_{t,i}}{\delta}$$

However, as I discuss the case of an accession country, one has to consider whether $\log Q_i > 0$ or $\log Q_i < 0$ prior to accession. Suppose that the accession country is at full employment with no productivity shock. Then,

$$\log C_i = \left(-A + \frac{1}{\theta}\log C^W - \log Q_i - \frac{2\varepsilon_i}{\delta}\right) \rightarrow \log C^{CU}, with \ \log Q_i = 0$$

If $\log E_i < 0$, then C_i declines and converges to C^{CU}, whereas if $\log E_i > 0$, then C_i increases and converges to C^{CU}.

There are many crutial matters which are left out of this model, moreover, some implications which could have been captured within the frames of this model might have been washed out by simplifying assumptions such as the one above. However the current framework that I use here shows that the more depreciated a country's currency is against the common currency of the union, the higher are the benefits of joining the union for this country. One possible objection could be that differences in nominal exchange rates are pure nominal matters. In this model, however, nominal exchange rates affect country specific consumption based price indeces and thus they affect consumption decisions. Nominal exchange rates in this model can be thought of embodiment of any transactions costs and rigidities that arise due to fluctuations in nominal exchange rates.

Incentives for a country to join a currency union has long been investigated, but my question is, how does $\log Q_i < 0$ or $\log Q_i > 0$ affect the optimal target criterion of the currency union?

Suppose that the accession occurs in period t . Comparing Ω_t under accession (Ω_t^A) to its "would-be" value Ω_t if no accession occured ($C_{t,i}$ follows from Euler equaion and serves as projection of country $i's$ consumption index if no accession occured):

$$\Omega_t^A - \Omega_t = \frac{\left(n_1 C_{t-1}^{CU} + \Psi_{t-1}\right)}{\left(\left(n_1+1\right) C_t^{CU} + \left(\Psi_t - C_{t,i}\right)\right)} - \frac{\left(n_1 C_{t-1}^{CU} + \Psi_{t-1}\right)}{\left(n_1 C_t^{CU} + \Psi_t\right)} \tag{IV.5}$$

Hence,

$$\Omega_t^A - \Omega_t < 0 \; if \;\; \left(C_t^{CU} - C_{t,i}\right) > 0 \; i.e. \log Q_{t,i} > 0 \tag{IV.6}$$

$$\Omega_t^A - \Omega_t > 0 \; if \; \left(C_t^{CU} - C_{t,i}\right) < 0 \; i.e. \log Q_{t,i} < 0 \tag{IV.7}$$

Recall that $\frac{\partial \pi}{\partial \Omega} > 0$, hence accession of a country with appreciated national currency versus the common currency of the union ($\log Q_{t,i} < 0$), would increase the optimal target criterion for the currency union's monetary policy. Accession of a depreciated currency country will, on the other hand, decrease the optimal target criterion.

Optimal Target Under Monetary Shocks and Productivity Shocks

Above, I have shown that an optimal target criteria is:

$$\pi_t = \varphi \pi_{t-1} - \lambda \left(\frac{\alpha}{\delta} \log \frac{m_{t,i}}{m_{t-1,i}} - \frac{\alpha}{\delta} \log \left(\frac{\frac{1}{i_{t,i}} + 1}{\frac{1}{i_{t-1,i}} + 1} \right) + \frac{\alpha}{\delta \theta} \log \Omega_t + \left(\frac{\delta + 2\alpha}{\delta} \right) \Delta \varepsilon_{t,i} \right)$$

As far as this criterion is concerned, an unanticipated expansionary monetary shock in current period necessitates an upwards revision of the inflation target and a contractionary monetary policy allows for lower target values, which is not very surprising. Interaction of monetary shocks with productivity shocks works in opposite directions as long as $\frac{\delta+2\alpha}{\delta} < 0$. If, on the other hand, $\frac{\delta+2\alpha}{\delta} > 0$, then monetary shock needs to be in the same direction as the productivity shock to cancel out its effect on optimal inflation target.

CHAPTER V

CONCLUSIONS

Interactions between the capital tax rate and the inflation rate have been investigated under two possible scenarios: First, when countries have their own currencies, namely 'monetary independence', and second, when countries form a currency union and introduce a common currency for the union.

Capital tax rates and inflation rates interact in three different ways: The capital tax rate set by the national government of a country creates a horizontal externality for the other country's national government, and this effect pushes the equilibrium level of capital tax rates in both countries down. A similar effect is present for the choice of the inflation rate associated with the domestic currency. Inflation tax competition pushes the equilibrium level of inflation rates in both countries down. However, there is a vertical externality created by the interaction of capital taxes and inflation, which may lead to higher capital tax rates in both countries.

If the two countries form a currency union, then inflation rate that prevails across the currency union will be higher than the inflation that would prevail in individual countries under monetary independence. Although inflation rate will be higher, individual countries may choose a lower or a higher capital tax rate than what they would choose under monetary independence. The decision of whether the optimal capital tax rate in a given country will increase or decrease due to creation of a currency union depends on the inflation elasticities of the demand for each country's national curren

The 'same sign problem' arises when using the 2000 Census migration data, as it has when using earlier Census migration data. Our main contribution is to demonstrate

that the same sign problem tends to diminish when migrations over very short distances are excluded from the regressions, or when only outmigration from higher per-capita income states is considered. These two methods apparently provide some correction for the heterogeneity of elderly migrants. Once corrected, the relative attractiveness of a state's bundle of public goods and taxes becomes more apparent.

Previous studies have shown that prices of location specific amenities are to some extent implicit in labor market and/or land market prices. A state or local government's tendency to additionally impose higher taxes on residents to capture those residents' willingness to pay for amenities will inevitably lead to a sort of 'double taxation' of the tax base, as is noted in 'vertical tax competition' studies. The investigation of the effects of such a 'double taxation' is necessarily our next stop.

Accession of a country with an appreciating currency would force the optimum inflation target of the currency union upwards, whereas a country with a depreciating currency will cause a downward push. Analyzing the comovement of productivity shocks and aggregation of currency union-wide productivity shocks are problems that need to be worked on more carefully.

Intiutively, accession of a country with appreciating currency might cause an upward price adjustment in other member states. This also depends on the size of the accession country, however in this model, all countries are of equal size, only size of the currency union differs from that of the accession country since the union necessarily includes more than one country. Size of the currency union will come into play upon relaxation of the simplifying assumption that the accession country is in full employment level with no productivity shock during accession..

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