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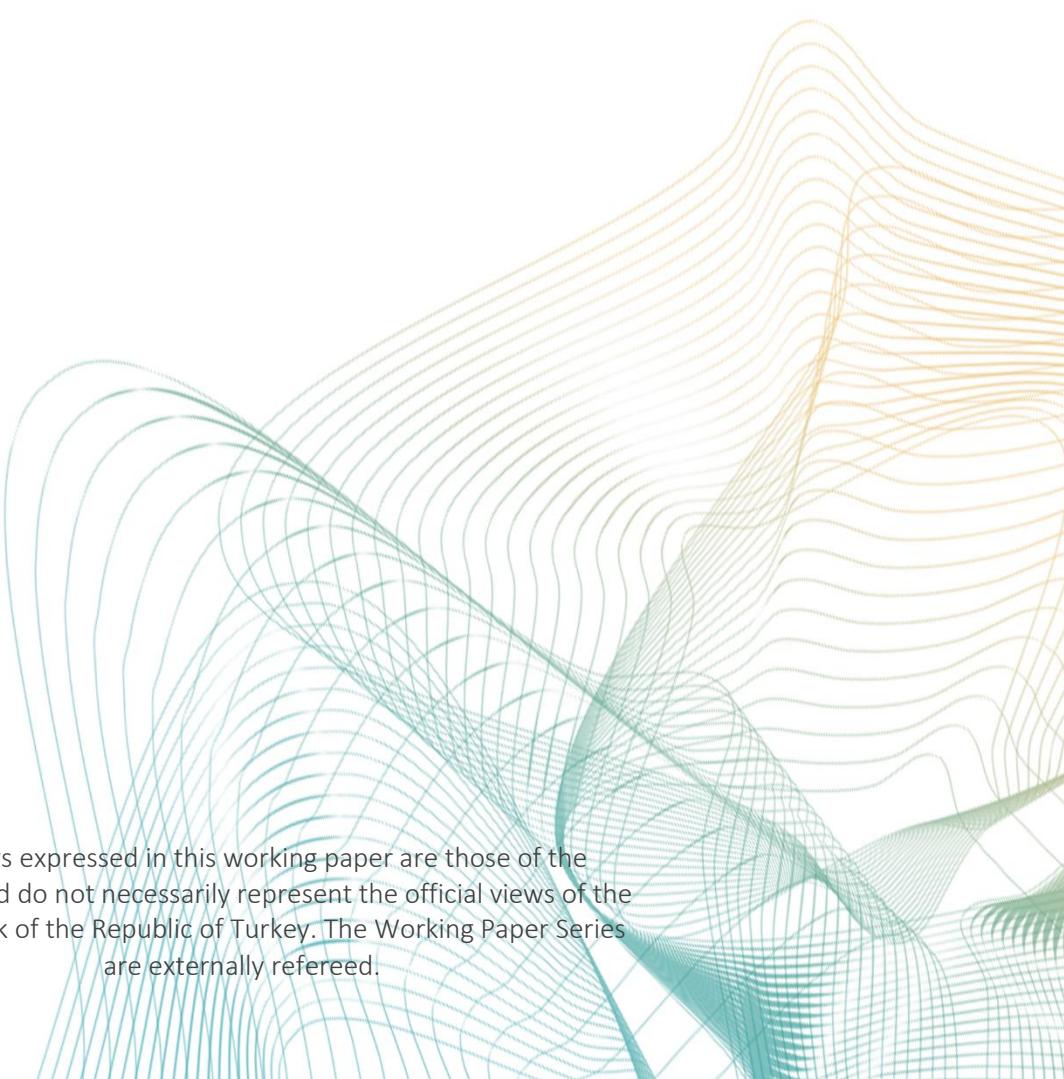
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VAT Treatment of the Financial Services: Implications for the Real Economy^{*}

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Abstract: Financial institutions are exempt from the Value-Added Tax in most countries. We develop a general equilibrium model with endogenous firm entry and a banking sector to accommodate three key distortions related to exempt treatment: (i) self-supply bias in the banking sector, (ii) under-taxation of payment services, and (iii) input distortions in the business sector and tax cascading. We calibrate our model to the average of Germany, France and the U.K data. Our results show that repealing exempt treatment always increases tax revenues. However, welfare gains occur only at low VAT rates due to the hump-shaped VAT Laffer curve.

Keywords: VAT, Financial Services, Exempt Treatment, Laffer Curve, Heterogeneous Firms

JEL Codes: G20, H21, H24, H25, H30

Özet: Finansal kurumlar çoğu ülkede Katma Değer Vergisi'nden muافتir. Endojen firma girişi ve bankacılık sektörünün de eklendiği detaylı bir genel denge modeli ile bu muafiyetin reel ekonomiye olan üç temel etkisi analiz edilmiştir: (i) bankacılık sektöründe öz-arz yanılılığı, (ii) (hanehalkına yönelik) finansal hizmetlerin olması gereğinden daha düşük oranlarda vergilendirilmesi ve (iii) reel sektör girdi maliyetleri üzerindeki baskı ve bu baskının, fiyat mekanizması üzerinden, tüm ekonomiye yayılması. Modelimizi Almanya, Fransa ve İngiltere verilerinin ortalamasına kalibre ediyoruz. Sonuçlarımız, muafiyeti ortadan kaldırmanın vergi gelirlerini artırdığını göstermektedir. Bununla birlikte, refah kazançları, kambur biçimli KDV Laffer eğrisi nedeniyle, sadece düşük KDV oranlarında gerçekleşmektedir.

Keywords: KDV, Finansal Hizmetler, KDV Muafiyeti, Laffer Eğrisi, Heterojen Firmalar

JEL Codes: G20, H21, H24, H25, H30

Non-Technical Summary

Under a regular Value Added Tax (VAT) system, VAT registered businesses should effectively pay zero tax. According to this system, a VAT registered business entity pay VAT (VAT deductible) on its input purchases and collects VAT (VAT payable) from its sales. At the end of the fiscal term, this business sends the difference (VAT payable - VAT deductible) to government if the difference is positive or receives a tax return from the government if the difference is negative. In contrast to this regular practice, financial institutions are treated differently under VAT in most countries due to technical difficulties in implementation. Different than regular businesses, financial institutions are exempt from VAT. This means that they pay VAT on their input purchases (e.g., IT services) but are not allowed to charge VAT on most of their supplies, especially the margin-base transactions such as loans. Nor they receive any compensation from the government for the unrecoverable VAT. Although it was designed as a consumption tax, the VAT becomes an input tax for financial institutions under the exempt-treatment policy. That increases the cost of intermediation and thus, the price of financial services, which creates several distortions for the real economy. The aim of this paper is to theoretically model these distortions in a general equilibrium framework and quantify their impact on overall welfare and total tax revenue.

The theoretical model accounts for three main distortions, which received the most attention in the related literature. The first one is the so called self-supply bias, where the banks favor producing more inputs (e.g., IT services) in-house to avoid paying VAT, when they outsource. This may distort the economy in many ways but in the simplest form, self-producing/supplying more inputs may render

bank to produce goods and services that the banks are not specialized at. Secondly, the irrecoverable VAT due to exemption will eventually be embedded in to the cost of intermediation, which will increase the price of financial services. Depending on the type of customer of these financial services, we would expect different effects. If it is a regular (VAT registered) business, receiving loans from banks, it will face with a higher interest rate, which does not only contain cost of funds, intermediation cost and risk premium but also the embedded VAT. As a result, businesses will reflect this additional cost on their prices that will cascade through the entire economy. If the bank customer is actually a final consumer, who supposedly should bear the full burden of VAT, s/he would pay only the embedded VAT rather than the full VAT. This is to say that final consumers pay less VAT (or under-taxed) under the so called exempt treatment policy. As a result, final consumers may actually over consume financial services than the naturally optimal level. After modeling these three main distortions, we also account for an important fact in the model that is the effect of exempt treatment would create only a marginal increase in the price of financial services to businesses. This marginal increase may only affect the firms, which operate on tight profit margins. We introduce this in to the model by endogenous entry and exit.

The main parameters of the model are matched to the average of the data from three major EU countries, namely Germany, France and the United Kingdom. We then analyze the numerical impact of the exempt treatment on total tax revenues and overall welfare. We find that repelling exempt treatment (and moving towards a full VAT system, where financial institutions effectively pay zero VAT) abolishes the above mentioned distortions: financial services are now cheaper to firms and

slightly more expensive to consumers, and there is no more incentive for banks to self-supply bias. In net, we always observe an increase in total tax revenues. However, welfare gains only occur at relatively low VAT rates due to the existence of hump-shaped VAT Laffer curve. These findings provide vital policy lessons for policymakers. In general, along a reasonable range of VAT rates, e.g., below the current average EU VAT rate of 17 %, repealing exempt treatment is welfare improving and tax revenue increasing. However, countries with higher VAT rates should apply a reduced VAT rate to financial services before repealing exempt treatment to achieve both improvements in tax revenues and welfare.

1 Introduction

Value-added tax (VAT) treatment of financial services has been one of the most vexing issues in public finance for decades due to technical difficulties in implementation. Most financial and insurance services are exempt from VAT in many countries with a VAT system.¹ Under this treatment, financial institutions do not charge VAT on their sales and likewise, do not receive input credits for the VAT paid on many of their inputs. As such, the irrecoverable VAT is embedded in the price of exempt financial services, which creates several distortions in the economy. Three key distortions, in particular, have received most of the attention in the literature: (i) under-taxation of financial services to consumers; (ii) self-supply bias in the financial sector; and (iii) tax cascading in the real sector.² The aim of this paper is to model these distortions in a general equilibrium framework and quantify their impact on welfare and total tax revenue. Our results show that exempt treatment is the most distortionary policy among alternatives, e.g., full taxation and zero-rating, creating significant welfare and tax revenue losses.³ Moving away from exempt treatment towards a full VAT system always increases total tax revenues. However, due to the existence of a VAT Laffer curve, repealing exempt treatment brings positive welfare effects only up to the peak point of the Laffer curve. After crossing this peak point, all the positive welfare effects reverse sign.

We develop a representative household model with endogenous firm entry and

¹For a cross-country policy discussion, see Gendron et al. (2007) and Schenk (2009).

²Another distortion that results from the exempt treatment of the financial sector is import bias, which is an impediment to international competitiveness. Chisari et al. (2016) provides a discussion on the impact of exempt treatment in an open economy framework. For further discussion, see Firth and McKenzie (2012).

³Full taxation is the way non-financial corporations are currently taxed under VAT and under zero-rating policy, the government compensates financial institutions for the irrecoverable VAT.

a financial sector. The financial sector is composed of banks that provide payment services to a representative household and loan services to producers. The banks hire labor and purchase inputs that are subject to input VAT. Unlike firms in the production sector, banks can only partially recover the input VAT. This treatment creates incentives for banks to self-produce their inputs in order to avoid the VAT burden. Moreover, the uncovered VAT increases the marginal cost of financial services that is naturally shifted on the price of financial services, which creates asymmetric distortions depending on nature (e.g. VAT registration status) of the banks customers. For instance, firms in the production sector face higher cost for loans inclusive of hidden VAT and thereof, charge higher prices for their output, which results in tax cascading. This is to say that under the exempt treatment, banks shift the irrecoverable VAT onto firms (i.e. bank-to-business (B2B) transactions are over-taxed) and similarly, firms do the same through the price of their outputs. Thus, the hidden VAT circulates through the economy. On the contrary, the representative household is under-taxed under the exempt treatment, where she pays only the hidden VAT instead of a full VAT applied on the top of the price of financial services (i.e. bank-to-consumer, B2C, transactions are under-taxed). In modeling these decisions, we introduce a VAT recovery rate into the banks' cost minimization problem and derive the price of financial services in terms of the VAT recovery rate. We then use this tool to analyze the impact of different VAT policies on the economy.

A more distinctive feature of our model is firm heterogeneity and endogenous entry. While existing studies focus on the overall effects of a change in the tax policy regime, we are able to study the firm-level effects of such a policy change alongside intensive and extensive margins. This is especially important for evaluating the

effects of a VAT policy change on different type of firms. For instance, small and medium sized enterprises (SMEs) mostly finance their investments through bank loans, whereas large firms usually have better access to other means of finance, e.g. money and capital markets.⁴ This observation suggests that a decrease in the cost of finance due to switching from exempt treatment to full taxation enables the marginal firms to enter the market and may potentially improve welfare. We model endogenous firm entry by extending the framework of Hopenhayn and Rogerson (1993) and Atkeson and Kehoe (2005). Although we extend the model in several dimensions, the model remains fairly tractable.

Our model also allows the representative household to allocate her labor between market and home production in a similar fashion to Benhabib et al. (1991). This feature brings more flexibility to the households decisions, where she can shift between market good and home-produced good consumption in response to a change in the price of market goods. Shifting towards consuming home-produced goods implies supplying less labor to the market and doing more home production. This flexibility creates a direct link between consumption and labor supply decisions, which generates a single peaked VAT Laffer curve. The Laffer curve provides a useful tool to discuss how fast the VAT tax base can shrink in the presence of aforementioned distortions.

We calibrate our model to match the salient features of the tax system in three major European Union (EU) countries, namely United Kingdom, France and Germany. Using our calibrated model, we provide a detailed discussion on the change in welfare and tax revenues in response to a VAT policy shift from exempt treatment

⁴See Denis and Mihov (2003) on bond issue and firms size, and Houston and James (1996) and Johnson (1997) on bank loans concentrating among small firms in the U.S.

to full taxation and zero-rating policies. We repeat our analysis for different VAT rates given the large spectrum of VAT rates prevailing in different EU countries.

Our main results show that switching the VAT regime from exempt treatment to full taxation or to zero-rating for a given level of total tax revenue brings sizable improvements in welfare. Our decomposition of the extensive and intensive margin effects indicates that endogenous entry amplifies these welfare gains. We also find that interaction between VAT, and labor and capital taxes magnifies the distortions given that labor and capital tax revenues decline sharply with the VAT rate. However, the Laffer curve shows that the VAT tax base shrinks as the VAT rate increases and after the peak point of the Laffer curve, the positive welfare effects generated from repealing exempt treatment reverse sign. Repeating the same exercise but now for a given level of welfare shows a moderate increase in total tax revenues on either side of the Laffer curve. The overall policy message of our results is that policy-makers should consider repealing exempt treatment of financial services for better alternatives such as full taxation or zero-rating unless the prevailing VAT rate is considerably high, where they may be better off staying with the exempt treatment regime or switching to another regime only after reducing the VAT rate.

Our conclusion is important to explain an unsettled debate in the literature on the net effects of exempt treatment. While a number of papers, e.g. Buettner and Erbe (2014), EU Commission (2010), and Huizinga (2002), Genser and Winker (1997), find that repealing exempt treatment is welfare improving and/or tax revenue increasing, there are also opposing evidence, e.g. PricewaterhouseCoopers (2011), and De la Feria and Lockwood (2010). One explanation that our paper brings to the literature is that the welfare impact may actually depend on the VAT

rate. This is to say that exempt treatment may actually generate higher welfare than alternative regimes at higher VAT rates.

The paper is organized as follows. The next section describes our model. We characterize and discuss the equilibrium in Section 3. Section 4 calibrates the model and Section 5 provides the results from our policy analysis. The last section concludes.

2 The Model

2.1 Overview

The model is set up in discrete time. There are four agents in the model: producers, banks, a representative household, and the government. The role of the government is to collect taxes and transfer the receipts to the household in a lump-sum fashion. The representative household maximizes expected lifetime utility with a discount factor of β . She elastically supplies labor and can choose to engage in home production.

There is a continuum of perfectly competitive firms which produce a consumption good. The production technology in this sector uses both labor and capital. Firms are heterogeneous with respect to their productivity and there is endogenous entry into the market. The capital market is facilitated by banks which accept deposits from households and issue loans to the consumption good producers. In addition to loan services, banks also provide payment services to the households for their consumption good purchases.

Different from the consumption good, there is also a homogeneous capital good

produced in a competitive market using only labor. Henceforth, we use homogeneous good and capital good interchangeably. A distinctive feature of the banking activities is that banks hire labor and purchase inputs from the homogenous good market to produce banking services.⁵ These purchases of the banks are subject to VAT, while some of these financial services are VAT exempt.

2.2 The Representative Household

The representative household has one unit of time which she can supply as labor in the market, n , use it to produce a home production, n_h , or enjoy as leisure, l . We choose labor to be the numéraire and normalize the wage rate to one, which is subject to an income tax at the rate of t_w . n_h units of labor can be turned into $z_h n_h$ units of home produced good, which neither can be sold in the market nor can be stored for future consumption.

Although she cannot store the home produced good, she can smooth consumption of the market (consumption) good, c , by adjusting her wealth, k , measured in terms of the capital good. We assume that the production of one unit of the capital good requires one unit of labor. This production technology implies that the price of the capital good is also one. All savings are deposited at the banks for a risk free rate of return, r , which are then loaned to the producers. The return to capital, net of depreciation, ϕ , is subject to a tax at t_k .

The consumption good is sold at price p and is subject to VAT at the rate of τ . We assume that λ fraction of the consumption good purchases are made through

⁵This can be thought as the banks purchasing consulting services, e.g. IT consulting, directly from households instead of producing these services within the bank.

payment services produced by banks.⁶ The price paid on payment services is \bar{f}_s , which includes VAT charged by the bank for its services. Finally, lump-sum transfers, lst , consist of profits from the consumption goods sector and the total tax revenue. We explain them in more detail in the subsequent sections.

Using prime ('') to denote next period variables, the representative household's problem can be written recursively as follows:

$$v(k) = \max_{c, c_h, n, n_h, l, k'} U(c, c_h, l) + \beta v(k'),$$

subject to the budget constraint:

$$(1 + \lambda \bar{f}_s)(1 + \tau)pc + k' = (1 - t_w)n + (1 - t_k)(r - \phi)k + k + lst \quad (1)$$

The household is also constrained by time and home production technology:

$$l + n_h + n = 1 \quad (2)$$

$$c_h = z_h n_h \quad (3)$$

We assume that the utility function takes the same form as in Benhabib et al. (1991):

$$U(c, c_h, l) = \frac{(\tilde{c}^b l^{1-b})^{1-\eta} - 1}{1 - \eta}, \quad \text{where} \quad \tilde{c} = (\kappa c^{\frac{\psi-1}{\psi}} + (1 - \kappa)c_h^{\frac{\psi-1}{\psi}})^{\frac{\psi}{\psi-1}}. \quad (4)$$

⁶Lockwood (2014) endogenizes λ by inserting the disutility due to not using bank services in a similar framework, developed by Auerbach and Gordon (2002) and Atkeson et al. (1999). Kleven et al. (2000) and Kleven (2004) provide an alternative approach to modeling payment services with household production. For tractability, we treat the intensity of payment services as exogenous.

Benhabib et al. (1991) explains the properties of this utility under several parameter values. In particular, when $\eta \rightarrow 1$ and $\psi \rightarrow 1$, we can explicitly solve for optimal c_h , and substitute it out from the utility function. In this case, the utility function reduces to the canonical log-log form. Trabandt and Uhlig (2011) shows that, under this specification, the implied Laffer curve associated with VAT is everywhere upward sloping. When $\psi \rightarrow +\infty$, home produced good and market good become perfect substitutes. Benhabib et al. (1991) show that there is no wealth effect on leisure decision under this specification. An increase in the VAT rate, therefore, discourages market activity, and when this is not accompanied by a strong wealth effect, the total tax revenue may fall with the tax rate. This result is important for the existence of a single peaked VAT Laffer curve. In principle, we could obtain a single peaked Laffer curve with any utility function that lessens the income effect on leisure.⁷ However, home production provides a micro-foundation and disciplines our parameters choices in the numerical analysis part.

We focus on the steady state equilibrium. The first order condition for k' along with the envelope condition implies that the steady state value of the real return on savings, r , is:

$$r = \frac{1 - \beta}{\beta(1 - t_k)} + \phi. \quad (5)$$

Furthermore, the first order conditions can be rearranged to obtain the optimal home

⁷In an earlier version of our paper, we adopted a utility function as in Greenwood et al. (1988) with no home production and qualitatively obtained the same results.

production in terms of the consumption of the market good as follows:

$$c_h = \left(\frac{(1-\kappa)z_h(1+\lambda\bar{f}_s)(1+\tau)p}{\kappa(1-t_w)} \right)^{\psi} c. \quad (6)$$

Similarly, we can obtain labor supply in the competitive market in terms of c and c_h as follows:

$$n = 1 - \frac{c_h}{z_h b} - \frac{(1-b)(1+\lambda\bar{f}_s)(1+\tau)pc}{b(1-t_w)}. \quad (7)$$

2.3 Banking Sector

Banks produce two streams of services in a perfectly competitive environment: loan services for firms and payment services for consumption good purchases. We assume that there are no economies of scope in the production of loan and payment services, and each stream operates independently.

In practice, along with their own resources, banks also purchase inputs which are mostly subject to VAT. There is a wide variation of policy practices across countries, but in most instances many of the so-called “arranging for” input services (e.g., IT services, payroll services, credit background checks, market research), materials and equipments (e.g., computers) purchases of financial institutions are subject to taxation under the VAT. If a financial institution in turn provides an exempt service that is produced using the inputs purchased from outside, it is not able to recover the resulting VAT, which is then embedded in the price of this service.

We model the banking services in the next two subsections in line with these observations. To capture the essence of the taxation of financial services in practice,

we assume banks employ labor and use the homogeneous good as input in the production of financial services. Purchases of the homogeneous good are subject to VAT, but banks can only partially recover the VAT paid on these inputs.

2.3.1 Loan Services

Banks incur monitoring and administrative costs to extend a loan to a consumption good producer. To produce m units of loan services, banks use labor, n_m , and the homogenous good as input, y_m , according to a Cobb-Douglas production function:

$$m = A_m n_m^{1-\zeta} y_m^\zeta \quad (8)$$

Unlike capital, banks exhaust the homogeneous input good completely in the production process. We also assume that labor can freely move between the consumption good producers and banks and are paid at the same rate regardless of the sector they are employed in. This latter assumption implies that the prices of both bank inputs (i.e. labor and capital good) are the same except the purchases of y_m are subject to a VAT at the rate of τ . Therefore, by using its own resources, a bank can avoid paying VAT on its inputs and this property of the production function allows us to examine the effects of changes in the tax policy on the resource allocation in the banking sector.

When extending financial services to consumption good producers, the banks can charge VAT on ρ_m fraction of their services and thus, they can only recover this portion of the input VAT paid on y_m used in the production of these services. However, the banks cannot charge VAT on $(1 - \rho_m)$ fraction of their services (i.e.

exempt services) and thus, cannot recover the input VAT paid on y_m used in the production of these exempt services. In short, ρ_m is a policy tool in the tax system and determined by the government.⁸ Accordingly, we can write the cost minimization problem for producing one unit of loan services as follows:

$$C_m(n_m, y_m) = \min_{n_m, y_m} \rho_m(n_m + y_m) + (1 - \rho_m)(n_m + (1 + \tau)y_m) \quad (9)$$

subject to (8) with $m = 1$. Note that, for the part of the financial services that are exempt, the effective cost to the bank is $(1 + \tau)$.

The unit cost of loan services, f_m , can be calculated as:

$$f_m = C_m(n_m^*, y_m^*) = \frac{R_m^\zeta}{A_m Z}, \quad (10)$$

where $R_m = \rho_m + (1 - \rho_m)(1 + \tau)$ and $Z = \zeta^\zeta(1 - \zeta)^{1-\zeta}$. Furthermore, a bank must produce $(1 + aM)$ units of monitoring and administrative services to issue a loan of size M . The constant term, which we normalize to one, captures the fixed costs associated with the loan services. In practice, these fixed costs might include any paper work or a standard procedure in evaluating the loan application. The second term captures the variable cost of the loan services extended. The variable costs might be associated with following up for the timely payments from the clients or additional monitoring activities to reveal more information about the default risk of the borrower. In our model, banks charge the fixed component, f_m , as a one time

⁸See the UK HM Revenue and Customs page for an illustration of how the VAT exemption for the banking sector is calculated in practice (Link: <https://www.gov.uk/government/publications/vat-notice-706-partial-exemption/vat-notice-706-partial-exemption#how-to-calculate-how-much-input-tax-you-can-recover>).

payment, which we refer to as loan application fee, and the variable cost part, af_m , is embedded into the loan interest rate.⁹

Next, we specify the loan interest rate, r_m . Consumption good producers are subject to a uniform exogenous default risk, δ . Without loss of generality, we assume that the principle amounts of loans are fully collateralized, i.e., defaulting firms exit the market and return the loan principal, but are unable to pay the loan interest. Nevertheless, banks still have to pay interest to their depositors, at the rate of r . In equilibrium, banks make zero profit. Hence, the expected return from a loan of size M is equal to zero: $((1 - \delta)r_m - r - af_m)M = 0$. After rearranging, the loan interest rate is:

$$r_m = \frac{r + af_m}{1 - \delta}. \quad (11)$$

Note also that R_m is decreasing in ρ_m . This result has two implications which are basis for the distortions we study in the policy analysis below. First, input demand ratio implies that,

$$\frac{n_m^*}{y_m^*} = \frac{1 - \zeta}{\zeta} R_m. \quad (12)$$

As ρ_m decreases, i.e. the banks can recover less of the input VAT, the banks employ more labor relative to taxable inputs. This relationship establishes one of the distortions we want to show in this paper: exempt treatment leads to “self-supply bias” in the banking sector. From the production function in equation (8), this price

⁹See Russ and Valderrama (2012) for a detailed discussion on fixed and variable costs of loan monitoring.

distortion leads to inefficiencies in the banking sector. Second, under exempt treatment (as ρ_m decreases) both the fixed (f_m) and the variable cost of loans (r_m) are higher. This implies a higher the borrowing cost to consumption good producers, which distorts the resource allocation in that sector, as well as, increases the price of their products. Overall, consumers at the end of the value chain will face a VAT inclusive price, where the VAT is applied on the producer price that already contains the embedded VAT (i.e. similar to double taxation). Through this channel, we obtain the so-called tax cascading effect in our model.

2.3.2 Payment Services

Payment services are provided to households for their purchases of consumption good. To facilitate purchase of consumption goods, the banks have to produce s units of payment services. Similar to loan services, payment services are produced using labor and inputs from the homogeneous good sector according to a Cobb-Douglas production function:

$$s = A_s n_s^{1-\gamma} y_s^\gamma \quad (13)$$

With a slight change in notation, cost minimization problem is as follows:

$$C_s(n_s, y_s) = \min_{n_s, y_s} \rho_s (n_s + y_s) + (1 - \rho_s) (n_s + (1 + \tau) y_s) \quad (14)$$

subject to (13). Unlike the loan services, there is no heterogeneity on the consumer side. As long as the number of transactions is a constant fraction of the total consumption, assuming fixed or variable cost of payment services imply the

same pricing rule for banks.¹⁰ Accordingly, we assume that s units of payment services must be produced whenever the representative household purchases one unit of consumption good and normalize s to one.

The constant marginal cost of processing any amount of consumption good purchase can be calculated as:

$$f_s = C_s(n_s^*, y_s^*) = \frac{R_s^\gamma}{A_s \Gamma}, \quad (15)$$

where $R_s = \rho_s + (1 - \rho_s)(1 + \tau)$ and $\Gamma = \gamma^\gamma(1 - \gamma)^{1-\gamma}$. Different than the constant marginal cost to the bank, the cost to the consumers, \bar{f}_s , includes VAT for the recovered part of the payment services, i.e. $f_s + \rho_s \tau(n_s + y_s)$. Combining this with the input demand functions yields:

$$\bar{f}_s = f_s \left[1 + \rho_s \tau \left(1 - \gamma + \frac{\gamma}{R_s} \right) \right]. \quad (16)$$

Note that, under full-recovery tax regime, $\rho_s = 1$, the price paid by the consumer inclusive of VAT is equal to $(1 + \tau)/(A_s \Gamma)$. Under exempt treatment, $\rho_s = 0$, the price paid by the consumer is equal to $(1 + \tau)^\gamma/(A_s \Gamma)$, which is less than the price under full-recovery, as long as $\gamma < 1$. In other words, consumers are under-taxed under exempt treatment in our model. This feature of the model captures the under-taxation of financial services to consumers and “consumption distortion” - i.e. over consumption of financial services by consumers.

In general, \bar{f}_s is increasing in ρ_s whenever $0 < \gamma < 1$. To understand the intu-

¹⁰We elaborate more on this issue in the calibration section. In practice, fixed card fees are negligible when compared to merchant service fees.

ition, it is helpful to re-write \bar{f}_s in terms of the input demand functions:

$$\bar{f}_s = (1 + \rho\tau)n_s + (1 + \tau)y_s.$$

Taking the ratio of input demand functions and using the production function for payment services, we obtain:

$$\bar{f}_s = \frac{1}{A_s\Gamma} \left((1 - \gamma)(1 + \rho_s\tau)R_s^\gamma + \gamma(1 + \tau)R_s^{\gamma-1} \right),$$

Taking the derivative of the above equation with respect to ρ_s and re-arranging, we obtain the following expression:

$$\frac{d\bar{f}_s}{d\rho_s} = \frac{1}{A_s\Gamma} (1 - \gamma)\tau R_s^\gamma \left(1 - \gamma \frac{1 + \rho_s\tau}{R_s} + \gamma \frac{1 + \tau}{R_s^2} \right) \quad (17)$$

There are three terms in parenthesis that determine the sign of this expression. The first term is equal to one and captures the direct effect of a change in ρ_s . As ρ_s increases, the total tax burden on consumers from the labor input also increases. The second and the third terms capture the relative price effect on the firm's cost minimization problem. As the recovery rate gets closer to one, banks can recover a larger portion of the VAT paid on taxable inputs. Cost minimization requires banks to use relatively less labor input and more taxable input in their production process. On one hand, the relative price effect reduces the tax burden stemming from the use of labor input that is captured by the negative sign in front of the second term. On the other hand, the relative price effect raises the tax burden on consumers stemming from the use of taxable inputs. Hence, there is a positive sign in front of the third

term above. Overall, the sign of the equation in (17) is positive, as long as $\gamma < 1$.

2.4 Consumption Good Producers

This part of the model extends the span-of-control model developed in Lucas (1978) by allowing for endogenous entry as in Hopenhayn and Rogerson (1993). Our set-up is closest to Atkeson and Kehoe (2005).¹¹ Firms are heterogeneous with respect to their productivity and each firm, indexed by the subscript i , produces one (homogenous) consumption good according to a Cobb-Douglas production function:

$$y_i = \varphi_i^{1-\sigma} (n_i^\alpha k_i^{1-\alpha})^\sigma, \quad (18)$$

where $0 < \sigma < 1$ governs the entrepreneurial contribution to the firm's output. φ_i is drawn after paying a (real) fixed entry cost, f_e , from a fixed distribution with cumulative distribution function (c.d.f.) $H(\varphi)$ defined over $[\varphi_{min}, \varphi_{max}]$. φ_i remains the same until the firm is exogeneously destroyed with the probability δ .

To characterize the firm's optimal decision, we first derive the unit marginal cost of production (from the firm's cost minimization) problem as follows:

$$MC(y_i) = \frac{r_m^{1-\alpha}}{\sigma B} \left(\frac{y_i}{\varphi_i} \right)^{\frac{1-\sigma}{\sigma}}, \quad \text{where } B = \alpha^\alpha (1 - \alpha)^{1-\alpha}. \quad (19)$$

Firms choose to produce y_i such that $MC(y_i) = p$, which can be calculated from

¹¹A monopolistic competition framework with constant returns to scale and endogenous entry, as in Melitz (2003), would provide a similar setup. Nonetheless, the market equilibrium would be distorted not only by the tax system, but also due to the monopolistic competition. We are able to focus on the distortions due to the tax system by excluding inefficiencies resulting from the market structure. It should be noted that our qualitative results don't change even with monopolistic competition.

equation (19). Equation (19) implies that firms with identical productivity produce the same amount. Hence, we write optimal output as a function of productivity, $y(\varphi)$, and drop the subscript i in the subsequent sections. Note also that the loan application fee makes some of the firms non-profitable. Accordingly, a firm produces if and only if optimal $y(\varphi)$ yields non-negative profits. We can also show that, after paying the factors of production, the firm retains $(1 - \sigma)$ fraction of the revenues. Hence, profits in the current period can be compactly written as follows:

$$\pi(\varphi) = \max\{0, (1 - \sigma)py(\varphi) - f_m\} \quad (20)$$

The last term is the loan application fee paid to the banks as capital financing cost.¹²

2.5 Equilibrium

To close the model, we impose a free entry condition (FE): the expected discounted value of a potential entrant firm, net of entry fixed cost, is equal to zero, i.e.,

$$\int_{\varphi_{min}}^{\varphi_{max}} \frac{\pi(\varphi)}{1 - \beta(1 - \delta)} dH(\varphi) = f_e. \quad (21)$$

where integration is over the domain of φ .

Assuming that f_m is sufficiently large, profits are negative for some of the low productive firms. Hence, there exists a reservation productivity, φ^* , such that, in equilibrium, only firms with $\varphi \geq \varphi^*$ produce. We solve for the equilibrium value of φ^* in the next section using this reservation productivity property and the free entry

¹²Without loss of generality, we assume that the loan application fee internally financed and there is no interest charge on this component.

condition. Free entry condition also implies that there is a constant mass of firms, g , that is endogenously determined in equilibrium. In particular, the stationary condition requires that the mass of successful entrants are equal to the mass of exiting firms: $(1 - H(\varphi^*))g_e = \delta g$.

Together with market clearing conditions, we are now in a position to characterize steady state equilibrium.

3 Characterization of Equilibrium

3.1 Equilibrium Reservation Productivity

The existence of a reservation productivity has two implications. First, the discounted value of a firm is $\pi(\varphi)/(1 - \beta(1 - \delta))$, if $\varphi \geq \varphi^*$ and zero otherwise. Hence, the expected discounted value of a potential entrant is the product of the probability of successful entry, $1 - H(\varphi^*)$, and the average discounted value of successful firms:

$$\bar{\pi} = \int_{\varphi^*}^{\varphi_{max}} \frac{\pi(\varphi)}{1 - \beta(1 - \delta)} dH(\varphi | \varphi \geq \varphi^*). \quad (22)$$

Then, the free entry condition (FE) implies the following condition on $\bar{\pi}$:

$$\bar{\pi} = \frac{(1 - \beta(1 - \delta))f_e}{(1 - H(\varphi^*))} \quad (23)$$

Second, operating profits of a firm with reservation productivity makes zero profit: $\pi(\varphi^*) = 0$. This zero profit condition (ZP) implies that the revenue for this firm is

$$py(\varphi^*) = \frac{f_l}{1-\sigma}.$$

Moreover, using the ratio of average ($\bar{\varphi}$) and marginal (φ^*) productivity firms' revenues, we can write the average operating profits as follows:

$$\bar{\pi} = \left[\frac{\bar{\varphi}}{\varphi^*} - 1 \right] f_m, \quad (24)$$

where

$$\bar{\varphi} = \left(\int_{\varphi^*}^{\varphi_{max}} \varphi dH(\varphi | \varphi \geq \varphi^*) \right). \quad (25)$$

At this point, we assume that φ is distributed according to a Pareto distribution with c.d.f. $H(\varphi) = 1 - \varphi^{-\theta}$ defined over $[1, +\infty]$. This assumption implies the following linear relationship between φ^* and $\bar{\varphi}$:

$$\bar{\varphi} = \frac{\theta}{\theta - 1} \varphi^*. \quad (26)$$

Plugging this back into ZP equation in (24), we can write the average operating profits as:

$$\bar{\pi} = \frac{f_m}{\theta - 1}. \quad (27)$$

ZP and FE conditions together with Pareto distribution assumption on productivity deliver a closed form solution for φ^* :

$$\varphi^* = \left(\frac{f_m}{f_e(\theta - 1)(1 - \beta(1 - \delta))} \right)^{\frac{1}{\theta}} \quad (28)$$

We depict the determination of equilibrium value of φ^* in Figure (1). Note

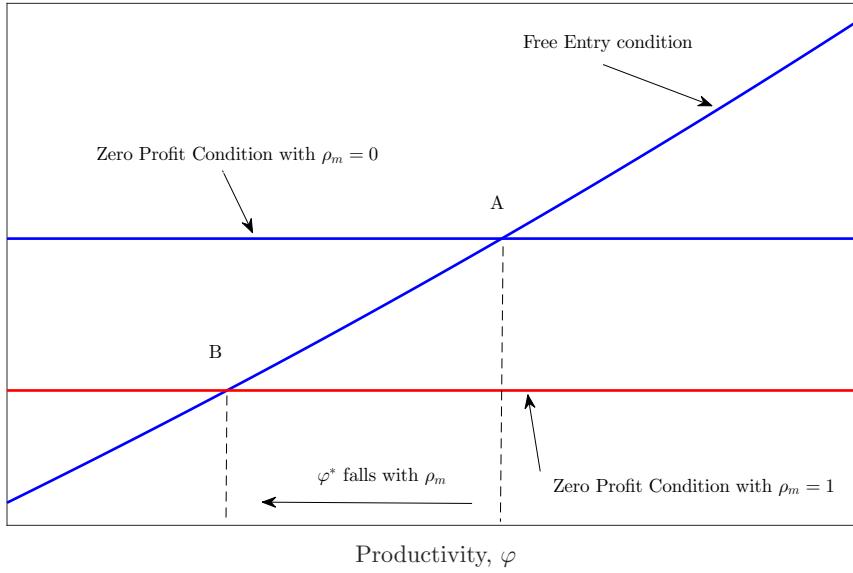


Figure 1: Determination of Productivity Threshold

that FE is always an increasing function of φ , but ZP is independent of φ^* due to the Pareto distribution assumption. Repealing exempt treatment and moving towards full taxation decreases the fixed cost of obtaining a loan, f_m , and leads to a downward shift in ZP line. This shift moves the equilibrium from point A to point B such that φ^* is lower. In other words, lower cost of capital allows low productive firms enter into the market. This effect on productivity threshold is one channel how tax policy can affect the extensive margin in the production sector. In the next section, we analyze the effect of the change in tax policy on the other equilibrium outcomes.

3.2 Aggregation and Market Clearing

Once φ^* is determined, we can obtain the market clearing price from the zero profit condition as follows:

$$p = \left(\frac{f_m}{\varphi^*(1-\sigma)} \right)^{1-\sigma} \left(\frac{r_m^{1-\alpha}}{\sigma B} \right)^\sigma \quad (29)$$

While the firm retains $(1 - \sigma)$ fraction of the total revenue, the remaining is allocated between capital and labor. Thus, the total revenues for producing firms, given φ^* , is:

$$py = (1 - \delta)g \frac{f_m \theta}{(1 - \sigma)(\theta - 1)}. \quad (30)$$

Note that y can be calculated once g is known. We calculate equilibrium value of g from the labor market clearing condition. Total demand for labor includes labor demand in the consumption good sector, banking sector, and the homogeneous good sector. The labor demand in the homogeneous good sector is equal to the investment expenditures, banking sector input, and the total fixed entry cost. The total demand for labor in the consumption good sector is:

$$n_\varphi = (1 - \delta)g \int_{\varphi^*}^{\infty} n(\varphi) dH(\varphi | \varphi \geq \varphi^*) = \alpha \sigma py \quad (31)$$

Similarly, total demand for capital is:

$$k = g \int_{\varphi^*}^{\infty} k(\varphi) dH(\varphi | \varphi \geq \varphi^*) = \frac{(1 - \alpha)\sigma py}{(1 - \delta)r_m}. \quad (32)$$

Total capital demand has an interpretation similar to the labor demand function in

the consumption good sector. Interpretation of the labor and capital demand functions follow straightforward Cobb-Douglas properties: α and $(1 - \alpha)$ fraction of the total revenue after profits are taken are paid to the labor and capital, respectively. At the steady state equilibrium, total investment is ϕk , and this value adds to the total labor market demand.

In the banking sector, the production of one unit of homogeneous good requires one unit of labor. Therefore, the labor demand due to loan services is the sum of these factors of production: $(n_m + y_m)(g + ak)$. Similarly, the labor demand due to payment services is $(n_s + y_s)\lambda(1 + \tau)py$. Note that we already used the goods market clearing condition here: $c = y$. Finally, total entry cost incurred is equal to $gefe$.

Setting equation (7) from consumer's problem equal to total labor demand gives us the mass of the firms in the equilibrium. Inspection of the total labor demand reveals that both the labor demand and labor supply is linear in g , the labor demand is increasing in g , but the labor supply is decreasing in g . We can write the labor market equilibrium in a compact form as follows:

$$N^s = N^d \rightarrow 1 - c_1(f_m, f_s)g = c_2(f_m, f_s)g, \quad (33)$$

where c_1 and c_2 are functions of f_m and f_s . Note that c_1 is increasing both in f_m and f_s , while c_2 is increasing in f_m but decreasing in f_s .

We plotted the labor market equilibrium in Figure 2. Note that the equilibrium is stable. When $g < g^*$, labor supply is greater than labor demand and new firms enter to close the gap. Conversely, when $g > g^*$, labor demand exceeds labor supply

and firms exit to bring the market to the equilibrium.

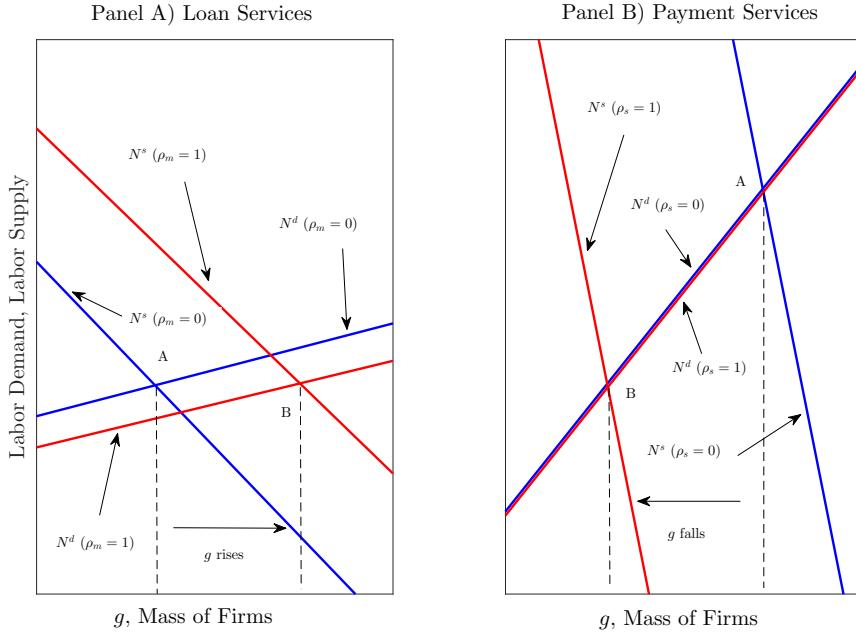


Figure 2: Equilibrium Mass of Firms after Switching from Exempt Treatment ($\rho_{m,s} = 0$) to Full Taxation ($\rho_{m,s} = 1$)

We can analyze the effects of a tax regime change in the banking sector on the mass of firms. For example, switching from exempt treatment to full taxation in the loan services lowers f_m , which in turn decreases the labor demand and increases the labor supply for a given g . As a result, equilibrium g increases. We show the effect of this policy change in panel A of Figure 2. Recall that, a decrease in f_m lower the productivity threshold. Hence, the total effect on the extensive margin of switching to full taxation in loan services is always positive.

A similar tax regime switch in the payment services has no effect on productivity threshold, but decreases both the labor demand and supply. We show the effect of this policy change in panel B of Figure 2. In the figure, there is a smaller number

of firms at the new equilibrium, but, in general, the effect on equilibrium g is ambiguous and depends on the elasticity of labor supply.¹³ Recall that consumers are under-taxed under exempt treatment and switching to full taxation increases the tax paid by the consumers. In response to the increased tax burden on consumption, the representative consumer substitutes from consumption to leisure and home production. The decrease in labor supply has a negative impact on the mass of firms in equilibrium.

It is of our interest to know the magnitude of these effects on tax revenue and consumer welfare and their interaction with the other tax policy instruments. In the next section, we quantify these effects using a calibrated version of the model.

4 Calibration

Table 1 shows the calibrated parameter values. We set a period to be one year and the discount factor, β , equal to 0.960, which implies an annual interest of 4.2%. We choose the parameters related to production and consumer preferences in line with the literature. Following the Real Business Cycle (RBC) literature, we set the physical capital depreciation rate, ϕ , equal to 0.1. Due to the existence of homogeneous good sector, the labor share of production in the consumption good sector is different than the curvature parameter of the production function, α . Using plant-level data, Cooper et al. (2015) estimate $\alpha = 0.64$ and we use this value in our calibration. This value implies that the share of labor in total production is around

¹³In the extreme case where labor supply is inelastic, g would increase in equilibrium.

70%, which is consistent with the estimates in Gomme and Rupert (2007).¹⁴ As in Atkeson and Kehoe (2005), we set the value of the span-of-control parameter, σ , equal to 0.85. Note that firm size is proportional to φ and, therefore, is also Pareto distributed with the shape parameter θ . We set $\theta = 1.059$, which is the point estimate in Axtell (2001).

Table 1: Calibrated Model Parameters

Parameter	Target/Source	Value
Production and Consumer Preferences		
β :	Discount factor	Annual interest rate of 4.2 percent
α :	Labor share (consumption)	Cooper et al. (2015)
ϕ :	Depreciation rate	RBC literature
σ :	Span-of-control parameter	Atkeson and Kehoe (2005)
θ :	Pareto distribution shape parameter	Axtell (2001)
ψ :	Elas. of subs. (home vs. market)	Benhabib et al. (1991)
Tax System		
τ :	VAT rate	Trabandt and Uhlig (2011)
t_w :	Payroll tax rate	Trabandt and Uhlig (2011)
t_k :	Capital income tax rate	Trabandt and Uhlig (2011)
ρ_m, ρ_s :	VAT recovery rate	De la Feria and Lockwood (2010)
Banking Sector		
δ :	Default probability	Succurro (2017)
ζ, γ :	Input Share (loan & payment services)	PricewaterhouseCoopers (2011)
λ :	Share of pc using payment services	Bagnall et al. (2014)
Calibrated Parameters		
b :	Elas. of subs. (leisure vs. consumption)	$N = 0.200$
κ :	Preferences over market good	$h_m = 0.178$
z_h :	Productivity (home production)	c_h relative to total output: 0.250
a :	Variable cost loan services	Interest rate spread: 2.2 percent
A_s :	Productivity (payment services)	Merchant service fee: 1.5 percent
A_m :	Productivity (loan services)	Survival probability, $\varphi^{*-θ} = 0.8$
f_e :	Fixed entry cost	Avg. firm size: 13.4 employees

We set $\psi = 5$ based on the estimates reported in Benhabib et al. (1991). The

¹⁴Elsby and Michaels (2013) follows the same strategy to calibrate the curvature parameter of the production function in a model with labor market frictions.

shape of the Laffer curve is sensitive to this parameter value. While a sufficiently small value implies an increasing Laffer curve as in Trabandt and Uhlig (2011), a sufficiently large value implies a decreasing Laffer curve. Our choice for this parameter value implies a peak point in the Laffer curve at a VAT rate of around 17.2%, which is close to the average VAT rate in EU countries. In other words, the government in our calibrated model is close to the peak point of the Laffer curve with respect to the VAT rate.

Other parameters, in particular the banking sector parameters, are less documented. We choose the remaining parameters that correspond to the average of Germany, France, and the UK, where we have the most complete data. Country specific calibration and policy analysis are deferred to our online appendix.¹⁵

Trabandt and Uhlig (2011) reports the marginal tax rates for the European countries and the U.S. We use their estimate for the average of Germany, France, and the UK. Accordingly, we set the VAT rate, τ , equal to 16.3%. The payroll tax rate, t_w , and the capital income tax rate, t_k , are equal to 38.3% and 34.6%, respectively. De la Feria and Lockwood (2010), using national accounts data and input-output tables, estimate that financial institutions can recover about 21% of the VAT paid on their inputs.¹⁶ They also show that the recovery rate does not seem to change much across different EU countries.¹⁷ In the absence of separate estimates for payment and loan services, we set both ρ_m and ρ_s to 0.21.

¹⁵See: https://drive.google.com/file/d/1E8yd7i4vDkab0BlmcjrInCFcP_fFD0gD/view

¹⁶There is a wide range of estimates for the recovery of VAT paid on inputs in EU countries. Estimates based on national account data range from zero (PricewaterhouseCoopers (2011)) to 0.59 (Buettner and Erbe (2014)). Using micro-level data on 22 financial institutions in EU countries, PricewaterhouseCoopers (2006) also finds that the average recovery rate is 0.21, which is also used in EU Commission on the issue, EU Commission (2010).

¹⁷Germany stands out with high recovery rates at 59% in Buettner and Erbe (2014).

Succurro (2017) provides direct estimates of firm default probability using micro-level data for a selected number of EU countries. The average of her estimates for Germany, France, and the UK is 3%. Accordingly, we set loan default probability, δ , to 0.03. This figure is also close to the average of non-performing loan ratio for Germany, France, and the UK, which we calculate as 3.05% for the last five years before the financial crises.

Banks employ labor and intermediate inputs for the production of financial services in our model and all the intermediate input purchases are subject to VAT. We calibrate ζ and γ to the share of taxable inputs in total operating costs of banks. However, note that, unlike our model, some of the inputs in reality are supplied from other financial institutions that are usually VAT exempt (e.g., insurance services). We therefore utilize PricewaterhouseCoopers (2011) estimates on the share of taxable bank inputs, which exclude the VAT exempt inputs. These shares for Germany, France and the UK from 2003 to 2007 averages at 33%. We therefore set ζ and γ to 0.33.

Using cross-country dairy surveys, Bagnall et al. (2014) calculate that the share of non-cash transactions in consumer spending, which shows great cross-country variation, ranging from 27% in Austria to 60% in the US. These transactions are mediated by banks, and in most cases either by a debit or a credit card. The reported figures for Germany and France, are 41% and 44%, respectively. Unfortunately, this study excludes the UK. According to another study by Paul Hastings LLP (2018) the share of non-cash transactions in total value of transaction in 2016 are 55% and 63% respectively for the UK and the US. If we take the ratio of the share of non-cash transactions to be same between the US and the UK in both studies, the implied

share in Bagnall et al. (2014) is 53% in the UK. Overall, we use these numbers to calculate the average share of non-cash transactions for Germany, France, and the UK in Bagnall et al. (2014), and set the share of transactions that uses payment services in the model, λ , equal to 0.457.

According to a report by EU Commission (2006) on payment cards, merchant service charges also show great variation across European countries. Depending on the type of the card used in transaction (credit vs. debit), location (domestic vs. international), firm size and industry, the costs borne by the merchants are from 0.50% for a domestic debit card transaction to 3.20% for an international credit card transaction. Although merchant service charges are sizable, the cases where consumers pay a transaction fee is rare in European countries, and if a consumer ever pays a transaction fee, it is typically less than 1%. In addition, card issuance and annual fee charges are small, on average 24 Euros per credit card. Nonetheless, one would expect that sellers would reflect their share of the payment service fee on the price, at least partially.¹⁸ Based on this information, we choose the productivity parameter in payment services, A_s , to reflect the merchant service fees reported in this study. Given that debit card fees are smaller and most of the transactions use a debit card, we choose a conservative target at 1.5% and equate payment services fee in the model, \bar{f}_s , to this number. The implied value for A_s is 135.373.

There are six more parameters to be calibrated in the model: the preference parameters, b and κ ; the productivity parameter in home production, z_h ; the scale parameter and share of variable costs in loan services production, A_l and a , and the

¹⁸There is a large literature on credit card surcharges, which attempt to understand why cash price is usually different than the credit card price for the same good, see Rysman and Wright (2014) for an extensive literature review.

fixed entry cost, f_e . We calibrate these parameters simultaneously and choose our targets as follows.

For the preference parameters, we follow exactly the same calibration strategy in Benhabib et al. (1991). We choose the value of b so that in equilibrium 20% of the representative household's time is allocated to paid work. This number is the same targeted value in Trabandt and Uhlig (2011) for European Countries. Furthermore, time use data from OECD Gender Data Portal 2016 implies that total time spent at unpaid work is on average 89% of that of paid work in the three countries we study. Together with our target for paid work, this value implies that home production constitutes 17.8% of the total household time. Hence, we choose the value of κ by targeting the time spent in home production at 17.8%.¹⁹ Finally, we choose the value z_h so that the total home production is 25% of the total market output.

Recall that successful entry in this model depends on drawing a firm productivity higher than a threshold. To draw its productivity, a firm has to pay an entry cost. One interpretation of this entry cost is that a potential entrant firm incurs these costs implicitly by performing an initial investment, a pilot production, or conducting a marketing research. By doing so, the firm learns about its productivity and the productivity distribution of other firms in the market. Along these lines, we interpret the successful entry probability in the model, $\varphi^{*-θ}$, as the survival probability of an entrant firm in the first year. Using data from OECD countries for the period from 1990 to 2000, Bartelsman et al. (2005) reports that 77%, 78% and 81% of the new firms survive in their first year respectively for Germany, France and the UK.

¹⁹For the U.S., Benhabib et al. (1991) targets 33% and 28% for market work and home production, respectively. Despite the differences in absolute values, the ratio of market work to home production is comparable to our targets.

EUROSTAT provides data on firm survival rates in the first year of newborn enterprises in 2009 and 2010. Survival rates from this database for more recent years are comparable to those from Bartelsman et al. (2005).²⁰ Given the value of θ , we target $\varphi^* = 1.235$ in equilibrium so that 80% of the firms decide to produce after drawing their productivity level. Note that φ^* depends on the ratio of f_m and f_e and the value of f_m depends on A_m . For a given value of f_e , there is a unique value of A_m that achieves our targeted productivity cut-off level and we calibrate A_m to this value.

While the fixed loan application fee affects the productivity threshold, the variable cost component directly enters the loan interest rate and increases the spread between the loan and deposit interest rate, $(r_m - r)$. For a given value of default probability, which captures the risk premium in the spread, we calibrate the share of variable costs, a , so that the interest rate spread is 2.20% in the model. Our targeted value corresponds to average interest rate spread in these three European countries in the first half of 2000s and before the Great Recession.²¹

Before explaining the calibration of f_e , it is helpful to report certain equilibrium ratios implied by our calibration so far. The ratio of the total costs (both labor and taxable input) of the banking sector to total output is 3.62% in the model. For credit institutions in Germany, France, and the UK, we calculate the corresponding number to be on average 4.17% in 2006, which is close to its model counterpart. Moreover, the banking sector employs 3.60% of the total labor supply in the model. From the data, we calculate the share of the financial sector in total employment to

²⁰See Appendix Table A2.

²¹See Appendix Table A3.

be on average 5.17% for these countries in the same year.²² Given that the financial sector includes other businesses, e.g. insurance companies, our calibration implies a reasonable employment share for the banking sector alone. We also calculate the share of labor income in total output before any taxes to be 69.67%, which is also close to its data counterpart calculated as 67.43% in 2006 for the same countries. Finally, the amount of the total loan application fees collected is only 0.51% of the total capital loaned out to the intermediate good producers, which also accords with the estimates for the U.S. banks provided by DeYoung and Rice (2006).

Note that these ratios are independent of the actual value of f_e and hold as long as our targeted productivity cut-off level is satisfied. In other words, the exact value of f_e only determines the scale of the economy. We choose f_e to target an average firm size for consumption good producers. We set our target at 13.4 employees based on the firm size data we extracted from OECD website.²³ Taking n units of labor supply equivalent to one worker, the average firm size is given by $n(\bar{\varphi})/n_\varphi$. From equation (31), this targeted value implies that equilibrium mass of firms, g , must be such that $g(1 - \delta) = 0.077$. This equilibrium target requires f_e to be equal to 5.383. For this value of f_e , the implied values of A_m and a are 71.970 and 0.601, respectively.

²²We stick to the year 2006, because detailed data for credit institutions is available only for that year.

²³See Table A4 in the Appendix. Firm size distribution is less documented for European countries relative to the US. The OECD data covers only manufacturing sector. Therefore, we re-scaled the firms sizes with respect to the US taking the average size in the US as 22 employees.

5 Policy Analysis

5.1 Policy Choice, Welfare, and Tax Revenue

There are mainly three VAT policies used in practice and thus, received close attention in the literature. We begin our policy analysis with a discussion of these policies, and then present our findings on welfare and tax revenues associated with VAT treatment of financial services. The first and the second policies are common to both services and correspond to the two extreme values of the recovery rate: $\rho_i = 0$, i.e. exempt treatment of financial services, and $\rho_i = 1$, i.e. full taxation of financial services, for $i = \{m, s\}$. The third regime, referred to as zero-rating (ZR), provides an intermediary case where the financial institutions are credited for the amount of unrecoverable VAT by the government. In a nutshell, zero-rating financial services implies that the banks pay VAT on their inputs and the government issues a VAT rebate, as opposed to the banks embedding the input VAT in the price of financial services under exempt treatment. An interesting point is that full taxation is equivalent to zero-rating policy for loan services in the context of our model. This is mainly because the loan services are provided only to firms in the model and firms effectively pay zero VAT under both full taxation and zero-rating regimes.

Countries employ different VAT policies for financial institutions. To capture these practical differences in tax policy, we perform five different policy experiments and compare the outcomes to a benchmark regime. The benchmark regime in all cases is “exempting both payment and loan services” ($\rho_s = \rho_m = 0$) at the three country average VAT rate, 16.3 %. In each experiment, we shift the VAT policy from the benchmark regime to a new regime. Under Regime 1 ($\rho_s = 0, \rho_m = 1$),

payment services are exempt, while loan services are fully taxed and Regime 2 ($\rho_s = 1, \rho_m = 0$) is the reverse of Regime 1. The policy in Regime 3 ($\rho_s = ZR, \rho_m = 0$) assumes payment services to be zero-rated and the loan services to be exempt. Both of the financial services are fully taxed in Regime 4 ($\rho_s = \rho_m = 1$) and zero-rated in Regime 5 ($\rho_s = \rho_m = ZR$).

5.1.1 Welfare

In order to compare the magnitude of the impacts, we hold the total tax revenue under the benchmark regime constant across all regimes. Table 2 reports percentage changes in some of the key variables relative to the benchmark regime. Welfare comparisons are based on compensated variation (CV) as a percentage of GDP under the benchmark regime.

Table 2: Tax Revenue Neutral Policy Comparison

	(1) $\rho_s = 0$ $\rho_m = 1$	(2) $\rho_s = 1$ $\rho_m = 0$	(3) $\rho_s = ZR$ $\rho_m = 0$	(4) $\rho_s = 1$ $\rho_m = 1$	(5) $\rho_s = ZR$ $\rho_m = ZR/1$
VAT rate	16.093	16.168	16.316	15.964	16.0968
Entry Prob. ($\phi^{*-θ}$)	5.022	0.046	0.004	5.022	5.022
Average Prod. ($\bar{\phi}$)	-4.742	-0.044	-0.003	-4.742	-4.742
Price	-0.180	-0.002	-0.000	-0.180	-0.180
Mass of Firms	5.693	0.202	0.104	5.786	5.756
Employment	0.818	0.153	0.097	0.908	0.880
Output	0.735	0.153	0.098	0.826	0.797
Welfare	0.183	0.033	0.021	0.203	0.196

All the changes are percent changes relative to the benchmark regime ($\rho_s = 0, \rho_m = 0$) except the VAT rate and welfare. The reported VAT rate is the actual rate that makes the total revenues equal to that of the benchmark case. Welfare calculations are compensating variation and measured as a percentage of GDP under the benchmark regime.

Our results show that exempt treatment regime is the most distortionary pol-

icy among all other alternatives. In fact, the total tax revenue generated under the benchmark regime can be achieved with lower VAT rates under all of the five regimes. This implies that a policy shift from the exempt treatment to any of the five regimes is welfare improving. Furthermore, there are significant differences in the magnitude of welfare improvements across the regimes. For instance, Regime 4 (full taxation of both services) generates the largest welfare improvement, corresponding to 0.203% of GDP. Regime 5 (zero-rating both services) presents the second-best alternative, after Regime 4, with the second largest welfare improvement that is only slightly less than the first best. Zero-rating financial services appears to be a promising option, where especially full taxation is not practically feasible. There are in fact several countries practicing this alternative in especially marginated based transactions, where full taxation is practically costly.²⁴ Furthermore, output and employment gains are also the highest under Regime 4 and that is followed by Regime 5. Compared to the benchmark, productivity threshold is lower under all regimes, as a result of low financing cost, and thus the mass of firms is larger. This improves competition and sustains the output price at a relatively lower level.

The results also display significant differences between the various types of financial services. For instance, a policy shift from exempt treatment to full taxation only in loan services (Regime 1) leads to higher welfare improvement than Regimes 2 and 3, where only the payment services are released from the distortions of VAT exemption. This suggest that larger gains are generated by removing the VAT exemption from loan services rather than payment services, as the exemption of loan

²⁴For instance, Australia, New Zealand, Israel and Quebec (province of Canada) are just some of the countries using a zero-rating regime in loan intermediation. See Chaudhry et al. (2015).

services distorts production that cascades through the supply-chain.

Repealing exempt treatment policy in loan services generates different movements along both intensive and extensive margins. On one hand, moving from exempt treatment to full taxation lowers the cost of finance that allows the firms at the margin to access bank loans (i.e. extensive margin). On the other hand, firms above the margin that already have access to bank loans are now able to borrow more (i.e. intensive margin) at a lower interest rate under full taxation. It is therefore important from a policy making point of view to understand the size of both margins.

In our model, the extensive margin effects come from two sources: the productivity threshold, φ^* , and the mass of firms, g . Note also that resource allocation at the firm level, i.e. intensive margin effects, depends on φ^* . In order to decompose these effects, we design a *profit tax* where, under this regime, loan services are fully taxed, i.e., $\rho_m = 1$, but each firm is charged an additional lump-sum tax to force the equilibrium productivity threshold, φ^* , to be equal to its value under exempt treatment. The profit tax is equal to the difference between the loan application fee under exempt treatment and full taxation. Although not practically applicable, this profit tax ensures that the productivity threshold is unchanged under the new regime. In terms of the implementation, we first calculate the equilibrium under exempt treatment in loan services for the average VAT rate, 16.33%. Then, we switch to full taxation of loan services (Regime 1; leaving the payment services under VAT exemption), while holding the productivity of the marginal firm constant through the profit tax. In Table 3, we report percent changes in the main aggregates following a VAT regime shift from the benchmark to full taxation in loan services (Regime 1)

with and without the profit tax. We decompose the total change in employment as extensive and intensive margins.

Table 3: Percentage Changes in Equilibrium Variables after Repealing Exempt Treatment in Loan Services: VAT rate is held at 16.33%. φ_{old}^* refers to the productivity cut-off under the benchmark regime.

Variable (Change in %)	Regime 1	Profit Tax
Entry Probability ($\varphi^{*-θ}$)	5.702	---
Average Productivity ($\bar{\varphi}$)	-4.742	---
Mass of firms (g)	5.244	0.174
Employment (Consumption Good)	0.223	0.174
<i>Extensive Margin</i> ($\varphi < \varphi_{old}^*$)	0.280	---
<i>Extensive Margin</i> ($\varphi > \varphi_{old}^*$)	5.106	0.174
<i>Intensive Margin</i>	-5.164	---
Total Tax Revenue	0.014	-0.065
<i>Payroll Tax</i>	0.372	0.272
<i>Capital Tax</i>	0.674	0.626
<i>VAT</i>	-0.819	-0.868
Output	0.288	0.239
Welfare (CV)	0.089	0.071

The first column in Table 3 shows the percentage changes in various equilibrium values after switching to full taxation in loan payment services. Under full taxation, the entry probability increases by 5.702% relative to its equilibrium value under exempt treatment. However, the new entrants at the lower tail of the distribution lowers the average productivity by 4.742%. The change in the mass of firms is also sizable and increases by 5.244% after repealing the exempt treatment. The effect of tax policy regime on total employment in the consumption good sector is 0.223% increase and this total effect is a combined effect of extensive and intensive margins. We find that existing firms lower their employment by 5.164%, but this decrease is largely balanced with the increase in the mass of firms which are at least as productive as the marginal firm under exempt treatment. In addition to that,

the newly entering firms which would not be profitable under exempt treatment increase employment by 0.280%. The increase in employment results in a 0.288% increase in total output. Our calculations indicate a 0.089% increase in welfare after switching to full taxation.

We report the results from switching to full taxation accompanied with a profit tax in the second column of Table 3. By construction, all the variation comes from the change in the mass of firms and this allows us to isolate the impact of the marginal firms. Compared to the first column, the responses of output and welfare are muted, accounting for roughly three quarters of the increase in these variables without the profit tax. Moreover, we find a decrease in total tax revenue under the regime with the profit tax.²⁵ In other words, extensive margin effects are sizable and ignoring these extensive margin adjustments would underestimate the welfare gains from repealing exempt treatment.

5.1.2 Tax Revenue

Improving welfare is an important motivation for policymakers. However, they are also concerned about tax revenues. For this purpose, we analyze the revenue impact of the same five regimes. As before, for comparability of the results across different regimes, we now hold welfare constant at the benchmark regime and calculate changes in tax revenue. The benchmark regime is still the one where both financial services are exempt ($\rho_s = \rho_m = 0$) at the average VAT rate of 16.3 %. Table 4 shows welfare neutral percentage changes in total tax revenue and its components with respect to the benchmark regime. For total tax revenue change, we also report

²⁵In fact, the regime with the profit tax cannot generate the total tax revenue generated under the benchmark regime at $\tau = 16.33\%$ at any VAT rate.

its size as a percentage of GDP under the benchmark regime.

Table 4: Welfare Neutral Policy Comparison

	(1) $\rho_s = 0$ $\rho_m = 1$	(2) $\rho_s = 1$ $\rho_m = 0$	(3) $\rho_s = ZR$ $\rho_m = 0$	(4) $\rho_s = 1$ $\rho_m = 1$	(5) $\rho_s = ZR$ $\rho_m = ZR/1$
VAT rate	16.554	16.251	16.369	16.472	16.594
Total Revenue	0.025	0.004	0.002	0.029	0.027
VAT (total)	0.119	0.022	0.014	0.141	0.134
VAT (from consumption)	1.167	-0.489	0.235	0.666	1.408
Payroll	-0.051	-0.005	-0.003	-0.057	-0.055
Capital	0.250	-0.001	-0.002	0.247	0.248
Δ Total Revenue/GDP	0.161	0.009	0.005	0.169	0.166

All the changes are percent changes relative to the benchmark regime ($\rho_s = 0, \rho_m = 0$), except the VAT rate. The reported VAT rate is the actual rate that makes the steady state utility level equal to that of the benchmark regime. Total tax revenue is also reported as a percentage of GDP under benchmark regime.

Adapting full taxation in both types of financial services (Regime 4) generates the largest tax revenue improvement, about a 0.03% increase in total and a 0.141% increase in total VAT revenues compared to the benchmark case. This increase corresponds to 0.169% of GDP under the benchmark regime. Regime 5, zero-rating both services, also leads to an improvement in total tax and VAT revenues that are slightly less than Regime 4. Resembling the earlier results, Regime 5 is the second-best option. Moreover, tax revenue loss is also larger when exempting only loan services rather than exempting only payment services. For instance, shifting the policy from exempt treatment to full taxation of only loan services (Regime 1) generates a larger tax revenue increase than the cases where the VAT policy is shifted to either full taxation or zero-rating in only payment service (Regimes 2 and 3).

Table 4 also shows that a change in VAT policy also has indirect effects on capital and labor markets. For instance, repealing exempt treatment increases total tax revenues albeit reduces labor tax revenues moderately. This is mainly due to the fact that an increase in the VAT rate raises the relative price of the market good and thus the representative household switches to home production. Such a shift in the policy leads to a slight decrease in labor tax revenues. Similar effects occur under Regimes 2 and 3 for capital tax revenues, although the percentage change is even smaller.

Overall, several positive and negative adjustments occur in the economy following a shift in VAT policy. However, these adjustments do not change our final conclusion: “*repealing exempt treatment of financial services increases total tax revenues and improves welfare*”.

5.2 Laffer Curve, Welfare and Tax Revenue

Until now, we have presented our results with the VAT rate that is fixed at the average of Germany, France and the UK, 16.33%, under the benchmark regime. However, there is a large variation in VAT rates across different EU countries, ranging 5% to 27%. It is therefore important to show how our results from the previous section would change with respect to the choice of VAT rate. Figure 3 shows how total tax revenues change with the VAT rate under Regimes 4 and 5 and the benchmark.²⁶ It is evident that there exists a single-peaked VAT Laffer curve and thus, our results in the previous section may alter depending on the position of the VAT

²⁶For clarity of figures, we focus on the regimes 4 and 5. We defer the analysis for other regimes to our online appendix. Nonetheless, these results mimic our findings in the previous section.

rate choice with respect to the peak point of the VAT Laffer curve.

Trabandt and Uhlig (2011) provides a detailed discussion on Laffer curves in Europe and the U.S. for various taxes. Although they find a single-peaked Laffer curve for capital and labor income taxes, they find that the VAT (consumption tax in their paper) Laffer curve is ever increasing in a model with standard utility functions.²⁷ Our model extends the framework of Trabandt and Uhlig (2011) by incorporating home production that implies a single-peaked VAT Laffer curve. Our parametrization indicates that the peak point under the benchmark regime is at 17.2%, which is close to the average of Germany, France, and the UK.

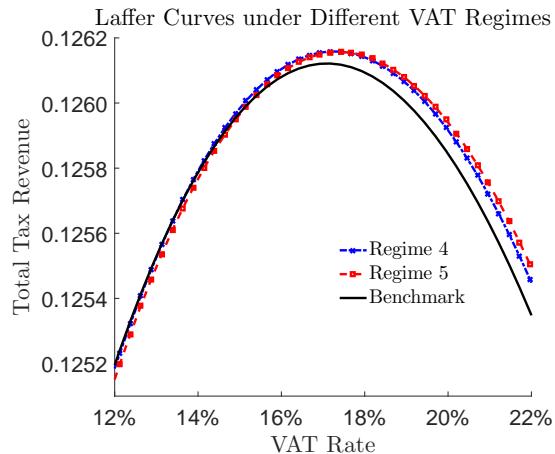


Figure 3: Laffer Curve under Different VAT Regimes

To better understand the effects of various regimes on tax revenue, we repeat the analysis in Table 2 but now for different VAT rates. This is to say that what if our average country implements the policy shift from exempt treatment towards full taxation at lower or higher VAT rates than the peak point, 17.2 %. As in the table,

²⁷Specifically, Trabandt and Uhlig (2011) uses a utility function that features constant Frisch elasticity of labor supply. For a more detailed analysis of consumption tax Laffer curve, see Hiraga and Nutahara (2017).

we compute total tax revenue under exempt treatment for a given VAT rate and find the VAT rate that generates the same total tax revenue under the new regime.²⁸ We then calculate welfare gains based on CV as a percentage of GDP under the benchmark regime.

Figure 4 displays our results. It turns out that our results in the previous section in Table 2 hold only in the increasing part of the VAT Laffer curve, whereas these results reverse in the decreasing part of it. We therefore present our results with VAT rates below and above the peak point, i.e. 17.2%, in panels (a) and (b), respectively.

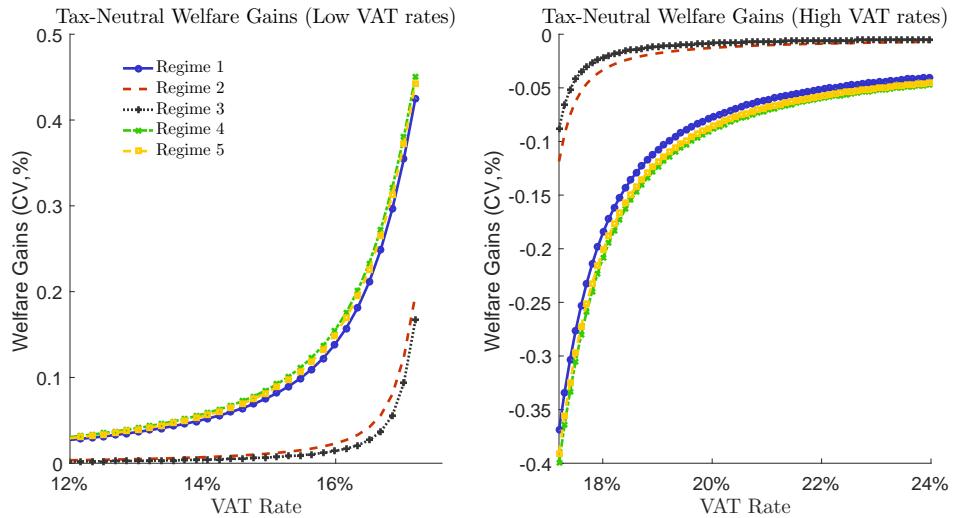


Figure 4: (a) % Change in Welfare (Tax Revenue Neutral) at low VAT rates. (b) % Change in Welfare (Tax Revenue Neutral) at high VAT rates: Benchmark is exempt treatment ($\rho_s = 0, \rho_m = 0$) in all cases. Low and high VAT rates correspond to the VAT rates before and after the peak point of the benchmark regime Laffer curve, respectively.

To explain our results in Figure 4, consider a government at a 17.2% VAT rate which is planning to switch from exempt treatment to full taxation of both financial

²⁸Note that there are two VAT rates that can generate the same tax revenue under the new regime. We use the VAT rate that is closer to the VAT rate under the benchmark regime because governments, in practice, do not know where they stand on the Laffer curve.

services (Regime 4). Without the knowledge of the Laffer curves, it is not clear whether the total tax revenues would rise or fall after the regime switch. If the government at a 17.2% VAT rate, not guided by the Laffer curve, believed that total tax revenues would fall after the regime switch, it would decide to increase the VAT rate under the new regime to compensate for the loss in total tax revenues. Such a regime shift accompanied with a higher VAT rate would rather generate welfare losses. If the same government, foreseeing the increase in tax base, reduced the VAT rate along with the regime shift, this would be welfare improving. More generally, Figure 4 shows that, at a VAT rate below 17.2%, a tax revenue neutral regime shift from exempt treatment to an alternative regime is welfare improving (panel (a)), but it is welfare worsening on the other side (panel (b)). Furthermore, the magnitudes of welfare gains and losses are remarkably similar and we obtain exactly the reverse ordering of the regimes.

We next turn to the welfare neutral tax revenue comparisons at different VAT rates. In Figure 5 panel (a), we plot the period utility under each regime at different VAT rates. Because VAT is a distortionary tax, a higher VAT rate reduces period utility in all cases. Panel (b) of Figure 5 shows how the total tax revenues, for a given level of welfare, respond to a policy change from the benchmark regime to an alternative regime. As before, we hold welfare constant by computing per period utility for a given VAT rate under the benchmark regime, and then match this utility level by changing the VAT rate under each alternative regime.

According to the Figure 5 panel (b), moving away from the benchmark regime to any of the alternative regimes, holding the welfare constant, always increases total tax revenues regardless of the VAT rate. These findings verify that the earlier

results, presented in Table 4, are robust to the choice of VAT rate and holds despite the Laffer curve. As an example, switching the VAT regime from the benchmark to full taxation (Regime 4) brings higher utility (Figure 5 panel(a)). This increase in utility level enables the government to levy a higher VAT rate and raise more tax revenues without changing the initial welfare. We already know from Figure 3 that raising the VAT rate beyond the peak point actually reduces total tax revenues. However, the tax revenue gap between the benchmark and full taxation regimes is large enough to eventually increase the total tax revenues after repealing exempt treatment.

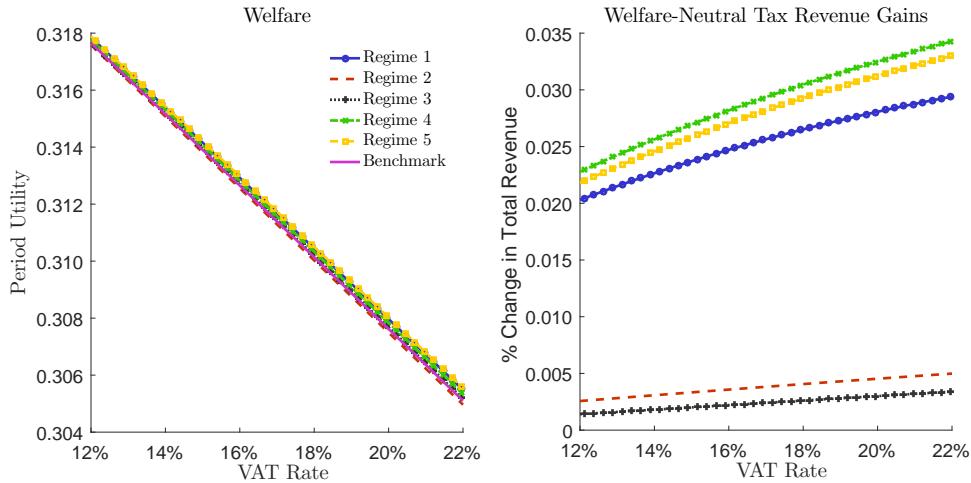


Figure 5: (a) Period Utility under each regime. (b) Change in Total Tax Revenue (Welfare Neutral): Benchmark is exempt treatment ($\rho_s = 0$, $\rho_m = 0$) in all cases. Percent changes are calculated relative to total tax revenue under the benchmark regime at a given VAT rate.

These findings provide vital policy lessons for policymakers. In general, along a reasonable range of VAT rates, e.g. below the current average EU VAT rate, repealing exempt treatment is welfare improving and tax revenue increasing. However,

countries with high VAT rates, e.g. above the current average VAT rate, should apply a reduced VAT rate to financial services before repealing exempt treatment to achieve both improvements in tax revenues and welfare.

6 Conclusion

Treatment of financial institutions under the VAT is a complex issue in public finance. For various technical and practical reasons, financial services are generally exempt from VAT in most countries and this policy regime creates several distortions for the real economy. While some related literature has discussed the importance of these distortions, the precise transmission mechanisms of these distortions, and their net impact on the real economy, have not been explored in a general equilibrium setting.

We achieve this goal in a dynamic general equilibrium framework with heterogeneous firms and a banking sector. The heterogeneity in the production sector allows us to account for both extensive and intensive margin movements. This is important, as the current VAT treatment of financial services in many countries - the exempt treatment - increases the cost of financial intermediation, which in turn raises cost of capital that mainly hits the firms at the margin. The banking environment in the model encompasses both loan and payment services. These services establish the main channels, which transmit the effect of VAT policy for financial services on the real economy. We find that the effects of VAT policy for financial services on the real economy through these channels have significant policy implications.

Using our calibrated model, we perform policy analysis under different tax regimes. We find that the exempt treatment of financial services is the most distortionary approach among alternative policies. More specifically, switching the VAT policy from the exempt treatment towards full taxation in loan services and in payment services for a given level of tax revenue lowers entry costs into the production sector, induces entry of new firms, and lowers capital costs for all the firms. Overall, welfare is higher under full taxation followed by zero-rating of both financial services. However, these positive welfare results are only relevant for the increasing part of the VAT Laffer curve and the results reverse in the decreasing part. Repeating the same policy exercise but now holding welfare constant always leads to an increase in total tax revenues. We also find that ignoring the extensive and intensive margin interactions underestimates the welfare and tax revenue gains from a policy shift from exempt treatment to full taxation, accounting for roughly 20% of the overall gains.

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1 Online Appendix

1.1 Tax Revenue Decomposition and the VAT Laffer Curve

Figure A1 panel (a) shows the VAT Laffer curves for the regimes omitted in the main text. Figure A1 panel (b) displays that total tax revenues follow a similar trend to the shape of VAT revenue curve, while other taxes steadily decline following an increase in VAT rate. Increasing the VAT rate reduces the demand for final goods, as consumers shift towards home production. This results in a decline in production, which in turn reduces both labor and capital income tax bases and tax revenues from these sources decrease. Because the decline in the VAT base occurs at a slower rate than other taxes, total tax revenues keep rising up to a peak point. Eventually, the decline in income and capital tax revenues dominates the incremental increase in VAT revenues, and thereafter we observe a decline in total tax revenues.

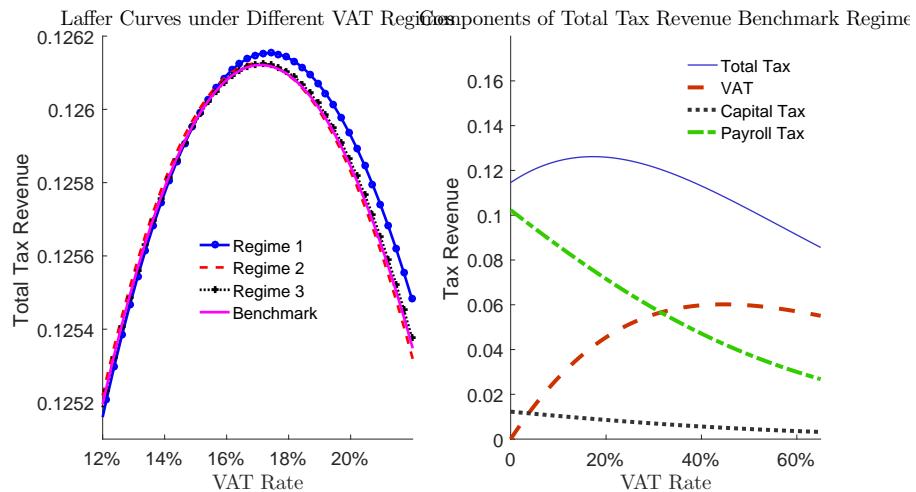


Figure A1: (a) Laffer Curve under Different VAT Regimes and (b) Components of Total Tax Revenue under Full Taxation

1.2 Data Details

Table A1 shows fraction of time allocated to market and unpaid work in the selected European countries. The data is obtained from OECD Gender data portal 2016.

Table A1: Average Time Use in Europe

Country	Paid Work or Study	Unpaid Work	Unpaid-Paid Work Ratio
Germany	16.14	14.75	0.914
France	14.00	13.16	0.940
United Kingdom	17.07	13.93	0.816
Overall	15.89	13.95	0.890

The numbers in the first two columns correspond to the fraction (in percentages) of time spent at paid work or study and unpaid work. The third column is the share of paid work in total work time.

SOURCE: OECD Gender Data Portal, 2016

Table A2 shows the firm survival rates for Germany, France, and the UK in 2009 and 2010 obtained from EUROSTAT. The observed values are comparable to Bartelsman et al. (2005).

Table A3 shows the average interest rate spreads observed in Germany, France, and the UK from 2003 to 2007. We excluded the global crisis period where interest rate spreads were higher. The data is obtained from the European Central Bank.

Table A4 shows the average number of employees in the manufacturing sector for Germany, France, and the UK in 2009. We obtained the data from OECD. We also report their ratio to the average firm size for the US in the same dataset. For calibration, we assume that the average firm size is 22 employees in the US and scale the firm size in each country accordingly.

Table A5 shows the share of labor costs and purchases of goods and services

Table A2: Firm Survival Rates

Year	Average	Germany	France	UK
2009	0.829	0.763	0.785	0.940
2010	0.800	0.770	0.721	0.909
Overall	0.815	0.767	0.753	0.924

SOURCE: EUROSTAT- cohort business survival rate. Retrieved from:
https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Business_demography_statistics#Enterprise_survival_rate

Table A3: Average Interest Rate Spread

Year	Average	Germany	France	UK
2003	2.11	2.56	0.96	2.82
2004	2.20	2.59	1.33	2.69
2005	2.23	2.49	1.38	2.84
2006	2.28	2.48	1.46	2.91
2007	2.21	2.34	1.68	2.63
Overall	2.21%	2.49%	1.36%	2.77%

¹ Spread = lending interest rate - deposit interest rates
² Deposit interest rate for new deposits up to one year
³ Loan interest rate for new loans issued up to EUR 1 million
SOURCE: European Central Bank, Monetary and Financial Statistics, Bank Interest Rates

Table A4: Average Firm Size

	Germany	France	UK
Manufacturing	36.47	14.75	19.42
Relative to US	0.945	0.382	0.503

SOURCE: EUROSTAT- cohort business survival rate. Retrieved from:
https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Business_demography_statistics#Enterprise_survival_rate

relative to GDP for Germany, France, and the UK in 2006. We obtained the data from EUROSTAT.

Table A5: Cost of Credit Institutions (2006)

	Labor Costs	Cost of Goods and Services	Total Costs
Germany	1.77	1.80	3.57
France	1.64	2.26	3.90
U.K	2.25	2.78	5.03
Average	1.89	2.28	4.17

Numbers are reported as a percentage of GDP.

SOURCE: EUROSTAT- financial and insurance sector statistics. Retrieved from: [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Credit_institutions_\(NACE_Class_65_12_and_Group_65_2\)_Main_indicators,_2006_\(1\).PNG](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Credit_institutions_(NACE_Class_65_12_and_Group_65_2)_Main_indicators,_2006_(1).PNG)

Table A6: Employment Share of the Financial Sector and Total Labor Income Share (2006)

	Employment Share	Income Share
Germany	4.50	66.57
France	5.00	67.57
U.K	6.00	68.15
Average	5.17	67.43

Numbers are reported as a percentage of total employment or GDP.
 SOURCE: OECD Database.

Table A6 shows the share of employment in the financial sector in total employment and share income labor income in total GDP for Germany, France, and the UK in 2006. We obtained the data from OECD database.

1.3 Country Specific Analysis

In this part, we calibrate our model specifically for Germany, France, and the UK and repeat our policy analysis. Table A7 illustrates the calibrated parameter values for each country. Other parameters are kept at their benchmark value. Parameters

and their calibration targets are described in detail in Table 1. Here we report only the targeted values for brevity. We use the same sources for calibration targets.

Table A7: Country Specific Calibrated Parameters

Parameter	Germany		France		UK	
	Parameter Value	Target Value	Parameter Value	Target Value	Parameter Value	Target Value
τ	0.15	—	0.18	—	0.16	—
t_w	0.41	—	0.46	—	0.28	—
t_k	0.23	—	0.35	—	0.46	—
ρ_m, ρ_s	0.21	—	0.21	—	0.21	—
δ	0.041	—	0.036	—	0.014	—
ζ, γ	0.338	—	0.302	—	0.356	—
λ	0.41	—	0.44	—	0.53	—
b	0.511	0.20	0.542	0.474		0.20
κ	0.479	0.182	0.479	0.188	0.468	0.162
z_h	0.386	—	0.384	—	0.455	—
a	0.429	0.025	0.444	0.014	1.067	0.028
A_s	135.257	—	132.707	—	137.677	—
A_m	47.792	0.773	112.289	0.781	84.923	0.847
f_e	6.802	20.8	3.037	8.41	6.329	11.08

Next, we repeat the same analysis in the main text for each country separately. Our focus is to test whether we obtain similar welfare gains when using the model calibrated for each country separately. In Figure A2 we plot welfare gains for each country from a tax revenue neutral analysis (corresponding to Figure 3 in the main text).

We obtain the same ranking of the regimes with respect to welfare gains as in the main text, but the magnitudes and the peak points of the Laffer curves are different. In particular, we find bigger responses for the UK on each side of the Laffer curve.

We also calculate the tax revenue gains from a welfare neutral analysis. Figure A3 repeats the same analysis in Figure 3 in the main text but separately for

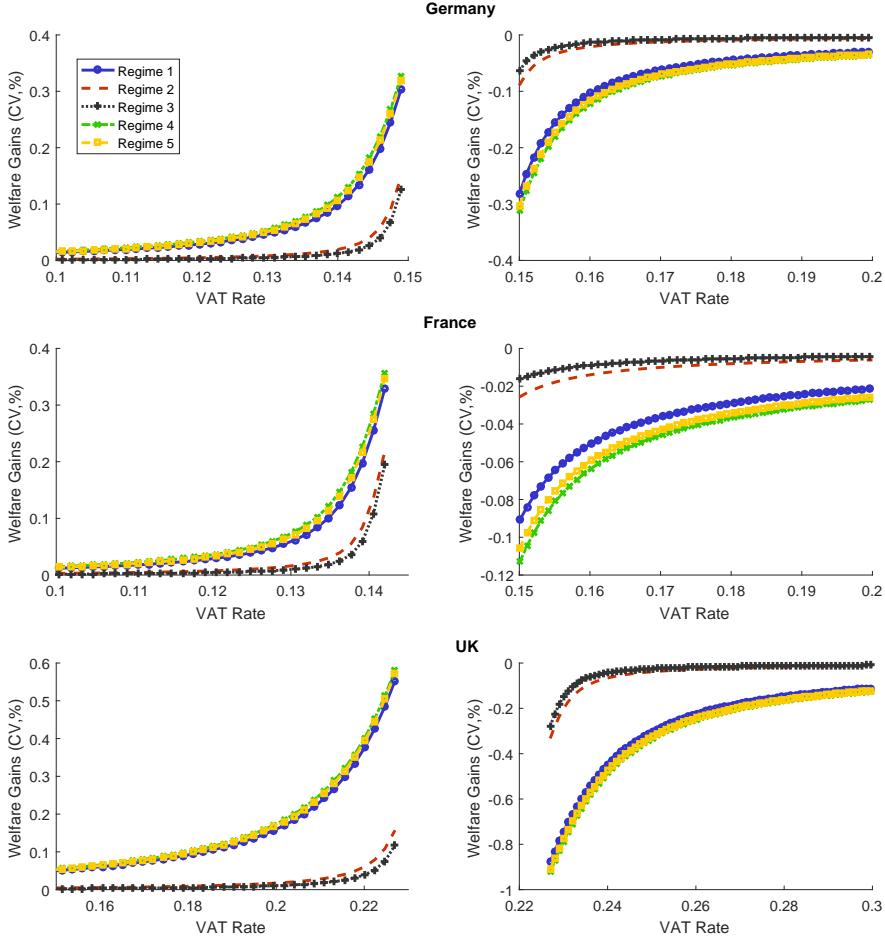


Figure A2: Tax Revenue Neutral Welfare gains for Germany, France and the UK. Left and right panels are drawn for the increasing and decreasing part of the Laffer curve, respectively.

each country. Again, we find larger tax revenue gains for the UK. Inspecting the calibrated parameter values reveals that a is particularly bigger for the UK, which translates into higher marginal cost of monitoring costs. Therefore, the gains from moving from exempt treatment to full taxation is bigger for the UK.

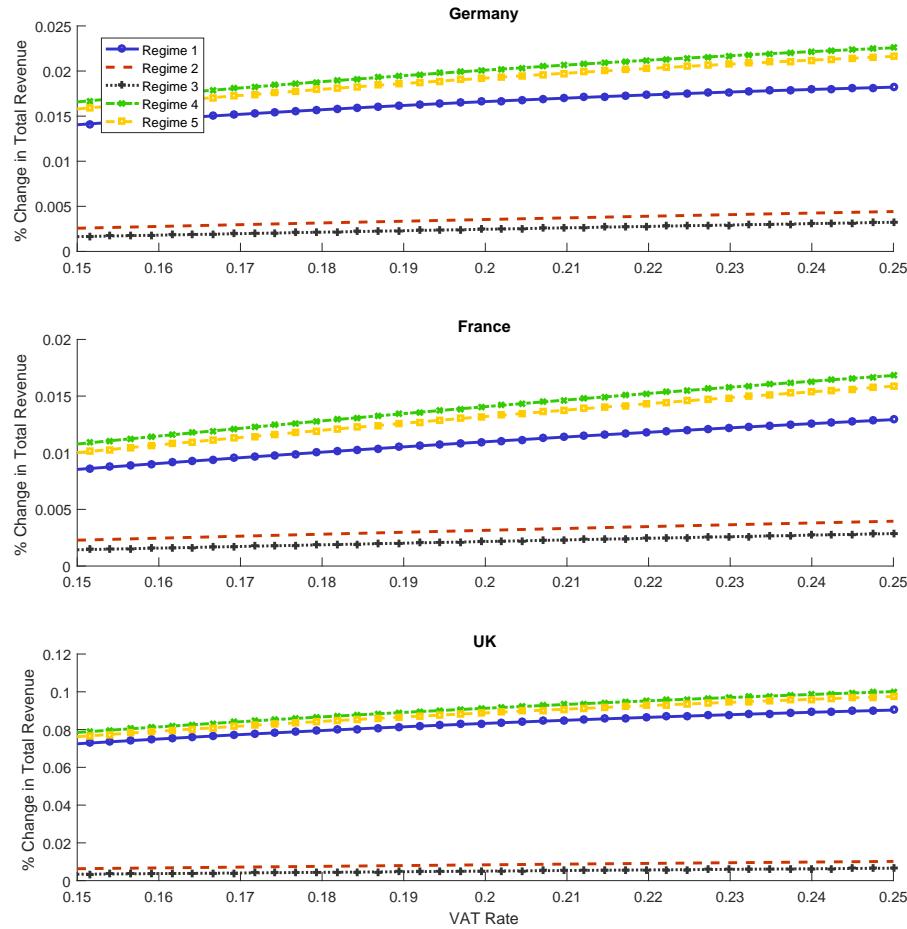


Figure A3: Welfare Neutral Tax Revenue gains for Germany, France and the UK.

1.4 Welfare Gains and Elasticity of Substitution: ψ

In this section, we repeat our analysis for higher and lower values of ψ . Specifically, we set ψ equal to 10 and 2.5 respectively to assess the role of elasticity of substitution between home and market production on welfare and tax revenue gains from switching from exempt treatment to another regime. Figures A4 and A5 display our

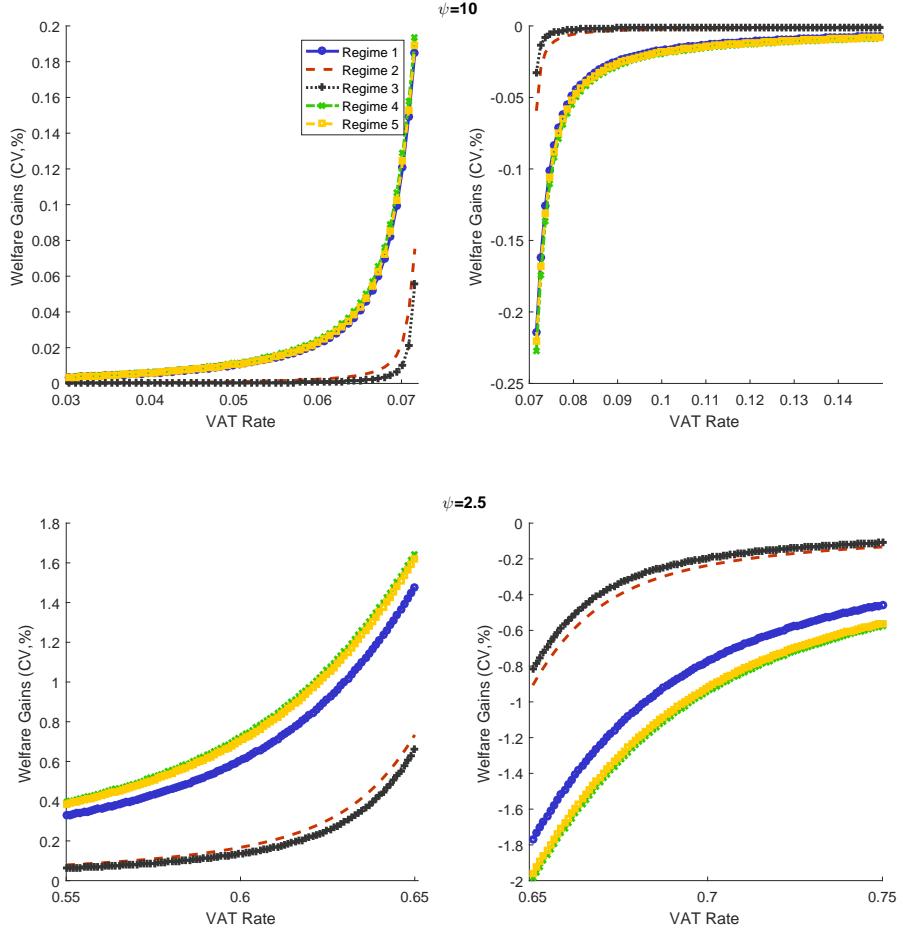


Figure A4: Tax Revenue Neutral Welfare gains for high and low ψ . Left and right panels are drawn for the increasing and decreasing part of the Laffer curve, respectively.

results.

Our results indicate that a higher value of ψ implies that the peak point of the Laffer curve occurs at a lower VAT rate. This finding is not surprising because a higher VAT rate discourages market production and the impact on labor supply

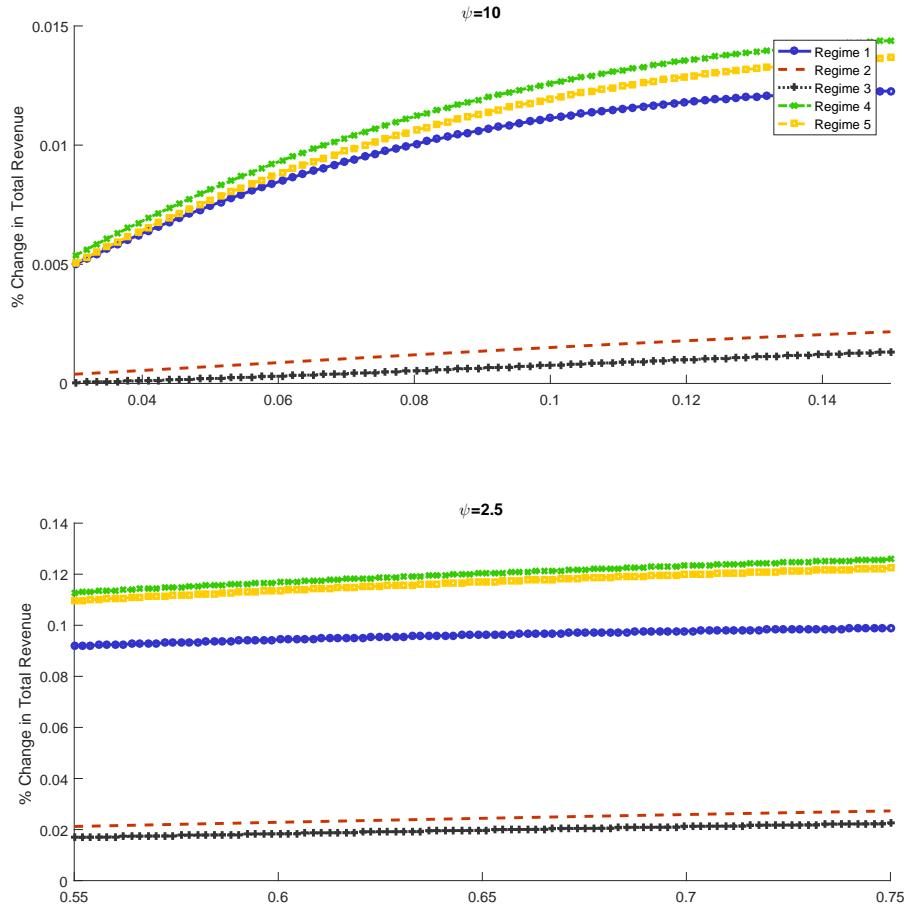


Figure A5: Welfare Neutral Tax Revenue gains for high and low ψ .

is larger for a higher value of ψ . As ψ gets smaller, labor supply becomes more inelastic due to stronger income effect. Therefore, increases in VAT rate reduces payroll tax revenue at a slower rate. When $\psi = 2.5$, the peak point of the Laffer curve occurs at 60% VAT rate. At this point, welfare gains (and losses) as well as tax revenue gains are about ten fold bigger. Nonetheless, the ranking of the regimes with respect to their welfare gains remain the same.

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